TM 5-5404

WAR DEPARTMENT TECHNICAL MANUAL

GENERATOR SET, PORTABLE, GASOLINE ENGINE-DRIVEN, SKID-MOUNTED, 3-KW, 115-VOLT, 1-PHASE, 60-CYCLE, AC, ONAN, MODEL W3M-19

(ENGINE: ONAN, MODEL W2C)

MODEL XRPI

★

MAINTENANCE INSTRUCTIONS AND PARTS CATALOG

WAR DEPARTMENT • 15 MARCH, 1944

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AND

PARTS CATALOG

FOR

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USED ON FOLLOWING:

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TM5-5404, Generator Set, Portable, Gasoline Engine-Driven, Skid-Mounted, 3-KW, 115-Volt, 1-Phase, 60-Cycle, Onan, Model W3M-19, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:
G. C. MARSHALL
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OFFICIAL:
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"IBn 1: T/O & E 1-1-1S, Hq Hq Sq AAF Fi Comd; 1-50-1S, Hq Hq Sq Fi Comd Sp; 1-100-1, Hq Hq Sq BC; 1-100-1S, Hq Hq Sq BC, Sp; 1-200-1, Hq Hq Sq Fi Comd; 1-300-1, Hq Hq Sq; Tr Carr Comd; 1-450-1, Hq Hq Sq, Base Comd; 1-500-1, Hq Hq Sq, Ground Air Support Comd; 1-690-1S, Hq Hq Sq, Island Air Comd Sp; 1-800-1, Hq Hq Sq, AF; 1-10-1S Hq Hq Sq, Fi Wg, Sp; 1-110-1, Hq Hq Sq, Bomb Wg (H or M); 1-310-1, Hq & Hq Sq, Tr Carr Wg; 1-760-1, Hq Hq Sq, Photo Wg Strat Rcn MC; 1-27, Sq Fi Single Engine; 1-37, Sq Fi, Two Engine; 1-47, Sq, Fi, Control; 1-67, Sq Fi Night; 1-117, Sq Fi, Bombardment Hv; 1-127, Sq Bomb (M); 1-137, Sq Bomb (L); 1-147, Sq Bomb, Dive; 1-317, Sq Tr Carr; 1-417, Sv Sq; 1-478S, Adrm Sq Sp; 1-547, Air Support Con Sq; 1-637, Wea Tcn Sq (M); 1-758, Sq Photomapping; 1-777S, Comp Sq; 1-977, Liaison Sq.

"IBn 5: T/O & E 5-385, Engr Forestry Bn; 5-415, Engr Avn Bn; 5-465, Cam Bn Avn; 5-535S, Engr Base Shop Bn; 5-115, Engr Sq; 5-75, Engr Cons Bn; 5-655S, Refinery Bn.

"IBn 8: T/O & E 8-15, Medical Bn.

"IC 5: T/O & E 5-267, Engr Base Dep Co; 5-377, Engr Base Equip Co; 5-800-2, Hq Co, AF; 5-36, Hq Hq Sv Co, Engr Bn (Sep); 5-96, Hq Hq Sv Co, Cam Bn (A); 5-387, Forestry Co; 5-466, Hq Hq Co, Cam Bn Avn; 5-467, Cam Co, Cam Bn Avn; 5-56, Hq Hq Sv Co, Top Bn (A); 5-59, Photomapping Co, Top Bn (A); 5-188, Survey Co, Base Bn; 5-167, Top Co, Corps; 5-536S, Hq Hq Det, Engr Sp Shop Bn; 5-537S, Power Plant Rep Co, Engr Sp Shop Bn; 5-538S, Hull Rep Co, Engr Sp Shop Bn; 5-539S, Salvage and Dockage Co, Engr Shop Bn; 5-547S, Dep Co, Engr Sp Shop Bn; 5-116, Hq Hq Sv Co, Engr Sq; 5-22, Hq Hq Sv Co, Gen Sv Regt; 5-327, Engr Petroleum Distr. Co; 5-367, Engr (L) Equip Co; 5-652S, Engr Petr Prod Dep, Hq Hq Co, 5-659S, Maint Co, Refinery Bn.

"IC 8: T/O & E 8-18, Clearing Co, Med Bn.

"IC 20: T/O & E 20-42, Hq Hq Co, Repl Dep; 20-46, Hq Det, Repl Bn.

"IC 55: T/O & E 55-110-1, Hq Hq Co, Ports, 55-500, Ry Workshop Platoon."

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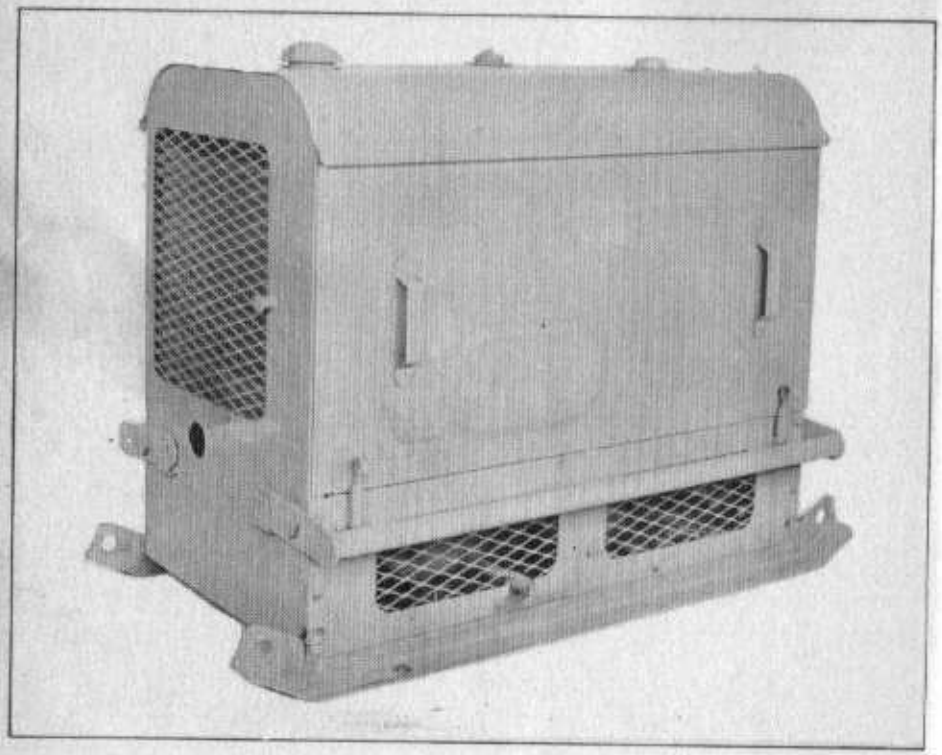

FIG. 1 POWER UNIT—ONAN MODEL W3M-19

(Frontispiece)

I--Description

1. GENERAL DESCRIPTION

This instruction manual covers Generator Set T-1446A which is Onan Model W3M-19 and will be referred to throughout this manual as Power Unit W3M-19, or simply as a Power Unit.

Power Unit W3M-19, Figs. 1, 2 and 3, is a complete electric generating plant. It consists of an engine and generator, with the necessary accessories and controls, mounted in a metal housing with skid base.

2. SPECIFICATIONS

a. **POWER UNIT**—Length over-all, 44 in.; width over-all, 22 in.; height over-all, 33 in.; weight, net, including tools and spare parts, 595 lbs.

b. **OUTPUT RATING**—3 KW.; or 3 K.V.A. at unity power factor; 115 volts; 60 cycles per second, single phase, alternating current.

c. **ENGINE**—Horsepower, 7; R.P.M., 1800; cooling system capacity, 9 quarts; crankcase oil capacity, 6 quarts; air cleaner oil capacity, about ¼ pt.; fuel 68 to 74 octane gasoline; fuel tank capacity, 3 gallons.

d. **FUEL CONSUMPTION**—Average fuel consumption is approximately 0.6 gal. per hr. at full load; 0.52 gal. per hr. at ¾ load; 0.45 gal. per hr. at ½ load; 0.35 gal. per hr. at ¼ load; 0.28 gal. per hr. at no load.

3. ENGINE AND ACCESSORIES

a. **TYPE**—The engine, Figs. 2, 3, and 4, is a two-cylinder, L-Head, water-cooled, gasoline type. It is connected direct to the generator which it drives.

b. **FUNCTIONING**—The engine is of the internal combustion type which develops power by burning a mixture of gasoline and air under compression in the cylinders and applying the resulting expanding force on the heads of the pistons. The resulting downward motion of pistons is transmitted through connecting rods to the crankshaft, resulting in rotary motion of the crankshaft. This engine operates on the usual four-stroke-cycle principle, the action of which is a repetition of a cycle of four different strokes. The action is the same for both cylinders but differs one complete revolution of the crankshaft in timing, the cylinders firing alternately.

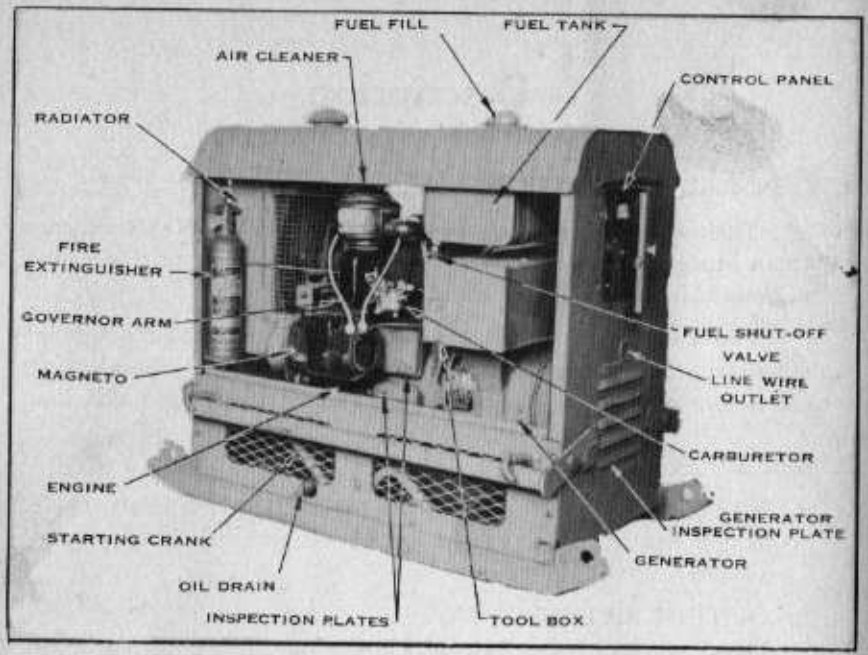

FIG. 2 RIGHT SIDE OF POWER UNIT

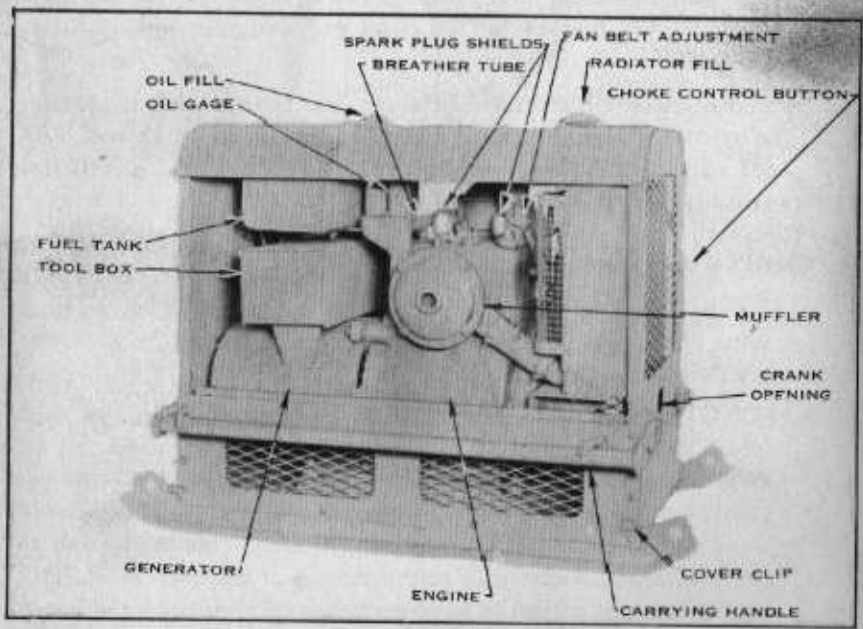

FIG. 3 LEFT SIDE OF POWER UNIT

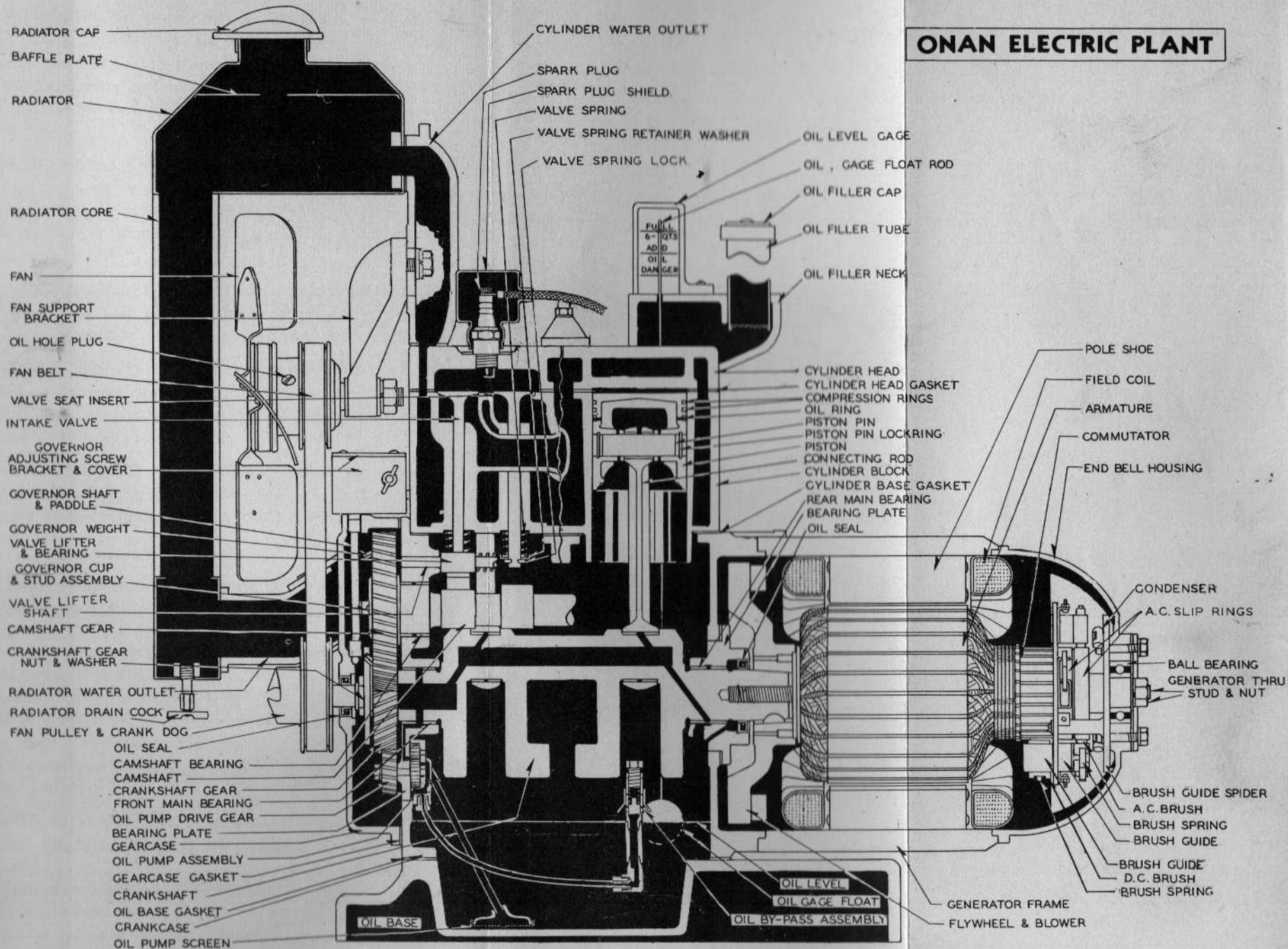

FIG. 4 SECTIONAL VIEW OF ENGINE AND GENERATOR (INSERT—LARGE)

c. **INTAKE STROKE**—The piston travels downward while the intake valve is open and the exhaust valve is closed. The resulting reduction in pressure within the cylinder allows air to rush in through the air cleaner, carburetor and intake valve port. As the air passes through the carburetor the proper proportion of gasoline is mixed with it.

d. **COMPRESSION STROKE**—The piston travels upward with both valves closed and compresses the fuel mixture in the combustion chamber at the upper part of the cylinder. As the piston nears the top of the stroke, a spark occurs at the spark plug and burning of the fuel mixture begins.

e. **POWER STROKE**—Burning of the fuel mixture continues, developing great heat and pressure. Both valves are closed. The piston is forced downward, transmitting its power to the crankshaft.

f. **EXHAUST STROKE**—The piston travels upward with the exhaust valve open, intake valve closed, and forces the exhaust gases from the cylinder. These gases pass out through the exhaust port, exhaust manifold, exhaust pipe, and muffler.

g. **COOLING SYSTEM**—The engine cooling system, Fig 4, is of the type usually called thermo-siphon. It serves to keep the operating temperatures of the cylinders, pistons, valves, and adjacent parts low enough for proper operation and to prevent overheating and resulting damage.

Circulation of the liquid is maintained by connection; the cooler and heavier liquid from the radiator displacing the heated and lighter liquid in the water jacket and forcing it upward, through the outlet connection to the top compartment of the radiator. The liquid is cooled as it flows down through the thin-walled tubes of the raditaor to replace liquid which has passed to the water jacket. An adjustable V-belt driven fan, aids cooling by blowing a stream of cooling air forward through the radiator core.

The cooling system may be drained by opening the drain cock beneath the radiator.

h. **LUBRICATING SYSTEM**—The lubricating system, Fig. 4, provides a thin film of oil between adjacent bearing surfaces within the engine.

Oil poured through the oil filler tube, fills the crankcase to a level indicated by the float-operated oil gage. Circulation of oil throughout the system is maintained by a gear type oil pump, driven by a gear which meshes with the crankshaft gear. The pump delivers oil under pressure, to the main and connecting rod bearings. Other internal parts are lubricated by spray from these bearings.

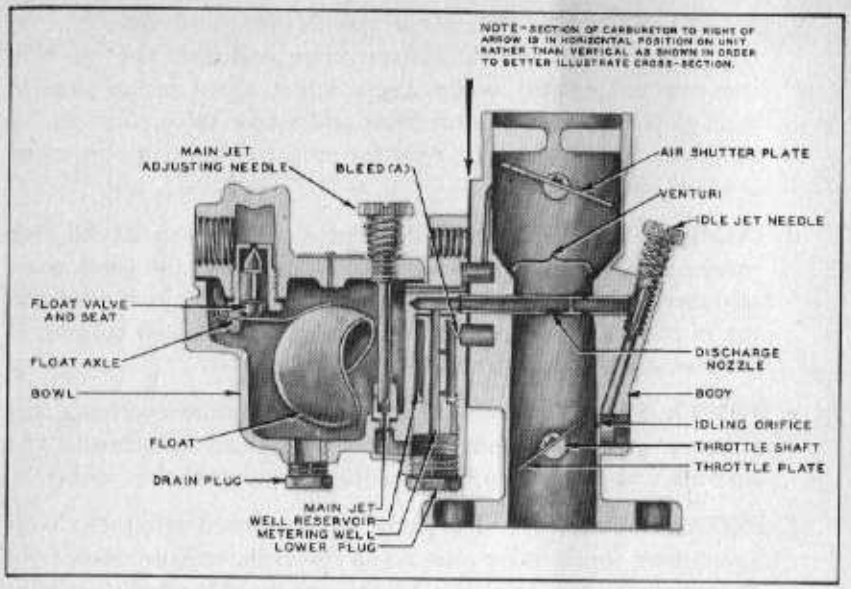

FIG. 5 SECTIONAL VIEW OF CARBURETOR

The spring-loaded relief valve regulates the oil pressure by allowing some oil to return direct to the crankcase when pressure exceeds the proper value. The engine oil pressure gage on the right side of the engine indicates the oil pressure.

i. **FUEL SYSTEM**—Gasoline from the fuel tank, Fig. 2, flows by gravity to the carburetor where it is mixed with air in proper proportion before entering the cylinders.

The carburetor, Figs. 2 and 5, mixes fuel and air in proper proportions and its throttle valve controls the flow of the mixture to the engine, thus regulating the engine speed.

Gasoline enters the carburetor bowl through the float valve and rises to a level regulated by the float. Fuel passes through the main jet and rises in the well reservoir and in the metering well, to the same level as in the bowl.

With engine operating at open throttle, air is drawn rapidly through the venturi. This creates suction which draws fuel up through the metering well and out through the discharge nozzle into the air stream. As the fuel leaves the discharge nozzle and enters the air stream it is atomized and thoroughly mixed with the air to provide the proper fuel mixture for the engine.

The main jet and its adjusting needle regulate the supply of fuel. The metering well controls the mixture characteristics. The bleed (A) controls the rate of air flow into the metering well chan-

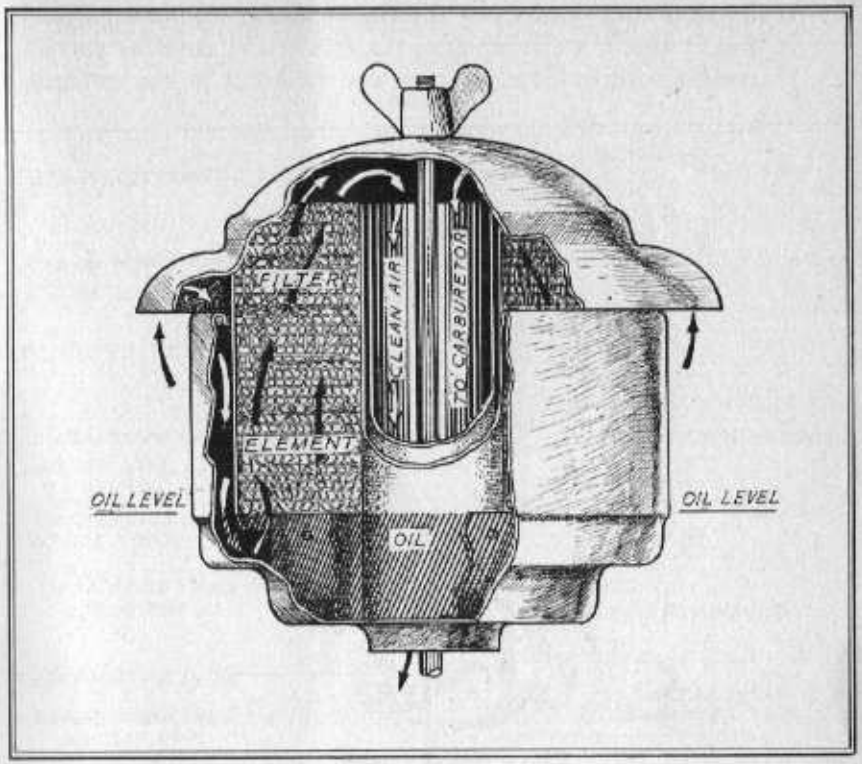

FIG. 6 SECTIONAL VIEW OF AIR CLEANER

nels. These functions combine to provide a proper fuel mixture at all throttle positions except the almost closed position.

When the throttle butterfly is almost closed, as at very light load or at no-load and slow speed, there is considerable suction at the idling orifice and very little at the discharge nozzle. Under these conditions, fuel is fed into the main air stream through the idling orifice, the amount being regulated by the idle jet needle.

A hand-operated choke enriches the mixture for cold starting.

j. **AIR CLEANER**—The air cleaner, Figs. 2 and 6, cleans the air before it enters the carburetor. Air enters near the top, passes down and over the pool of oil at the bottom, then up through the filtering element. Some oil is carried up and deposited on the filtering element. Surplus oil not adhering to the filtering element, runs back into the cup. Foreign particles in the air adhere to the oil surfaces in the element and are washed down into the cup, settling to the bottom. Periodic cleaning and filling with clean oil is necessary.

k. **ENGINE GOVERNOR**—The four fly-weights of the governor, Figs. 2 and 7, are attached to the face of the camshaft gear and revolve with it. The governor arm is linked to the carburetor

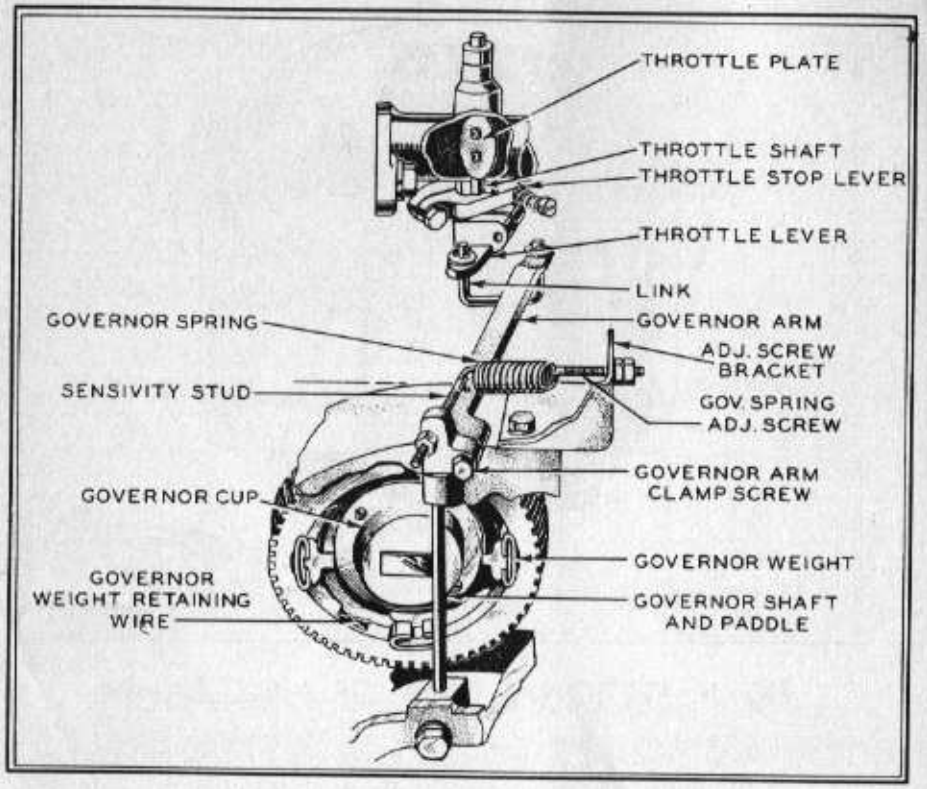

FIG. 7 FUNCTIONAL DIAGRAM OF ENGINE GOVERNOR

throttle arm. When the engine speed increases, centrifugal force moves the fly-weights outward. This motion is transmitted through the governor cup, governor shaft, governor arm and linkage, to the carburetor throttle arm, moving it toward the closed position. The movement is resisted by the governor spring. A reverse action occurs when the engine speed decreases. On constant load and speed, the throttle is held at the position where the centrifugal force and the spring tension balance. Increasing the spring tension increases the speed. Reducing the spring tension reduces the speed. The sensitivity adjustment is used to eliminate any hunting condition.

l. **MAGNETO**—The compressed gases of the fuel mixture in the cylinders are ignited by electric sparks which jump the spark plug gaps. The high voltage required to produce the sparks is gener-

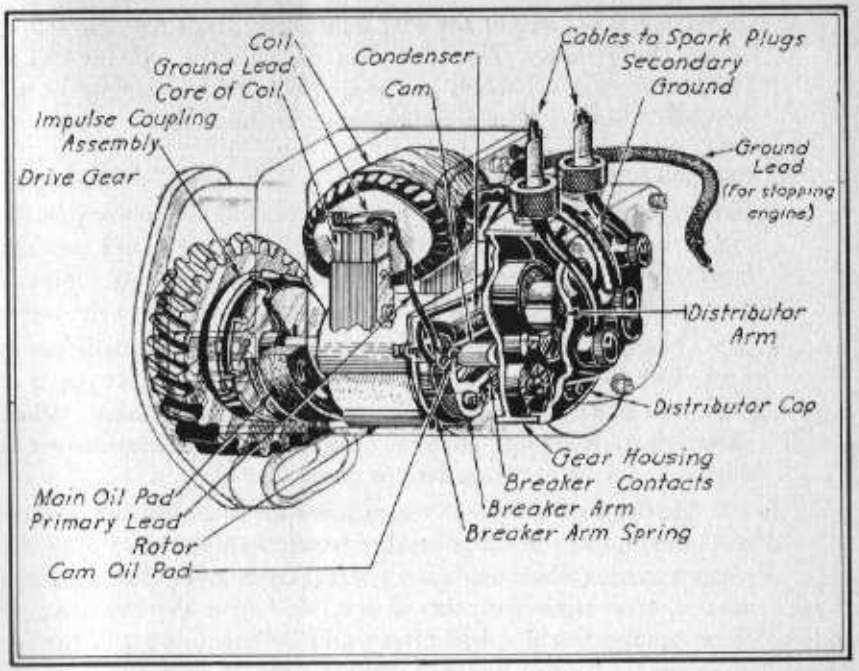

FIG. 8 SECTIONAL VIEW OF MAGNETO

gated by the Wico magneto, Figs. 2 and 8. The spark must occur in each cylinder at the proper time with respect to the upward travel of the piston near the top of its compression stroke. The magneto is driven by gearing which engages with the camshaft gear.

The magneto works on the principle that any change in the amount or direction of the magnetic flux passing through a coil of wire, induces an electrical voltage in the coil. The greater the rapidity of change and the greater the number of complete turns of wire in the coil, the higher will be the induced voltage.

m. **ROTATING MAGNET**—The source of the magnetic flux for the magneto is a permanent magnet mounted on the rotor so as to revolve between the legs of the soft iron core of the coil. The two poles of the magnet are of opposite polarity. When the rotor is in such position that the legs of the core cover the maximum area of the pole pieces, a maximum magnetic flux is established in the soft iron core. As the rotor turns from this position, the amount of magnetic flux decreases, due to the decreasing cross-sections of the iron paths at the pole pieces, reaching zero at about ¼ revolution. Further turning, allows magnetic flux to pass through the core in the opposite direction, reaching a maximum after another ¼ revo-

lution, when the legs of the core again cover rotor pole pieces but of reversed polarity. Thus, the magnetic flux through the coil is changed from a maximum in one direction to a maximum in the opposite direction twice each revolution of the rotor.

n. **MAGNETO COIL**—The magneto coil has a primary winding of comparatively few turns of insulated wire, and a secondary winding of many turns of smaller wire. The iron core passes through both windings and the changing magnetic flux in the core induces two voltage impulses in the windings, each revolution of the rotor.

Only one impulse is necessary each revolution and only one is used. The cam on the end of the rotor causes the breaker points to close and open the primary circuit once each revolution. When closed, the induced voltage in the primary winding causes current to flow in it, increasing from zero to maximum.

The increasing current resists and retards the change in magnetic flux in the core. The breaker contacts are timed to open the primary circuit when the current reaches maximum. The retarding effect ceases when the contacts open and then the flux changes more rapidly than if it had been retarded. This rapidity is further increased by the condenser discharge as explained later. The very rapid flux change induces in the secondary winding, a voltage high enough to jump a spark plug gap.

o. **BREAKER CONTACTS**—The breaker contacts are connected across the ends of the primary winding. One contact is stationary and adjustable, the other is mounted on a movable breaker arm. A spring holds the contacts closed except when opened by a cam mounted on the rotor. This cam opens the contacts once each revolution, each time, as the primary current reaches maximum value. A spark occurs at a spark plug each time the contacts open, and the opening is timed properly with the engine.

p. **MAGNETO CONDENSER**—The magneto condenser greatly increases the intensity of the spark and the life of the breaker contacts. As the breaker contacts open, the resistance between them rises rapidly while the current drops to zero. The resulting increased voltage tends to cause an injurious arc between the contacts. However, with the condenser connected across the contacts, most of the energy that otherwise would discharge across the opening gap, passes into, and charges the condenser. When the contacts open far enough to completely interrupt the small arc which occurs. the condenser discharges through the primary coil in the reverse direction, thus increasing the rapidity of change of flux and increasing the voltage induced in the secondary coil.

q. **DISTRIBUTOR**—The high tension current from the secondary coil passes to the spark plugs by way of the distributor. It enters the distributor at the center tower, passes through the metal strip of the revolving distributor arm and out at the tower under which the metal strip is passing. The distributor arm turns at half of the crankshaft speed. Thus, the sparks are distributed through the magneto cables to the spark plugs in proper sequence.

r. **IMPULSE COUPLING** — If the magneto shaft were rigidly coupled to the engine it would not revolve fast enough at slow cranking speeds to provide a satisfactory spark. The impulse coupling causes the magneto shaft to revolve fast enough to produce a good spark regardless of how slowly the engine is cranked. It includes a drive cup, rigidly attached to the drive gear; both free to turn through an arc of about 60° on the rotor shaft. By means of a coil spring, the cup is attached to, and drives a driven flange fastened to the rotor shaft. Attached to the flange is a trip arm which may engage an adjustable impulse stop. At speeds below approximately 200 r.p.m., gravity causes the trip arm to strike against the stop. This prevents the rotor's turning until the drive cup has advanced far enough to strike the trip arm and disengage it from the stop. By this time, the advancing cup has stored up considerable energy in the spring, which snaps the rotor shaft around at high speed at just the right time to create a powerful spark and start the engine. This cycle is repeated once each revolution of the drive gear at low speed. As the speed increases, a point is reached (about 200 r.p.m.) where centrifugal force swings the trip arm to such position that it cannot engage the stop. At higher speeds the coupling functions as a rigid coupling.

s. **SPARK PLUGS**—The spark plugs, Fig 4, are important parts of the ignition system. Each consists of a center electrode highly insulated from the base which carries another electrode. The ignition spark jumps across the gap between the electrodes and it is important that this gap be kept adjusted to approximately .030 in. The spark plugs are Champion, No. 6M.

4. GENERATOR

The generator, Figs. 3 and 4, receives mechanical power from the engine and converts it to alternating-current electrical power. This generator is of the self-excited type which has the smaller direct-current exciting generator built into the same frame as the alternating-current generator.

The armature windings for the direct-current exciter are installed on the same armature core as the windings for the alternating-current

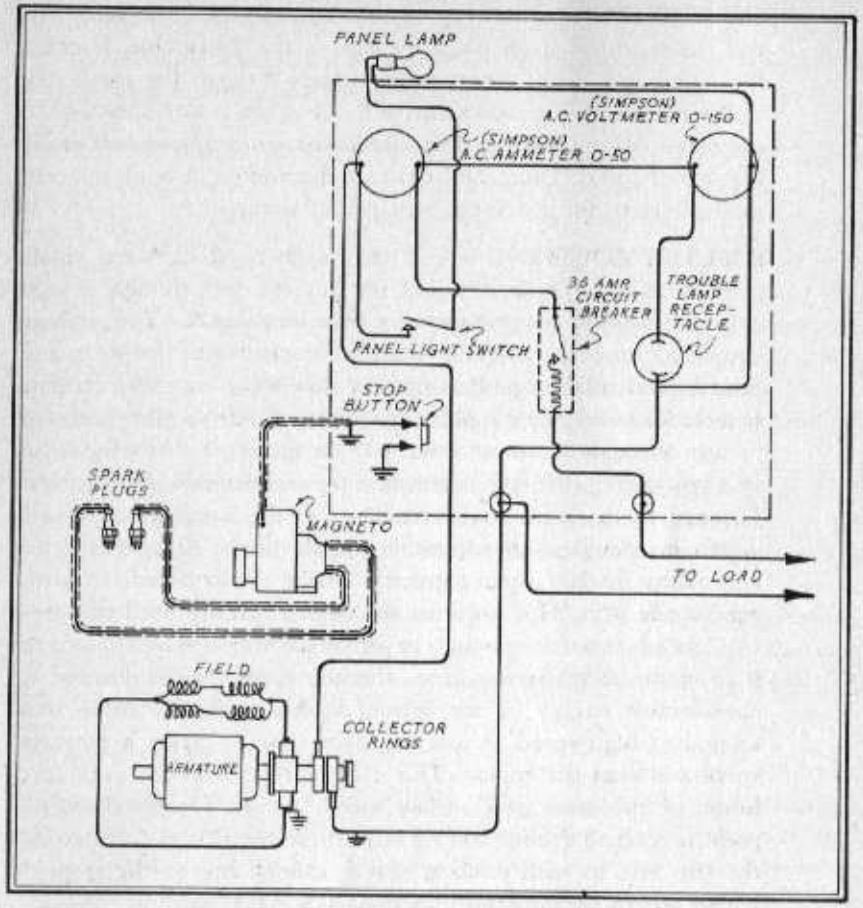

FIG. 9 WIRING DIAGRAM

generator. However, the two groups of windings are electrically insulated from each other.

The direct-current winding supplies the direct current for the field winding. The same field winding and magnetic circuit serve for both the alternating-current generator and the exciter. Residual magnetism remains in the magnetic circuit when not in operation. When the engine is started, the revolving armature carries its conductors by the field poles. The cutting of magnetic lines of force by these conductors as they pass poles of alternate polarity induces alternating voltages in the conductors. The conductors of the exciter winding are connected to commutator bars which revolve in contact with the exciter brushes. The various parts are so arranged that the commutator bars in contact with any given brush always have the same polarity. Thus, direct current flows in the exciter circuit outside the armature. The

exciter current passes through the field winding, Fig. 9, and increases the field strength which, in turn, greatly increases the voltage induced in the armature conductors. The exciter voltage thus builds up to a maximum of approximately 16 volts at normal operating speed.

The alternating current generated in the armature conductors passes from the armature by way of the slip rings and brushes, direct to the control panel, and from there to the load. If the circuit is complete, alternating current will flow in it while the power unit is running.

The generator supplies 115-volt, 60-cycle, single-phase, alternating current. It is designed to operate with a full load temperature rise not to exceed 50°C. Rated capacity is 3 KW., 3 K.V.A. at unity power factor.

REGULATION—The output voltage regulation of the generator after reaching normal operating temperature is within 10% from no load to full load. Regulation is obtained by strongly saturating certain parts of the magnetic circuit. Frequency regultaion depends on the regulation of the engine speed and is within the limit of about 1½ cycles per second.

5. CONTROL EQUIPMENT

No attempt to operate the Power Unit should be made until it has been properly installed, par. 8, properly prepared for operation, par. 9, and the operator has studied the operating procedure, pars. 10 to 17, inclusive.

The Power Unit is started by hand cranking. The starting crank may be inserted through an opening in the front of the housing, just below the radiator. Choking of the carburetor during starting and warming-up periods is done by pulling out the choke button at the front end of the housing as required.

When the engine starts, the oil pressure builds up and registers on the engine oil pressure gage, par. 3.

CONTROL PANEL—Meters and various controls are mounted on the control panel, Figs. 10 and 11.

The A.C. VOLTMETER shows the output voltage of the Power Unit.

The A.C. AMMETER shows the load amperes.

The CIRCUIT BREAKER serves to switch the load on or off the Power Unit. It trips and disconnects the load automatically in case of severe overload.

The PANEL LIGHT switch controls the 115-volt lamp which lights the control panel.

The TROUBLE LAMP receptacle is used for plugging in a 115-volt trouble lamp.

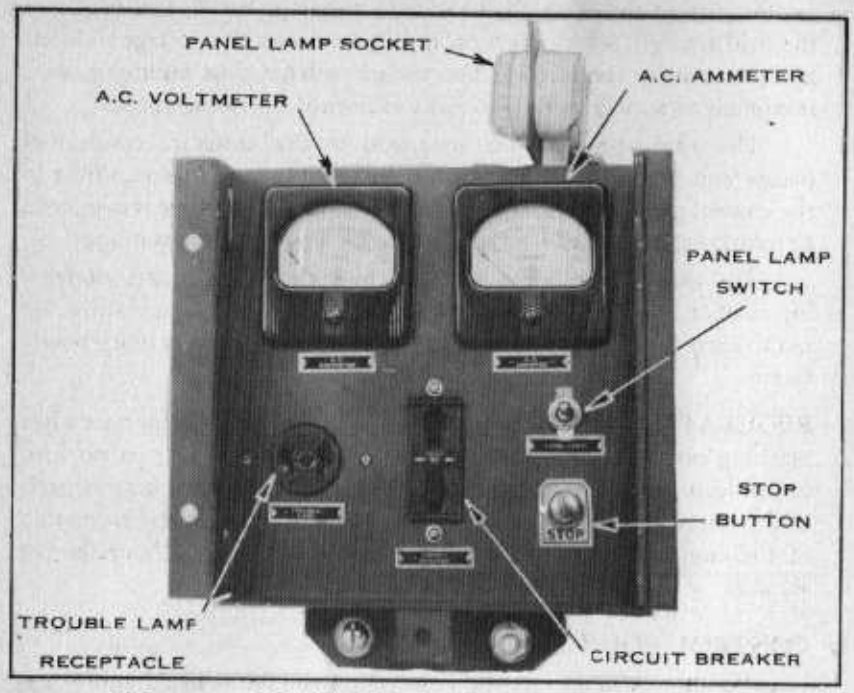

FIG. 10 CONTROL PANEL

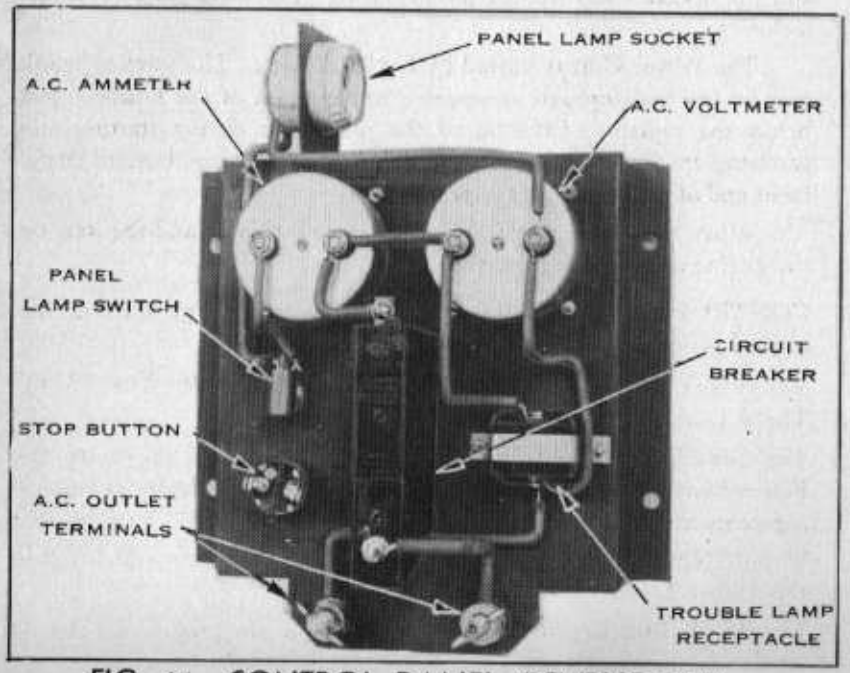

FIG. 11 CONTROL PANEL (REVERSE SIDE)

The Power Unit is stopped by pressing the STOP button, thus grounding the magneto ignitoin.

Terminals for connecting the load are located near the bottom of the reverse side of the panel.

6. HOUSING

The housing serves as radio shielding, provides some protection against damage and directs cooling air currents. Air enters through screen ventilators in the lower side plate of the housing and is discharged forward through the radiator. Side panels are removable for servicing the Power Unit. Rings permit attaching the snaps of the canvas cover. Provision is made for inserting a starting crank at the front of the housing. When not in use the starting crank is carried in a holder inside the housing. A tool box and a fire extinguisher are mounted inside the housing. A door at the rear protects the control panel.

II--Safety Precautions

7. SAFETY PRECAUTIONS

Power Unit W3M-19 generates high voltage. Severe, possibly fatal, shock may result from contact with parts carrying electric current while the Power Unit is operating, especially when ground is damp. Do not service with gasoline while Power Unit is running or while a radio transmitter is operating close to Power Unit. Stop the engine before removing the fuel tank cap. Avoid spilling gasoline. Do not fill tank so full that expansion of fuel will cause overflow.

Proper ventilation must be provided if the Power Unit is operated in a confined space.

Exhaust gases are poisonous. Excessive inhalation will cause severe sickness or death. Do not operate the Power Unit in a building or other confined space without piping all exhaust gases outdoors.

Do not attempt adjustments or changes on wiring while the engine is operating.

Observe every standard safety precaution while servicing or operating the Power Unit.

Do not run the Power Unit with the canvas cover on it.

III--Preparation for Initial Operation

8. INSTALLATION OF THE POWER UNIT

a. **IMPORTANCE OF PROPER INSTALLATION** — Although Power Unit W3M-19 is completely self-contained, it is important that it be properly installed to give good service. The housing protects it so that it may be operated outdoors, if necessary, but rain, snow, dust, and grit are unfavorable to satisfactory operation. If practicable, install the Power Unit in a building or inside a mobile vehicle.

Remove the crate or packing case from the Power Unit with care to avoid damage. The substantial, box-like case used for export shipment may be lifted off the Power Unit after removing the lag screws which attach the case to its wood base.

Depending on the type of shipment for which the Power Unit has been prepared, some or all of the following openings will have been closed in the manner indicated and such plugs and taping must be removed:

Fuel Tank Cap	**Openings Taped**
Air Cleaner	**Openings Taped**
Oil Fill Tube	**Openings Taped**
Oil Gage Opening	**Opening Taped**
Exhaust Outlet	**Opening Taped**

b. **MOBILE INSTALLATION**—Attach the Power Unit securely to the floor or other supporting member of the vehicle in such position that it will set approximately level when operating. Locate the Power Unit so as to provide proper ventilation and space for servicing.

If the vehicle is a closed one, ventilation must be provided. This will require at least one inlet near the rear end of the Power Unit and one outlet near the radiator end. Several small openings will serve, but there must be a total of at least 3½ square feet of opening for inlet and similar amount for outlet.

Pipe exhaust gases outside the vehicle with pipe as large as the exhaust outlet of the Power Unit. This piping must be mechanically secure and permanently gas tight within the vehicle, par. 7. Keep the pipe at least several inches from inflammable material.

Do not run the vehicle into a closed building and operate the Power Unit without carefully attaching an extension exhaust line that will carry all exhaust gases outside the building. The size of the extra

piping should be increased one pipe size for each 10 feet of length. Avoid using elbows if possible.

When the Power Unit is in use, it should be as near the center of the load as practicable and should be set reasonably level. Use sufficiently large insulated wire to connect the Power Unit to the load. The size wire required depends largely on the distance and permissible voltage drop between Power Unit and load, and the amount and kind of load. For a unity power factor load, such as incandescent lighting and resistance type heating, the wire size for outside wiring may be selected from the following table, based on about 5% voltage drop.

Load in Watts	A.C. Amperes	Distance in Feet									
		100	200	300	400	500	600	700	800	900	1000
500	4.17	10	10	10	10	10	10	10	8	8	8
1000	8.34	10	10	10	8	8	6	6	6	6	4
1500	12.5	10	10	8	6	6	6	4	4	4	2
2000	16.7	10	8	6	6	4	4	4	2	2	2
3000	25.0	10	6	6	4	2	2	2	2	1	0

Loads of lower than unity power factor, such as motors, transformers and fluorescent lighting, may require larger wire than indicated for the corresponding amperes in the above table. Motors require starting current much greater than their full load running current.

Run the insulated load wires through the conduit bushing in the rear end of the housing. If the load wires do not have suitable terminals, bend an eye at the end of each wire that will fit over a load terminal near the bottom of the control panel, Fig. 11. Connect one load wire to each load terminal and tighten the nuts securely.

No larger than 1½ H.P. motor should be used with this Power Unit. If a large portion of the output is to be used to drive motors, they should be started singly or in small groups to avoid too great a starting load. Use repulsion-induction type motors wherever practicable. Select motors of such sizes as will operate at approximately full load. Motors too large for their loads, or allowed to run without loads, result in lower power factor loads.

c. INDOOR STATIONARY INSTALLATION—When making an indoor stationary installation follow generally the instructions for installing in a mobile vehicle. The room should be clean, dry, well ventilated and, if necessary, heated in very cold weather. If the

floor is not strong enough to permanently support the load, it must be reinforced. If preferred, the Power Unit may be mounted on a substantial timber or concrete base which has a firm footing in the ground. Set the Power Unit level.

Pitch the exhaust pipe downward from its connection at the Power Unit, if possible. If the pipe must be pitched upward, construct a condensation trap of pipe fittings and install it in the exhaust line at the point where the upward pitch begins. It serves to catch water which condenses in the exhaust line and to prevent its running into the muffler. This trap must be drained periodically. If the exhaust pipe passes through an inflammable wall, partition or floor, install in metal collars so as to hold it at least several inches from the inflammable material.

9. PREPARING THE POWER UNIT FOR USE

Comply with the following instructions in preparing the Power Unit for initial operation.

a. Recheck to make sure that all instructions for installing the Power Unit, par. 8, have been complied with.

b. Remove the canvas cover and housing side panels.

c. Crank the engine over a few times with the hand crank to make sure that pistons are free and that the generator turns freely. The hand crank is attached inside the housing base. Keep it there when not in use.

FIG. 12 OIL LEVEL GAGE

d. Check all electrical connections to make sure they are tight.

e. Fill the crankcase to the FULL mark on the oil level gage, Figs. 4 and 12. Use Army No. 2-104-A (OE) oil of proper SAE number according to the lowest temperature to which the Power Unit will be exposed, as indicated in the following table.

Lowest Temperature	SAE Number
Above 32° F.	No. 30
Between 0° and 32° F.	No. 10
Below 0° F.	No. 10 Diluted with 10% kerosene as instructed in par. 14.

CAUTION:

Do not put diluted oil into the engine until ready to start it. The Oil and kerosene may separate if allowed to stand too long before use. Mix well just before pouring into the engine.

Refer to the Lubrication Chart, par. 19, Fig. 15, in connection with crankcase and other lubrication.

f. Remove the cover from the air-cleaner, Fig. 2 and 6, and fill the cup to the proper level with oil the same as used in the crankcase.

g. Place a drop of OE oil in each joint of the throttle control rod and check to make sure the mechanism moves freely, Fig. 24.

h. Remove the oil plug from the fan hub, Fig. 19, and fill the hub with OE-30 oil until oil seeps out on the shaft at the rear of the hub. Install the plug.

i. Close the drain cock at the bottom of the radiator.

j. Remove the radiator cap and fill the radiator to a level even with the top of the baffle plate, with clean, alkali-free water. Distilled or rain water may be used. The capacity is about 9 quarts. If there is danger of freezing, use a standard anti-freeze in proper proportion, par. 14. Check for leaks and correct any found. Replace the radiator cap.

k. Open the control panel door and make sure that the CIRCUIT BREAKER handle, Fig. 10, is in the OFF position so no load is connected.

l. Close the fuel shut-off valve under the fuel tank, Fig. 2. Turn clockwise to close. Remove the fuel tank cap and fill the fuel tank with clean, fresh gasoline of 68 to 74 octane rating. If necessary to use highly leaded fuel, refer to par. 17. Observe the usual safety precautions in handling the fuel and filling the tank, par. 7. Make sure that the vent in the fuel tank cap is open. Replace the cap.

m. Open the fuel shut-off valve and inspect the fuel system for leaks. Correct any leaks found.

n. If the Power Unit was processed at the factory for export shipment, the generator brushes were pulled out a short distance in their holders to prevent contact with commutator or slip-ring. The brushes are held in such positions by placing the ends of the springs against the sides of the brushes. Remove the generator end bell cover band which is held in place by two screws. Push each brush inward until it rests firmly against the commutator or slip-ring.

Then place the end of the spring so that it rests firmly on the outer end of the brush. See that each brush is firmly held against commutator or slip ring by its spring. Replace the cover band and tighten its retaining screws. This operation of setting the brushes is necessary only on Power Units processed for export shipment.

After all the foregoing instructions have been carefully complied with, the Power Unit is ready to be started. However, before starting the Power Unit, study paragraphs 10 to 17, inclusive, which contain instructions on Proper Operating Procedure and Abnormal Operating Conditions.

IV--Proper Operating Procedure

10. PRELIMINARY PREPARATION

Do not start the Power Unit until it has been properly prepared for operation, par. 9, and you have studied the Proper Operating Procedure given in this section.

Remove the canvas cover.

If the preparation has been made for cold weather operation, the initial filling of the crankcase with diluted oil may have been left to be done immediately before starting the Power Unit. Check the oil level. Make sure the crankcase is filled with proper oil to the FULL mark on the gage, Fig. 4.

See that the fuel shut-off valve, Fig. 2, is open and that the filter bowl is full of fuel.

11. STARTING THE POWER UNIT

Proceed as follows: (See Figs. 2 and 10.)

a. See that the CIRCUIT BREAKER is in OFF position.

b. Pull out the CHOKE button as required by the temperature conditions of the engine. For a cold start in cold weather this button may have to be all the way out. When starting a warm engine, no choking may be required. Do not overchoke.

c. Remove the starting crank from inside the housing and insert it through the hole below the radiator. See Fig. 13. Be sure that it engages positively with the crankshaft ratchet. Crank the engine with a strong, quick, upward pull. DO NOT SPIN OR PUSH DOWN ON THE CRANK. Repeat if necessary.

NOTE:

When cranking, a sharp snap will be heard in the magneto. This is due to the normal operation of the impulse coupling and is normal at speeds lower than 200 r.p.m.

d. If the engine does not start after several attempts, check the fuel shut-off valve to be sure it is open. See that the magneto cables are properly connected to the spark plugs. Set the choke button to a new position and repeat the cranking.

NOTE:

Oil was placed in the cylinders before shipping and it may be necessary to remove and clean the spark plugs with gasoline before the engine will start the first time.

e. When the engine starts, push the CHOKE button part way in. Avoid over-choking or running with too rich a mixture. Gradually push the CHOKE button entirely in as the engine warms up. If the engine hunts (alternately speeds up and slows down) during the warming up period, the CHOKE button is out too far. If the engine sputters, the CHOKE button is too far in for the cool engine. When the engine is warm enough to permit it, the CHOKE button must be ALL THE WAY IN.

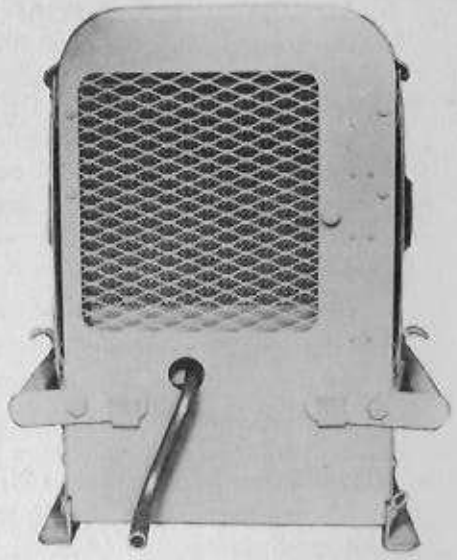

FIG. 13 STARTING CRANK IN POSITION FOR CRANKING

12. OPERATION AFTER THE ENGINE STARTS

a. CHECKING OPERATION—Check the ENGINE OIL PRESSURE GAGE immediately after the engine starts. Pressure will be high until the engine warms up. Observe the readings of gages and meters on the control panel, Fig. 10, as a check on normal operation. Normal readings after the Power Unit reaches normal operating temperatures are given here.

ENGINE OIL PRESSURE, about 15 pounds.

A.C. VOLTMETER, indicates the voltage at the alternating current output terminals. After reaching normal operating temperature, and with a unity power factor load, the voltage should be between 115 and 131 volts, depending on the amount of load.

A.C. AMMETER, indicates the alternating current load in amperes. The actual reading depends on the amount of load, the power factor of the load and the operating voltage. At 115 volts operating voltage and a unity power factor load, the full load amperage is 26.

b. CONNECTING THE LOAD—When practicable to do so, allow the Power Unit to warm up somewhat before connecting the load. This warming up should reach at least the point where the engine operates smoothly with the CHOKE button entirely in. Then connect the load by throwing the CIRCUIT BREAKER control handle, Fig. 10, to the ON position. The CIRCUIT BREAKER will open automatically and disconnect the load if the Power Unit is severely overloaded. Throw the control handle to the OFF position to disconnect the load when desired.

c. HOUSING SIDE PANELS—Keep the side panels on the housing except while servicing. They help direct cooling air and reduce radio interference. Do not operate the Power Unit while the canvas cover is on the housing.

13. STOPPING THE POWER UNIT

When it is desired to stop the Power Unit, first disconnect the load by throwing the CIRCUIT BREAKER handle, Fig. 10, to the "OFF" position. Then press the "STOP" button firmly until the engine has entirely stopped. Whenever the Power Unit is not to be operated within a few hours, keep the canvas cover installed on it. It is important to keep this cover on the Power Unit at all times when the Power Unit sets outdoors or is in transit, unless the Power Unit is in operation or is being serviced.

V--Abnormal Operating Conditions

14. COLD TEMPERATURES

Lubrication and fuel require special attention at temperatures below 0° F. Cooling requires special attention at temperatures below 32° F.

a. LUBRICATION—For temperature below 0° F. use OE, SAE 10 oil diluted with 10% kerosene for crankcase lubrication, as an aid to starting and to assure proper lubrication. If the crankcase is filled with undiluted oil, run the engine until warm then drain the oil and replace the drain plug securely.

THOROUGHLY mix 1 pint of kerosene with each 5 quarts of the OE, SAE 10 oil. If kerosene is not available use 1 pint of a good grade of distillate instead. Do not dilute heavier than SAE 10 oil.

Fill the crankcase with such diluted oil to the FULL mark on the gage and immediately run the engine 10 minutes to circulate the mixture throughout the lubricating system.

NEVER ADD KEROSENE ALONE TO THE CRANKCASE. Mix with the oil before pouring into the crankcase. This applies to oil added between changes, also.

When using diluted oil, change the oil every 64 operating-hours and check the level every 8 operating-hours, or oftener if experience shows it to be necessary.

b. AIR CLEANER—For temperatures below 32° F. use SAE No. 10 oil. If congealed No. 10 oil or frost formation within the air cleaner restricts the flow of air, remove and clean the air cleaner, par. 21. Reassemble and use without oil. As soon as temperature and humidity conditions permit, oil should be used with the cleaner in the normal manner.

c. COOLING SYSTEM—The liquid in the cooling system must be protected if there is any possibility of its freezing. Use any good anti-freeze as directed by the manufacturer. Common ones are alcohol, Prestone and Zerone. NEVER USE KEROSENE OR DISTILLATE. Drain the cooling system while warm (never hot) and flush the cooling system with running water or approved flushing agent. Never flush a very cold cooling system with water or any solution which may freeze upon contact with the cold metal and cause damage.

Close the drain cock and fill the radiator to a level even with the baffle plate, with water and anti-freeze solution in proper proportions.

Check the cooling mixture often, both as to the amount and the degree of protection. Protect for the lowest temperature that may occur.

d. ENGINE WATER TEMPERATURE—If necessary under very cold operating conditions, cover a portion of the radiator surface with cardboard in order to raise the engine water temperature to normal. Avoid overheating. The temperature must be kept below the boiling point.

e. FUEL—Give special attention to fuel. Fresh fuel and higher test fuel aid starting. Keeping the fuel tank nearly full reduces moisture condensation. Never fill entirely full with cold gasoline.

15. HOT TEMPERATURES

Under extremely warm operating conditions make sure there is ample ventilation. Keep radiator well filled and fan belt properly adjusted. Keep the crankcase oil level near the FULL mark. Flush the cooling system if necessary, and refill. Make sure radiator hose is not obstructed.

16. DUST AND DIRT

Under dusty, dirty conditions, keep the Power Unit as clean as practicable. Check operation oftener and service as needed. Clean the air cleaner and refill the oil cup as often as necessary. Check daily. Clean the commutator, slip rings and brushes often and see that brushes ride freely in holders. Keep supplies of fuel and oil in air-tight containers.

17. USE OF LEADED FUELS

The performance of gasoline engines deteriorates with use until it eventually becomes necessary to remove the carbon, grind the valves, install new spark plugs, etc.

Lead is added to many gasolines to increase the octane rating. Due to the action of the lead in the combustion chamber and on the valve seats, the use of such fuels causes the engine performance to deteriorate more rapidly. When using highly leaded fuel there is a regularly increasing lead content in the crankcase oil.

If the gasoline contains ½ cubic centimeter of lead, or less, per gallon there is little such effect. However, as the proportion of lead is increased the deterioration in engine performance is greatly accelerated.

Under normal operating conditions with unleaded fuel it may be necessary to remove carbon each 1000 operating-hours, grind valves each 1000 to 2000 operating hours, clean spark plugs each 200 operating-hours, and change crankcase oil each 200 operating-hours.

When using 100 octane fuel containing 4 cubic centimeters of lead per gallon, it may be necessary to remove carbon and grind valves each 100 to 200 operating-hours, clean spark plugs each 50 operating-hours, replace them each 200 operating-hours and change the crankcase oil each 50 to 100 operating-hours. If carbon is removed every 100 to 150 operating-hours the periods between valve grinding jobs usually can be considerably lengthened.

When using leaded fuels, inspect the engine more often and give it the more frequent service required.

VI--Periodic Servicing

18. PERIODIC SERVICING SCHEDULE

Follow a definite schedule of inspection and service to maintain a high level of operating efficiency. The following schedule is based on regular intervals of 8 operating-hours and multiples thereof. Lubrication is an important part of periodic servicing and reference should be made to par. 19, Fig. 15. Use the Corps of Engineers' Lubrication Check Card to keep a written record as instructed in Engineer Field Service Bulletin L-1000. See Fig. 14.

The service periods indicated are for normal service. For extreme conditions of load, temperature, frequent starts, dust and dirt, service oftener. See pars. 14, 15, 16 and 17.

If the Power Unit operates less than 8 hours daily, give the 8-hour service daily. If operation is less than 64 hours weekly, give the 32 and 64-hour services weekly. If operation is less than 256 hours monthly, give the 128 and 256-hour services monthly. If operation is less than 1024 hours each 3 months, give the 512 and 1024-hour services each 3 monthts.

Check the various gages and instruments on the control panel frequently and promptly take any corrective measures indicated. See par. 20.

SERVICE ONLY WHILE ENGINE IS NOT RUNNING. OBSERVE SAFETY PRECAUTIONS, PAR. 7. When lubrication is indicated, refer to par. 19 for instructions.

SERVICE EVERY 3 OPERATING-HOURS

FUEL SUPPLY—Check the fuel supply by means of the bayonet gage attached to the fuel tank cap. Add proper gasoline as necessary to assure ample fuel at all times. The tank holds 3 gallons, enough for more than 3 hours' operation at full rated load. See par. 26.

SERVICE EVERY 8 OPERATING-HOURS

RADIATOR—Check the cooling liquid level and add liquid as needed. See par. 31.

CRANKCASE OIL LEVEL—Check the oil level as shown by the gage, Fig. 4, and add oil, if needed. See par. 19.

AIR CLEANER—Check oil level and refill to proper level. See par. 19.

DATE (MO'S)	METER READING OR HRS. OPERATED	P. M. SERVICES	P. M. CHECKED BY	LUBR. HOURS	LUBRICATION CHECKED BY	DATE	METER READING OR HOURS OPERATED	P. M. SERVICES	P. M. CHECKED BY	LUBR. HOURS	LUBRICATION CHECKED BY	DATE	METER READING OR HOURS OPERATED	P. M. SERVICES	P. M. CHECKED BY	LUBR. HOURS	LUBRICATION CHECKED BY
		D		8				D		32				D		8	
		D		16				D		8				W		64	
		D		8				D		16				D		8	
		D		32				D		8				D		16	
		D		8				W		128				D		8	
		D		16				D		8				D		32	
		D		8				D		16				D		8	
		W		64				D		8				D		16	
		D		8				D		32				D		8	
		D		16				D		8				NW		256	
		D		8				D		16				D		8	
		D		32				D		8				D		16	
		D		8				W		64				D		8	
		D		16				D		8				D		32	
		D		8				D		16				D		8	
		W		128				D		8				D		16	
		D		8				D		32				D		8	
		D		16				D		8				W		64	
		D		8				D		16				D		8	
		D		32				D		8				D		16	
		D		8				NW		512				D		8	
		D		16				D		8				D		32	
		D		8				D		16				D		8	
		W		64				D		8				D		16	
		D		8				D		32				D		8	
		D		16				D		8				W		128	
		D		8				D		16				D		8	
		D		32				D		8				D		16	
		D		8				W		64				D		8	
		D		16				D		8				D		32	
		D		8				D		16				D		8	
		NW		256				D		8				D		16	
		D		8				D		32				D		8	
		D		16				D		8				W		64	
		D		8				D		16				D		8	
		D		32				D		8				D		16	
		D		8				W		128				D		8	
		D		16				D		8				D		32	
		D		8				D		16				D		8	
		W		64				D		8				D		16	
		D		8				D		32				D		8	
		D		16				D		8				NW		1024	
		D		8				D		16		START NEW RECORD CARD					

FIG. 14 CORPS OF ENGINEER'S PREVENTIVE MAINTENANC AND LUBRICATION RECORD CARD

SERVICE EVERY 64 OPERATING-HOURS

FAN BELT—Inspect the fan belt. Adjust or replace as needed. See par. 25.

FAN HUB—Lubricate. See par. 19.

CRANKCASE—Drain and refill to proper level with OE oil according to par. 19.

AIR CLEANER—Disassemble, clean and refill with OE oil. See par. 19.

OIL CAN POINTS—Lubricate. See par. 19.

SERVICE EVERY 256 OPERATING-HOURS

MAGNETO—Clean the distributor inside and outside. Adjust the breaker contacts to .015 in. when wide open. Install new contacts, if needed. Inspect the cables and install new ones, if needed. See par. 30. Remove the oil plug from the near side of the housing and lubricate at that point. See par. 19.

FUEL SEDIMENT BULB—See Fig. 2. Clean the fuel sediment bulb and screen, par. 26.

ENGINE COMPRESSION—Check the compression of the engine cylinders by means of the hand crank. See par. 23. If compression is poor on one or both cylinders and the trouble cannot be corrected in the field, return the Power Unit to the depot for repairs.

CARBURETOR—See Fig. 2. Drain the carburetor and replace the drain plugs, par. 22.

GENERATOR—Examine the commutator, slip rings and brushes. Clean, adjust or replace as needed. See par. 27.

EXHAUST SYSTEM—Inspect all exhaust connections. Tighten or replace all parts requiring it. See par. 24.

GENERAL—Inspect the Power Unit thoroughly for leaks, loose electrical connections and other external items that may need attention. Make needed corrections.

SERVICE EVERY 1024 OPERATING-HOURS

GENERATOR BALL BEARING—Lubricate. See par. 19.

19. LUBRICATION CHART

The Lubrication Chart, Fig. 15, provides detailed information regarding proper periodic lubrication of the Power Unit.

ADDITIONAL LUBRICATION AND SERVICE INSTRUCTION NOTES

(See also Paragraph 20)

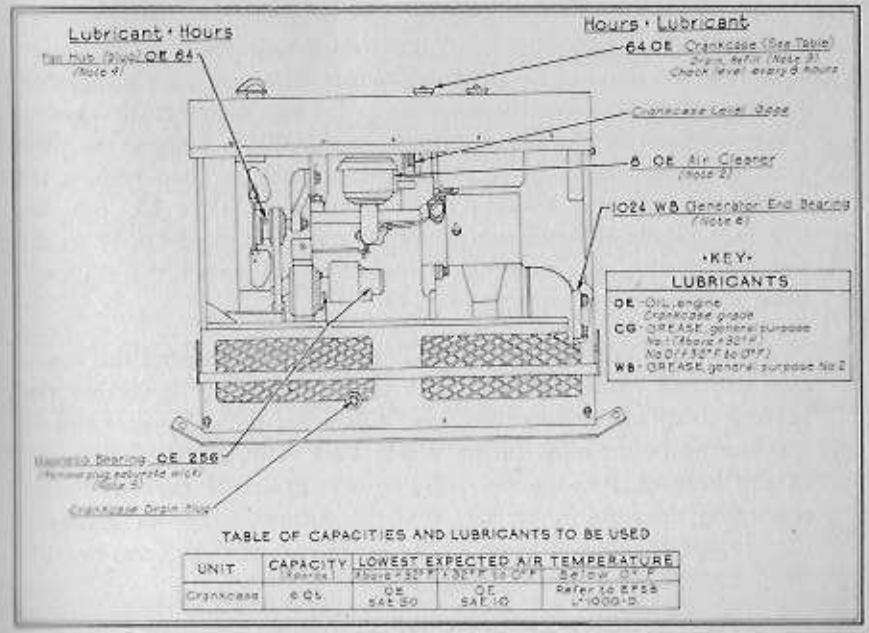

FIG. 15 LUBRICATION CHART

NOTE 1. HOURS—The hours indicated are for normal service. For extreme conditions of heat, cold, dust and dirt change crankcase oil and lubricate more frequently.

NOTE 2. AIR CLEANER—Every 8 hours, check the oil level and refill to the level mark with OE. Drain, clean and refill every 64 hours, more often under extremely dusty conditions.

NOTE 3. CRANKCASE—Every 8 operating-hours check the oil level as shown by the oil level gage. Fill to the FULL mark.

Every 64 operating-hours drain the oil from the crankcase while the engine is warm and refill to the FULL mark on the gage.

CAUTION:

When running the engine, be sure the pressure gage indicates oil is circulating. Every 2048 operating-hours, remove the oil base and thoroughly clean the crankcase, oil base, oil pump screen, and oil lines.

NOTE 4. FAN HUB—Remove the oil plug from the hub. Fill the hub with OE-30 until the lubricant seeps out on the shaft at the rear of the hub. Install the plug.

NOTE 5. MAGNETO—Every 256 operating-hours remove the oil plug from the near side of the magneto housing and fill the opening to overflowing with OE-10.

Every 1024 operating-hours remove the magneto from the engine and flush the impulse coupling mechanism thoroughly with kerosene, taking care not to allow the kerosene to get into the magneto housing. Then lubricate the coupling sparingly with OE-10. Remove the plate from the distributor end of the magneto housing. Then remove the distributor cap, gear housing and cam oil pad. Work CG into the cam oil pad and reinstall the pad. Add a few drops of OE-10 to the felt pad in the gear housing. Reassemble and install the magneto, being sure to time it correctly, par. 49.

NOTE 6. GENERATOR END BEARING—Remove the generator end bell band. Clean all dirt from around the generator end bearing cover and remove the cover. Clean out the old grease and fill the bearing housing ½ full of WB-2. Pack well into the lower half of the bearing. Reassemble, using a new gasket if needed. Before tightening the nuts, make sure that the witness marks on the bearing support and on the brush spider are in correct alignment, par. 27. Keep dirt out of the bearing housing.

NOTE 7. OIL CAN POINTS—Every 64 operating-hours lubricate the throttle shaft bearings, throttle to governor link bearings, door hinges, locks and housing hood fasteners with OE.

NOTE 8. POINTS REQUIRING NO LUBRICATION—Engine Governor, Generator Front Bearing.

VII--Inspections and Adjustments

20. GENERAL

The operator should become familiar with the performance and the sound of the Power Unit under various operating conditions so that he will recognize any unusual condition that requires attention. He should notice the performance whenever near the Power Unit. Loose bolts or screws should be tightened at once. Leaks should be corrected promptly.

The Periodic Servicing Schedule, par. 18, should be followed. Instructions for the simpler inspections and adjustments are given in that schedule for convenience. More detailed instructions for certain periodic inspections and adjustments follow in this section. This section also includes instructions for certain adjustments which are not of a periodic nature, but which the operator should be able to make when needed. Major servicing jobs will be greatly reduced and power failures seldom will occur if the Power Unit is well serviced as instructed herein.

If trouble develops, the operator should follow an orderly procedure in determining the cause before attempting repairs. For assistance, reference should be made to the Trouble and Remedy Chart, par. 33.

21. AIR CLEANER

Remove the thumb nut at the top of the air cleaner and lift the cleaner from the Power Unit for cleaning. The cover and element assembly may be lifted from the cup. See Fig. 16. Clean the old oil

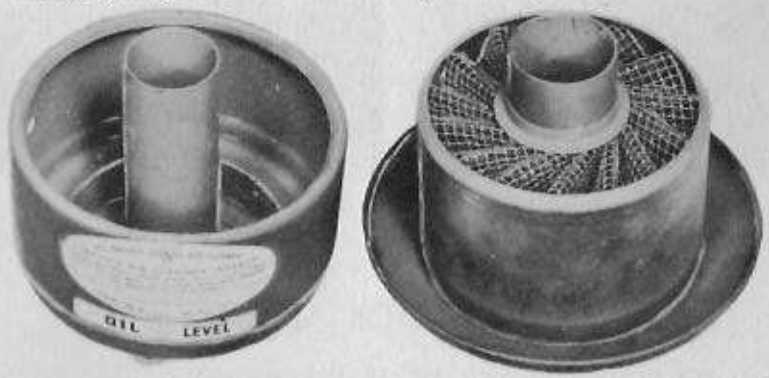

FIG. 16 AIR CLEANER WITH COVER REMOVED

and sediment from the cup. Clean the element thoroughly by sloshing up and down in a suitable cleaning fluid or in gasoline. Allow it to dry or dry it by using an air hose. Fill the cup to the level mark with clean oil of the same kind as used in the engine crankcase. Reassemble and install the cleaner, tightening the thumb nut securely.

22. CARBURETOR

If the engine is not performing correctly, do not hastily conclude that the carburetor is at fault. The ignition system, valve action, compression, and fuel system other than the carburetor must be functioning properly before the carburetor can be properly adjusted.

Water and sediment which may have collected in the bottom of the carburetor bowl or in the chamber below the metering well, may be drained by removing the drain plug and the lower plug. Major repairs to the carburetor seldom are needed and are explained in the Repair Section.

The carburetor may be adjusted in the following manner:

a. Loosen the screw which clamps the choke control wire to the choker arm of the carburetor, Fig. 17. Push the choke control button in as far as it will go and move the choker arm as far backward, toward the generator, as it will go. Then tighten the screws. This adjusts the choker so that it will be entirely open when the choke button is pushed in.

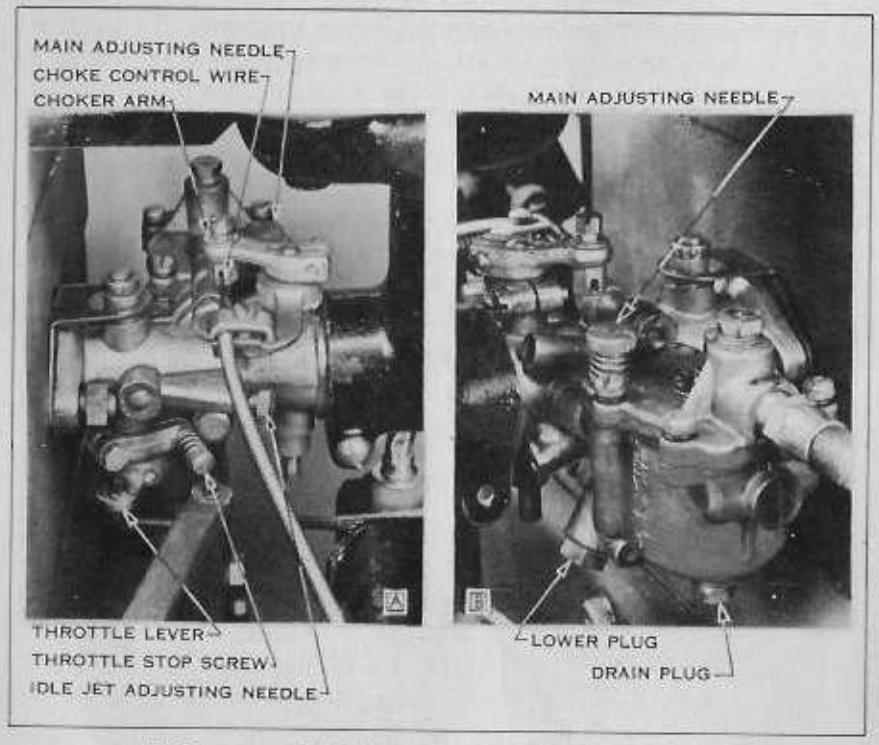

FIG. 17 CARBURETOR ADJUSTMENTS

b. With the Power Unit running at normal operating temperature and carrying a load of 1500 to 3000 watts, turn the main jet adjusting needle out (counter-clockwise) 3 turns. Then turn this needle in (clockwise) until the engine begins to lose power and speed.

Next, turn the needle out very slowly until the engine regains maximum power and speed. The correct adjustment is the one which provides the maximum speed and voltage. However, if there is a tendency for the engine to hunt (alternately gain and lose speed), it may be necessary to turn the needle out a little further. Do not turn it out more than ½ turn beyond the point of maximum power.

c. With the Power Unit running at normal operating temperature and with no load, turn the idle jet needle in (clockwise) until the engine loses considerable speed. Then turn this needle out (counter-clockwise) until the engine runs its smoothest. The correct setting usually is ½ to 1¼ turns open from the fully closed (in) position.

If the carburetor has been tampered with and is entirely out of adjustment, an approximate adjustment that will permit starting the engine may be made by turning both needle adjustments entirely in and then turning them out about 2½ turns. Final adjustments always must be made with the engine at normal operating temperature.

Do not turn either needle tightly into its seat or the seat may be damaged.

23. COMPRESSION

The engine must have uniformly good compression on both cylinders in order to function properly. Loss of compression may be due to leaking spark plugs, spark plug gaskets or cylinder head gasket. These can be tightened or replaced by the operator. The most common cause of compression loss is leaking valves. Compression loss may result from sticking or broken piston rings or badly worn cylinders. Servicing of valves, pistons and cylinders is a shop job not to be attempted by the operator inexperienced in such work. He can, however, determine when such major service is needed. Loss of compression sufficient to affect the operation of the Power Unit should be corrected as soon as possible.

When testing the compression, have someone press the STOP button so the engine will not start. Insert the hand crank and pull upward. Compression should rock the crank backward forcibly if allowed to do so when well up on the compression stroke.

Compressed gases leaking past an exhaust valve can be heard at the exhaust outlet. If leaking past an intake valve, a hissing noise may be heard through the carburetor. Remove the air cleaner and disconnect any exhaust line extension at the Power Unit, and have someone crank the engine manually while you listen for these sounds, if it is suspected that the valves are leaking. If any valve is leaking, all should be serviced. A compression leak past the piston rings will cause a hiss inside the crankcase and may be heard at the oil filler opening. Reassemble after testing both cylinders.

24. EXHAUST SYSTEM

If the Power Unit is operated inside an enclosure, such as a room or the compartment of a mobile vehicle, all exhaust gases must be piped outdoors. All parts of the exhaust system from engine cylinders to outdoors must be kept mechanically secure and gas tight. Examine the muffler carefully. Do not allow the exhaust line to become clogged with carbon. A clogged exhaust line will cause carbon to collect in the engine and require removal and, probably, grinding of valves. The muffler may be disassembled for cleaning. Be sure to assemble it gas tight.

25. FAN

Inspect the fan belt, Fig. 18. Do not use a fan belt until it breaks. If the belt surface is broken, install a new belt. If the belt should break in service, the engine might overheat and be damaged to the point requiring major repairs. Too tight a belt will have a short life and cause unnecessary wear on the fan bearing. A loose belt will slip, become hot and fail to drive the fan fast enough for proper cooling.

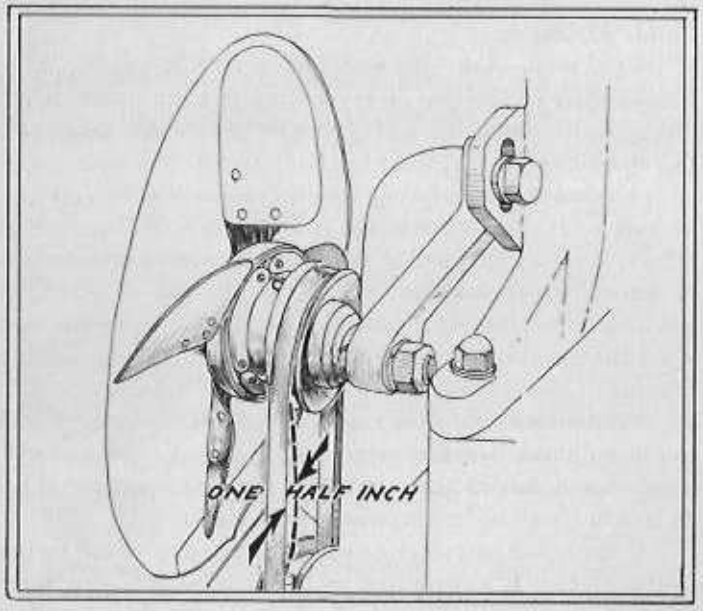

FIG. 18 FAN BELT ADJUSTMENT

Adjust the belt tension by loosening the cap screws which hold the fan bracket and raising or lowering the bracket. The correct tension permits one side of the belt to be pushed inward about ½ in. without a great deal of effort when pressure is applied at a point midway between the pulleys. Tighten the cap screws securely.

To lubricate the fan bearing, remove the oil plug from the hub and fill hub with OE-30 until oil seeps out on the shaft at the rear of the hub. See Fig. 19. Install the plug.

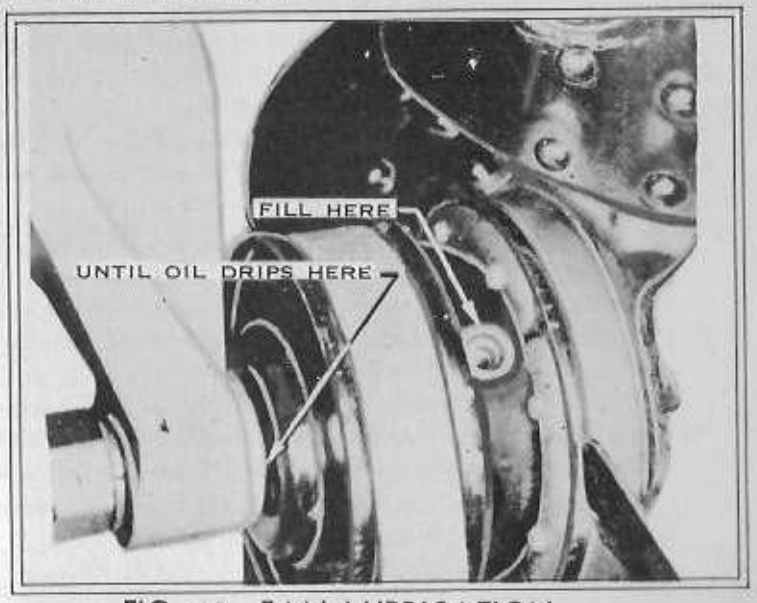

FIG. 19 FAN LUBRICATION

26. FUEL SUPPLY

The fuel screen may be removed for cleaning after first closing the shut-off valve and removing the sediment bulb, Figs. 2 and 20. Be sure the gasket is in good order and in place before installing the sediment bowl. Inspect for leaks after opening the shut-off valve. Correct all leaks at once. Do not fill the tank entirely full of cold gasoline. It may overflow when it becomes warm and cause a fire.

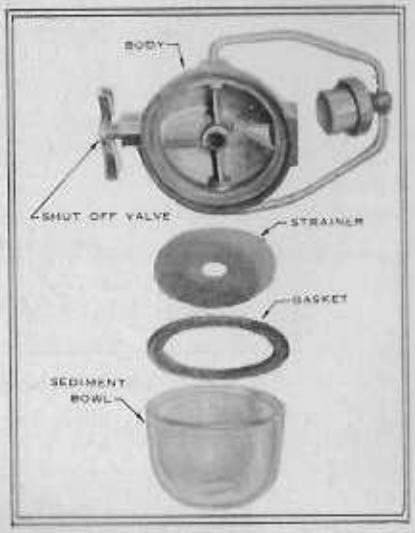

FIG. 20 FUEL STRAINER AND SHUT OFF VALVE ASSEMBLY

27. GENERATOR

Refer to Fig. 4. Remove the cover from the exciter every 256 operating-hours, at least once a month, and inspect the commutator, collector rings, and brushes. Make sure that the brushes move freely in holders and have uniformly good spring tension. Correct spring tension

is 16 to 20 ounces when the end of the spring is even with the top of the brush holder. Replace any brushes worn to less than 3/4 in. length.

a. Sand new brushes to a good seating contact. Provide several strips of No. 00 sandpaper about 1 1/8 in. wide by 9 in. long for use on the commutator. For use on the slip rings the sandpaper need not be so wide. Some Scotch tape will be required.
Lift all brushes from their holders and place the ends of the brush springs against the sides of the brushes in such position as to hold them high.

Lay a strip of the sandpaper on a bench, sanded side up. Take a piece of Scotch tape about the same width as the paper and 3 1/2 in. long, and stick it on one end of the sandpaper. It should be in line with, and extended 2 in. beyond the end of the sandpaper. Now take this sandpaper with tape attached and feed it onto the commutator (or collector ring, as the case may be) in the direction in which the armature normally rotates. This should be done in such manner that the tape may be pressed against, and will adhere to, the commutator or collector ring. Crank the engine slowly by means of the hand crank and feed the paper carefully so that it will be pulled entirely around the commutator or collector ring, sanded side out, Fig. 21.

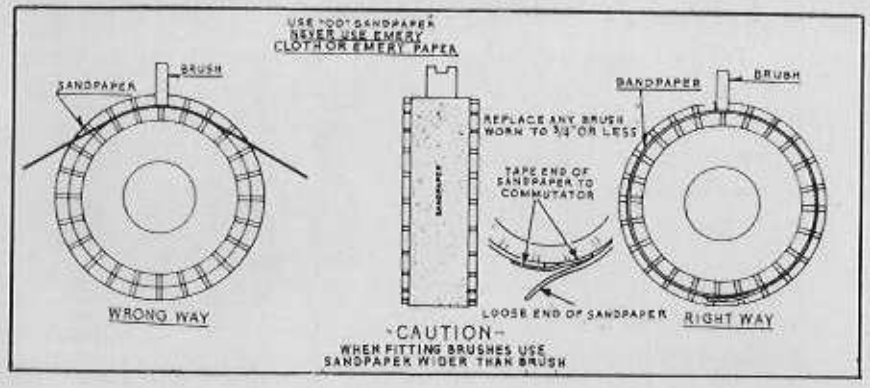

FIG. 21 SANDING BRUSHES

Release the brushes so they rest on the sandpaper with normal spring tension. Remove the wires from the spark plugs, or have someone press the STOP button, to prevent the engine from starting. Then crank the engine until the brushes are sanded to proper seats. Examine each brush every few revolutions and sand no more than necessary to produce proper seats. If necessary, renew the sandpaper. When sanding is completed, remove the sandpaper, tape

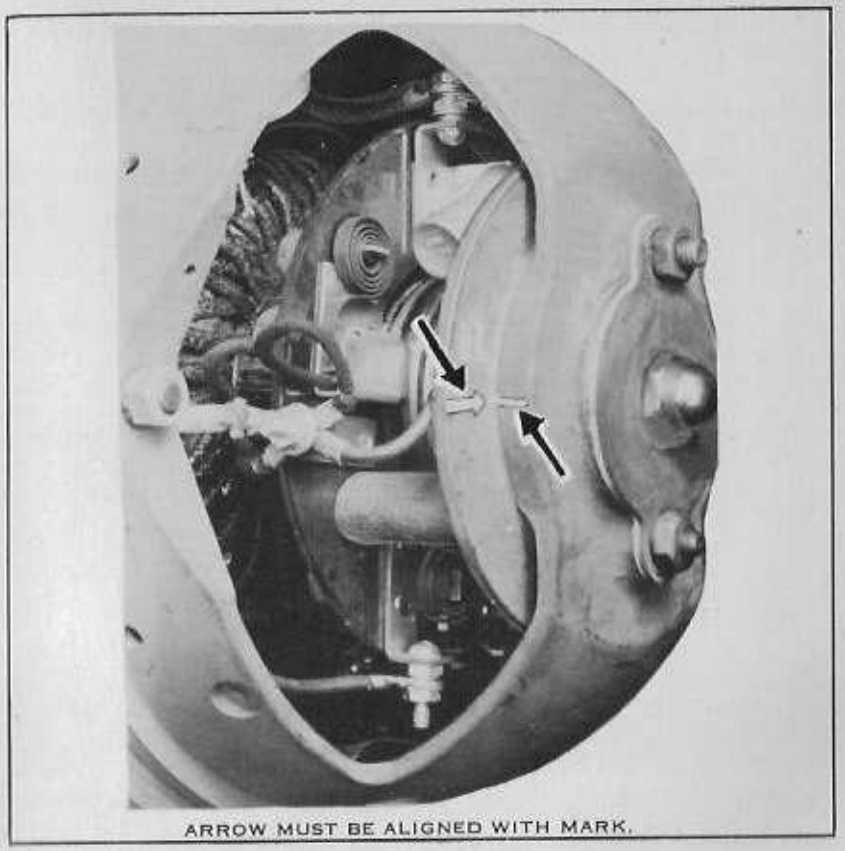

FIG. 22 NEUTRAL POSITION OF BRUSHES

and all traces of adhesive. Blow the dust away and install the brushes. Observe the brushes under operation to be sure there is no arcing due to improper seating. Then replace the cover.

b. The commutator acquires a mahogany-colored surface after being in service a short time. If smooth, this surface requires no attention. Slight roughness may be improved by holding a piece of No. 00 sandpaper against the surface while the engine operates slowly. Brushes should be lifted in holders while doing this operation. A badly worn, burned or pitted commutator will require refinishing in a lathe. Whenever the copper has worn down flush with the mica insulation which is between the bars, or after refinishing the commutator, the mica must be undercut 1/32 in. as shown in Fig. 59. Return the Power Unit to the depot for this major reconditioning of the commutator.

c. An arrow cast on the brush spider, coincides with a yellow mark on the generator bearing support, when the spider is correctly

located to hold the brushes in proper neutral positions. See Fig. 22. This neutral setting of the brush rig should be maintained. The position of the spider may be changed after loosening the nuts on the generator ball bearing cover.

d. The slip rings require the same attention as the commutator except that there is no mica to be undercut.

e. After servicing the commutator, slip rings and brushes, blow the sand, copper, and carbon dust from the generator.

f. Lubricate the generator ball bearing according to schedule. Remove the bearing inspection cover from the housing end panel. Remove the end bell band. Clean all dirt from the outer end of the end bell.

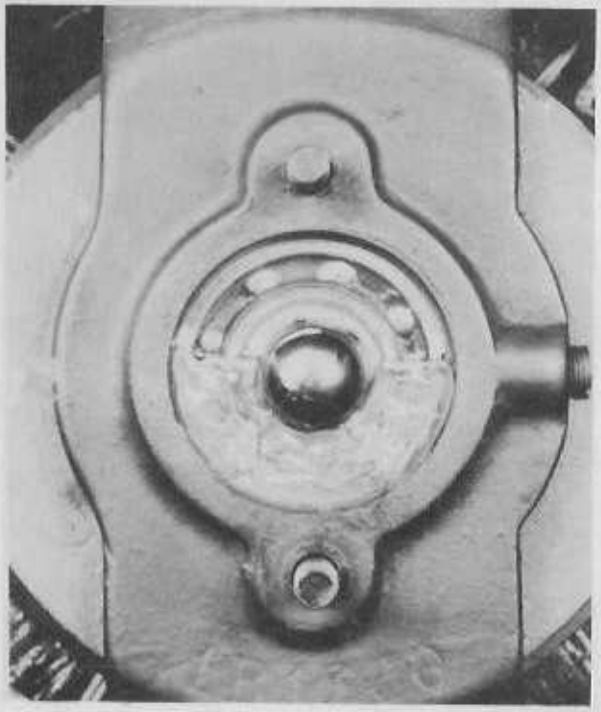

FIG. 23 GENERATOR BALL BEARING PROPERLY LUBRICATED

Remove the bearing cover, clean out the old grease and fill the bearing housing ½ full of WB-2 GREASE, general purpose No. 2. Pack the grease well into the lower half of the bearing. Replace the cover, using a new gasket, if needed. Before tightening the nuts, check the position of the brush spider as indicated by the arrow. See Fig. 23, to make sure that it is in correct position. Avoid getting any dirt whatever into the bearing housing.

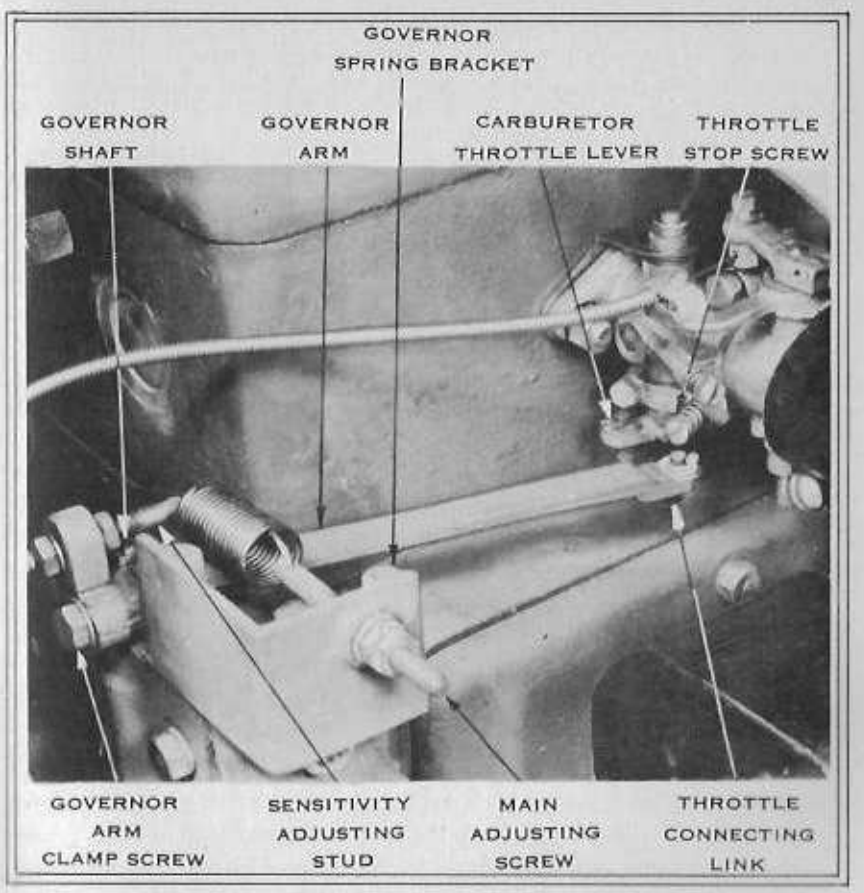

FIG. 24 GOVERNOR ADJUSTMENTS

28. GOVERNOR

The governor, Fig. 24, is lubricated from the engine gearcase and normally requires little attention. However, it must function properly, par. 3.

When adjustment becomes necessary it is convenient to refer to the A.C. VOLTMETER while adjusting. After reaching normal operating temperature the voltage should remain between the limits of 131 volts at no load and 115 volts at full load. Use an incandescent lamp load or a resistance load when adjusting the governor and proceed as follows.

With the Power Unit running at normal operating temperature and with no load, loosen the main adjusting stud locknut and turn the adjusting nut on this stud to obtain the correct generated voltage. Turn this nut clockwise to raise the voltage, counter-clockwise to lower it. The voltage should be slightly under 131.

Then check the voltage at full 3 kw. resistance load. The voltage should not drop below 115. If it remains higher than 115, it may be lowered to that voltage by turning the adjusting nut counter-clockwise. Then tighten the locknut.

If there is a tendency of the governor to hunt (alternately gain and lose speed) it may be necessary to adjust the sensitivity adjusting stud so that the inner end of the spring is held farther from the governor shaft. Regulation is better with the inner end of the spring closer to the shaft, but the tendency to hunt is increased, also. The correct position is the one which gives the best regulation with no tendency to hunt.

If it is impossible to keep the no-load and full-load voltages within the specified limits, it is probable that the engine or the generator brush adjustment needs attention.

The throttle stop screw should be set at such position as will give a voltage of 100 when the governor arm is held in the closed position by hand.

It is necessary that the throttle arm and throttle stop bracket be set at the correct angles to permit the governor to function properly. If these have been tampered with, it will be necessary to reset them to approximately the positions shown in Fig. 48.

29. LUBRICATION

CRANKCASE—Check the oil level at least every 8 hours. Never run the engine if the oil level gage indicates that the oil level is down to the DANGER point. Keep the level near the FULL mark. Follow the instructions on the Lubrication Chart, Fig. 15, regarding oil changing.

GENERAL—Refer to paragraphs 18 and 19 for detailed lubricating instructions.

30. MAGNETO

Refer to paragraphs 18 and 19 for lubricating instructions applying to the magneto.

a. If the spark is weak (should jump at least $\frac{3}{16}$ in. when spark plug end of cable is held that distance from base of spark plug while engine is being cranked) the magneto should be checked.

b. Remove the distributor shield cover from the end of the magneto, held by three screws and lockwashers. Disconnect the high tension cables from the distributor cap. Remove the three screws and lockwashers which hold the shield to the magneto housing. Remove the shield with cables attached.

c. Unhook the distributor clips by prying outward with a screwdriver. Remove the distributor cap and wipe it clean inside and outside.

If it is cracked, shows evidence of arcing, or has corroded high tension inserts, a new cap is required.

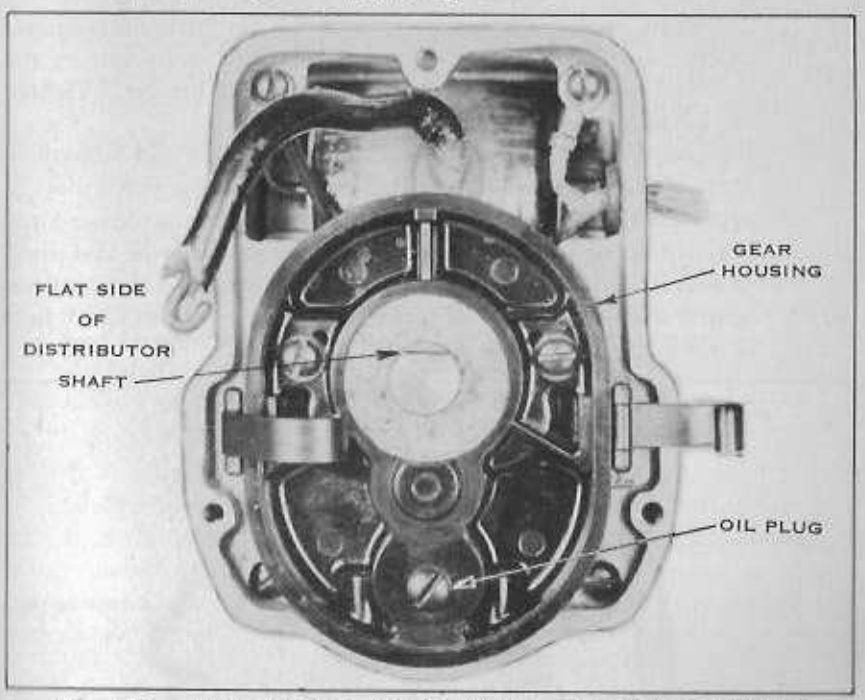

FIG. 25 MAGNETO (SHOWING GEAR HOUSING)

d. Pull the distributor arm from the shaft. Wipe it clean. If the spring is broken or the metal segment is too short, indicated by a burning condition on top of segment, a new distributor arm is required.

e. Crank the engine slowly until the flat side of the magneto distributor shaft is on top, Fig. 25. Then remove the distributor gear and housing assembly, held by two screws. The breaker contacts will be open wide when the engine has been cranked to the position mentioned and no further cranking should be done while the gear housing is off the magneto. To do so might result in the distributor being out of time when reassembled.

Remove the screw slotted oil plug from the front of the gear housing and add a few drops of OE-10 to the felt pad in the gear housing.

f. Breaker contacts eventually become pitted and eroded. Examine them, Fig. 26. They should be clean, free of pits and pyramids and in alignment. If not too bad they may be resurfaced by using a small, file-like carborundum hone. Use care to get them square. They may be cleaned with lacquer thinner and must be free of

foreign material. After making sure that the contacts are in good order, the gap must be adjusted. The gap should be .015 in. To adjust, loosen the screw which holds the stationary contact bracket and move the bracket the proper amount by turning the eccentric headed screw in the open slot of the bracket. Tighten the holding screw and recheck the gap.

g. Remove the cam oil pad, work CG grease into it and reinstall it. If the contacts are found to be badly burned and somewhat sooty in appearance, and the spark weak and yellow, a new condenser probably is needed. Otherwise the condenser need not be disturbed. If necessary, it may be removed after disconnecting the lead terminals attached to it and then removing the two screws which hold it in place.

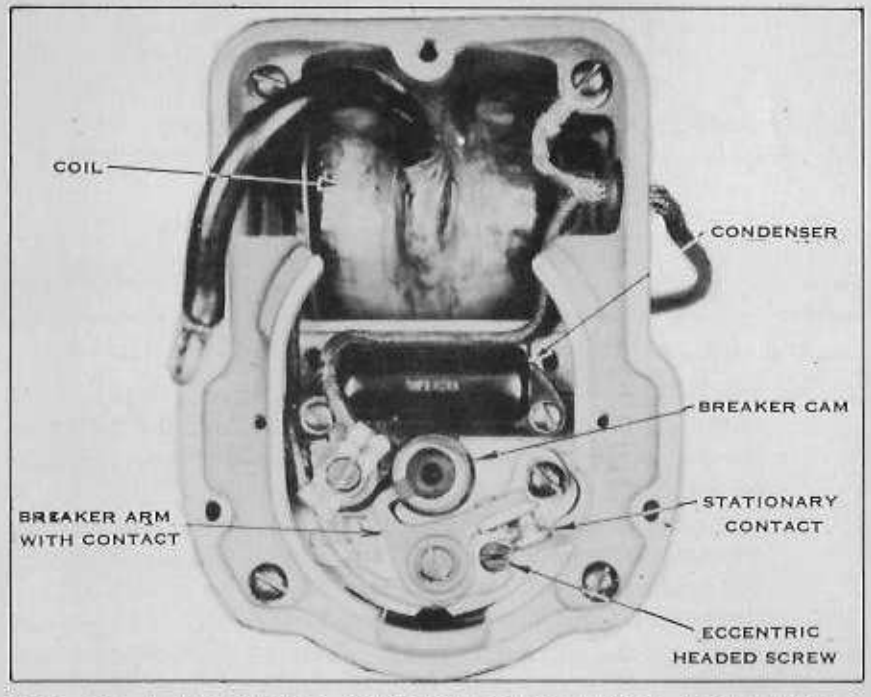

FIG. 26 MAGNETO (SHOWING BREAKER MECHANISM)

h. Reassemble the magneto by reversing the procedure used in disassembling. The projecting lug on the distributor drive gear shaft must fit into the corresponding slot in the end of the cam when reassembling. It will do this easily if the flat side of the distributor shaft is at the top and the engine has not been cranked while the gearbox was off.

i. When replacing the distributor arm, be sure the key lines up with the flat side of the shaft. When a new distributor arm or distributor

cap is installed, be sure the arm does not hit the inside of the cap. Test this by installing the distributor arm and cap on the gear housing while the gear housing is off the magneto; noting whether there is any tendency of the arm to strike the cap when the gearing is turned several revolutions by means of the protruding shaft.

j. Complete the assembly, tightening all screws securely. If the magneto requires other servicing than this, return the unit to the depot for repairs.

31. RADIATOR

Keep the radiator filled with water or suitable anti-freeze, but do not fill so full as to cause unnecessary loss of liquid through the overflow. Inspect every 8 hours, oftener if necessary. Use rain water or distilled water, if available. Do not change the water oftener than necessary to keep the cooling system clean, or to change to anti-freeze. Keep hose connections tight. For best results, the radiator must be kept clean inside and outside, particularly throughout the core. If old radiator hose swells inside and restricts the flow, install new hose. To drain the cooling system, open the drain cock, Fig. 4. If the water boils, allow the engine to cool below the boiling point before adding water. Allow a hot engine to cool down to moderate temperatures before draining the cooling system.

32. SPARK PLUGS

Remove the spark plugs. Clean them, if needed, and inspect for cracked or badly eroded porcelains or badly eroded electrodes. Discard any spark plugs not in good condition and replace with new ones of correct type, Champion 6M. Adjust the gaps to .030 in. When installing, make sure the gaskets are in place. Tighten securely.

VIII--Troubles and Remedies

33. TROUBLE AND REMEDY CHART

ENGINE CRANKS TOO STIFFLY

Possible Cause	Check	Remedy
Too heavy oil in crankcase.	Inspect oil.	Drain, refill with lighter oil.
Engine stuck.	Try with hand crank.	Return unit to depot for repairing.

ENGINE WILL NOT START WHEN CRANKED

Faulty ignition.	Spark plugs.	Clean, adjust or replace plugs.
	Magneto.	Repair, or replace.
Lack of fuel or faulty carburetion.	Fuel tank empty.	Refill.
	Carburetor adjustment.	Adjust.
	Shut-off cock.	Open.
	Fuel screen.	Clean.
	Cylinders flooded.	Crank few times with spark plugs removed.
	Poor fuel.	Drain, refill with good fuel.
Poor compression, usually because of leaking valves.	Cylinder compression.	Tighten head gasket and spark plugs. If still not corrected return unit to depot for repairing.
Wrong timing.	Magneto timing.	Retime.

ENGINE RUNS BUT A.C. VOLTAGE DOES NOT BUILD UP

Possible Cause	Check	Remedy
Poor commutation.	Exciter brushes and commutator.	See that brushes seat well on commutator, are free in holders, are not worn shorter than ¾" and have good spring tension. If commutator is rough or badly grooved, return unit to depot for repair.
Open circuit, short circuit or ground in generator.	No simple test, see paragraph 55.	Return unit to depot for repairs.
Poor seating of brushes.	Slip rings and brushes.	Give slip ring brushes same attention as commutator brushes.

VOLTAGE UNSTEADY BUT ENGINE NOT MISSING

Poor commutation or poor brush contact at slip rings.	Exciter commutator and brushes.	See that brushes seat well on commutator, are free in holders, are not worn shorter than ¾" and have good spring tension. If commutator is rough or badly grooved, return unit to depot for repairing.
Loose connections, especially in exciter circuits.	Check for loose connections.	Tighten connections.
Fluctuating load.	Check load for unusual conditions. Some fluctuating loads, such as a motor driving a single action reciprocating pump, are normal conditions.	Correct any abnormal load condition causing trouble.

GENERATOR OVERHEATING

Overloaded.	Ammeter.	Reduce load.

VOLTAGE DROPS UNDER HEAVY LOAD

Possible Cause	Check	Remedy
Engine lacks power.	See symptom of engine missing under heavy load.	See remedies for engine missing under heavy load.
	Cylinder compression.	Tighten head gasket and spark plugs. If still not corrected, return unit to depot for repairs.
	Carburetor.	Clean and adjust.
	Carburetor air cleaner.	Clean and refill.
	Choke.	See that it opens wide enough.
	Carbon in cylinders.	Remove carbon.
	Restricted exhaust line.	Clean or increase the size.

ENGINE MISSES AT LIGHT LOAD

Carburetor idle adjustment set wrong or clogged.	Carburetor.	Adjust, clean if needed.
Spark plug gaps too narrow.	Spark plugs.	Set at .030"
Intake air leak.	Intake manifold.	Tighten or replace gaskets.
Faulty ignition.	Magneto.	Adjust or replace.
Uneven compression.	Cylinder compression.	Tighten head gasket and spark plugs. If still not corrected, return unit to depot for repairs.

ENGINE MISSES AT HEAVY LOAD

Spark plugs defective.	Spark plugs.	Replace.
Faulty ignition.	Magneto.	Adjust or replace.
Clogged carburetor jets.	Carburetor.	Clean.
Clogged fuel screen.	Fuel screen.	Clean.
Defective spark plug cables.	Spark plug cables.	Replace.

ENGINE MISSES AT ALL SPEEDS

Possible Cause	Check	Remedy
Fouled spark plug.	Spark plugs.	Clean and adjust.
Defective or wrong spark plug.	Spark plug.	Replace.
Sticking valves.	Valves.	Return unit to depot for repairs.
Broken valve spring.	Valve springs.	Replace.
Defective ignition wires.	Ignition wiring.	Replace.
Defective or improperly adjusted magneto.	Magneto.	Adjust or replace.

LOW OIL PRESSURE

Oil too light.	Inspect oil.	Drain, refill with proper oil.
Oil badly diluted.	Inspect oil.	Drain, refill with proper oil.
Oil too low.	Oil level.	Add oil.
Oil relief valve not seating.	Oil relief valve.	Remove and clean.
Badly worn engine bearings.	Smoky exhaust, excessive oil consumption which cannot otherwise be accounted for.	Return unit to depot for repairs.
Sludge on oil screen.	Oil screen.	Remove and clean.
Badly worn oil pump.	No simple check.	Return unit to depot for checking.
Defective oil gage.	No simple check.	Return unit to depot for checking.

HIGH OIL PRESSURE

Oil too heavy.	Inspect oil.	Drain, refill with proper oil.
Clogged oil passage.	No simple test.	Return unit to depot for repairs.
Oil relief valve stuck.	Oil relief valve.	Remove and clean.
Defective oil pressure gauge.	Return of indicator to zero when unit not operating.	If not, install new oil pressure gauge.

ENGINE STOPS UNEXPECTEDLY

Fuel tank empty.	Fuel in tank.	Refill.
Defective ignition.	Magneto.	Repair or replace.

ENGINE BACKFIRES AT CARBURETOR

Possible Cause	Check	Remedy
Lean fuel mixture.	Carburetor.	Clean carburetor.
	Fuel screen.	Clean screen.
	Air leaks at intake manifold.	Replace gaskets, tighten.
Poor fuel.	Fuel.	Drain, fill with good, fresh fuel.
Spark too late.	Magneto timing.	Retime.
Spark plug wires crossed.	Spark plug wires.	Install wires correctly.
Intake valves leaking.	Hiss through carburetor when hand cranked with ignition off.	Return unit to depot for repairs.

EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST

Poor compression, usually due to leaking valves.	Cylinder compression.	Tighten head gasket and plugs. If still not corrected, return unit to depot for repairs.
Oil leaks from oil pan or connections. This does not cause smoky exhaust.	Inspect visually for leaks.	Replace gaskets and leaking tubing. Tighten screws and connections.
Oil too light or diluted.	Inspect oil.	Drain, refill with correct oil.
Bearing clearance too great.	Oil pressure registers low and this cannot otherwise be accounted for.	Return unit to depot for repairs.
Oil pressure too high.	Oil pressure.	Refer to symptom of high oil pressure for remedies.
Engine misses firing.	Voltmeter reading unsteady and exhaust irregular.	Refer to symptoms of engine misses.
Faulty ignition.	Spark plugs.	Clean, adjust or replace.
	Magneto.	Repair, or replace.
Unit operated a great deal at light or no load.	Operating conditions.	No remedy needed.
Too much oil.	Bayonet gauge.	Drain excess oil.

BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUGS WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD

Possible Cause	Check	Remedy
Fuel mixture too rich.	Carburetor adjustment.	Adjust.
	Carburetor float for leak and high level, needle valve for leak, jets for wear or damage, gasket washers for leaks.	Install needed carburetor parts, adjust float level. Be sure all gaskets are in place and tight.
Choke not open.	Choke.	See that choke opens properly.
Dirty carburetor air cleaner.	Air cleaner.	Clean, refill to proper oil level.

LIGHT POUNDING KNOCK

Loose connecting rod bearing.	Short out one spark plug at a time to locate.	Return unit to depot for repairs.
Low oil supply.	Bayonet gage.	Add oil.
Low oil pressure.	Oil pressure gage.	Refer to symptom of low oil pressure for remedies.
Oil badly diluted.	Inspect oil.	Change oil.

DULL METALLIC THUD. IF NOT BAD, MAY DISAPPEAR AFTER FEW MINUTES OPERATION. IF BAD, INCREASES WITH LOAD.

Loose crankshaft bearing.	Accelerate under load.	Return unit to depot for repairs unless one of the next three remedies permanently correct the trouble.

SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE FIRST STARTED

Low oil supply.	Bayonet gage.	Add oil.
Low oil pressure.	Oil pressure gage.	Refer to symptom of low pressure for remedies.
Oil badly diluted.	Inspect oil.	Change oil.

PINGING SOUND WHEN ENGINE IS RAPIDLY ACCELERATED OR HEAVILY LOADED

Possible Cause	Check	Remedy
Carbon in cylinders.	Inspect through spark plug hole.	Remove carbon.
Spark too early.	Magneto timing.	Retime magneto.
Wrong spark plugs.	Spark plugs.	Install Champion 6-M plugs.
Spark plugs burned or carboned.	Spark plugs.	Install new plugs.
Valves hot.	Tappet clearance.	Return to depot for repairs.
Fuel stale or low octane.	Fuel.	Use good fresh fuel.
Lean fuel mixture.	Carburetor.	Clean and adjust.

TAPPING SOUND

Tappet clearance too great.	Tappet clearance.	If too bad, return to depot for repairs.
Broken valve spring. (Engine misfiring)	Valve springs.	Install new spring.

HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD

Loose pistons.	Put two teaspoonfuls heavy oil in cylinder suspected. Crank engine with ignition off to lubricate piston and rings. Then start engine. If noise not present, indicates loose piston or piston rings.	If noise only slight and disappears when engine warms up, no immediate attention needed. Otherwise return unit to depot for repairs.

CIRCUIT BREAKER TRIPS AND DISCONNECTS LOAD

Load too great.	Ammeter.	Reduce load.
Load line short circuited.	Ammeter.	Remove short circuit.

LIGHT DIM AT FAR END OF LINE BUT BRIGHT NEAR POWER UNIT

Too small line wire for load and distance.	Wire size, against load and distance.	Install larger or extra wires or reduce load.

MOTORS RUN TOO SLOWLY AND OVERHEAT AT FAR END OF LINE BUT OK NEAR POWER UNIT

Too small line wire for load and distance.	Wire size, against load and distance.	Install larger or extra wires or reduce load.

IX--Preparation for Storage

34. PREPARING THE POWER UNIT FOR STORAGE

When use of the Power Unit is to be discontinued for several weeks, or longer, it should be prepared for storage as follows:

a. Drain the fuel from the fuel tank and filter bowl. Then start the engine and allow it to run until it stops, thus emptying the fuel line and carburetor.

b. Drain all oil from the oil base while the engine is warm. Replace the drain plug securely.

c. Drain the cooling system, being sure the liquid drains freely from the drain cock. Be sure caps are left on fuel tank, radiator and crankcase oil filler hole.

d. Remove the spark plugs and pour two tablespoonfuls of OE-50 oil in each cylinder. Crank the engine over several revolutions to lubricate the cylinders. Replace the spark plugs, with gaskets, completing the assembly.

e. Clean the generator brushes, brush holders, commutator and slip rings by wiping with clean cloth. Do not coat with grease or other preservative.

f. Disassemble and clean the air cleaner. After drying, dip the element in OE-30 oil and allow to drain. Then reassemble without putting oil in the cup.

g. Wipe all exposed parts clean and coat with a film of grease all exposed parts liable to rust.

h. Oil the throttle control link joints with OE-50 oil.

i. Plug the exhaust outlet with a wood plug to prevent the entrance of moisture or small animals.

j. Install the housing side panels and the canvas cover.

k. Store in a clean, dry place as well protected from the elements as practicable.

35. RETURNING STORED POWER UNIT TO SERVICE

When preparing a properly stored Power Unit for service, follow generally the instructions for placing a new Power Unit in service, pars. 8 and 9, taking these ADDITIONAL precautions.

a. Remove all protective coatings of grease from external parts and wipe the entire Power Unit clean of accumulated dust or other foreign material.

b. Inspect carefully for any damage or other conditions requiring repairs and correct it.

c. Remove the plug from the exhaust outlet.

d. Remove, clean and adjust the spark plugs. While the spark plugs are out, crank the engine several revolutions to distribute oil on the cylinder walls. If cylinders are dry, put a tablespoonful of oil in each cylinder and crank again to distribute it. Replace the spark plugs, with gaskets, and complete the assembly.

e. Remove the magneto distributor cap and clean it inside and outside. Clean the breaker contacts. Reassemble. Install new spark plug cables, if needed.

f. Examine the fan belt. Adjust or install a new one, as needed.

g. Examine the radiator hose. Install new hose, if needed.

h. Examine carefully for leaks of gasoline, water, and oil after filling. Correct all leaks before starting the engine.

i. Carefully recheck to make sure everything has been attended to. Then the Power Unit may be started in the regular manner. See paragraphs 10 to 17, inclusive.

MAINTENANCE SECTION

X--General

36. RELATION OF REPAIR AND OPERATION SECTIONS

The Repair Section of this Maintenance Manual treats of major repairs. The mechanic should refer to the Operations Section for descriptions of functional details and for instructions regarding servicing which the operator may do when required in the field. In addition to the paragraphs dealing directly with the sub-assembly being repaired, the mechanic should study the paragraphs dealing with related parts.

The mechanic is better equipped in training and with tools than the operator. Therefore, whenever servicing a Power Unit, he should make all the repairs that are required at the time, at least as far as it is practicable to do so. This keeping of the equipment in as good condition as practicable assures better performance, prolongs the life of the equipment and actually reduces the amount of major repairs ultimately required.

Reference may be made to the Trouble and Remedy Chart, par. 33, for assistance in locating and correcting troubles which occur. Before disassembling a portion of the Power Unit for repairs, a careful analysis of the existing conditions should be made to determine whether that is the correct procedure.

Maintain factory limits and clearances when doing repair work on the engine. See par. 51.

XI--Engine

37. VALVE AND PISTON RING SERVICE

Reduced engine power results from leaking valves and worn piston rings which allow compressed gases to escape from the cylinder into the exhaust or intake manifold or into the crankcase. By proper use of a cylinder compression gauge, loss of compression may be determined. Compression gauge readings for the cylinders should be within 10 pounds of each other and not lower than 85 pounds at sea level. If testing equipment is not available, refer to par. 23.

For valve and piston ring servicing, proceed as follows:

a. Disconnect the exhaust pipe.

b. Remove the housing side panels and top plate.

c. Remove the muffler by disconnecting the flange casting at the cylinder block.

d. Drain the radiator.

e. Close the fuel shut-off valve and disconnect the fuel line at the swivel end.

f. Remove the air cleaner and tube assembly. Then remove the air cleaner adapter bracket and the air cleaner adapter.

g. Disconnect the throttle control rod and the choke control from the carburetor and remove the carburetor.

h. Remove the spark plug shields, disconnect the spark plug wires and remove the spark plugs.

i. Remove the magneto.

j. Disconnect the fan bracket from the water outlet casting and then remove the casting.

k. Disconnect the water inlet casting from the cylinder block.

l. Remove the remaining cylinder head nuts and remove the cylinder head from the cylinder block. Do not pry the head loose with a screwdriver or other tool. If it sticks, tap it sharply on the side with a hammer to loosen it. See Fig. 27.

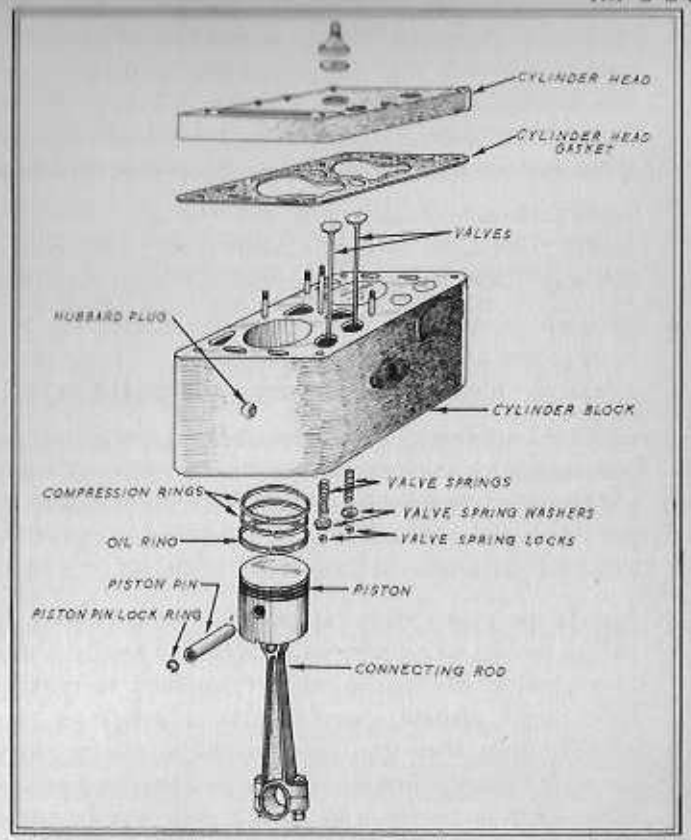

FIG. 27 PISTON, CYLINDERS, AND VALVES

m. Lift the cylinder block carefully from the crankcase. As this is done, lift both ends evenly and be careful that the pistons do not fall against the sharp edges of the crankcase.

n. Set the cylinder block on a bench. Compress the valve springs and remove the valve locks, valve spring washers, and valve springs. Then remove the valves.

o. Carefully remove all carbon from the valves. Examine the valve stems and faces. Discard any valves on which the stems are excessively worn or warped, or on which the valve faces are so badly worn or burned, that they cannot be refaced properly, and replace with new ones.

p. Reface to a 45° angle the old valves which are to be retained, using an approved refacing machine.

q. Clean all carbon from the valve seats and ports. Clean the exhaust and intake passages through the cylinder block. Clean all gasket surfaces. Inspect the cylinders. If badly worn or scored, a new cylinder block should be used. This will require new pistons and piston rings as well.

r. Inspect the valve seat inserts. Reface to a 45° angle if necessary, using an abrasive type reseating tool driven by an electric drill. The finished seat should be between .032 in. and .078 in. wide. The exhaust valve seat inserts are pressed into place after being contracted by cooling with dry ice. They rarely need to be replaced.

s. Grind each valve in its proper seat with fine valve grinding compound. Grind just enough to assure correct seating between valve and seat. Clean the grinding compound thoroughly from all parts.

t. Assemble the valves to the cylinder block, being sure to place each in its proper location. When assembling, lubricate the valve stems and faces. Install the valve springs, washers and locks.

u. Check the fit of the connecting rod bearings by grasping each piston and working it carefully to note the looseness of the connecting rod bearings. In a similar manner check the looseness of the piston pin. If looseness is excessive, it should be corrected by installing such new parts as are required. See paragraphs 38, 39 and 40.

v. Inspect the piston rings carefully for fit in grooves, for tension and for seating on cylinder walls. If they fit snugly in their grooves, have considerable tension when compressed to cylinder size and have bright, smooth, exterior surfaces, indicating correct fit to cylinder walls, they may be continued in service. Remove them carefully from the pistons to avoid breakage or permanent distortion. Keep in proper order so that each may be replaced in the same groove and with the same side up as before removing. Clean the grooves carefully. Clean the oil return holes in the pistons and the oil return holes in the piston rings. Scrape the carbon from the insides of the rings. Replace the rings on the pistons.

w. If there is any doubt about the serviceability of the old piston rings, install new ones. Fit each new ring individually to the cylinder in which it will be used. Insert it into the cylinder from the crankcase end of the cylinder. Square it up in the cylinder an inch or so from the crankcase end of the cylinder and observe the gap. The gap should be approximately .010 in. as measured by a feeler gage. If necessary, file the ends of the rings slightly to obtain the proper width of gap. If the ring is too large, it may be necessary to file the gap slightly before the ring can be squared up in the cylinder. Rings so large as to require too much filing at the gap will not have uniform pressure on the cylinder wall and should not be used.

x. See that each piston ring will slide freely in its groove and that the groove is clean and slightly deeper than the thickness of the ring. If new rings are of the tapered type, the smaller diameter will

be marked "TOP" or identified in some other manner. This smaller diameter should be placed nearer the head of the piston. Install all rings on the pistons.

y. Make sure all gasket surfaces are clean and that all carbon has been removed from cylinder block, cylinder head and pistons. Lubricate the cylinder walls, piston walls and piston rings with engine oil. Arrange the rings of each piston so that the gaps are equally spaced around the circumference of the piston. Assemble the cylinder block to the crankcase, using a new gasket. When placing the cylinders over the pistons, compress each piston ring carefully so it will enter its cylinder properly, lower the cylinders over the pistons evenly and do not use excessive force. Install the cylinder head, using a new gasket and coating both sides of the cylinder head gasket evenly with a mixture of powdered graphite and oil. Draw the nuts down evenly, then tighten securely, beginning with the center nut and working toward the ends. Use a torque indicating wrench, if available, and tighten to a tension of 50 foot-pounds.

z. Adjust the valve tappets as explained in a later paragraph.

aa. Reassemble the power unit completely, using new gaskets and following an order of procedure the reverse of that used in disassembling. Adjust the fan belt, par. 25. Inspect the radiator hose inside and outside. If not in good condition, install a new one. When the radiator has been filled, inspect the hose connection and all gaskets for leaks. After connecting the fuel line, open the fuel shut-off valve and inspect the fuel line and carburetor for leaks. Any leaks found should be corrected before starting the engine.

bb. After the engine has been started and has reached normal operating temperature, it is advisable to check the cylinder head nuts to be sure they are tight. Use a good socket wrench when tightening the nuts.

cc. After the engine has run for several hours, check the adjustment of the tappets and make any readjustments needed to maintain standard clearances. After this operation is completed, including timing and installing the magneto, the load may be connected.

VALVE TAPPET ADJUSTMENT—The valve tappets are of the type shown in Fig. 28. The adjustment is accessible after first removing the magneto and the valve tappet inspection plate. Before checking the clearances, tighten all cylinder head nuts. If a torque-

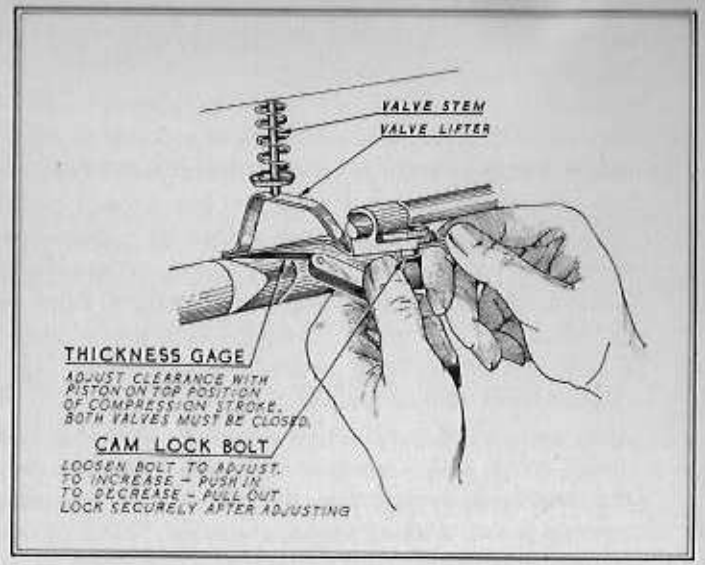

FIG. 28 VALVE TAPPET ADJUSTMENT

indicating wrench is available, tighten to 50 foot-pounds. Then crank the engine slowly until the No. 1 valve closes and continue about one-half turn farther until the top center marks on flywheel and crankcase, Fig. 29, coincide. This places the No. 1 piston at the top of its compression stroke and the camshaft in correct position for adjusting tappets Nos. 1 and 2. Loosen the cap screw in the No. 2 (exhaust) valve lifter just enough to permit pushing the lifter lever inward. Insert an .008 in. feeler gage between cam surface and the lifter. Then pull the lever outward as far as possible without tightly pinching the feeler between cam and lever. Tighten the cap screw securely and recheck the adjustment. The .008 in. feeler should pass easily between cam and lifter, but a .010 in. feeler should not pass. Readjust, if necessary.

Adjust the No. 1 (intake) valve lifter in the same manner, but with .006 in. and .008 in. feelers. The .006 in. feeler should pass freely but the .008 in. feeler should not pass.

Then crank the engine one complete revolution, which will bring the TC marks into alignment again and place the camshaft in correct position for adjusting the No. 3 (exhaust) and No. 4 (intake) lifters. Adjust these lifters in the same manner, being sure to

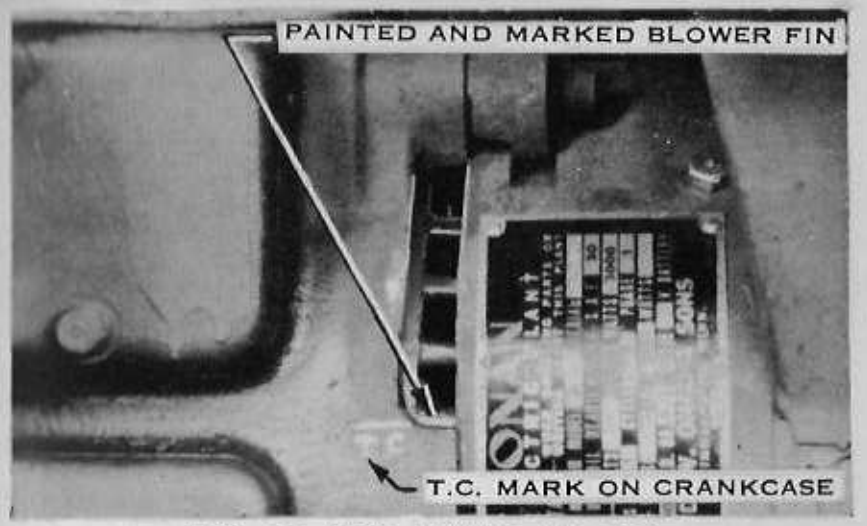

FIG. 29 TOP CENTER MARKS

use the .006 in. and .008 in. feelers for No. 4 and the .008 in. and .010 in. feelers for No. 3.

Reassemble, using a new gasket if available. It will be necessary to time the magneto, par. 9, as it is installed.

38. DISASSEMBLY FOR MAJOR OVERHAUL

Inspection of certain internal parts of the engine to help in determining the need for major overhauling, may be made through the inspection openings after draining the oil and removing the inspection plates from the crankcase. See Fig. 30. Place a trouble lamp inside the crankcase and inspect the interior. Feel the fits of the working parts. In this manner the need for a major overhaul may be determined.

The oil by-pass valve may be serviced after the lower inspection plate is removed. It is possible to remove and install the connecting rod bolt nuts by working through this inspection hole after first removing the oil by-pass valve, but it is not easily done and requires a special wrench. Therefore, it is recommended that the engine generator set be removed from the housing and that the oil base be removed from the engine whenever the connecting rod bearings and piston pins are to be serviced or the pistons are to be changed.

It is necessary to remove the engine-generator set from the housing for most other service within the engine crankcase.

Instructions for disassembling the engine for a complete overhaul are given in this paragraph. The details of servicing certain sub-assemblies are covered in other paragraphs in this section. The mechanic should study the entire Repair Section before disassembling the power unit for

major servicing. When the immediate service job is to be less than a complete overhaul, only those operations essential to the particular job need be done. Do not disturb, unnecessarily, parts which are not to be serviced.

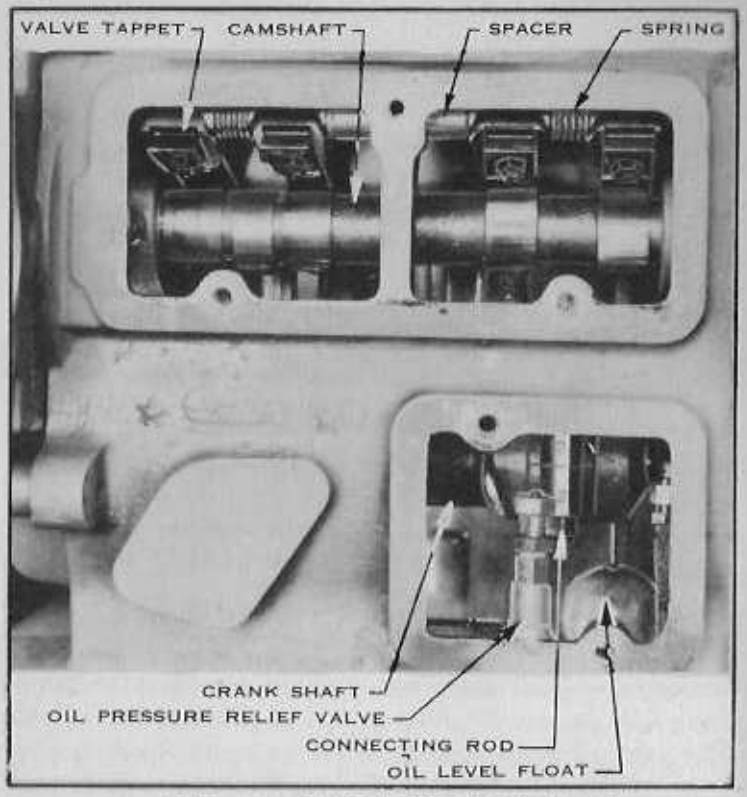

FIG. 30 INSPECTION PLATES REMOVED FROM CRANKCASE

Disassembling procedure follows:

(1) Remove the side panel from the right side of the housing, disconnect the power lines from the A.C. OUTLET terminals and remove these wires from the housing.

(2) Disconnect any external exhaust line.

(3) Remove the left housing side panel.

(4) Close the fuel shut-off valve and disconnect the fuel line at the swivel end.

(5) Drain the radiator and the crankcase.

(6) Remove the five sheet metal screws from each end of the housing top plate and lift the top plate and full tank assembly from the housing as a unit.

(7) Disconnect the A.C. generator leads and the magneto stop wire at the control panel.

(8) Disconnect the choke control wire and tube at the carburetor.

(9) Remove the carrying handles from the housing.

(10) Remove the housing side plates.

(11) Remove the front and rear housing panels.

(12) Remove the four nuts, lockwashers, washers and mounting rubbers by which the engine oil base is attached to the housing base.

(13) Lift the engine-generator unit from the housing and set it on a substantial work bench. See Fig. 31.

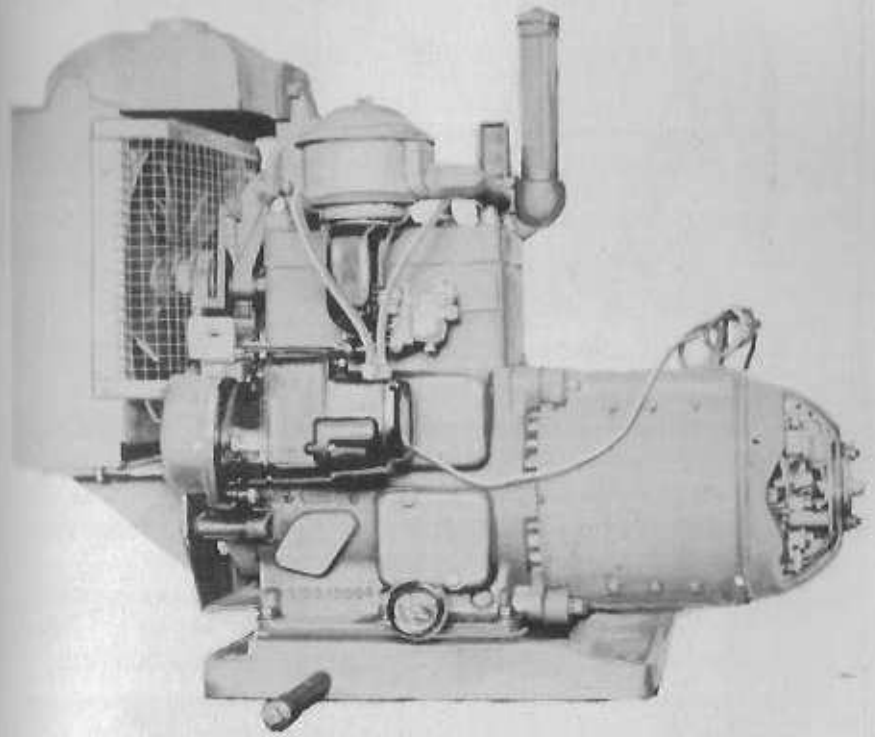

FIG. 31 ENGINE—GENERATOR UNIT REMOVED FROM HOUSING

(14) Remove the generator end bell band and the tool box.

(15) Lift all generator brushes away from contact with commutator and collector rings and hold them so by setting the ends of the brush springs against the sides of the brushes.

(16) Remove the four cap screws and clamp washers which hold the generator frame to the engine. Then remove the generator frame carefully, not allowing it to drag on the armature or strike the commutator and collector ring.

(17) Remove the armature through stud nut. Then, while forcibly pulling the armature outward so that the thrust will not be taken

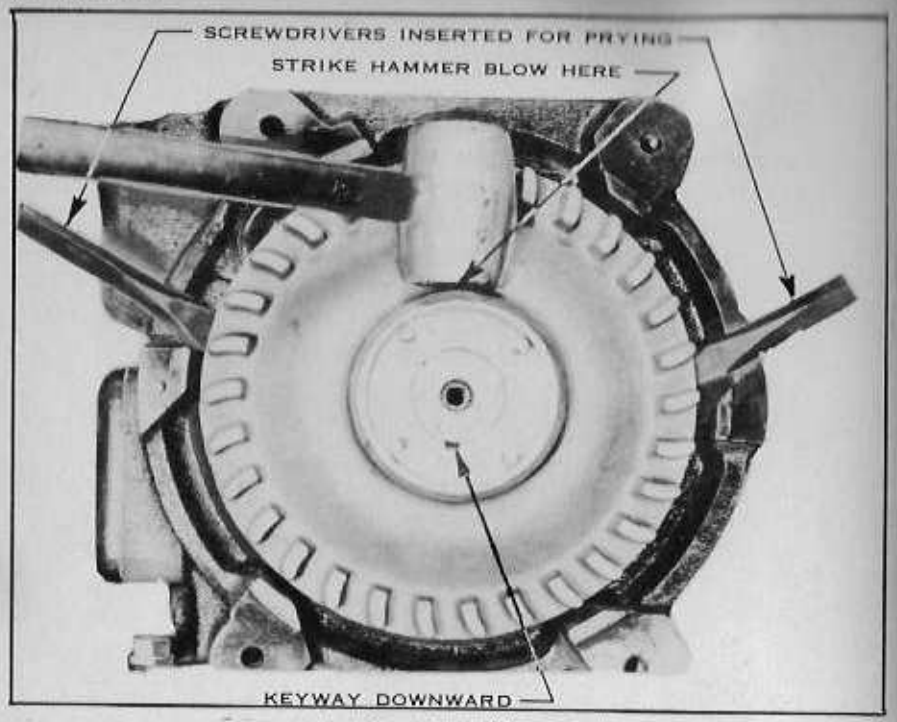

FIG. 32 REMOVING FLYWHEEL

by the front crankshaft bearing, strike a sharp forward blow on the armature through stud with a soft faced hammer to loosen the armature. Pull off the armature. Four dowel pins at the front end of the armature may be tight enough to offer some resistance. If so, grasp the armature firmly in both hands and work it up and down while pulling it loose. Do not pound on the commutator or collector rings. Careful use of a rubber hammer on the laminated core is permissible when necessary.

(18) Remove the armature through stud by unscrewing with a pipe wrench.

(19) Turn the flywheel until the key way is downward. Insert a heavy screwdriver or similar pry between flywheel and crankcase at the right and left sides. These pries should be inserted in such way that they will hold the crankshaft firmly against the rear crankshaft bearing. Then strike a sharp downward blow on the hub with a lead hammer. See Fig. 32. Avoid dropping the flywheel.

(20) Remove the flywheel key from the crankshaft.

(21) Remove the nuts from the exhaust flange and remove the muffler assembly.

(22) Remove the radiator drain cock.

(23) Remove the cap screws from the top of the upper radiator connection.

(24) Remove the cap screws from the cylinder water inlet connection. The radiator hose may be removed after loosening the nose clamp bolts, if desired.

(25) Remove the sheet metal screws which hold the fan guard to the radiator.

(26) Remove the bolts which hold the radiator to the mounting bracket and lift the radiator away from the engine. Lay the fan guard aside.

(27) Remove the nuts which hold the radiator support to the crankcase and remove the support.

(28) Remove the fan bracket cap screws. Remove the fan and fan belt. Lay the fan face down to prevent oil from running out.

(29) Remove the cap nuts which hold the water outlet casting and remove the casting.

(30) Remove the air cleaner.

(31) Remove the air cleaner and breather tube assembly.

(32) Remove the air cleaner adapter.

(33) Remove the governor arm to throttle link.

(34) Loosen the governor arm clamp screw.

(35) Remove the governor spring cover. If there is no need to remove either governor spring adjusting stud, do not do so. Remove the cap screws which hold the governor spring bracket to the crankcase. Then remove the bracket, spring and governor arm assembly as a group.

(36) Remove the spark plug shields and disconnect the cables from the spark plugs.

(37) Remove the cap screws from the magneto mounting flange and remove the magneto.

(38) Remove the magneto drive gear box.

(39) Remove the carburetor flange nuts. Remove the carburetor and the distribution plate.

(40) Remove the spark plugs.

(41) Remove the cap nuts from the cylinder head. Remove the cylinder head, tapping it on the side with a soft faced hammer to loosen, if necessary.

(42) Loosen the two headless set screws in the pulley on the crankshaft and pull the pulley from the shaft. Remove the woodruff key from the shaft, if loose, to avoid losing it.

(43) Remove the gear case cover and the governor cup.

(44) Remove the crankshaft gear locknut and washer.

(45) Pull the crankshaft gear from the shaft by means of a suitable gear puller. Holes in the front bearing plate accommodate the puller. Carefully avoid damage to the gear teeth.

(46) Loosen the oil filler neck cap screws. Tip the filler neck outward far enough so that the cylinder block will clear it, and remove the cylinder block. Raise both ends evenly. Do not allow the pistons to fall against the rough edges of the crankcase and become damaged.

(47) Remove the oil gage rod guard. Remove the nut from the top of the rod. The top of the rod has been riveted lightly over the nut. File away the riveted end just enough to permit removing the nut without damaging the threads.

(48) Remove the cap screws from the oil filler neck flange and lift the neck carefully off the oil gage rod. Avoid bending the rod.

(49) Remove the crankcase inspection and valve inspection plates.

(50) Remove the camshaft and gear assembly, sliding it out while raising the valve lifters so they will clear the cams and rear journal.

(51) If the valve lifter bearings and shaft are to be removed, seldom necessary, drive the shaft forward by using a $\frac{7}{16}$ in. rod and hammer, applied at the rear end. Avoid bruising the end of the shaft. It is well to mark it so that it may be replaced with same end toward rear. Keep the lifters and spacers in order so they may be replaced in same order if they are to be used again. In a complete disassembly of the engine, this operation may be done more conveniently after the crankshaft has been removed.

(52) Remove the cap screws which hold the crankcase to the oil base. Lift the crankcase off the oil base and lay it on its side. Be careful not to damage the oil pump intake cup or the oil level gage float and rod.

(53) Remove the oil level gage float and rod assembly.

(54) Remove the oil pump intake cup and tube assembly, unscrewing it from the pump body.

(55) Remove the connecting rods, keeping each rod, cap and liner assembly together and in same order as before removing.

(56) Remove the oil lines and the oil relief valve assembly.

(57) Remove the four cap screws which hold the front bearing plate and remove the bearing plate and pump assembly as a unit.

(58) Remove the crankshaft.

(59) Remove the crankshaft rear oil seal.

(60) Remove the crankshaft rear bearing plate.

(61) Remove the rear crankshaft bearing oil seal. This may be done without removing the rear bearing plate, if desired.

39. MAJOR OVERHAUL REASSEMBLY

Reassembling of the Power Unit after various parts have been reconditioned, or new parts have been provided, should be done in a careful, workmanlike manner. Refer to detailed instructions for the repairing of certain subassemblies given in other paragraphs under appropriate titles. Each subassembly should be in good condition before assembling on the Power Unit. All parts should be clean and in good condition. All gasket surfaces should be clean and it is well to use new gaskets. Tighten all nuts, screws and fittings properly. Use proper washers where required. Use new lockwashers, if available. Install new crankshaft bearing oil seals when making a complete overhaul. When reassembling, use an order of procedure the reverse of that used in disassembly. See paragraph 51 for proper clearances. Observe the special instructions for certain assembly operations which follow.

a. Rear crankshaft bearing plates have an oil return hole at the lower side of the bearing boss. Install the bearing plate with that hole down, toward the oil base. Use two gaskets with the rear bearing plate.

b. Coat the rear bearing oil seal with white lead or other sealing compound, on the surfaces where it contacts the bearing plate, before installing. Place a block of wood against the seal and drive it carefully into place, flush with the end of the bearing plate. If the seal is installed while the crankshaft is in place, first make sure that the shaft is smooth and well greased, then place a .002 in. feeler gage over the keyway to prevent injury to the leather while the seal is being installed.

c. When installing the valve lifters, insert the camshaft, with gear and spacing washer assembled, and make sure that each lifter is properly spaced with respect to the cam which it follows. When installing new lifter bearings it may be necessary to grind one end of one or more of the bearings to permit proper spacing. Grind squarely. One spring is used between Nos. 1 and 2 and the other spring between Nos. 3 and 4. Spacers may be required on sides of bearings opposite the springs. Usually two spacers per engine are required next to bearings Nos. 2 and 3. Spacers are available in various lengths from $\frac{3}{32}$ in. to $\frac{9}{16}$ in. If ordering spacers in advance for a particular plant when the exact length is not known, order the $\frac{9}{16}$ in. length which can be sawed and ground to length.

d. When installing the baffle plate, make sure that the lower flanged edge rests firmly against the camshaft bearing bosses.

e. Install the crankshaft carefully to avoid injury to the main bearings. Grease the bearing surfaces well and use care to avoid injury to the leather of the rear bearing oil retainer. Hold a .002 in. feeler gage over the keyway to protect the leather as the shaft is inserted.

f. Install the oil pump and drive gear on the front bearing plate before installing the plate. See Fig. 33. Check to see that the pump mechanism turns freely. Do not force the drive gear when installing, or the pump mechanism may be damaged. The drive gear lock nut may be tightened more easily after the crankshaft gear is installed, but be sure to do it. If the inlet boss of the pump strikes the crankcase as the bearing plate is being installed, file the case slightly for clearance. Tap the bearing plate into place before bolting.

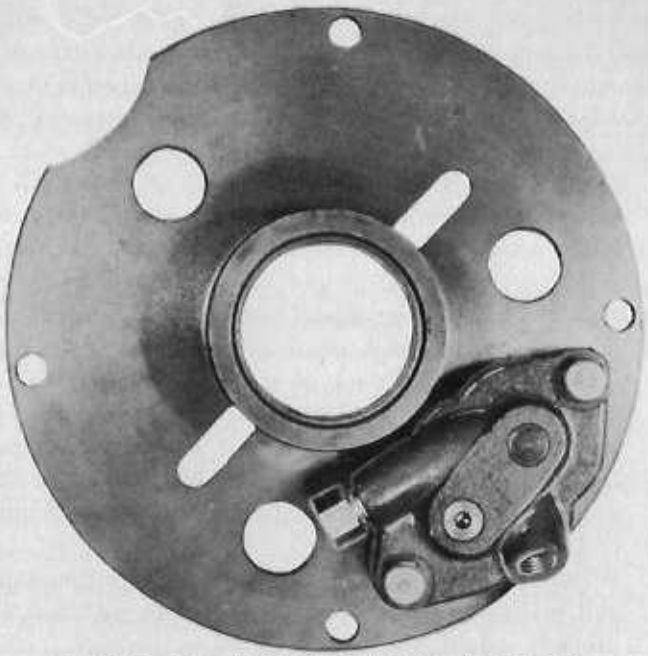

FIG. 33 OIL PUMP INSTALLED ON FRONT BEARING PLATE

g. Connecting rods and their bearing caps are numbered. These numbers should be toward the camshaft. Be sure that the bearing inserts are in proper position, and that no particle of dirt is behind the bearing liners or on the bearing surfaces. Check the fit by feel after the nuts are tightened. Use new locknuts.

h. Be sure to insert the oil gage float rod through the lower guide hole near the corner of the crankcase. This rod must be straight or it will bind and will not function properly.

i. See that the bottom of the oil pump intake cup, when tightly installed, sets at such position that it will be level when the engine is in normal upright position.

j. Before installing the crankcase on the oil base, inspect the interior of the crankcase to see that all parts are in proper place and that nuts are tightened. Before installing the cylinder block, lubricate the cylinder walls, piston walls and piston rings. Arrange the gaps of the piston rings on each piston so they are about equally spaced around the piston. See that all piston pin retainers have been installed. Compress each piston ring carefully so it will enter its cylinder properly. Lower the cylinders over the pistons evenly and do not use excessive force.

k. Before installing the cylinder head, make sure that the gasket surfaces are clean. Use a new gasket and coat each side lightly with a mixture of powdered graphite and oil. Draw the nuts down evenly then tighten securely, beginning with the center nut and working toward the ends. Use a torque indicating wrench and tighten to a tension of 50 foot-pounds. Re-tighten again after the engine has been run half an hour and is at operating temperature.

l. After installing the oil filler neck, install the nut on the oil float rod and peen the end of the rod just enough to hold the nut securely. If a new float rod has been installed, adjust the nut so that it is 3⅛ in. above the top of the oil filler neck casting when the rod is held at its extreme upper position. Then cut the rod off slightly above the nut and peen the end as described. Install the correct spacing washer behind the crankshaft gear, if required. The nut may be tightened after installing the flywheel. A screwdriver inserted between flywheel blower fins and against a crankcase generator boss while tightening the nut, will prevent the crankshaft from turning.

m. Install the correct spacing washer behind the crankshaft gear, if required. Use a suitable piece of brass, or iron pipe with hammer to drive the crankshaft gear onto the shaft. Be sure that the side having the timing mark (O) faces outward, that the keyway is in line with the Woodruff key, and that the teeth mesh properly with the teeth of the camshaft gear and the oil pump drive gear. The timing marks on crankshaft gear and camshaft gear must be aligned before meshing the gears. See Fig. 38. The nut may be tightened after installing the flywheel. A screwdriver inserted between flywheel blower fins and against a crankcase generator boss while tightening the nut, will prevent the crankshaft from turning.

n. Be sure that the flywheel key is installed and that the tapered surfaces of flywheel and crankshaft are clean and lightly lubricated before installing the flywheel.

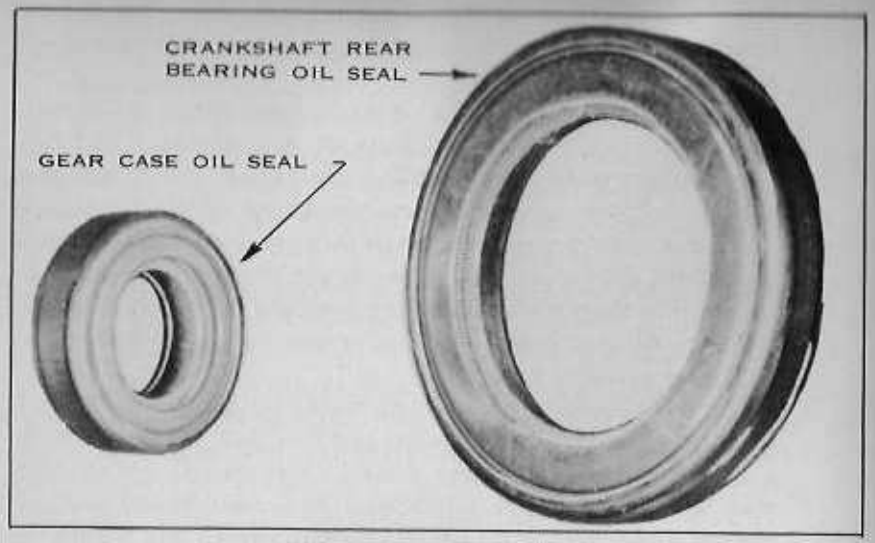

FIG. 34 OIL SEALS

o. A new oil seal (See Fig. 34) should be installed in the gear case cover during each major overhaul before the cover is installed on the engine. Install the seal in the cover in the same manner as the rear seal was installed in the rear bearing plate. The surface of the shaft which will run inside the seal must be free of nicks and scratches. If necessary, polish the shaft with a strip of abrasive cloth, pulling the strip so as to polish around the shaft rather than lengthwise. The seal must be expanded very carefully as it is placed over the shaft. This may be done by wrapping a 1 in. wide piece of .002 in. thick feeder gage stock 1¼ times around the shaft in such manner that the ring of stock extends about ¾ in. beyond the end of the shaft and may be compressed sufficiently to enter the seal. Grease the outside of this material, starting the seal over the compressed end and sliding it carefully onto the shaft as the gear case cover is installed. When installing the gear case cover, turn the governor shaft counter-clockwise (looking at top of shaft) as far as it will go, and hold it in this position until the cover is located on the dowel pins.

p. Before driving the pulley onto the crankshaft, make sure that the keyway is in line with the key. Install the fan and fan belt. Then, align the pulley on the crankshaft with the pulley on the fan. Try the starting crank and make sure that the pulley is not driven onto the shaft so far that the pin in the crank will not engage full depth in the teeth of the dog. Coat the headless cap screws with white lead or similar sealing compound and screw them tightly into place.

q. When the magneto drive gear case is being installed, be sure that the teeth of the idler gear mesh properly with the teeth of the camshaft gear. An inspection plug in the front of the gear case cover permits the backlash to be checked. This should amount to .002 in. to .005 in. and should be checked at all positions of the camshaft gear. The backlash is adjusted by adding or removing magneto gearcase gaskets. Check the backlash after the nuts are securely tightened. See par. 49 for instructions on timing of the magneto as it is being installed.

r. Lubricate the fan and adjust the fan belt, par. 25.

s. Place the felt dust washer on the governor shaft before installing the governor arm. Do not tighten the governor arm clasp screw until the governor arm to carburetor link, the governor spring bracket, and the governor spring have been installed. Then, with the governor spring holding the governor arm in the open-throttle position, insert a screwdriver into the slot at the top end of the governor shaft and turn the shaft clockwise as far as it will go. Hold in this position while tightening the clamp screw securely. Do not force the governor arm down on the shaft so far as to cause a binding condition. Set the arm at such height as to place the carburetor end of this arm approximately level with the forward end of the carburetor throttle lever. There must be no binding condition or unnecessary friction in the governor mechanism or its connection with the carburetor when the assembly is completed. The governor must be adjusted after the engine is started, see par. 28.

t. See that all surfaces of the flange joint between generator armature and flywheel are clean and lightly lubricated before installing the armature. The four dowel pins will permit the armature to be installed in any one of four different positions. Install in whichever position assembly is easiest. After tightening the armature through stud nut, observe the run-out at the bearing. If more than a few thousandths of an inch, it may be due to dirt between the flanges of the joint, or a nick on one of the flange surfaces. This condition should be corrected. The run-out might be reduced by changing to another of the four positions permitted by the four dowel pins.

u. When installing the engine-generator set in the housing, new mounting rubbers should be used to replace any that have become permanently compressed or which have deteriorated greatly from contact with oil or for other causes. Do not screw the mounting nuts down too tightly. One turn beyond finger tight is enough.

v. When installing the flexible fuel line, the non-swivel end should be installed and tightened first. Then use two wrenches when connect-

FIG. 35 INSTALLING FUEL LINE

ing the swivel end; one to hold the swivel end of the line from turning, while tightening the inverted nut with the other. See Fig. 35. The line may be damaged if allowed to be twisted.

40. CONNECTING ROD AND PISTON ASSEMBLY

The servicing of piston rings is described in par. 37. The servicing of connecting rod and piston assemblies will require removing them from the crankcase, described in par. 38.

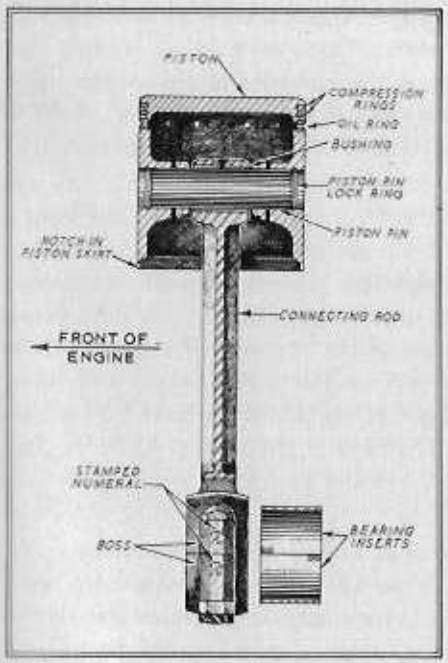

FIG. 36 SECTIONAL VIEW OF PISTON AND CONNECTING ROD ASSEMBLY

Before removing the connecting rods from the crankshaft, check for looseness by "feel." See the Table of Clearances, par. 51. Install new bearing inserts if needed. If new bearing inserts are not to be installed, keep the old ones in their correct places in the connecting rods, by placing the caps on the rods as soon as removed from the crankcase. Connecting rods and bearing caps are numbered on the camshaft side of the bearing end. They should be installed correctly when reassembling.

Remove the piston pin retainers, See Fig 36. Check the fit of the piston pin in piston and connecting rod by

"feel," then remove the piston pins. If the pistons are to be used again, mark them before removing, so each will be installed on its respective connecting rod when reassembling.

If new piston pin bushings are required, remove the old ones and press the new ones carefully into place. They must fit tightly in the connecting rods. Drill the oil holes with a 5/32 in. drill. Then ream the bushings carefully to proper fit on the piston pins. Use a new piston pin if a new bushing is used.

Examine the pistons. If they are considerably scored, are excessively loose in the cylinders, have excessively worn ring grooves, or otherwise are not in good condition, install new pistons. Install new pistons if the old ones are so loose on the piston pins that the condition cannot be corrected by installing new .002 in. oversize piston pins.

Each piston should be installed on its connecting rod in such position that the notch in the piston skirt will be toward the front (radiator) end of the engine when completely assembled. After assembling the piston to the connecting rod, the assembly must be checked for alignment on an approved aligning jig. Realign if required.

Be sure to install the piston pin retainers, all four of them. It is best to use new ones. Be sure they fit into place with considerable spring tension. They can be expanded somewhat before installing, to increase this tension. They must fit tightly enough to avoid any possibility of movement while in service.

Pistons should be handled carefully to avoid nicking of walls. Any raised surface resulting from an accidental nick must be dressed down very carefully with a fine file.

41. CYLINDERS

After long periods of service, the cylinder walls become worn and require attention. Operating the engine without sufficient coolant in the cooling system or without proper lubrication may result in scored cylinders which require attention. Pistons are available in .005 in., .010 in. and .025 in. oversizes, but their use will require refinishing the cylinder walls by honing, boring or grinding. It may be found more satisfactory to install a new cylinder block and use a set of new standard pistons. The new cylinder block provides new valve guides and valve seats, also.

If the cylinder walls are worn more than .005 in. out of true, it is advisable to install a new cylinder block with new standard pistons or, to refinish the cylinders to accommodate new pistons of one of the available oversizes. See the Table of Clearances, par. 51.

The exhaust valve seats seldom require replacing. Before being pressed into place in the cylinder block they were contracted by being

cooled with dry ice. They fit tightly into the cylinder block and must be removed carefully to avoid damage to the casting, if necessary to install new ones. After installing new seats it will be necessary to grind the seating surfaces to the correct 45° angle, using an approved valve seat grinder. See par. 51.

Core holes in the cylinder block are closed by welch plugs. See Fig. 37. After long periods of service, these may rust through and permit leakage of coolant from the water jacket. A leaking plug should be replaced at once with a new one. Knock a hole in the leaking plug with a prick punch and pry it out. Clean the recess carefully. Coat the edge of the new plug with white lead or other sealing compound. Place the plug in its seat, convex side out. Expand it tightly into place by light hammer blows at its center. If one of these plugs should leak because of looseness, possibly resulting from freezing of the coolant, it usually can be tightened by a hammer blow, first making sure that it is correctly in its seat.

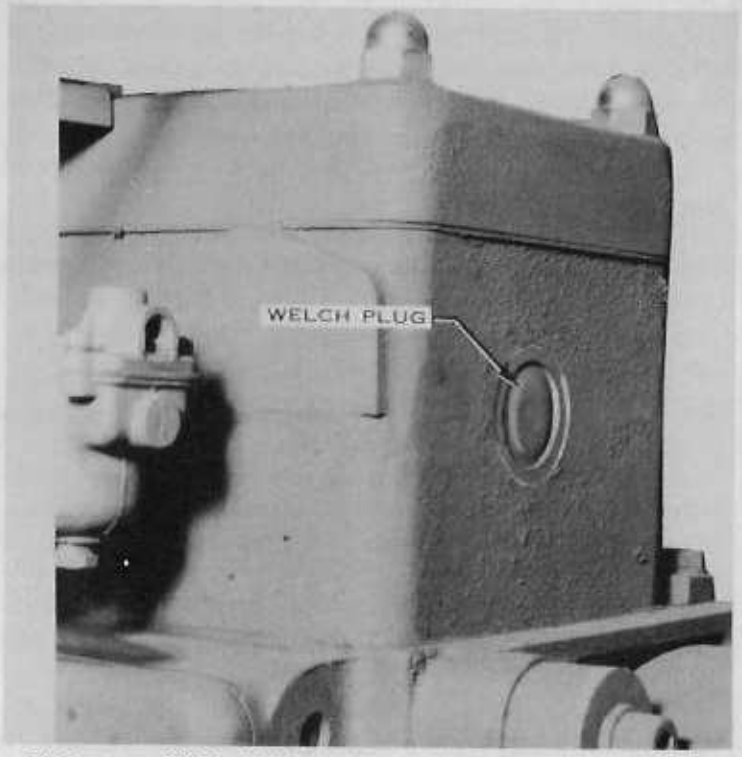

FIG. 37 WELCH PLUG IN CYLINDER BLOCK

42. CRANKSHAFT

The crankshaft is supported in two, steel backed, babbitt lined, non-adjustable, sleeve type bearings. Each bearing is pressed into a re-

movable bearing plate. Then the bearing plates are assembled to the crankcase and the two bearings are line reamed at one operation. When new bearings are to be installed, the same procedure should be followed. If a line reamer is not available it is possible to line bore the bearings with proper machine equipment. See par. 51 for clearances.

The two bearings are the same, but each must be installed properly in its bearing plate. Install the bearing in the rear bearing plate in such position that the crows foot of the oil groove will tend to carry oil toward the ends of the bearing as the shaft rotates in the normal direction within the bearing. Be sure to have the bearing oil hole at the top. The top of the plate is the side opposite the oil return holes. Install the front bearing with the crows foot in the same direction with respect to shaft rotation, but be sure that the bearing oil hole lines up with the depression in the bearing plate through which oil is supplied to it. Press both bearings in until the inner ends are flush with the inner ends of the bearing plates. Bearings must not extend farther inward than the ends of the bearing plates, because the thrust should be taken on the ends of the plates, not on the ends of the bearings.

Be sure that the bearing plates are installed in the crankcase with proper sides down. The oil return holes of the rear bearing plate should be down. The oil pump on the front bearing plate should be below and to the left of center. It is important that they be correctly installed during the line reaming operation, also. Use proper gaskets with the rear bearing plate.

After installing the crankshaft, check the total end clearance with a set of feeler gages. It should be between .008 in. and .010 in. When necessary, the inner end of the front bearing plate may be milled off the amount necessary to provide correct end clearance. The milled surface should be square with the shaft.

See that the oil passages through the crankshaft are clean.

43. CAMSHAFT AND VALVE LIFTERS

The camshaft is supported in two steel backed, babbitt lined bearings pressed into the crankcase. A thrust washer between the camshaft gear and the crankcase takes the rearward thrust. Forward thrust is taken by a special washer mounted on the crankshaft and overlapping the rim of the camshaft gear in such manner as to limit the forward movement of the camshaft. The thrust is rearward during normal operation. The camshaft and gear assembly can be removed only after the special washer has been removed from the crankshaft. After being pressed into correct positions in the crankcase, the two bearings are line reamed in one operation. If a line reamer is not available it is

possible to line bore the bearings with proper machine equipment. See par. 51 for clearances.

It is important that the bearings be properly installed in the crankcase. The oil groove of the rear bearing should be centered at the top. The hole in the side of the front bearing should be to your right when you face the front end of the crankcase. The end of the bearing farther from this hole is the front end. Installed in that manner, the oil groove will be near the top.

Coat the edge of the welch plug with white lead before installing it behind the rear camshaft bearing. Install with convex side out and expand it tightly into place by a light hammer blow at its center.

See paragraphs 37, 38 and 39 for information regarding the disassembling, assembling and adjusting of the valve lifter mechanism. All these parts are replaceable. Be sure to check the alignment of each lifter with its cam when assembling the engine. Because the spacing of the No. 1 and No. 4 lifters may have been adjusted originally by milling the outer ends of the lifter bearings, all should be assembled on the shaft in their original order to retain the correct spacing.

The valve lifter shaft is a straight shaft. It passes easily through the front and center holes but is a drive fit in the rear hole which holds it securely in place. It should be installed and removed through the front end of the crankcase.

44. TIMING GEARS

The flyweights of the mechanical governor are mounted in the recessed face of the camshaft gear. The weights are held in place by a special wire retainer and their mounting should not be disturbed. If either the gear or the weights are to be replaced, a complete gear and weight assembly should be installed.

The gear is a press fit on the camshaft and a Woodruff key, prevents its turning on the shaft. The gear should be removed and installed by means of an arbor press. Avoid damage to the hole in the camshaft and to the gear teeth. When installing the gear, set the camshaft on end so that it stands vertically with front end up. Be sure the keyway of the gear is properly aligned with the key in the shaft. Then press the gear onto the shaft to the shoulder.

The crankshaft gear is a press fit on the crankshaft. A Woodruff key, prevents its turning. It may be pulled from the shaft by means of a suitable gear puller, after first removing the crankshaft nut and special washer. Holes are cast in the front bearing plate to accommodate the gear puller. If the gear is to be used again, be very careful to apply the puller to the gear in such manner as to avoid damage to the teeth. The gear may be driven onto the shaft by using a hammer and a piece

of heavy brass tubing. The tubing should be of such diameter as to void damage to teeth and to the hole in the gear. The gear should be driven on until it reaches the shoulder on the shaft. It is important that the crankshaft gear and the camshaft gear mesh the full width of their teeth. It may be necessary to use a shim washer, part No. 773, between the gear and the shoulder on the shaft to obtain this correct alignment.

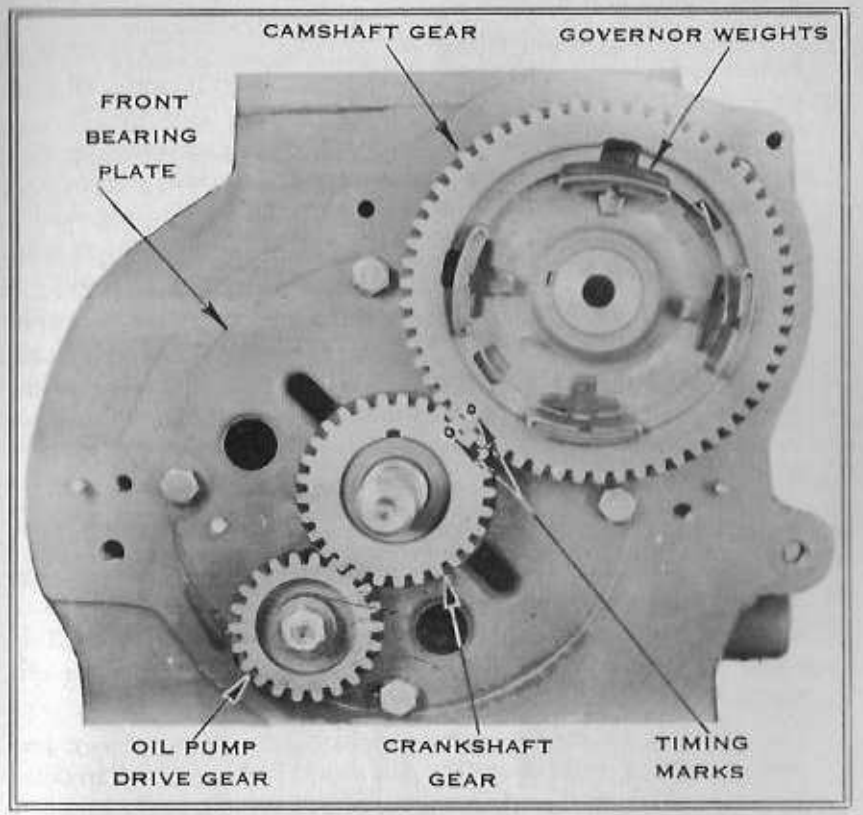

FIG. 38 TIMING GEAR MARKS

The timing mark on the crankshaft gear must coincide with the timing mark on the camshaft gear when the gears are installed, See Fig. 38. The correct amount of backlash between the teeth of the gears is .002 in. to .005 in. Check the backlash at all positions of the camshaft gear. It is good practice to inspect the teeth of both gears carefully to see that none are damaged. A small raised spot on the surface of a tooth, due to a bruise or nick, may cause a great deal of noise. If not too bad, the raised spot may be removed by careful filing.

For quiet operation it is advisable to install both a new crankshaft gear and a new camshaft gear when either is required.

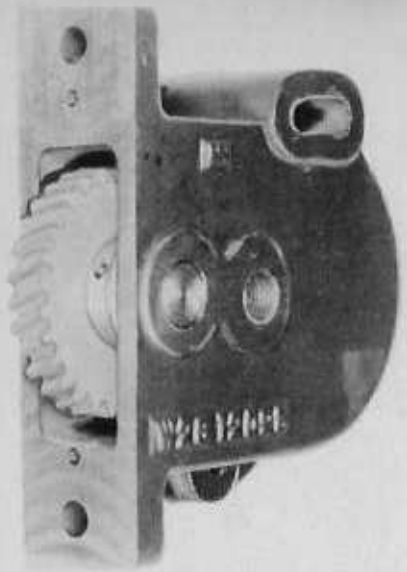

FIG. 39 MAGNETO DRIVE GEAR CASE ASSEMBLY

The magneto drive idler gear mounted in the magneto drive gear case See Fig. 39, is a fibre gear with bronze bushing. The straight shaft is a press fit in both sides of the case. When pressing the shaft from the case, support the front (closed) side of the case at the boss surrounding the shaft opening. Press the shaft from the back (open) side of the case. When installing the shaft, press it in from the front side of the case while the back side is supported at the shaft opening. See Fig. 40. The bronze bushing of the gear is replaceable. See par. 51 for clearances. Install the bushed gear within the housing so that the flange of the bushing is toward the front of the case. If

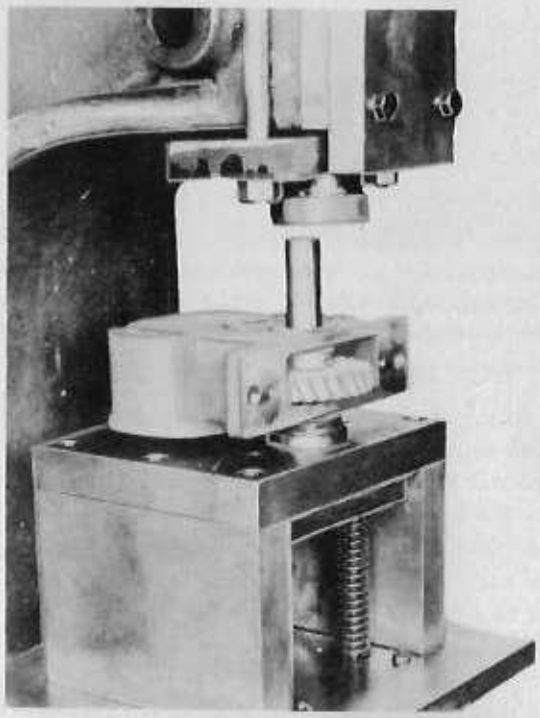

FIG. 40 INSTALLING SHAFT IN MAGNETO GEAR CASE

necessary to increase the end play, do so by carefully filing the side of the bushing flange. See par. 39 for instructions on installing this gear case to the engine.

The magneto drive gear is mounted on the magneto shaft and is removable with the magneto, par. 49.

45. GOVERNOR

The governor weights are permanently assembled to the camshaft gear and should not be removed from the gear. If any part of this assembly requires replacing, install an entire new assembly. When overhauling this engine, wash this mechanism thoroughly and see the mechanism is not excessively worn.

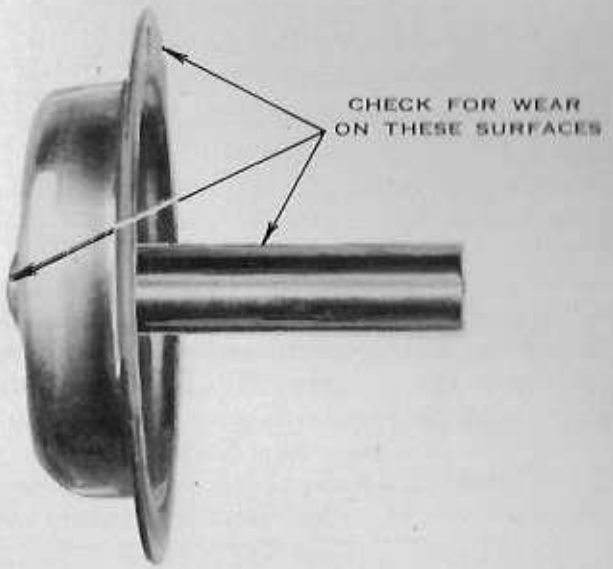

FIG. 41 GOVERNOR CUP ASSEMBLY

Inspect the governor cup assembly, See Fig. 41, for excessive wear at points where the weights contact it, at the radius, where the governor shaft paddle contacts it, and along the sides of the stud where it slides in the end of the camshaft. If excessively worn at any of these points, install a new one. The cup must be at right angles with the stud, and the cup must not be bent out of proper shape. It must fit loosely over the pin which makes it turn with the gear. Clean the hole in the camshaft and lubricate all moving parts with engine oil before assembling.

The governor shaft is supported in needle bearings in the gear case cover. The lower end of the shaft sets on a single steel ball which takes the downward thrust. A cotter pin through the shaft just below the

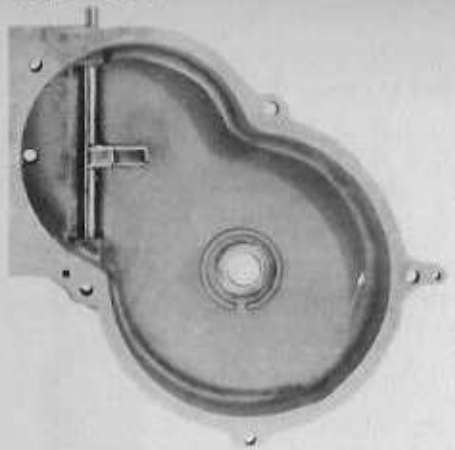

FIG. 42 GEAR CASE COVER
(SHOWING GOVERNOR SHAFT)

upper bearing keeps the shaft in proper position. The shaft cannot be removed from the gear cover. See Fig. 42. If any part of the assembly is to be replaced, a new gear cover assembly should be installed.

See paragraphs 28 and 39 for further instructions on assembling and adjusting the governor.

46. PRESSURE LUBRICATING SYSTEM

Every major overhauling of the engine should include a thorough checking of all oil passages to see that they are not obstructed.

After long use, various parts of the oil pump may become so worn as to require replacements. Excessive wear permits oil leakage within the pump and reduces the maximum oil pressure the pump will develop. The pump must be disassembled for examination. See Figs. 34 and 43.

When reassembling, it is important that no binding condition should exist. Any binding condition will create excessive heat and may cause seizing or scoring of parts. The only adjustment is that which regulates the clearance between the sides of the gears and the housing. This adjustment is made by using a gasket of a different thickness. A new pump usually requires a gasket thickness of about .008 in., but each assembly should be checked after the screws have been tightened.

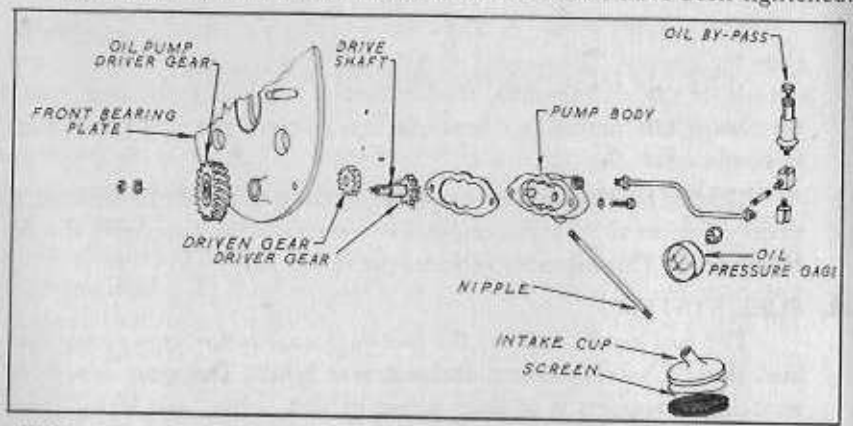

FIG. 43 EXPLODED VIEW OF OIL PUMP ASSEMBLY

Use gaskets of such thickness as to allow about .002 in. endwise movement of the shaft. Gaskets are available in various thicknesses and, if necessary, two gaskets may be used to obtain the correct clearance.

Check again for freedom of movement after the drive gear nut has been tightened, if any new parts have been installed. To do this it will be necessary to tighten the nut and make the test before installing the bearing plate on the crankcase. Lubricate the pump well with engine oil after it is finally assembled. This may be done by squirting the oil in through the inlet while turning the shaft counterclockwise.

The oil by-pass valve, See Figs. 30 and 44, is adjustable and should be set so as to provide a minimum gage pressure of 15 lbs. per sq. in. when the engine is operating at normal temperature. If any part of the by-pass valve requires replacing, install a complete new by-pass valve assembly. This valve may be adjusted after removing the lower inspection hole cover from the crankcase. Be sure that the locknut is tightened.

FIG. 44 ADJUSTABLE OIL BY-PASS ASSEMBLY

47. COOLING SYSTEM

The water passages through the thermo-siphon cooling system should be kept open so that the water or other coolant may circulate freely. When overhauling the engine, scale should be cleaned from all openings through which the coolant circulates from one casting to another. The interior of the hose connection should be inspected to make sure it has not deteriorated to the point where it soon may retard the circulation of the coolant.

The radiator should be flushed out to clean accumulated sediment from the interior. The outside of the core should be cleaned, also. If the outside of the core is dirty, the air flow is somewhat obstructed and the film of dirt, acting as a heat insulator, retards the transfer of heat from the core.

The fan has a plain bearing. When bearing and shaft become worn to the point requiring replacement, a complete new hub assembly should be installed. This assembly includes the shaft.

48. FUEL SYSTEM

The fuel system includes the fuel tank, carburetor, connecting fuel line, shut-off valve, strainer, and sediment bowl. The most important servicing it requires is to keep it free of dirt, water, and leaks. This requires care in handling of the fuel to avoid getting dirt or water into

the fuel system, and, periodic cleaning of sediment bowl and strainer, to keep dirt and water which enter, from reaching the passages and jets of the carburetor. Fuel leaks should be corrected as soon as discovered.

a. **FUEL TANK**—The 3-gallon fuel tank is mounted above the generator. It may be removed after first disconnecting the fuel line, removing the housing top plate and the supporting clamps.

b. **CARBURETOR**—The carburetor, Fig. 2, is a Zenith Model TU3YH. Its functioning and adjustment are described in paragraphs 3 and 22 and Fig. 5.

The following routine should be followed in overhauling the carburetor after removing it from the engine. Before disassembling the carburetor, place light punch marks on the bowl and on the throttle body near one of the assembly screws. See Fig. 45. This will indicate the correct one of four different positions in which these two parts may be assembled.

(1) Remove the four throttle body to bowl assembly screws and lockwashers, using a $\frac{7}{16}$ in. wrench.

(2) Remove the four bowl cover assembly screws and lockwashers, using a screwdriver. Remove the main adjusting screw from the cover.

(3) Remove the bowl cover and float assembly as a unit, using care to avoid damaging the float.

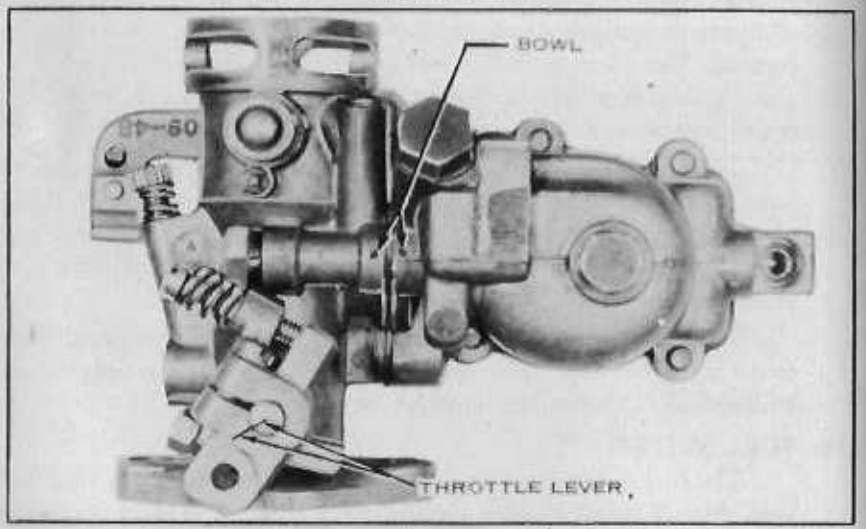

FIG. 45 WITNESS MARKS
(CARBURETOR BOWL AND THROTTLE LEVER)

(4) Remove the float axle after striking the smooth end lightly to loosen.

(5) Remove the float and the float valve.

(6) Remove the float valve seat and gasket, carefully using a screwdriver with a wide blade.

(7) Remove the main jet, using a screwdriver.

(8) Remove the lower plug and gasket, using a $\frac{1}{2}$ in. wrench.

(9) Remove the metering well and gasket, using a screwdriver with a $\frac{1}{4}$ in. blade. Use a piece of wire with a hook at the end to remove the gasket, if necessary.

(10) Remove the idling adjustment screw and spring.

(11) Remove the throttle butterfly screws and lockwashers, and the butterfly, after carefully noting its correct position.

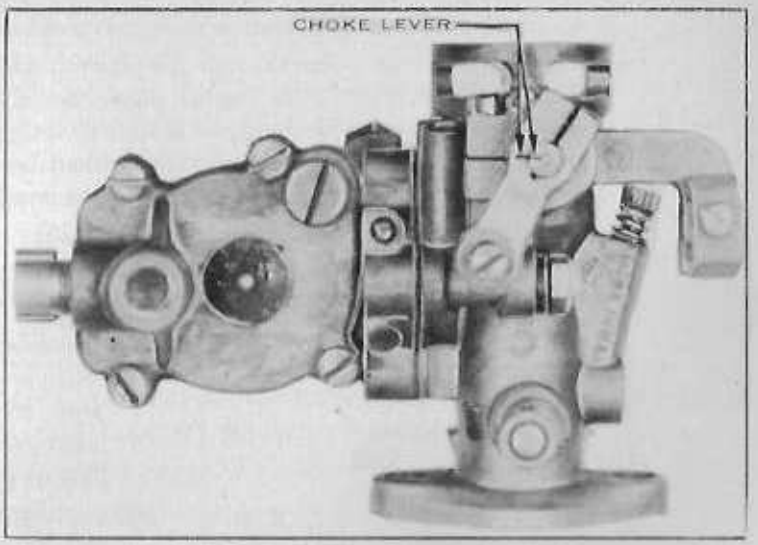

FIG. 46 WITNESS MARKS
(CARBURETOR CHOKER LEVER)

(12) Carefully mark the angular position of the throttle lever on the shaft by means of a straight scratch across the end of the shaft and across the arm. See Fig. 45. Loosen the clamp screw and remove the lever and spacing washers. Then remove the shaft from the opposite side of the body.

(13) Remove the choker butterfly screws and lockwashers and the butterfly.

(14) Mark the angular position of the choker lever on its shaft. See Fig. 46. Loosen the clamp screw and remove the lever.

(15) Do not remove the choke control bracket, channel plugs or discharge tube.

(16) Clean all parts in gasoline, taking the necessary precautions in handling this liquid. Do not boil in caustic solution. Blow through all channels with compressed air.

(17) Inspect all parts carefully and substitute new parts for those excessively worn or damaged. If the float valve is appreciably worn at the seating surface, use a new valve and seat assembly. Shake the float. If it contains gasoline, use a new one. If the idle needle is damaged at the seating surface, use a new one. If the main jet is damaged, a new one will be required. If the throttle shaft is worn appreciably, install a new one. Use a new set of gaskets.

(18) Reassemble, reversing the order of procedure used in disassembling and giving particular attention to the following:

(a) Install the throttle butterfly with the shorter side towards the idling orifice and with beveled edges parallel with the throttle body wall. The butterfly should fit snugly against the wall all the way around except at the shaft holes. Hold it tightly in this position as the screws are tightened.

(b) Install the choker butterfly with the longer side toward the bowl vent openings and with beveled edge parallel with body wall. Fit carefully as with the throttle butterfly.

(c) Check the float position, Fig. 47. If necessary, adjust by carefully bending the float lever at a point near the float.

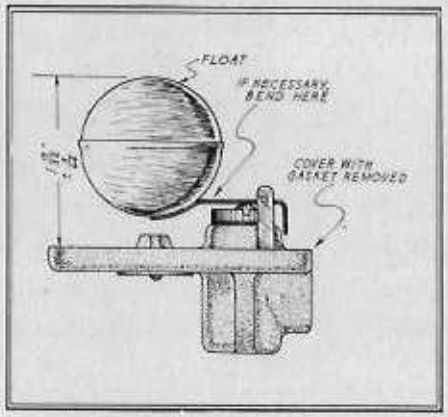

FIG. 47 CARBURETOR FLOAT ADJUSTMENT

(d) Observe the punch marks of bowl and throttle body to assure correct position when assembling these parts.

(e) Tighten the bowl cover screw and the bowl to throttle body screws evenly.

(f) Be sure the main adjusting needle is out when installing the bowl cover, so as not to strike its seat as the cover is installed.

(g) Set the choke lever, choke control bracket, throttle lever and throttle stop bracket as shown in Fig. 48.

(h) Turn both needle valves in lightly against their seats, then turn each needle out 2½ turns. Final adjustment must be made after assembling the carburetor to the engine. See par. 22.

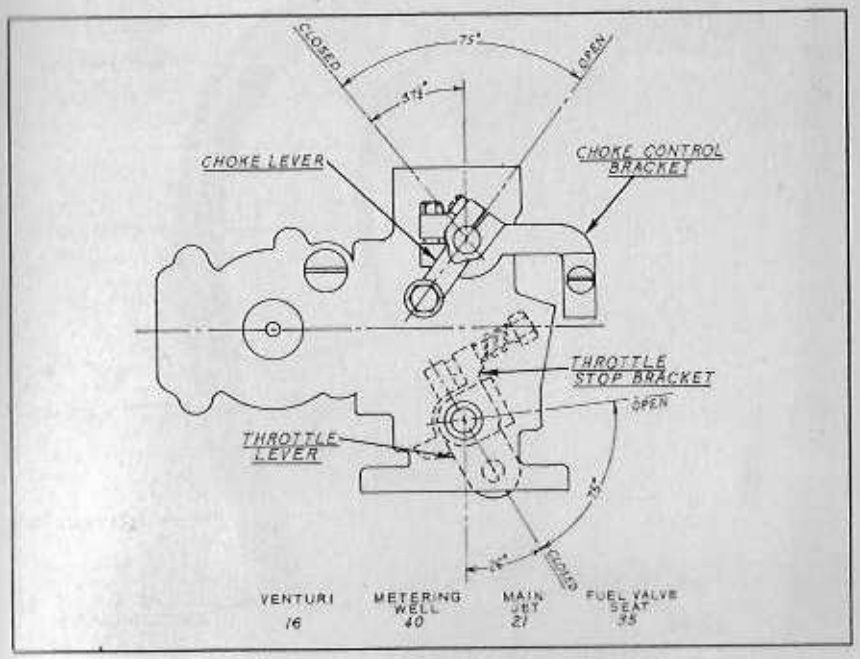

FIG. 48 CARBURETOR LEVER AND BRACKET POSITIONS

49. IGNITION SYSTEM

MAJOR MAGNETO REPAIRS—Major magneto repairs require removing the magneto from the engine. Remove the end plate. Disconnect the spark plug cables and shielding from the magneto. Disconnect the magneto ground wire at the control panel. Remove the cap screws by which the magneto is held to the gear case and remove the magneto.

The distributor cap, distributor arm, breaker mechanism and condenser may be serviced as already described, par. 30. The remainder of the magneto may be disassembled and reassembled by the following procedure:

a. Disconnect the lead terminals from the condenser, Fig. 26, unscrew the four fillister head screws which hold the housing group to the magneto frame. Lift the housing group, including breaker assembly, from the magneto. This gives access to the coil and core assembly, Fig. 49.

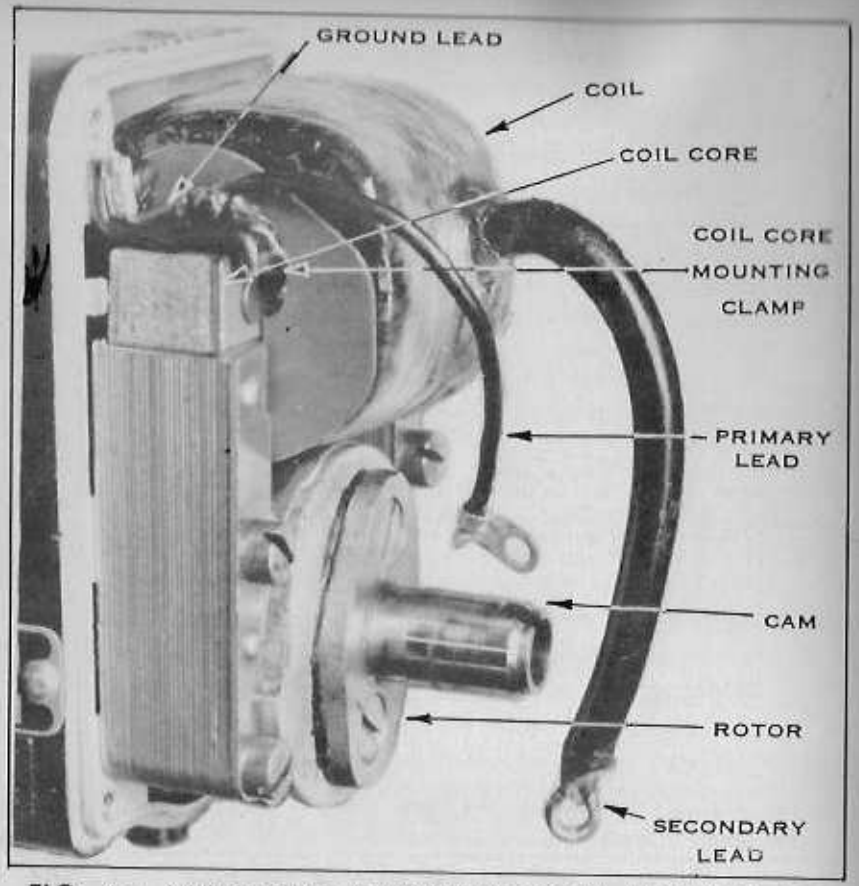

FIG. 49 MAGNETO (SHOWING COIL MOUNTING)

Remove the two screws which hold the coil core clamps in place. Under one screw is connected the ground lead of the coil. Turn the rotor to such position that the magnetism releases the coil core, and lifts the coil and core from its position.

b. If a new coil is to be installed, press the core from the old one. Install the core in the new coil in the same relative position so that when the coil is assembled to the magneto later, the smoothly machined surface of the core will fit tightly against the similarly machined ends of the laminated yoke.

Center the coil on the core and insert the wedges, one at each end on the top side of the core.

c. Do not loosen the screws which hold the laminated yoke to the frame of the magneto.

d. Remove the cotter pin and special hexagon nut from the drive gear, being careful not to damage the gear teeth. Lay the gear aside.

Remove the impulse coupling mechanism, Figs. 50 and 51, piece by piece, noting carefully the arrangement of the parts so as to facilitate reassembly.

e. The impulse coupling provides a retarded spark for starting and automatically advances the spark for normal operating speed. The amount of advance is determined by the position of the impulse stop plate. Note the position of the impulse stop plate as indicated on the graduated scale of the case before loosening the screws which hold the plate in place. Then remove the screws and the plate.

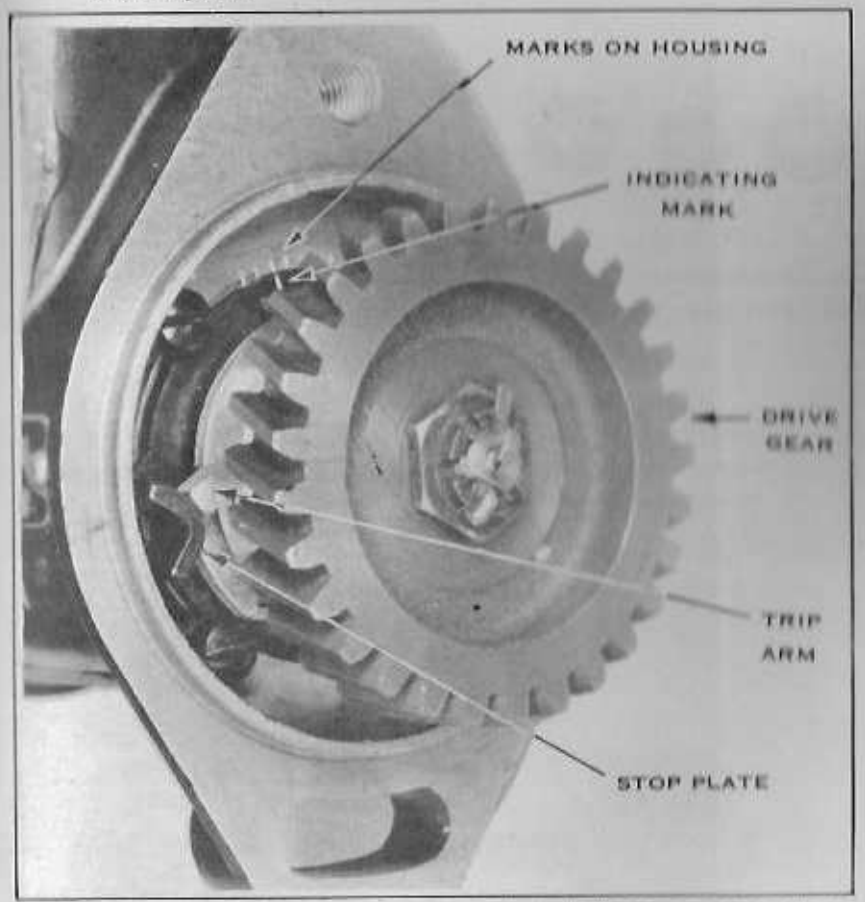

FIG. 50 MAGNETO (SHOWING IMPULSE COUPLING)

Remove the small collar and the oil distribution disc from the shaft.

Remove the rotor assembly. See Fig. 52.

Remove the oil felt and the oil scraper and spring assembly. See Fig. 53.

Wash all mechanical parts in gasoline. Examine the parts for wear.

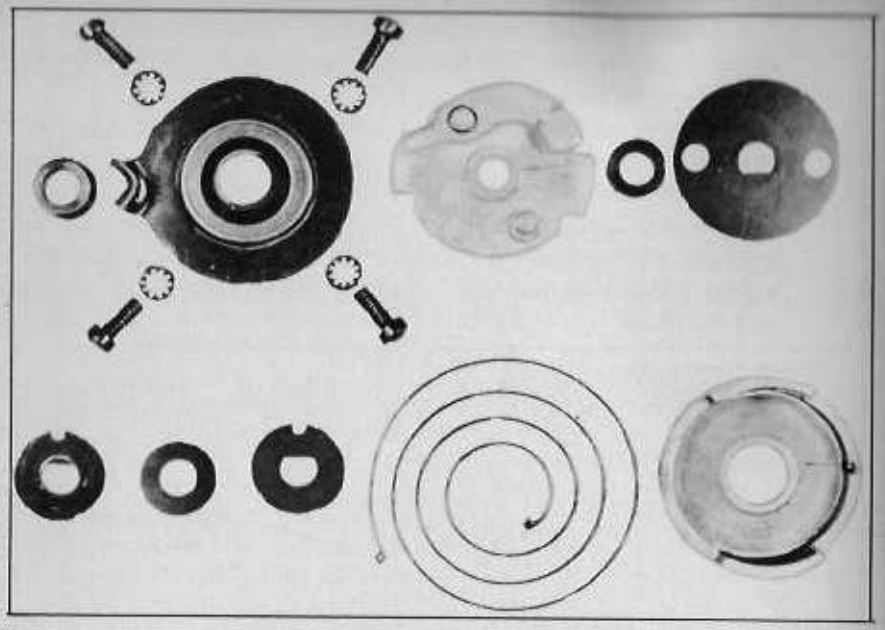

FIG. 51 MAGNETO IMPULSE COUPLING DISASSEMBLED

Provide any new parts required, including new gaskets.

If new rotor shaft bushings are required, press the old ones from the frame and press the new ones carefully into place. Line-ream to proper clearance, par. 51. Endwise clearance may be increased, if necessary, by carefully removing material from the flange of a bushing.

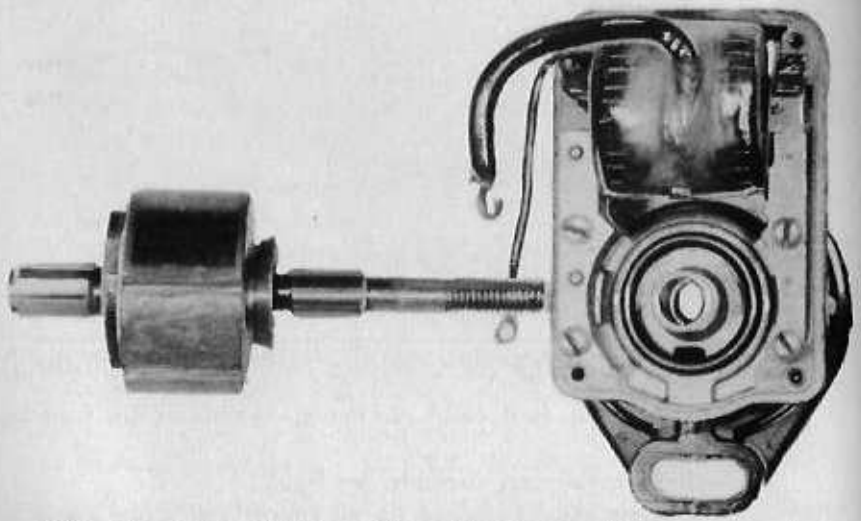

FIG. 52 MAGNETO (SHOWING ROTOR REMOVED)

f. Before reassembling, wash the felt oil pad thoroughly in clean OE-10. Install it while saturated with oil, first making sure that the oil pad spring plate is in place with prongs toward the case so that the flat side of the plate will be next to the felt pad.

Install the oil scraper and spring assembly.

Install the oil distribution disc and the small collar. Then install the impulse stop plate, placing it in correct position as already noted on the graduated scale of the case before tightening the screws. If the correct position was not noted, set the plate so that the indicating mark is midway between the third and fourth division mark on the case, counting from the left.

Install the weight carrying member of the impulse coupling with weighted arm outermost. Install the spacing collar and the large disc.

FIG. 53 MAGNETO (SHOWING PARTS OF LUBRICATING SYSTEM)

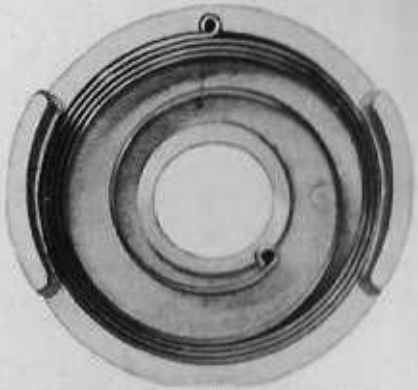

FIG. 54 MAGNETO IMPULSE COUPLING SPRING

g. Install the spring in the drive member so that, when facing the spring and starting at the outer end, the direction of the spiral is counter-clockwise. See Fig. 54. Assemble the two drive discs, with necessary spacing washers between them, inside the spring. Be sure both ends of the spring engage their respective notches. Assemble this group onto the shaft. The projections of the drive member must extend over the sides of

the weight carrying member. Turn the drive member counter-clockwise to the first position in which the projections will pass over the sides of the weight carrying member, then turn one-half turn further, thus applying the correct initial spring tension.

Replace the gear and special nut. Tighten the nut and install a cotter pin. This nut must not be tightened so tightly as to cause a binding condition in the coupling.

h. Complete the assembly by reversing the order of procedure used in disassembling. Be sure the coil core sets squarely on the yoke and against the locating bosses on the frame. Tighten all screws securely. Lubricate the cam oil pad and adjust the breaker point gap. Leave the cap off the distributor until the magneto has been properly timed and installed on the engine.

a. **TIMING THE MAGNETO**—Remove the spark plug from the No. 1 cylinder, the one nearer to the radiator. Hold a thumb over the spark plug hole and crank the engine slowly until the force of compression is felt against the thumb. Then continue to crank the engine slowly until the timing mark on the engine flywheel is exactly in line with the T.C. (top center) mark on the right side of the crankcase. The timing mark on the flywheel consists of a chisel mark covered by yellow paint. See Fig. 29.

Grasp the magneto gear aud turn in the normal direction of rotation until the impulse coupling just trips with the distributor arm pointing toward the No. 1 tower of the distributor. Install the magneto without turning the gear from this position.

b. Then crank the engine very slowly and note whether the impulse coupling trips when the timing marks on flywheel and crankcase are exactly in line. If not, the timing is incorrect. If not too far off, it may be corrected by loosening the cap screws which hold the magneto flange and turning the magneto frame slightly. See Fig. 55. If too far off, it will be necessary to disengage the teeth of the magneto gear and turn it one or more teeth to advance, or to retard the timing. Make final adjustment by shifting the position of the magneto as already described. This method, times the spark to occur at top dead center at cranking speed. The impulse coupling advances the spark for normal running speeds. The advance should amount to 25° (about 1¼ fin pitches on the flywheel). If a neon test lamp is available, timing should be checked at running speed. If necessary, remove the magneto and move the impulse stop-plate clockwise to decrease or counter-clockwise to increase the amount of advance. One division on the scale is equivalent to about 5° or ¼ fin pitch as measured on the flywheel. After changing the

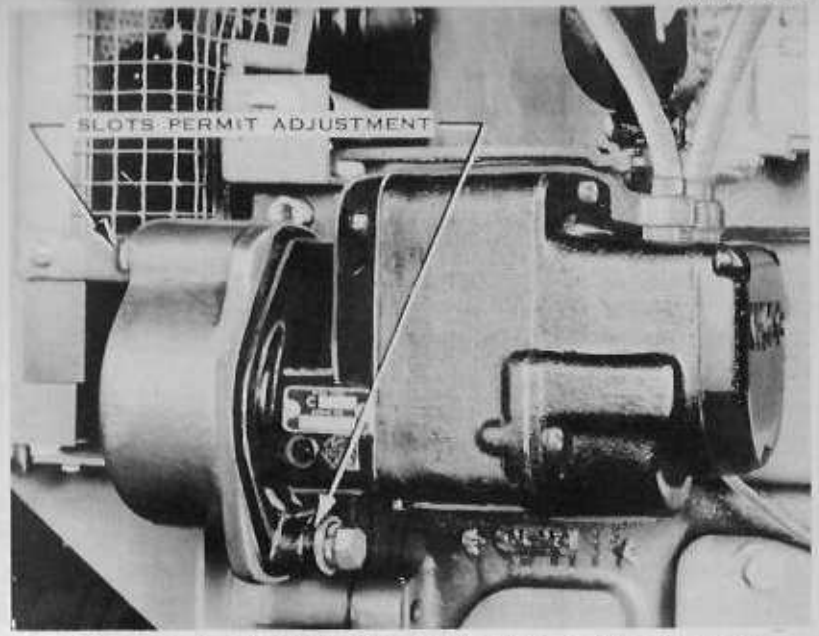

FIG. 55 MAGNETO MOUNTED ON ENGINE

position of the stop plate it will be necessary to completely retime the magneto to the engine.

c. **SPARK PLUGS**—The spark plugs are Champion—6M. These spark plugs are of the correct heat range for the engine. When replacements are made, the new spark plugs should be of the same make and model number to insure good results. Adjust the gaps to .030 in.

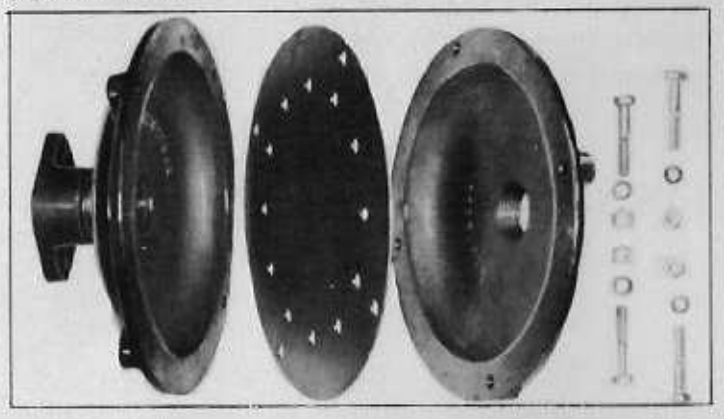

FIG. 56 EXHAUST MUFFLER DISASSEMBLED

50. EXHAUST MUFFLER

The muffler may be disassembled for cleaning, See Fig. 56, and this should be done when the engine is given a complete overhaul. When reassembled, use care to assure a tight joint.

51. TABLE OF CLEARANCES

	Minimum	Maximum
Valve Tappet Clearance (Intake)	.008″	.010″
Valve Tappet Clearance (Exhaust)	.010″	.012″
Valve Seat Width	$\frac{1}{16}$″	$\frac{3}{32}$″
Valve Stem Clearance in Guide (Intake)	.002″	.003″
Valve Stem Clearance in Guide (Exhaust)	.0025″	.003″
Crankshaft Main Bearing (Diameter)	.002″	.0025″
Crankshaft Main Bearing (End Play)	.008″	.010″
Connecting Rod Bearing (Diameter)	.0015″	.003″
Connecting Rod Bearing (End Play)	.004″	.006″
Camshaft Bearings	.002″	.0025″
Timing Gear Backlash	.004″	.005″
Magneto Idler Gear (Bushing to Shaft)	.0025″	.003″
Magneto Idler Gear Bushing (End Play)	.003″	.005″
Piston (Clearance in Cylinder)	.003″	.005″
Piston Pin (in piston)—	Hand Push Fit at 70° F.	
Piston Pin (in connecting rod)	.0002″	.0003″
Piston Ring Gap	.008″	.015″
Piston Ring to Groove Clearance	.001″	.0015″
Cylinder Bore (actual diameter)	3.003″	3.004″
Magneto Rotor Bearings (diameter)	.001″	.002″
Magneto Rotor Bearings (end play)	.005″	.008″

XII--Generator

52. GENERAL

The generator normally requires little servicing other than periodic attention to the brushes, commutator, slip rings and ball bearing, paragraphs 18, 19 and 27.

When it becomes necessary to undercut the mica of the commutator, to install a new generator ball bearing, or to perform other major service on the generator, disassembling is necessary. When both the generator and the engine require major servicing, the work should be combined in one job. Disassembly and reassembly operations for such a job are described in paragraphs 38 and 39. If only the generator is to be serviced, the engine need not be removed from the housing. Only those operations necessary to make the desired repairs need to be done.

To undercut the mica or install a new generator ball bearing, it will be necessary to perform disassembly operations 1, 3, 4, 6, 7, 9, 11 (rear only), 14 and 15. Then remove the nuts holding the end bell cover to the generator frame and pull the end bell from the generator. The generator frame and armature may be removed by performing the additional operations 16 and 17. See Figs. 57 and 58.

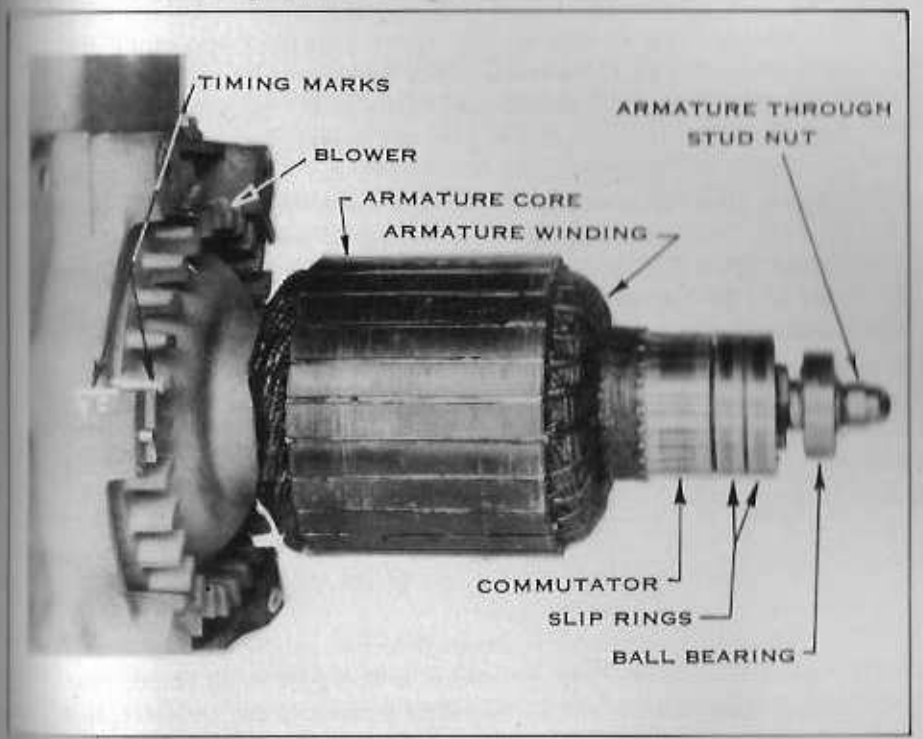

FIG. 57 GENERATOR ARMATURE ASSEMBLED TO ENGINE

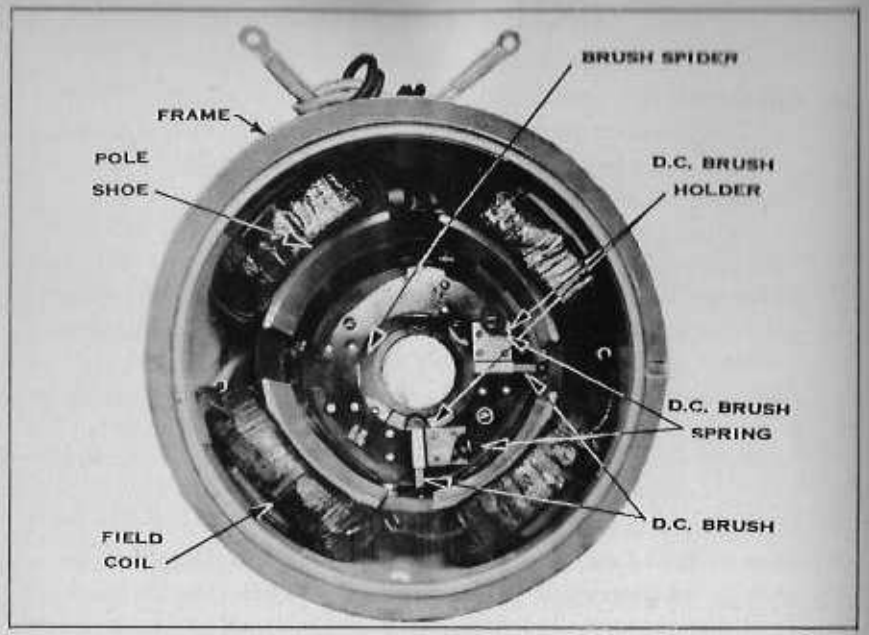

FIG. 58 GENERATOR FRAME ASSEMBLY

Reassembly is accomplished by reversing the procedure used in disassembling. See that all surfaces of the flange joint between generator armature and flywheel are clean and lightly lubricated before installing the armature. The four dowel pins will permit the armature to be installed in any one of four different positions. Install in whichever position assembly is easiest. After tightening the armature through stud nut, observe the run-out at the bearing. If more than a few thousandths of an inch, it may be due to dirt between the flanges of the joint or a nick on one of the flange surfaces. This condition should be corrected. The run-out might be reduced by changing to another of the four positions permitted by the four dowel pins.

53. COMMUTATOR AND SLIP RINGS

Eventually the commutator bars wear down so that the mica between them must be undercut. This should be done as soon as the mica on any part of the commutator touches the brushes. A suitable undercutting tool can be made of an old hack saw blade. Use it as shown in Fig. 59. Avoid injury to the surfaces of the copper bars. Leave no burrs along the edges of the bars.

When the commutator or slip rings become grooved, out of round, or the surface becomes pitted or rough, so that good brush seating cannot be maintained, it will be necessary to remove the armature and

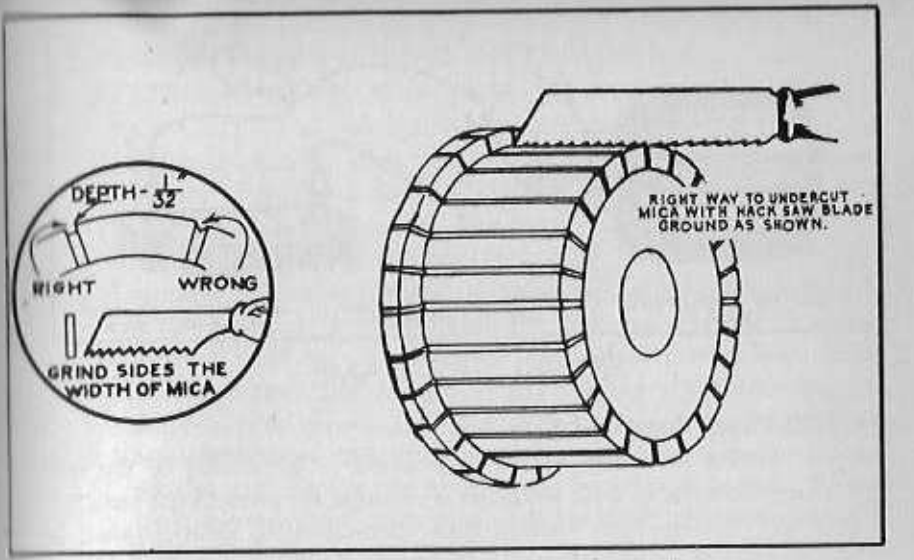

FIG. 59 UNDERCUTTING MICA

to refinish these parts in a lathe. Undercut the mica after refinishing the commutator.

54. GENERATOR BALL BEARING

The ball bearing may be removed from the armature shaft by means of a bearing puller. Avoid injury to the center of the shaft. This center must remain true, to serve as a turning center when it becomes necessary to refinish the commutator or slip rings. Avoid getting dirt into the bearing at any time. Unless actually working with the bearing, keep it covered with a clean cloth whenever it is out of its housing.

When installing a ball bearing, be sure to place the sealed side toward the armature. Press or drive it onto the shaft until it is against the shoulder. Press or drive on the inner race only, using next to the bearing, a piece of brass pipe approximately the size of the inner race, and large enough to clear the end of the shaft.

A notch in the outer edge of the bearing, engages a ball in the bearing housing and prevents the outer race from turning. It is not necessary to align the notch with the ball when assembling. A spring behind the ball will snap it into the notch if the outer race should ever turn sufficiently.

Remove the ball bearing cover and clean all old grease from the cover and from the bearing housing. After installing the bell housing, repack the bearing housing properly with the correct grease, paragraphs 19 and 29.

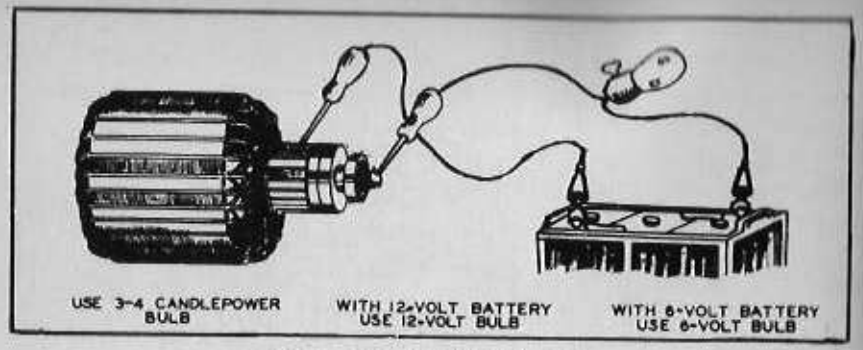

FIG. 60 TEST LAMP

55. TESTING WINDINGS

A test lamp set, Fig. 60, is required to make most of the tests described here. A D.C. voltmeter is required for some of the tests.

If an armature winding tests open-circuited, short-circuited or grounded, the practical repair is to install a new armature assembly.

If the field winding tests open-circuited, short-circuited or grounded, the practical repair is to install one, or more, new field coils unless the trouble is in the leads outside the winding proper.

If a winding having external leads tests defective, check the leads carefully. If the trouble is in a lead it can be repaired as the nature of the trouble requires.

Before starting the tests, remove the end bell cover, lift all brushes high in the holders and set the ends of the springs against them to hold them high. Then disconnect the two load wires from the A.C. OUTLET terminals, and the two leads from the control panel. See Fig. 9.

Test prods must make good electrical connections at points of contact.

a. TESTING EXCITER WINDING OF ARMATURE FOR OPEN- OR SHORT-CIRCUIT—This test requires the use of an armature growler after first removing the generator frame.

b. TESTING ARMATURE WINDINGS FOR GROUNDS—Touch one test prod to the armature shaft and the other to a collector ring. If the lamp lights, the a.c. power winding is grounded. Touch one test prod to the armature shaft and the other to the commutator. If the lamp lights, the exciter winding is grounded.

c. TESTING A.C. POWER WINDING OF ARMATURE FOR OPEN- OR SHORT-CIRCUIT—Touch one test prod to one slip-ring and the other test prod to the other slip-ring. If the lamp does not light, the a.c. power winding is open-circuited.

A short-circuit within this winding would cause heating of the short-circuited coils and result in burning of the insulation of those

coils. This condition could be determined by visual inspection of the inner winding at the end of the armature near the engine.

d. TESTING FIELD WINDINGS FOR OPEN- OR SHORT-CIRCUIT—The field windings are connected in parallel-series and the field assembly must be removed to test for short- or open-circuits. Disconnect the two series at a point where a field lead from the brush rig connects with them. This opens a parallel connection and provides open ends for testing the winding as a straight series of four coils. Use the test prods to test for open-circuit and for short-circuit between windings. Test for short-circuit in the turns of a coil by connecting the series of four shunt coils across a 6-volt battery and taking a voltage reading across each coil. If the voltage is lower on one coil than on the others, that coil has some turns short-circuited. To test for open-circuit, touch one test prod to each of the two ends of the series of four coils. If the lamp does not light, there is an open-circuit. Unless the trouble is located at connections between coils and easily repaired, install new coils.

e. TESTING FIELD WINDINGS FOR GROUNDS—Disconnect the field leads from the brush rig. Touch one test prod to the generator frame. Touch the other test prod to any of the field leads. If the lamp lights, the winding is grounded. Inspect the leads. If the ground is in a lead or in a connection between coils, tape the defective section with two layers of half-lapped rubber tape, then with two layers of friction tape. If the ground is in the winding proper, the generator frame must be removed. Then remove the screws which hold the field pole pieces to the frame. Remove screws from one pole piece at a time, push the pole piece and coil away from the frame and test again for ground. A ground is at the coil last loosened before the test indicates that the ground has been removed. Remove the pole piece from the coil and locate the grounded spot on the coil by visual inspection. Install a new coil. If a new coil is not available it may be possible to repair the coil by taping the defective area with several layers of carefully half-lapped friction tape, then shellacking the area. Replace after the shellac has dried.

56. CONTROL PANEL EQUIPMENT

If any unit of the control panel equipment fails to function properly it should be replaced by a corresponding new unit rather than to attempt repairs on the old one. No attempt should be made to repair such units as meters, circuit breakers, switches and receptacles.

REPAIR PARTS

WARNING

SPARE PARTS can be supplied promptly and accurately only if positively identified by correct part number and correct part name.

FURNISH THIS INFORMATION ON ALL REQUISITIONS.

WITHOUT FAIL, on all requisitions, give name of machine, name of manufacturer, model or size, manufacturer's serial number of each machine and subassemblies attached to machine, and components and accessories for which spare parts are required.

List spare parts for only one make or kind of machine on each requisition.

Requisitions must be double spaced to provide room for office notations when necessary.

GRD SPS 304

XIII--Preparation of Requisitions

57. PREPARATION OF REQUISITIONS.

Sample Copy for Use in the Preparation of Requisitions

On this page is shown a sample spare parts requisition on QMC Form No. 400 which conforms to the latest revisions. The marginal notes give instructions for preparing a requisition for spare parts for Engineer equipment.

The revised QMC Form 400 has new column headings. Until new forms are available use the present form and type or write in corrections in column headings as shown below.

Under revised heading "Nomenclature" and "Unit" list the article and the unit (ea for each; lb for pound; etc.). Under heading "Maximum or Authorized Level" list the authorized organizational allowances or depot stock levels given in ENG 7 and ENG 8 of the ASF Engineer Supply Catalog (superseding Part III, Corps of Engineers Supply Catalog). The total number on hand for each item is listed under "On Hand". In column headed "Due In" enter the total quantity previously requisitioned but not delivered. Column headed "Required" is to be changed to read "Quantity Desired" and column headed "Approved" is to read "Remarks." For "Initial" and "Replenishment" requisitions, the sum of "Quantity Desired", "Due In", and "On Hand" should equal "Maximum or Authorized Level."

(Additional details on this subject are covered in ENG 1 of the ASF Engineer Supply Catalog which incorporates information formerly contained in Section AA-I, Part III, Engineer Supply Catalog.)

State PERIOD designation by use of one of the following terms:
(1) "INITIAL"—first requisition of authorized allowances.
(2) "REPLENISHMENT"-subsequent requisitions to maintain authorized allowances.
(3) "SPECIAL"—requisitions for necessary repairs not covered by allowances.

Type "SPARE PARTS" in upper right hand corner of requisition.

Address requisitions to Engineer Field Maintenance Office, P. O. Box 1679, Columbus, Ohio (except for spare parts for searchlights and barrage balloons which are addressed to Schenectady, N. Y. or Ogden, Utah ASF depots).

Give complete shipping instructions. Special instructions for packing, marking, routing, etc., should be given at bottom of requisition.

State proper nomenclature of machine, also make, model, machine serial number and U. S. A. registration number.

Prepare a separate requisition for each different machine.

State basis or authority and date delivery is required, immediately below description of machine.

Double space between items.

Group parts required under group headings as shown in manufacturers' parts catalogs (Technical Manuals).

State OCE stock numbers, manufacturers' parts numbers and nomenclature accurately and completely. Do not use abbreviations.

SPARE PARTS

WAR DEPARTMENT
Q. M. C. Form No. 400
(Revised 15 Aug. 1941)

REQUISITION

To: Engineer Supply Officer
Columbus Quartermaster Depot, COLUMBUS, OHIO
No. of Sheets 1 Sheet No. 1
Requisition No. E-531-3-43 Date August 14, 1942 Period Special
SHIP TO Engineer Property Officer, Pine Camp, New York
MARKED FOR: Engineer Supply Officer, 802nd Engr. Battalion, Pine Camp, N. Y.

REQUISITIONED BY (show Signature, Rank, Organization, Destination. If different from "ship to" include address):
Robert E. Roe,
Major, E. C.,
Engineer Property Officer

FOR THE COMMANDING OFFICER:
John E. Doe,
Col., C. E.,
Executive Officer

STOCK NO.	NOMENCLATURE	UNIT	MAX OR AUTH. LEVEL	ON HAND	DUE IN	QUANTITY DESIRED	REMARKS
	PARTS FOR ONAN GENERATOR MODEL W3M-19 SERIAL NO. 69823 U. S. A. REG. NO. W-84997						
	Basis: Repair of Disabled Equipment.						
	Delivery is requested by August 20, 1943						
	ONAN ENGINE GROUP						
542	VALVE, Intake	ea.		0	1	2	
545	SPRINGS, Valve	ea.		0	1	2	
2211	GASKET, Cylinder Head	ea.		0	1	1	
	ONAN GENERATOR GROUP						
2591	COIL, Field	ea.		0	1	1	
76736	BAND, Generator End Bell	ea.		0	1	1	

"Nonexpendable items such as tools must be accounted for, when requisitioned, by a statement that they have been placed on REPORT OF SURVEY or STATEMENT OF CHARGES.

Emergency requisitions sent by telephone, teletype, cablegram, telegraph or radio must be confirmed immediately with requisition marked: "Confirming (state identifying data)."

PREPARATION OF REQUISITIONS

A sample requisition in the correct form for submission by the Engineer Property Officer is shown on the opposite page.

THIS SHALL BE FOLLOWED IN MAKING OUT REQUISITIONS

In order to eliminate duplication of work, Property Officers may authorize organizations to prepare requisitions in final form, leaving requisition number space blank for completion by Property Officer.

THE FOLLOWING RULES WILL BE OBSERVED CAREFULLY IN PREPARING REQUISITIONS FOR SPARE PARTS:

a. Prepare a separate requisition for each different machine.

b. Type "SPARE PARTS" in upper right hand corner of requisition form.

c. State PERIOD designation by use of one of the following terms:
   (1) "INITIAL"—first requisition of authorized allowances.
   (2) "REPLENISHMENT"—subsequent requisitions to maintain authorized allowances.
   (3) "SPECIAL"—requisitions for necessary repairs not covered by allowances.

d. Give complete shipping instructions.

e. State proper nomenclature of machine, and make, model, serial number and registration number.

f. State basis of authority, and date delivery is required, immediately below description of machine.

g. Group parts required under group headings as shown in manufacturer's parts catalogs.

h. State manufacturers' parts numbers and nomenclature descriptions accurately and completely. Do not use abbreviations.

i. Double space between items.

j. Emergency requisitions sent by telephone, telegraph, or radio must always be confirmed immediately with requisition marked: "*Confirming* (state identifying data)."

k. Nonexpendable items must be accounted for

58. REPAIR PARTS ILLUSTRATIONS

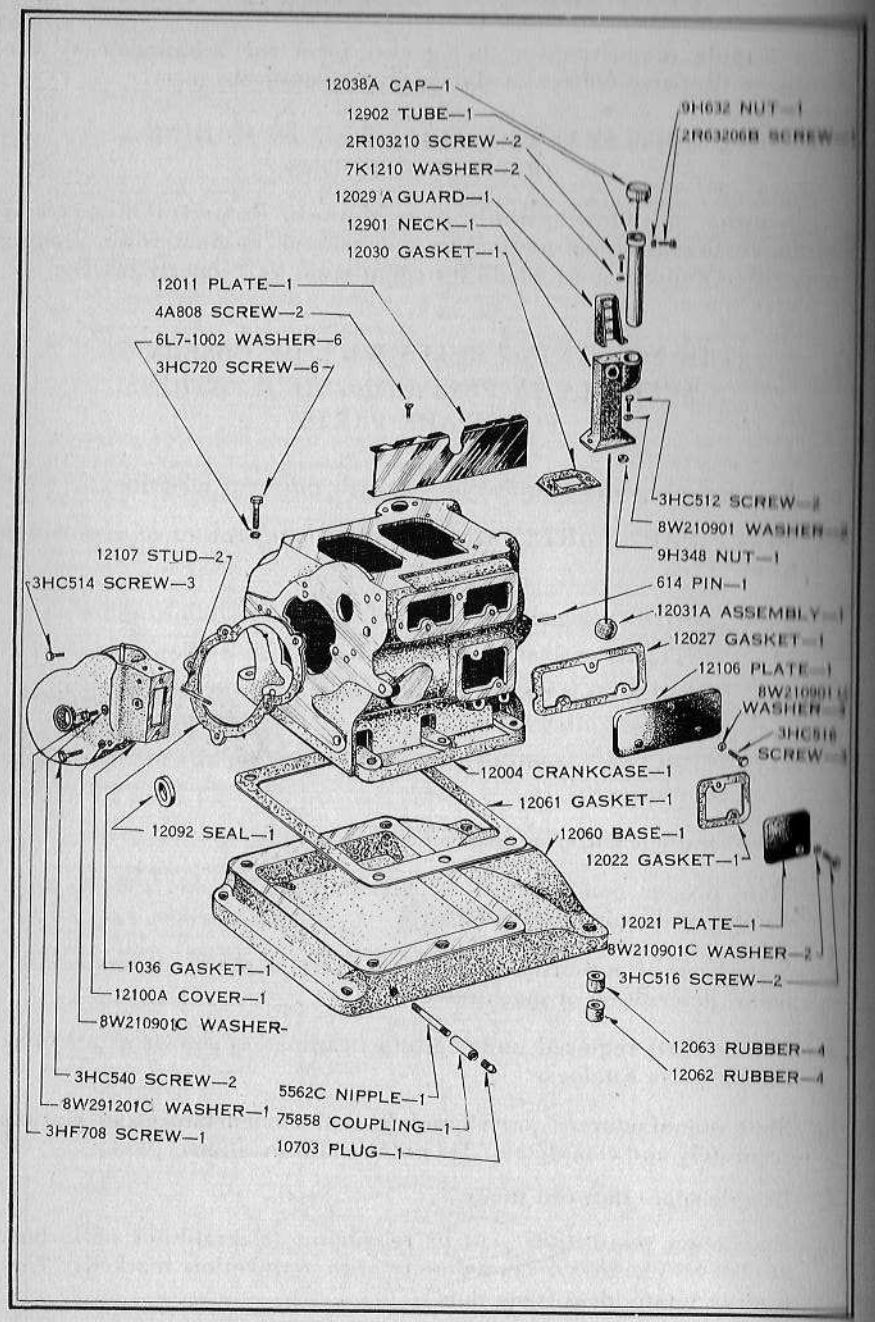

FIG. 61 CRANKCASE, OIL BASE AND GEAR COVER GROUP

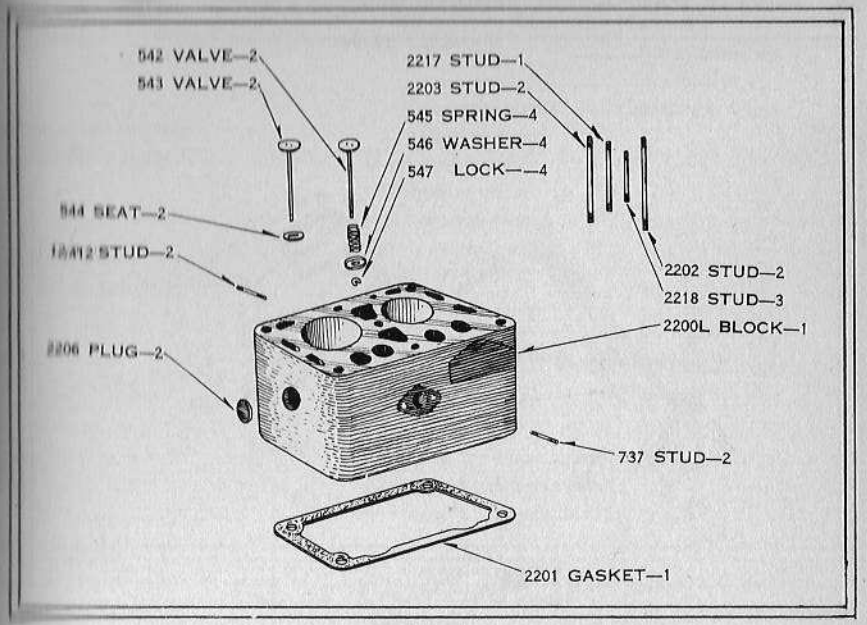

FIG. 62 CYLINDER AND VALVE GROUP

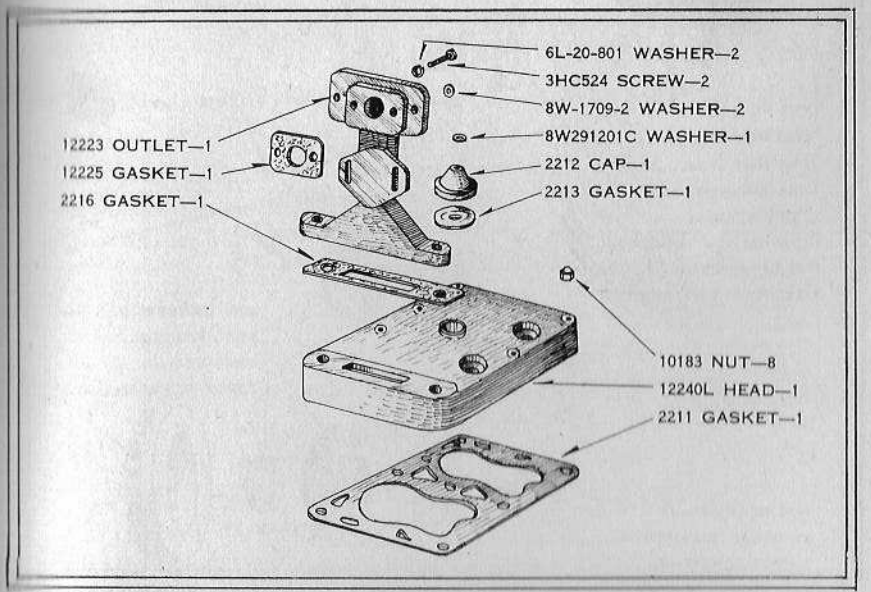

FIG. 63 CYLINDER HEAD GROUP

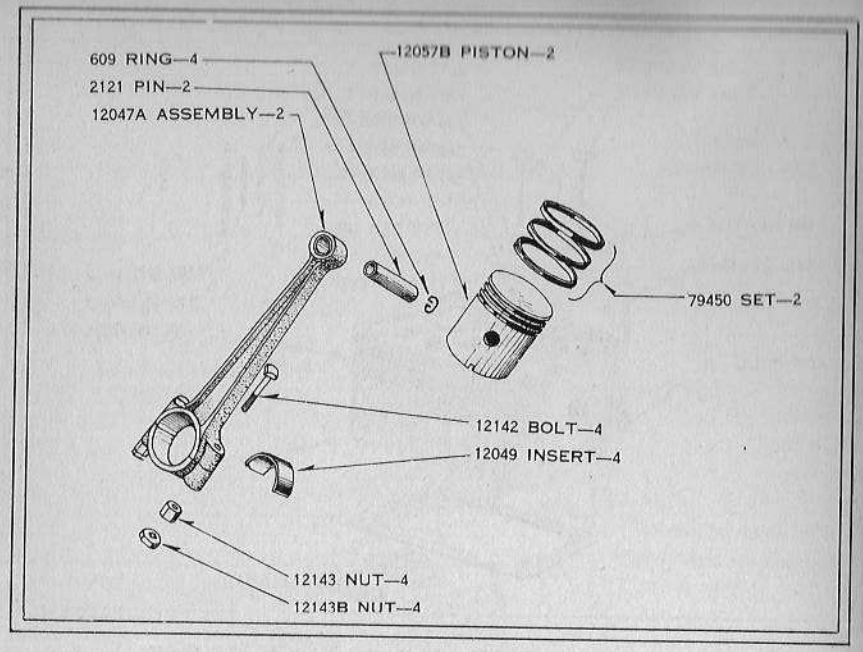

FIG. 64 PISTON AND CONNECTING ROD GROUP

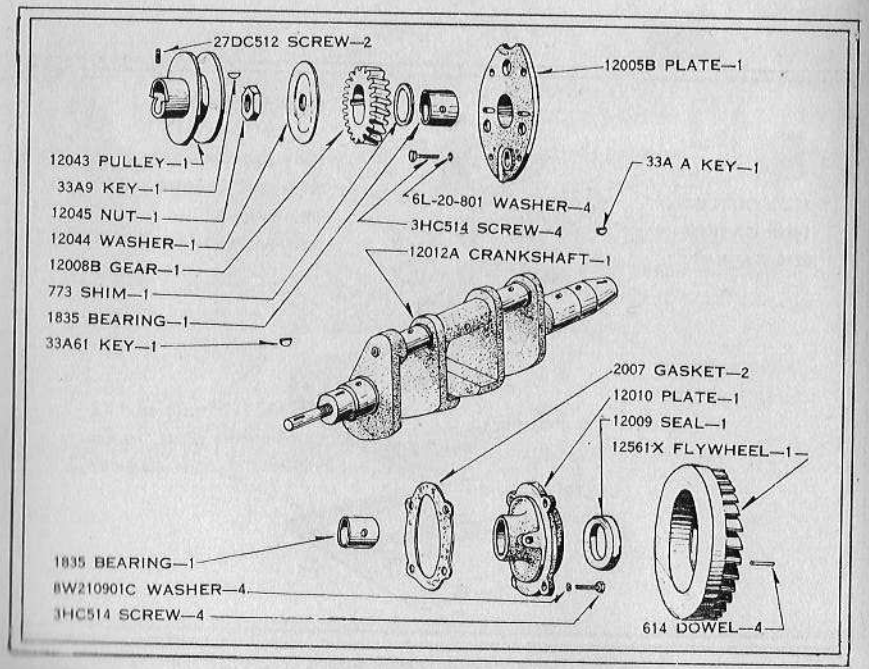

FIG. 65 CRANKSHAFT AND FLYWHEEL GROUP

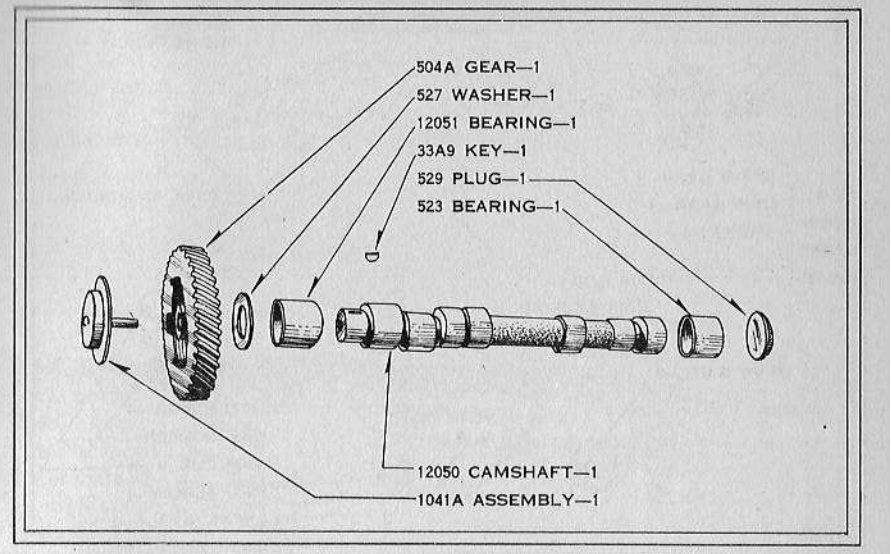

FIG. 66 CAMSHAFT GROUP

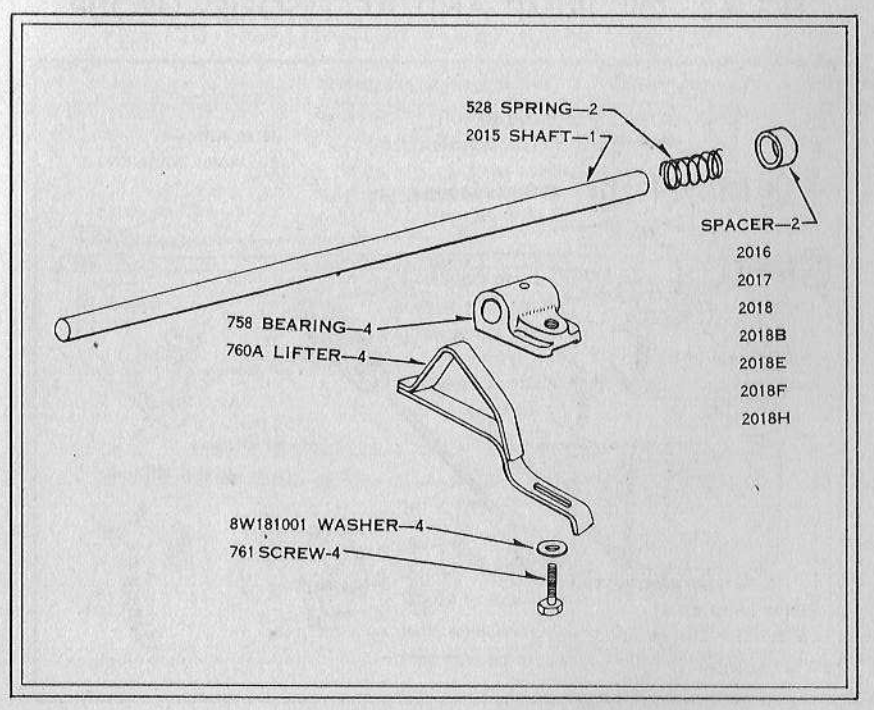

FIG. 67 VALVE LIFTER GROUP

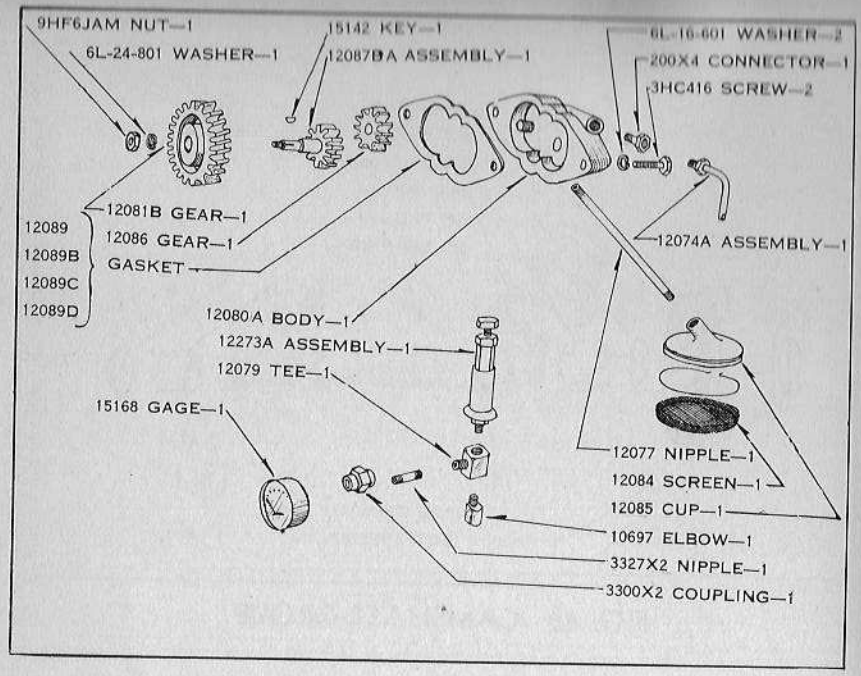

FIG. 68 OIL PUMP AND ACCESSORIES GROUP

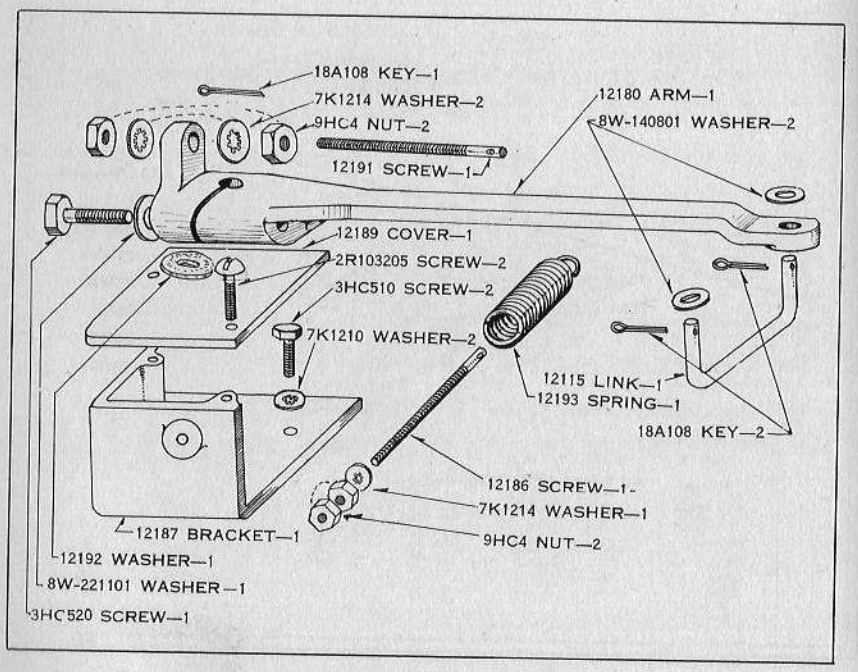

FIG. 69 GOVERNOR GROUP

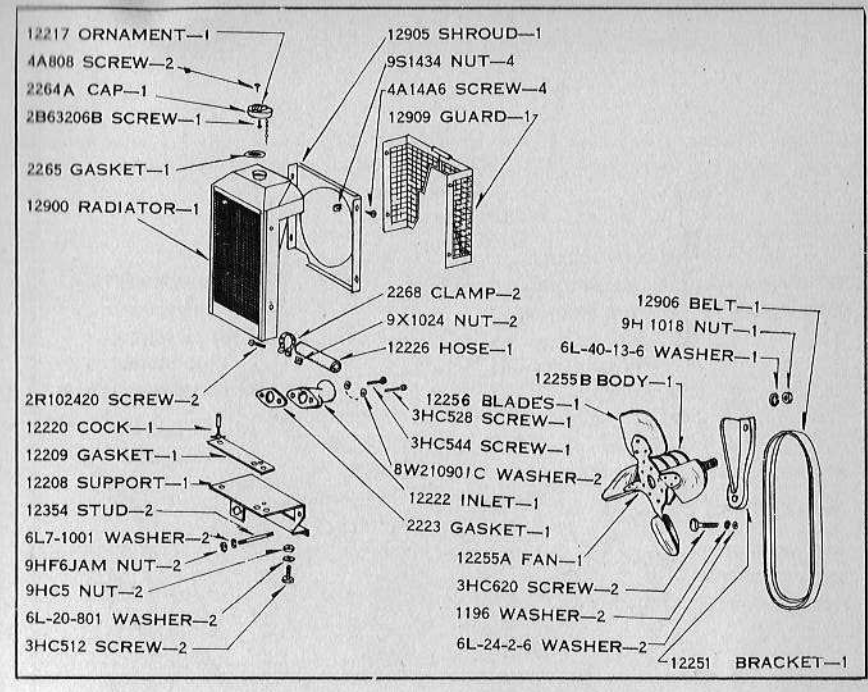

FIG. 70 RADIATOR AND FAN GROUP

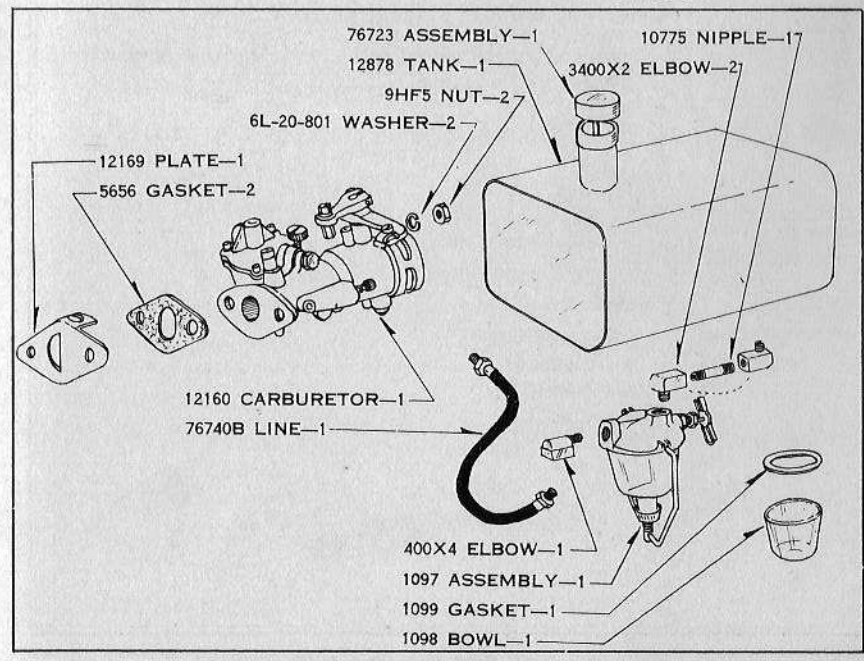

FIG. 71 FUEL SYSTEM GROUP

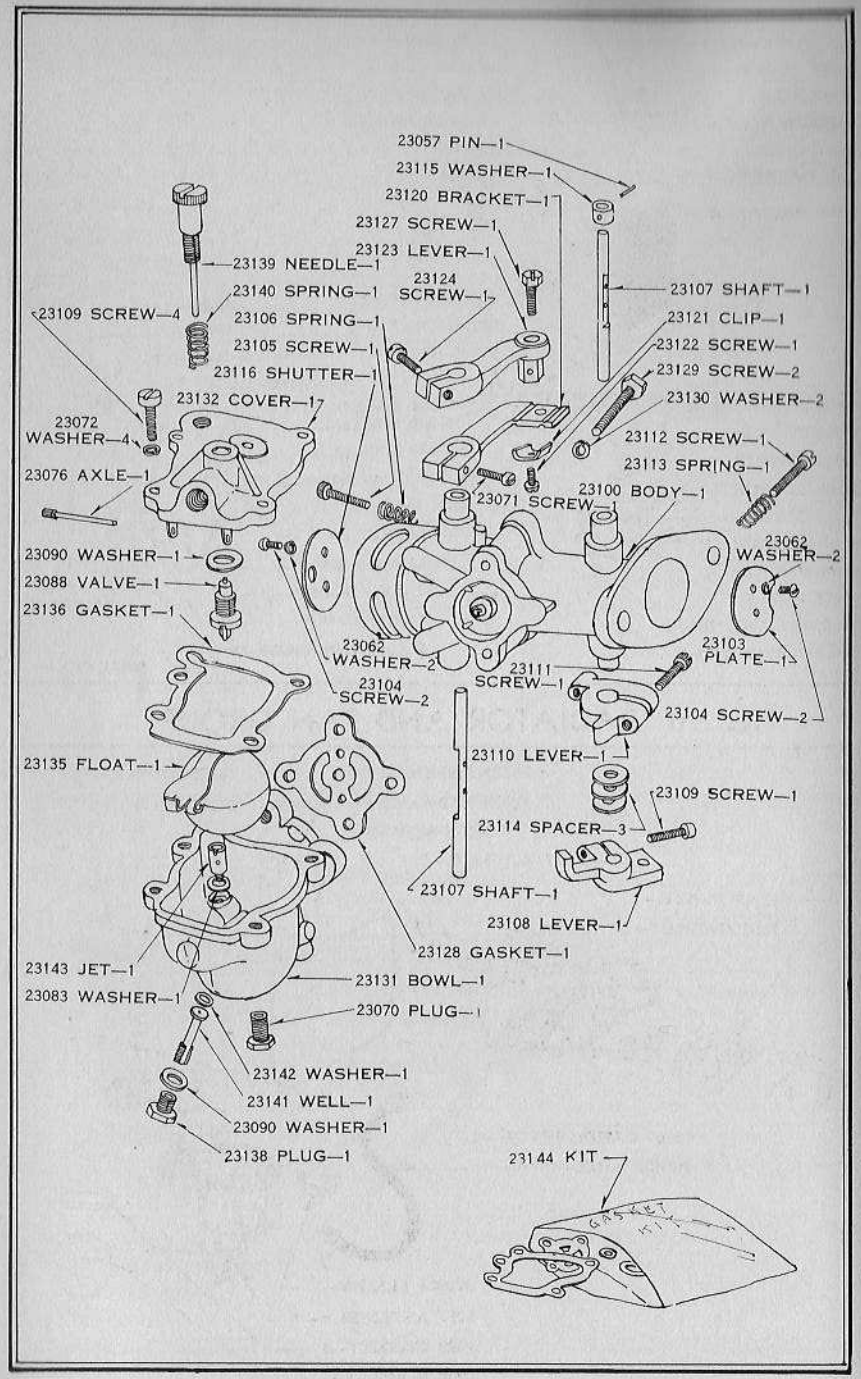

FIG. 72 CARBURETOR PARTS GROUP

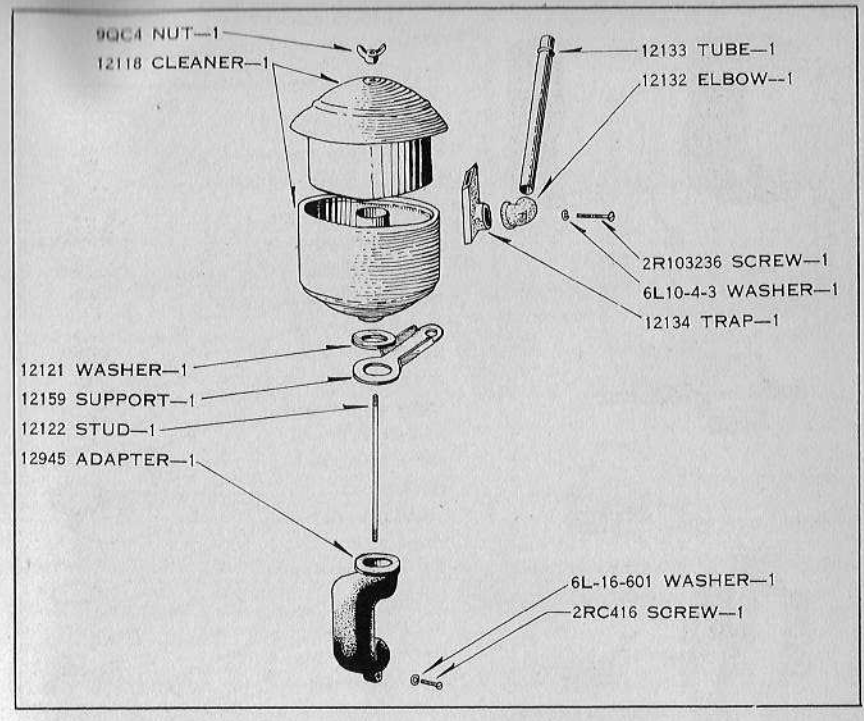

FIG. 73 AIR CLEANER GROUP

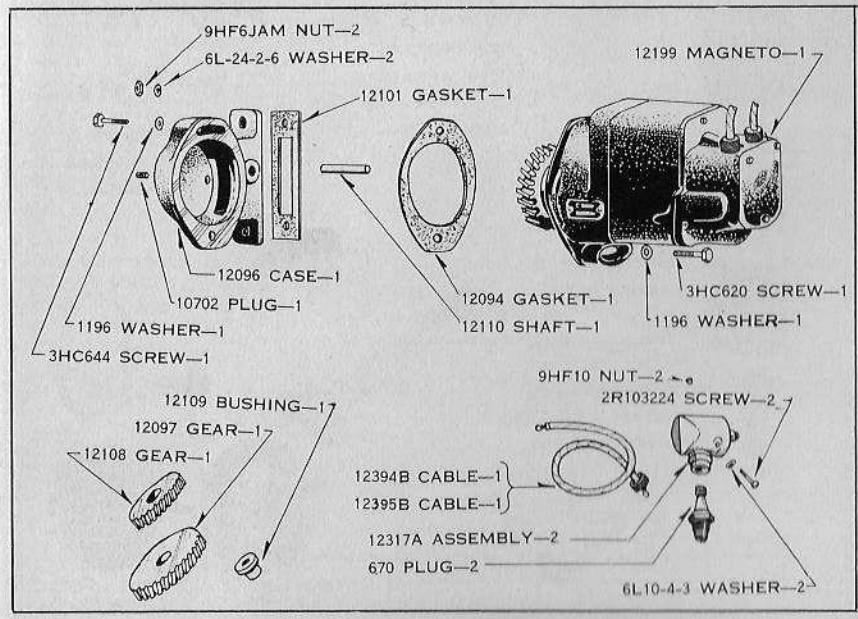

FIG. 74 IGNITION GROUP

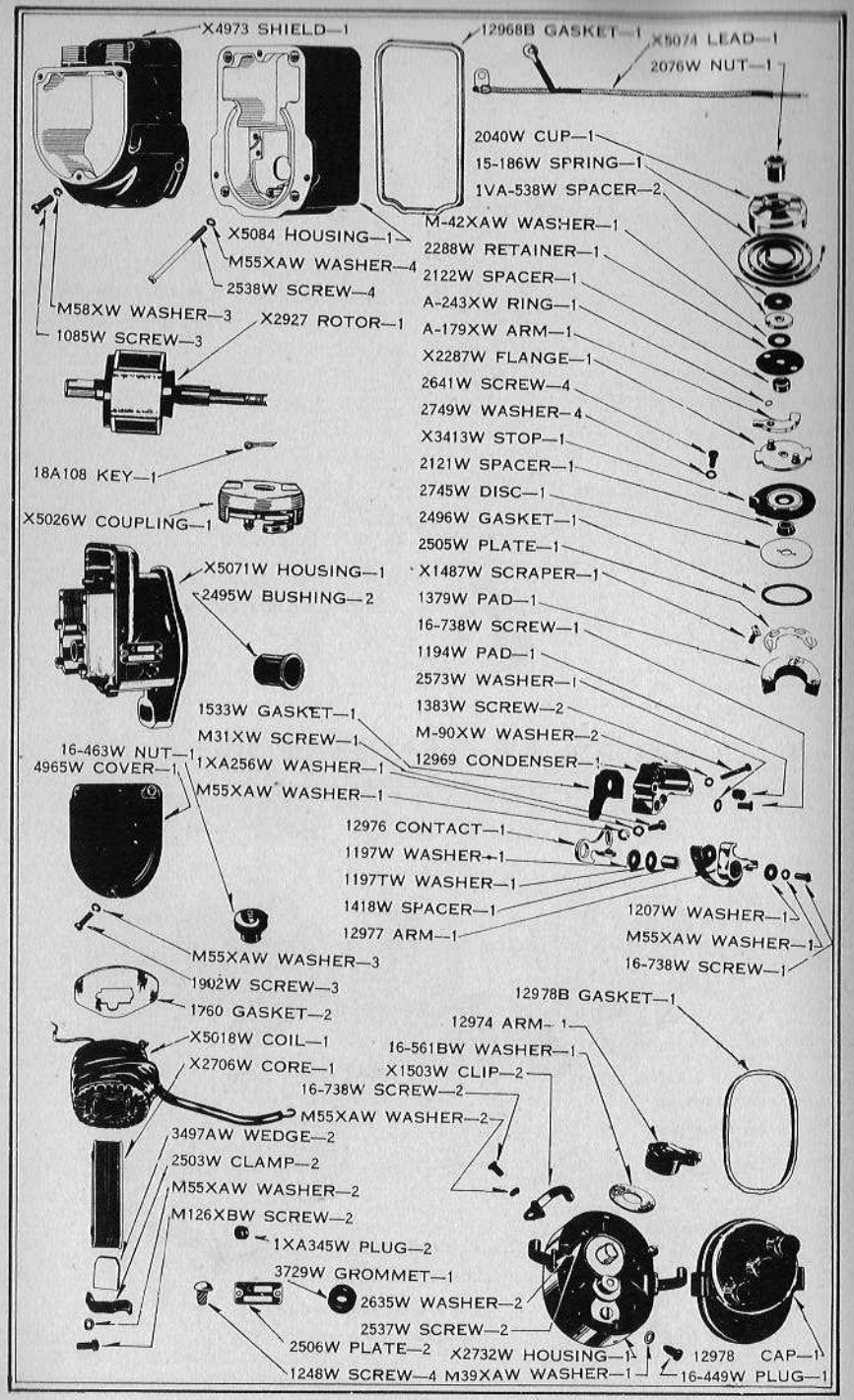

FIG. 75 MAGNETO PARTS GROUP

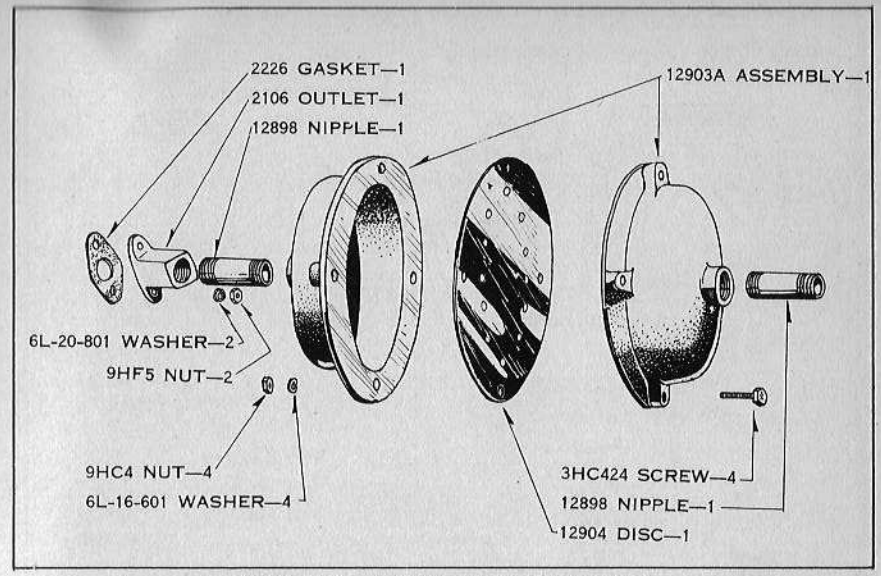

FIG. 76 MUFFLER GROUP

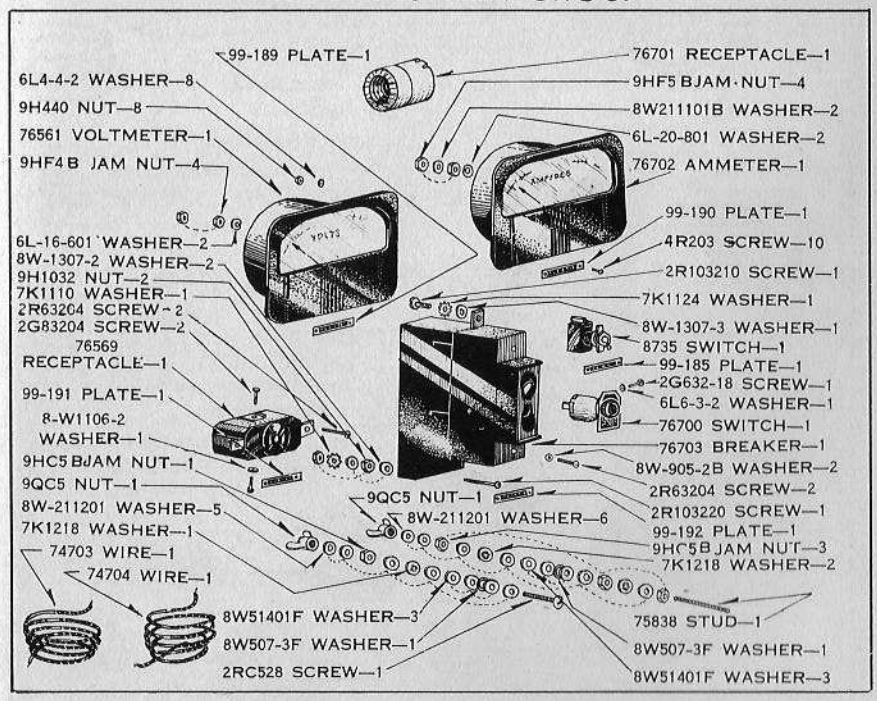

FIG. 77 CONTROL PANEL EQUIPMENT GROUP

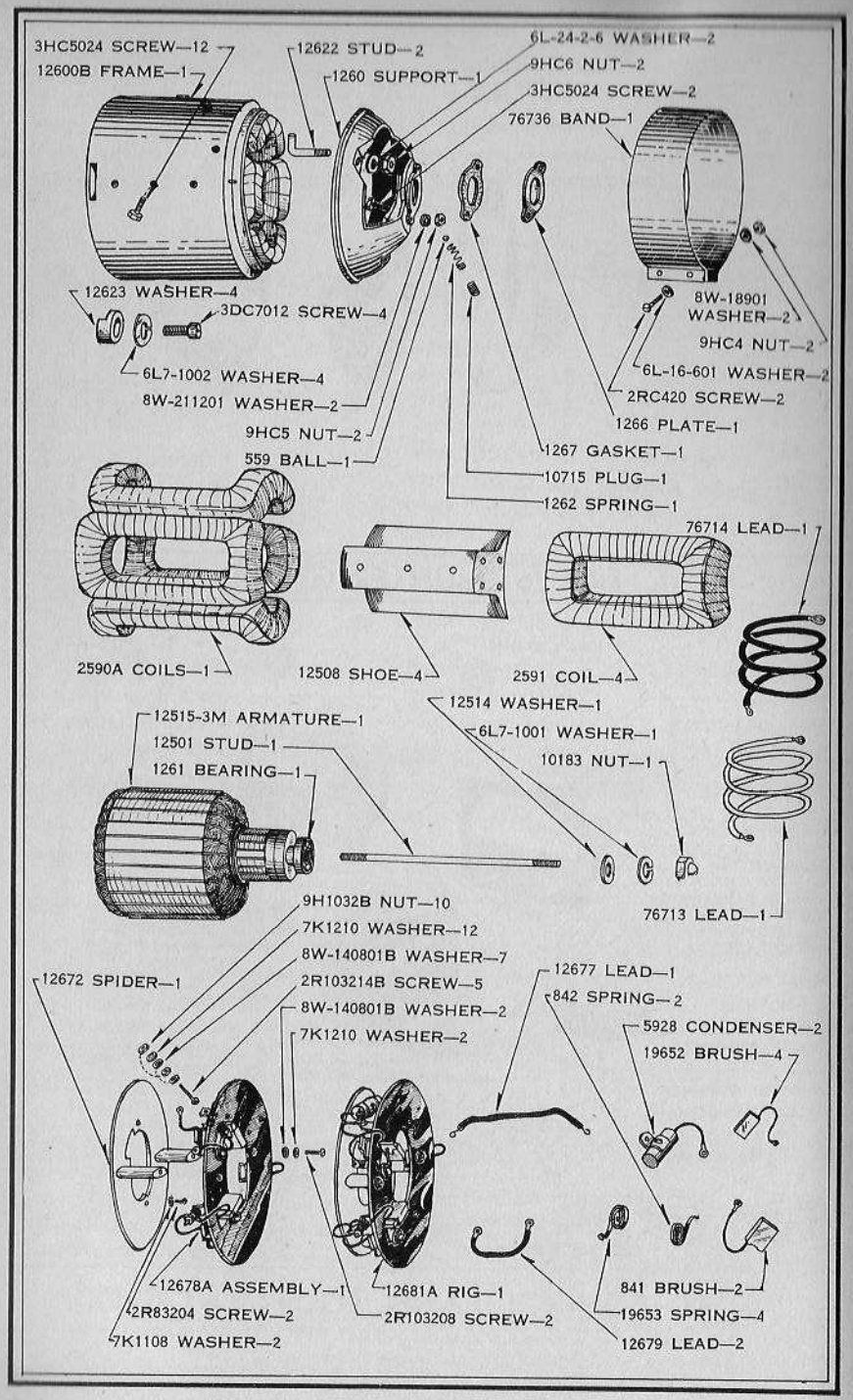

FIG. 78 GENERATOR GROUP

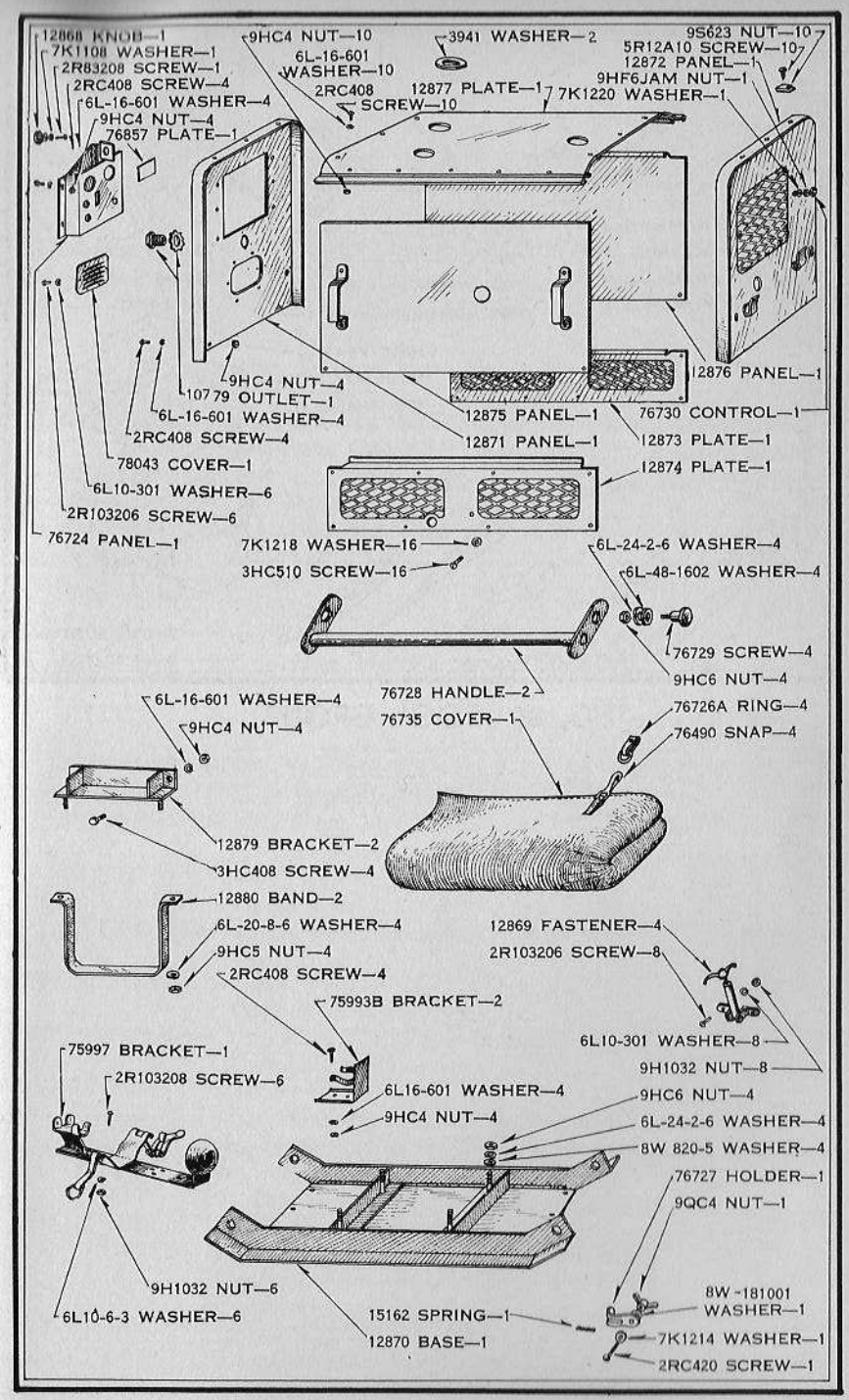

FIG. 79 HOUSING GROUP

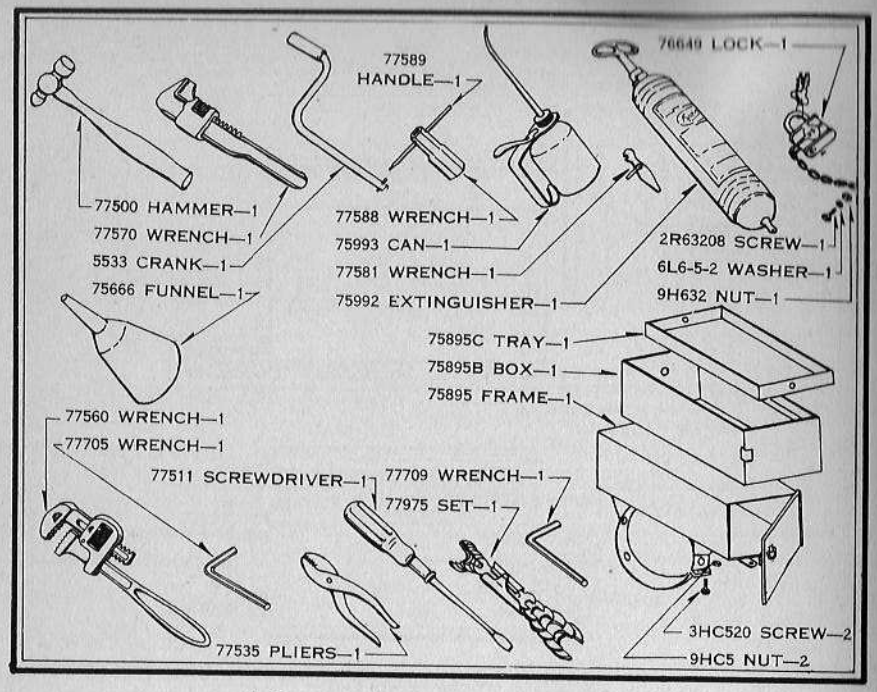

FIG. 80 TOOL GROUP

59. REPAIR PARTS, GROUP LISTING

Contractor's Part Number	Description	Quantity Per Group
	CRANKCASE, OIL BASE AND GEAR COVER GROUP	
	(Figure 61)	
2B63206B	Screw, Binding Hd.—No. 6-32 x 3/8"—Brass—Oil Cap Chain	1
2R103210	Screw, Rd. Hd. Mach.—No. 10-32 x 5/8"—Steel—Oil Gage Guard	2
3HC512	Screw Hex. Hd. Cap—5/16"-18 x 3/4"—Steel—Oil Fill Neck	2
3HC514	Screw, Hex. Hd. Cap—5/16"-18 x 7/8"—Steel—Gear Case Cover	3
3HC516	Screw, Hex. Hd. Cap—5/16"-18 x 1"—Steel—Crankcase Inspection Plate (2), Valve Inspection Plate (3)	5
3HC540	Screw, Hex. Hd. Cap — 5/16"-18 x 2 1/4" — Steel—Gear Case Cover	2
3HC720	Screw, Hex. Hd. Cap—7/16"-14 x 1 1/4"—Steel—Oil Base	6
3HF708	Screw, Hex. Hd. Cap—7/16"-20 x 1/2"—Steel—Gear Case Inspection Hole	1
4A808	Screw, Sheet Metal—No. 8 x 1/2"—Flathead Type Z—Steel—Oil Baffle Plate	2
6L7-1002	Washer, Spring Lock—7/16" (5/32" x 1/8")—Steel—Oil Base	6
7K1210	Washer, Int. Shakeproof Lock—Steel—Oil Gage Guard	2
8W-210901C	Washer, Plain—21/64" I.D. x 9/16" O.D. x 1/16"—Copper—Oil Fill Neck (2), Crankcase Inspection Plate (2), Valve Inspection Plate (3), Gear Case Cover (5)	12
8W-291201C	Washer, Plain—7/16" I.D. x 3/4" O.D. x 1/16"—Copper—Gear Case Cover Inspection Hole	1
9H348	Nut, Hex.—No. 3-48—Steel—Oil Gage Rod	1
9H632	Nut, Hex.—No. 6-32—Steel—Oil Cap Chain	1
614	Pin, Dowel—1/4" x 1"—Crankcase	1
1036	Gasket, Gear Case Cover	1
5562C	Nipple, Iron Pipe—1/2" x 5"—Oil Drain	1
10703	Plug, Iron Pipe—Sq. Hd. 1/2"—Oil Drain	1
12004	Crankcase	1
12011	Plate, Oil Baffle	1
12021	Plate, Crankcase Inspection	1
12022	Gasket, Crankcase Inspection Plate	1
12027	Gasket, Valve Inspection Plate	1

Contractor's Part Number	Description	Quantity Per Group
12029A	Guard, Oil Rod, Assembly	1
12030	Gasket, Oil Filler Neck	1
12031A	Assembly, Oil Level Float	1
12038A	Cap, Oil Filler Tube	1
12060	Base, Oil	1
12061	Gasket, Oil Base	1
12062	Cushion, Plant Mounting Rubber (Lower)—1/2" I.D. x 1 1/2" O.D. x 7/8"	4
12063	Cushion, Plant Mounting Rubber (Upper)—1/2" I.D. x 1 1/2" O.D. x 1"	4
12092	Seal, Gear Case Oil	1
12100A	Cover, Gear Case	1
12106	Plate, Valve Inspection	1
12107	Stud, Magneto Drive Gear Case Mounting—3/8" x 2"-1" US Thread One End, 1/2" SAE Thread Other End	2
12901	Neck, Oil Filler	1
12902	Tube, Oil Filler Neck	1
75858	Coupling, Iron Pipe—1/2" I.P.S.—Oil Drain	1

CYLINDER AND VALVE GROUP
(Figure 62)

542	Valve, Intake	2
543	Valve, Exhaust	2
544	Seat, Exhaust Valve	2
545	Spring, Valve	4
546	Washer, Valve Spring	4
547	Lock, Valve Spring	4
737	Stud, Carburetor Mounting—5/16" x 1 1/8"	2
2200L	Block, Cylinder	1
2201	Gasket, Cylinder Base	1
2202	Stud, Cylinder Block—7/16" x 7 7/8"	2
2203	Stud, Cylinder Block—7/16" x 7 1/8"	2
2206	Plug, Welch—1 1/4" O.D.—Cylinder Block	2
2217	Stud, Cylinder Head, Center—7/16" x 3 13/16"	1
2218	Stud, Cylinder Head—7/16" x 2 1/16"	3
12412	Stud, Exhaust Flange—5/16" x 1 1/4"	2

CYLINDER HEAD GROUP
(Figure 63)

3HC524	Screw, Hex. Hd. Cap—5/16"-18 x 1 1/2" — Steel—Radiator Inlet	2
6L-20-801	Washer, Spring Lock—5/16" (1/8" x 1/16")—Steel—Radiator to Inlet	2
8W-1709-2	Washer, Plain—17/64" I.D. x 9/16" O.D. x 1/32"—Steel—Water Outlet to Cylinder Head Stud	2
8W-291201C	Washer, Plain—7/16" I.D. x 3/4" O.D. x 1/16"—Copper—Cylinder Head Cap	1
2211	Gasket, Cylinder Head	1
2212	Cap, Cylinder Head	1
2213	Gasket, Cylinder Hd. Cap	1

Contractor's Part Number	Description	Quantity Per Group
2216	Gasket, Water Outlet—Lower	1
10183	Nut, Hex. Cap—7/16"-20—NP—Steel	8
12223	Outlet, Water	1
12225	Gasket, Water Outlet	1
12240L	Head, Cylinder	1

PISTON AND CONNECTING ROD GROUP
(Figure 64)

609	Ring, Piston Pin Lock	4
2121	Pin, Piston—3/4" x 2 7/16"	2
12047A	Assembly, Connecting Rod — (Includes Bushing and Bearing Inserts)	2
12049	Insert, Connecting Rod Bearing	4
12057B	Piston, Standard—With Pin	2
12142	Bolt, Connecting Rod—Special	4
12143	Nut, Connecting Rod Bolt—Special	4
12143B	Nut, Connecting Rod Bolt Lock	4
79450	Set, Piston Ring—For one Piston Only	2

CRANKSHAFT AND FLYWHEEL GROUP
(Figure 65)

3HC514	Screw, Hex. Hd. Cap—5/16"-18 x 7/8"—Steel—Rear Bearing Plate (4), Front Bearing Plate (4)	8
6L-20-801	Washer, Spring Lock—5/16" (1/8" x 1/16") — Steel—Front Bearing Plate	4
8W-210901C	Washer, Plain—21/64" I.D. x 9/16" O.D. x 1/16"—Copper—Rear Bearing Plate	4
27DC512	Screw, Socket Hd. Set—5/16"-18 x 3/4"—Steel—Pulley	2
33AA	Key, Woodruff No. 0—Steel—Flywheel	1
33A9	Key, Woodruff No. 9—Steel—Pulley	1
33A61	Key, Woodruff No. 61—Steel—Crank Gear	1
614	Pin, Dowel—1/4" x 1"—Flywheel	4
773	Shim, Crank Gear—.022" x 1 1/2" I.D. x 2" O.D.	1
1835	Bearing, Crankshaft — Front Bearing Plate (1), Rear Bearing Plate (1)	2
2007	Gasket, Rear Bearing Plate	2
12005B	Plate, Front Bearing	1
12008B	Gear, Crankshaft—Steel	1
12009	Seal, Crankshaft Oil, Rear	1
12010	Plate, Rear Bearing	1
12012A	Crankshaft	1
12043	Pulley, Fan Drive (Includes Crank Dog)	1
12044	Washer, Crankshaft Gear—Special	1
12045	Nut, Hex.—7/8"-14 x 1 1/2" x 1 1/32"—Steel—Crankshaft	1
12561X	Flywheel	1

CAMSHAFT GROUP
(Figure 66)

33A9	Key, Woodruff No. 9—Steel—Camshaft Gear	1

Contractor's Part Number	Description	Quantity Per Group
504A	Assembly, Camshaft Gear	1
523	Bearing, Camshaft Rear	1
527	Washer, Camshaft Gear Spacer—1 1/16" I.D. x 2 5/16" O.D. x 1/16"—Steel	1
529	Plug, Welch—2"—Camshaft Hole Thru Crankcase	1
1041A	Assembly, Governor Cup	1
12050	Camshaft	1
12051	Bearing, Camshaft Front	1

VALVE LIFTER GROUP
(Figure 67)

528	Spring, Valve Lifter Spacer	2
758	Bearing, Valve Lifter	4
760A	Lifter, Valve	4
761	Screw, Hex. Hd. Cap — 1/4"-28 x 3/4" — Steel—Valve Lifter	4
2015	Shaft, Valve Lifter—1/2" x 10 3/16"	1
2016	Spacer, Valve Lifter—1/2"—Steel—to be used as needed	As required
2017	Spacer, Valve Lifter—9/16"—Steel—to be used as needed	As required
2018	Spacer, Valve Lifter—1/16"—Steel	2
2018B	Spacer, Valve Lifter—3/8"—Steel—to be used as needed	As required
2018E	Spacer, Valve Lifter—3/32"—Steel—to be used as needed	As required
2018F	Spacer, Valve Lifter—1/8"—Steel—to be used as needed	As required
2018H	Spacer, Valve Lifter—1/4"—Steel—to be used as needed	As required
8W-181001	Washer, Plain—1/4"-9/32" I.D. x 5/8" O.D. x 1/16"—Steel—Valve Lifter	4

OIL PUMP AND ACCESSORIES GROUP
(Figure 68)

3HC416	Screw, Hex. Hd. Cap—1/4"-20 x 1"—Steel—Oil Pump	2
6L-16-601	Washer, Spring Lock—1/4"-3/32" x 1/16"—Steel—Oil Pump	2
6L-24-801	Washer, Spring Lock—3/8" (1/8" x 1/16")—Steel—Oil Pump Drive Gear	1
9HF6JAM	Nut, Hex.—3/8"-24—Steel—Oil Pump Drive Gear	1
200X4	Connector, Inverted Male—Steel—Oil Pump	1
3300X2	Coupling, Pipe—Oil Gauge	1
3327X2	Nipple, Pipe—1/8" x 1 1/2"—Iron—Oil Gauge	1
10697	Elbow, Inverted—No. 400X4—Oil Gauge to Oil Pump	1
12074A	Assembly, Oil Pump Outlet Tube	1
12077	Nipple, Iron Pipe—1/8" x 5 1/8"—Oil Intake Pipe	1
12079	Tee, Oil Line—No. 3600X2	1

Contractor's Part Number	Description	Quantity Per Group
12080A	Body, Oil Pump, Assembly	1
12081B	Gear, Oil Pump Drive	1
12084	Screen, Oil Pump Intake	1
12085	Cup, Oil Pump Intake	1
12086	Gear, Oil Pump Driven	1
12087BA	Assembly, Oil Pump Driver Gear and Shaft	1
12089	Gasket, Oil Pump Body—.012" Thick	As required
12089B	Gasket, Oil Pump Body—.002" Thick	1
12089C	Gasket, Oil Pump Body—.004" Thick	As required
12089D	Gasket, Oil Pump Body—.006" Thick	1
12273A	Assembly, Oil By-pass Valve	1
15142	Key, Woodruff No. 2—Oil Pump Drive Gear	1
15168	Gage, Oil Pressure—0-100 lbs	1
	Wire, Stove Pipe—10"—Holds Oil Pump Intake Screen	1

GOVERNOR GROUP
(Figure 69)

2R103205	Screw, Rd. Hd. Mach.—No. 10-32 x 5/16"—Steel—Adjusting Screw Bracket	2
3HC510	Screw, Hex. Hd. Cap—5/16"-18 x 5/8"—Gov. Adjusting Screw Bracket	2
3HC520	Screw, Hex. Hd. Cap—5/16"-18 x 1 1/4"—Steel—Gov. Arm	1
7K1210	Washer, Int. Shakeproof Lock—Steel—Gov. Adj. Screw Bracket	2
7K1214	Washer, Int. Shakeproof Lock—Steel—Sensitivity Adj. Screw—Gov. Spring Adj. Screw	3
8W-140801	Washer, Plain—3/16" I.D. x 1/2" O.D. x 1/16"—Steel—Gov. Arm to Carburetor	2
8W-221101	Washer, Plain—5/16" SAE x 11/32" I.D. x 11/16" O.D. x 1/16"—Steel—Governor Arm	1
9HC4	Nut, Hex.—1/4"-20—Steel—Gov. Spring Screws	4
18A108	Key, Cotter—1/16" x 1/2"—Steel — Gov. Link (2), Gov. Shaft (1)	3
3HC510	Screw, Hex. Hd. Cap—5/16"-18 x 5/8"—Steel—Gov. Adj. Screw Bracket	2
12115	Link, Governor Arm to Carburetor	1
12180	Arm, Governor	1
12186	Screw, Governor Spring Adjusting—1/4" x 2 1/4"—Special	1
12187	Bracket, Governor Adjusting Screw	1
12189	Cover, Governor Spring	1
12191	Screw, Sensitivity Adj.—1/4" x 2 3/4"	1
12192	Washer, Felt—5/16" I.D. x 3/4" O.D. x 3/32"—Gov. Shaft	1
12193	Spring, Governor	1

RADIATOR AND FAN GROUP
(Figure 70)

2B63206B	Screw, Binding Hd. — No. 6-32 x 3/8" — Brass—Radiator Cap Chain	1

Contractor's Part Number	Description	Quantity Per Group
2R102420	Screw, Rd. Hd. Mach.—No. 10-24 x 1¼"—Steel—Radiator Hose Clamp	2
3HC512	Screw, Hex. Hd. Cap — 5/16"-18 x ¾" — Steel—Radiator to Support	2
3HC528	Screw, Hex. Hd. Cap — 5/16"-18 x 1¾"—Steel—Water Inlet Casting to Cyl. Block	1
3HC544	Screw, Hex. Hd. Cap — 5/16"-18 x 2¾"—Steel—Water Inlet Casting to Cyl. Block	1
3HC620	Screw, Hex. Hd. Cap—⅜"-24 x 1¼"—Steel—Fan Support	2
4A14A6	Screw, Sheet Metal—No. 14A x ¾"—Steel—Fan Guard	4
4A808	Screw, Sheet Metal—No. 8 x ½"—Flathead Type Z—Steel—Radiator Cap Ornament	2
6L7-1001	Washer, Spring Lock—7/16" (5/32" x 1/16")—Steel—Radiator Support to Engine	2
6L-20-801	Washer, Spring Lock — 5/16" (⅛" x 1/16")—Steel—Radiator to Support	2
6L-24-8-6	Washer, Spring Lock — ⅜" (⅛" x 3/32")—Steel—Fan Support	2
6L-40-13-6	Washer, Spring Lock—⅝" (13/64" x 3/32")—Steel Fan Shaft	1
8W-210901C	Washer, Plain—21/64" I.D. x 9/16" O.D. x 1/16"—Copper—Water Inlet to Cyl. Block	2
9HC5	Nut, Hex.—5/16"-18—Steel—Radiator to Support	2
9HF6JAM	Nut, Hex.—⅜"-24—Steel—Radiator Support Stud	2
9H1018	Nut, Hex.—⅝"-18—Steel—Fan Shaft	1
9S1434	Nut, Speed — No. 1434—.034 — Sp. Steel—Fan Guard	4
9X1024	Nut, Square — 3/16"-24 — Steel — Radiator Hose Clamp	2
1196	Washer, Plain — 25/64" I.D. x ⅞" O.D. x ⅛"—Steel—Fan Bracket	2
2223	Gasket, Water Inlet	1
2264A	Cap, Radiator—with Gasket and Chain	1
2265	Gasket, Radiator Cap	1
2268	Clamp, Hose—2"	2
12208	Support, Radiator	1
12209	Gasket, Radiator Base—Cork	1
12217	Ornament, Radiator Cap	1
12220	Cock, Radiator Drain	1
12222	Inlet, Water	1
12226	Rose, Radiator—1⅝" x 5⅛"	1
12251	Bracket, Fan	1
12255A	Fan—Includes Shaft, Hub and Blades	1
12255B	Body, Fan—Includes Hub and Shaft	1
12256	Blades, Fan	1
12354	Stud, Radiator Support—7/16" x 3 9/16"	2
12900	Radiator	1

Contractor's Part Number	Description	Quantity Per Group
12905	Shroud, Fan	1
12906	Belt, Fan	1
12909	Guard, Fan—2 Pieces	1

FUEL SYSTEM GROUP

(Figure 71)

6L20-801	Washer, Spring Lock — 5/16" (⅛" x 1/16")—Steel—Carburetor Mounting	2
9HF5	Nut, Hex.—5/16"-24—Steel—Carburetor Mounting	2
400X4	Elbow, Inverted Male—Weatherhead—Fuel Filter	1
1097	Assembly, Fuel Filter	1
1098	Bowl, Filter—Glass	1
1099	Gasket, Filter Bowl	1
3400X2	Elbow, Street—⅛"	2
5656	Gasket, Carburetor Flange	2
10775	Nipple, Pipe—⅛" x 2¾"—Brass	1
12160	Carburetor	1
12169	Plate, Distribution	1
12878	Tank, Fuel	1
76723	Assembly, Fuel Tank Gap and Gage	1
76740B	Line, Fuel—Flexible 7"	1

CARBURETOR PARTS GROUP

(Figure 72)

23057	Pin, Taper—Thrust Washer	1
23062	Washer, Lock — ⅛" (1/32" x 1/32")—Throttle Plate Screw (2), Shutter Retaining (2)	4
23070	Plug, Bowl Drain	1
23071	Screw, Fill. Hd. Cap — No. 10-32 x ⅝"—Steel—Bracket Clamp Plated	1
23072	Washer, Lock—3/16" (1/16" x 3/64")—Steel—Assy. Screw	4
23076	Axle, Float	1
23083	Washer, Fiber—5/32" I.D. x 17/64" O.D. x 1/32"—Main Jet	1
23088	Valve, Fuel—Assembly—No. 35	1
23090	Washer, Fiber — ⅜" I.D. x 9/16" O.D. x .038" — Lower Plug (1), Fuel Valve Seat (1)	2
23100	Body, Throttle—Assembly—No. 16 Venturi	1
23103	Plate, Throttle	1
23104	Screw, Rd. Hd. Mach.—No. 5-40 x 3/16"—Brass—Throttle Plate (2), Shutter Retaining (2)	4
23105	Screw, Idle Adjusting	1
23106	Spring, Adjusting Screw	1
23107	Shaft, Throttle or Air Shutter	2
23108	Lever, Throttle Clamp	1
23109	Screw, Fill. Hd. Cap — No. 10-32 x ½" — Bowl Cover Assy. (4), Throttle Lever Clamp (1)	5
23110	Lever, Throttle Stop	1
23111	Screw, Stop Lever Clamp—Special	1

Contractor's Part Number	Description	Quantity Per Group
23112	Screw, Fill. Hd. Cap — No. 10-32 x 7/8"—Steel—Plated—Throttle Stop	1
23113	Spring, Stop Screw	1
23114	Screw, Throttle Lever	3
23115	Washer, Special—Throttle Shaft	1
23116	Shutter, Air	1
23120	Bracket, Air Shutter	1
23121	Clip, Bracket	1
23122	Screw, Fill. Hd. Cap — No. 8-36 x 1/2"—Steel—Plated—Bracket Tube Clamp	1
23123	Lever, Air Shutter—Assembly—Includes Swivel	1
23124	Screw, Fill. Hd. Cap—No. 8-36 x 1/2"—Air Shutter Lever Clamp	1
23127	Screw, Swivel—Special	1
23128	Gasket, Throttle Body to Bowl	1
23129	Screw, Hex. Hd. Cap — 1/4"-28 x 1 1/4"—Steel—Body to Bowl	2
23130	Washer, Lock—1/4" (9/32" x 3/32")—Steel—Body to Bowl	2
23131	Bowl, Fuel	1
23132	Cover, Fuel Bowl	1
23135	Float	1
23136	Gasket, Bowl Cover	1
23138	Plug, Lower—Metering Well Passage	1
23139	Needle, Main Jet Adjusting	1
23140	Spring, Main Jet Adj. Needle	1
23141	Well, Metering—No. 40	1
23142	Washer, Fiber—13/64" I.D. x 5/16" O.D. x .038"—Metering Well	1
23143	Jet, Main—No. 21	1
23144	Kit, Gasket	1

AIR CLEANER GROUP
(Figure 73)

2R103236	Screw, Rd. Hd. Mach.—No. 10-32 x 2 1/4"—Steel—Vapor Trap Elbow	1
2RC416	Screw, Rd. Hd. Mach.—1/4"-20 x 1"—Steel—Air Cleaner Adapter	1
6L10-4-3	Washer, Spring Lock — No. 10 (1/16" x 3/64")—Steel—Vapor Trap Elbow	1
6L-16-601	Washer, Spring Lock — 1/4" (9/32" x 1/16")—Steel—Air Cleaner Adapter	1
9QC4	Nut, Wing—1/4"-20—Steel—Air Cleaner	1
12118	Cleaner, Air	1
12121	Gasket, Air Cleaner—Cork	1
12122	Stud, Air Cleaner—1/4" x 6 1/4"-3/8" U.S.S. Thread One End, 7/8" U.S.S. Other End	1
12132	Elbow, Vapor Trap Adapter	1
12133	Tube, Breather	1
12134	Trap, Vapor	1

Contractor's Part Number	Description	Quantity Per Group
12159	Support, Air Cleaner	1
12945	Adapter, Air Cleaner	1

IGNITION GROUP
(Figure 74)

2R103224	Screw, Rd. Hd. Mach.—No. 10-32 x 1 1/2"—Steel—Spark Plug Shields	2
3HC620	Screw, Hex. Hd. Cap — 3/8"-16 x 1 1/4"—Steel—Magneto Mtg.	1
3HC644	Screw, Hex. Hd. Cap—3/8"-16 x 3"—Steel—Magneto Mtg.	1
6L10-4-3	Washer, Spring Lock — No. 10 (1/16" x 3/64")—Steel—Spark Plug Shield	2
6L-24-8-6	Washer, Spring Lock — 3/8" (1/8" x 3/32")—Steel—Magneto Mtg.	2
9HF6-JAM	Nut, Hex.—3/8"—24—Steel—Magneto Drive Gear Case	2
9HF10	Nut, Hex.—No. 10-32—Spark Plug Shield	2
670	Plug, Spark—6M Champion	2
1196	Washer, Plain — 25/64" I.D. x 7/8" O.D. x 1/8"—Steel—Magneto Mtg.	2
10702	Plug, Iron Pipe—Sq. Hd.—3/8"—Magneto Drive Gear Case	1
12094	Gasket, Magneto Flange	1
12096	Case, Magneto Drive Gear	1
12097	Gear, Magneto Drive	1
12101	Gasket, Magneto Drive Gear Case	1 or more
12108	Gear, Magneto Drive Idler	1
12108A	Gear, Magneto Drive Idler and Bushing, Assembly—Consists of Parts 12108 and 12109	1
12109	Bushing, Magneto Drive Idler Gear	1
12110	Shaft, Magneto Idler Gear	1
12199	Magneto, Includes Gear and Cables	1
12317A	Assembly Spark Plug Shield	2
12394B	Cable, High Tension—Shielded—17" Long—Includes Shield Coupling Nut	1
12395B	Cable, High Tension—Shielded—15" Long—Includes Shield Coupling Nut	1

MAGNETO PARTS GROUP
(Figure 75)

16-449W	Plug, Oil	1
16-463W	Nut, Distributor Cap Terminal	3
16-561BW	Washer, Distributor Arm Dust	1
16-738W	Screw, Breaker Arm Spring (1), Breaker Arm Clamp (1), Distributor Clip (2)	4
18A-108	Key, Cotter—1/16" x 1/2"—Steel	1
M-31XW	Screw, Fixed Contact	1
M-39XAW	Washer, Oil Plug	1
M-42XAW	Washer, Driven Flange Spacing	1

Contractor's Part Number	Description	Quantity Per Group
M-55XAW	Washer, Lock—Housing Shield Screw (4), Coil Core Clamp Screw (2), Fixed Contact Screw (1), Breaker Arm Clamp Screw (1), Dist. Cap Shield Cover Screw (3), Dist. Clip Screw (2)	13
M-58XW	Washer, Lock, Distributor Cap Shield Screw	3
M-90XW	Washer, Lock-Condenser Screw	2
M-126XBW	Screw, Coil Core Clamp	2
A-179XW	Arm, Trip	1
IXA-345W	Plug, Oil	2
IVA-583W	Spacer, Drive Cup	2
1085W	Screw, Distributor Cap Shield	3
1194W	Pad, Cam Oil	1
1197W	Washer, Breaker Arm Spacing	1
1197TW	Washer, Breaker Point Spacing	1
1207W	Washer, Breaker Arm Clamp	1
1248W	Screw, Identification Plate	4
1379W	Pad, Main Oil	1
1383W	Screw, Condenser	2
1418W	Spacer, Breaker Arm	1
X1487W	Scraper, Oil Assembly	1
X1503W	Clip, Distributor Cap	2
1533W	Gasket, Condenser Case	1
1760W	Gasket, Coil	2
1902W	Screw, Distributor Cap Shield Cover	3
2040W	Cup, Drive	1
2076W	Nut, Impulse Lock	1
2121W	Spacer, Impulse	1
2122W	Spacer, Driven Flange	1
X2287W	Flange, Driven	1
2288W	Retainer, Drive Spring	1
2495W	Bushing, Rotor Shaft	2
2496W	Gasket, Impulse Stop	1
2497W	Gasket, Distributor Cap	1
2503W	Clamp, Coil Core	2
2505W	Plate, Oil Pad Spring	1
2506W	Plate, Identification	2
2537W	Screw, Gear Housing	2
2538W	Screw, Housing Shield Clamp	4
2573W	Washer, Lock Breaker Arm Service Screw	1
2635W	Washer, Lock Gear Housing Screw	2
2641W	Screw, Impulse Stop	4
X2706W	Core, Coil	1
X2732W	Housing, Gear—Includes Gears	1
2745W	Disc, Oiling	1
2749W	Washer, Lock-Impulse Stop Screw	4
X2927W	Rotor Assembly	1
X3413W	Stop, Impulse	1
3497AW	Wedge, Coil	2
3729W	Grommet, Ground Lead	1
4965W	Cover, Distributor Cap Shield	1

Contractor's Part Number	Description	Quantity Per Group
X4973W	Shield, Distributor Cap	1
X5018W	Coil	1
X5026W	Coupling, Impulse—Assembly	1
X5071W	Housing, Main	1
X5074W	Lead, Ground	1
X5084W	Shield, Housing	1
12968B	Gasket, Cover	1
12969	Condenser	1
12974	Arm, Distributor	1
12976	Contact, Fixed	1
12977	Arm, Breaker Group	1
12978	Cap, Distributor	1
12978B	Gasket Distributor	1
15-186W	Spring Drive	1
A-243XW	Ring, Snap	1
IXA-256W	Washer, Fixed Contact Screw	1

MUFFLER GROUP

(Figure 76)

3HC424	Screw, Hex. Hd. Cap—1/4"-20 x 1 1/2"—Steel—Exhaust Muffler	4
6L-16-601	Washer, Spring Lock — 1/4" (5/32" x 1/16")—Steel—Exhaust Muffler	4
6L-20-801	Washer, Spring Lock — 5/16" (1/8" x 1/16")—Steel—Exhaust Outlet	2
9HC4	Nut, Hex.—1/4"-20—Steel—Exhaust Muffler	4
9HF5	Nut, Hex.—5/16"-24—Steel—Exhaust Outlet Mounting	2
2106	Outlet, Exhaust	1
2226	Gasket, Exhaust Outlet Flange	1
12898	Nipple, Close Pipe—1"—Muffler	2
12903A	Muffler, Exhaust Assembly	1
12904	Disc, Muffler	1

CONTROL PANEL EQUIPMENT GROUP

(Figure 77)

2G632-18	Screw, Binding Hd. Mach.—No. 6-32" x 9/32" Steel—Plated—Stop Button Terminal	1
2G83204	Screw, Binding Hd.—No. 8-32" x 1/4" Brass—Trouble Lamp Receptacle Terminal	2
2R63204	Screw, Rd. Hd. Mach.—No. 6-32 x 1/4" Brass—Receptacle Mtg. (2), Circuit Breaker Mounting (2)	4
2R103220	Screw, Rd. Hd. Mach.—No. 10-32 x 1 1/2"—Lower Terminal of Circuit Breaker	1
2R103210	Screw, Rd. Hd. Mach.—No. 10-32 x 5/8"—Steel—Plated—Upper Terminal of Circuit Breaker	1
2RC528	Screw, Rd. Hd. Mach.—5/16"-18 x 1 3/4"—Brass—A.C. Outlet Terminal	1
4R203	Screw, Sheet Metal—Blunt Point—No. 2-1/16"—Steel—Plated Nameplate	10
6L4-4-2	Washer, Lock—No. 4 (1/16" x 1/32")—Steel—Meter Mounting	8

Contractor's Part Number	Description	Quantity Per Group
6L-16-601	Washer, Lock—1/4" (5/32" x 1/16")—Voltmeter Terminal	2
6L-20-801	Washer, Lock—5/16" (1/8" x 1/16") — Ammeter Terminal	2
6L6-3-2	Washer, Lock—No. 6(3/64" x 1/32")—Stop Button Terminal	1
7K1110	Washer, Ext. Shakeproof No. 10—Lower Terminal of Circuit Breaker Screw	1
7K1124	Washer, Ext. Shakeproof No. 10—Steel—Plated—Circuit Breaker Terminal Screw	1
7K1218	Washer, Int. Shakeproof 5/16" — Steel—Plated—A.C. Outlet Terminal	3
8W507-3F	Washer, Insulating—5/16" I.D. x 7/16" O.D. x 3/64" —Fibre A.C. Outlet Terminal	2
8W-905-2B	Washer, Plain—9/64" I.D. x 5/16" O.D. x 1/32"—Brass—Circuit Breaker Mounting	2
8W51401F	Washer, Insulating—5/16" I.D. x 7/8" O.D. x 1/10"—A.C. Outlet Terminal	6
8W-1106-2	Washer, Plain—11/64" I.D. x 3/8" O.D. x 1/32"—Trouble Lamp Receptacle Terminal	1
8W-1307-2	Washer, Plain—.200 I.D. x 7/16" O.D. x 1/32"—Brass —Lower Terminal of Circuit Breaker	2
8W-1307-3	Washer, Plain—13/64" I.D. x 7/16" O.D. x 3/64"—Brass—Circuit Breaker Terminal Screw	1
8W-211101B	Washer, Plain—21/64" I.D. x 11/16" O.D. x 1/16"—Brass—Ammeter Terminal	2
8W-211201	Washer, Plain—21/64" I.D. x 3/4" O.D. x 1/16"—Brass—Plated A.C. Outlet Terminal	11
9H440	Nut, Hex.—No. 4-40—Brass—Plated—Meter Mounting	8
9H1032	Nut, Hex.—No. 10-32 — Brass — Plated—Lower Terminal of Circuit Breaker	2
9HC5B JAM	Nut, Hex. Jam. — 5/16"-18—Brass—Plated—A.C. Outlet Terminal	4
9HF4B JAM	Nut, Hex. Jam.—1/4"-28—Brass—Voltmeter Terminal	4
9HF5B JAM	Nut, Hex. Jam. — 5/16"-24 — Brass—Plated—Ammeter Terminal	4
9QC5	Nut, Wing—5/16"-18—Steel—Plated—A.C. Outlet Terminal	2
99-185	Plate, Name "Panel Light"	1
99-189	Plate, Name "A.C. Voltmeter"	1
99-190	Plate, Name "A.C. Ammeter"	1
99-191	Plate, Name "Trouble Lamp"	1
99-192	Plate, Name "Circuit Breaker"	1
695	Plate, Name "Stop"	1
8735	Switch, Two Wire Toggle—Panel Lamp Circuit	1
74703	Wire, No. 14 Switchboard Solid—3 ft. Sufficent to Rewire Control Panel	1

Contractor's Part Number	Description	Quantity Per Group
74704	Wire, Solid No. 10 Switchboard Coil—4 ft. Long	1
75738	Stud, A.C. Outlet Terminal — 5/16"-18 x 2 1/2" — Threaded Brass Rod	1
76561	Voltmeter, A.C. 0-150	1
76569	Receptacle, Twistlock 10 Amp	1
76700	Switch, Stop	1
76701	Receptacle, Panel Lamp	1
76702	Ammeter, A.C. 0-50	1
76703	Breaker, Circuit 35 Amp.—Single Pole	1
	Bulb, Light—50 Watt—Rough Service	1

GENERATOR GROUP

(Figure 78)

2R83204	Screw, Rd. Hd. Mach.—No. 8-32 x 1/4"—Steel—Condenser to Spider	2
2R103208	Screw, Rd. Hd. Mach.—No. 10-32 x 1/2"—Steel—Brush Ring to Spider	2
2R103214B	Screw, Rd. Hd. Mach.—No. 10-32 x 7/8"—Brass—Plated Brush Terminal Bracket	5
2RC420	Screw, Rd. Hd. Mach.—1/4"-20 x 1 1/4"—Steel—Generator End Bell Band	2
3DC7012	Screw, Socket Head Cap—7/16"-14 x 1 1/2"—Steel—Generator Mounting	4
3HC5024	Screw, Hex. Hd. Cap — 5/16"-18 x 1 1/2"—Steel—Field Pole Mtg. (12), Brush Rig Support (2)	14
6L7-1001	Washer, Spring Lock—7/16" (5/32" x 1/16")—Steel —Armature through Stud	1
6L7-1002	Washer, Spring Lock—7/16" (5/32" x 1/8")—Steel —Generator to Engine Mounting	4
6L-16-601	Washer, Spring Lock — 1/4" (5/32" x 1/16")—Steel—Generator to Bell Band	2
6L-28-2-6	Washer, Spring Lock — 3/8" (1/8" x 5/32")—Steel—Generator Frame Stud	2
7K1108	Washer, Ext. Shakeproof — Steel—Condenser to Spider	2
7K1210	Washer, Int. Shakeproof — Steel—Brush Ring to Spider (2), Brush Term. Bracket (12)	14
8W-18901	Washer, Plain — 9/32" I.D. x 9/16" O.D. x 1/16"—Steel—Generator End Bell Band	2
8W-140801B	Washer, Plain—7/32" I.D. x 1/2" O.D. x 1/16"—Brass —Plated—Brush Ring to Spider (2), Brush Terminal Brackets (7)	9
8W-211201	Washer, Plain—21/64" I.D. x 3/4" O.D. x 1/16"—Brass—Brush Rig to Support	2
9H-1032B	Nut, Hex. Hd.—No. 10-32—Brass—Plated—Brush Terminal Brackets	10
9HC4	Nut, Hex.—1/4"-20 — Steel—Generator End Bell Band	2
9HC5	Nut, Hex. Hd. — 5/16"-18 — Steel—Brush Rig to Bearing Support	2

Contractor's Part Number	Description	Quantity Per Group
9HC6	Nut, Hex.—3/8"-24—Steel—Generator Frame Stud	2
559	Ball, Bearing Lock—5/16"—Steel	1
841	Brush, D.C.—M-46-7/8"	2
842	Spring, D.C. Brush	2
1260	Support—Generator Bearing	1
1261	Bearing, Ball, Armature Shaft	1
1262	Spring, Ball Bearing Lock	1
1266	Plate, Generator Bearing	1
1267	Gasket, Generator Bearing Plate	1
2590A	Coils, Field (set of 4)	1
2591	Coil, Field	4
5928	Condenser, 1 MFD	2
10183	Nut, Hex. Cap—7/16"—Steel—Plated—Armature through Stud	1
10715	Plug, Iron Pipe 1/8"—Slotted Bearing Lock	1
12501	Stud, Armature through 7/16" x 12 1/8"	1
12508	Shoe, Pole	4
12514	Washer, Plain—29/64" I.D. x 7/8" O.D. x 1/16"—Armature through Stud	1
12515-3M	Armature, Includes Ball Bearing	1
12600B	Frame, Generator—Assembly—Includes Field Poles and Field Coils	1
12622	Studs, Bearing Support—Steel—Special	2
12623	Washer, Generator Frame Mounting	4
12672	Spider, Brush Rig	1
12677	Lead, Brush Connector 10-3/4"—No. 10 Solid Sw. Bd. Wire	1
12678A	Assembly, Brush Ring—Incl. Brushes, Springs, Guides	1
12679	Lead, Condenser to A.C. Brush 3 1/4"—No. 14—Two Lacquer Braid	2
12681A	Rig, Brush—Assembly—Incl. Spider	1
19652	Brush, A.C.—L-51—5/8"	4
19653	Spring, A.C. Brush	4
76713	Lead, A.C.—24"—White—Outlet Term. to A.C. Brush	1
76714	Lead, A.C.—24"—Black—Ammeter to A.C. Brush	1
76736	Band, Generator End Bell	1
	Tubing, Black, Insulatine 2"—Forms Insulation for Leads through Generator Frame	1
	Pin, Dowel—1/8" x 5/8" Long—Locates End Bell to Generator Frame	1

HOUSING GROUP
(Figure 79)

2R-83208	Screw, Rd. Hd. Mach.—No. 8-32 x 1/2"—Door Knob	1
2R103206	Screw, Rd. Hd. Mach.—No. 10-32 x 3/8"—Steel—Hood Hooks (8), Bearing Inspection Plate (6)	14
2R103208	Screw, Rd. Hd. Mach.—No. 10-32 x 1/2"—Steel—Fire Extinguisher Bracket	6

Contractor's Part Number	Description	Quantity Per Group
2RC408	Screw, Rd. Hd. Mach.—1/4"-20 x 1/2"—Steel—End Panel Mtg. (4), Control Panel Mtg. (4), Door Bead (10), Oil Can (2), Funnel Bracket Mounting (2)	22
2RC420	Screw, Rd. Hd. Mach.—1/4"-20 x 1 1/4"—Steel—Crank Clamp	1
3HC408	Screw, Hex. Hd.—1/4"-20 x 1/2"—Steel—Fuel Tank Bracket	4
3HC510	Screw, Hex. Hd. Cap—5/16"-18 x 5/8"—Steel—Housing Side Plates	16
5R12A10	Screw, Sheet Metal—No. 12 x 5/8"—Type "A" Rd. Hd. Steel—Housing End Panels	10
6L10-6-3	Washer, Spring Lock—No. 10 (3/32" x 3/64")—Steel—Fire Extinguisher Bracket	6
6L10-301	Washer, Spring Lock—No. 10 (3/64" x 1/16")—Steel—Hood Hooks (8), Bearing Inspection Plate (6)	14
6L-16-601	Washer, Spring Lock—1/4" (3/32" x 1/16")—Steel—Door Bead (10), End Panel (4), Funnel Bracket (2), Oil Bracket Mtg. (2), Control Panel Mtg. (4), Fuel Tank Bracket (4)	26
6L-20-8-6	Washer, Spring Lock—5/16" (1/8" x 3/32")—Steel—Fuel Tank Band	4
6L-24-8-6	Washer, Spring Lock—3/8" (1/8" x 3/32")—Steel—Engine Mtg. (4), Shoulder Screw (4)	8
6L-48-1602	Washer, Spring Lock—3/4" (1/4" x 1/8")—Steel—Carrying Handle	4
7K1108	Washer, Ext. Shakeproof Lock No. 8—Control Panel Door Knob Screw	1
7K1214	Washer, Int. Shakeproof Lock 1/4"—Steel—Crank Clamp	1
7K1218	Washer, Int. Shakeproof Lock 3/8"—Steel—Side Panel to End Panel	16
7K1220	Washer, Int. Shakeproof Lock 3/8"—Steel—Choke Control Mounting	1
8W820-5	Washer, Plain—1/2" I.D. x 1 1/4" O.D. x 5/64"—Steel—Engine Mounting	4
8W-181001	Washer, Plain—9/32" I.D. x 5/8" O.D. x 1/16"—Steel—Crank Clamp	1
9H1032	Nut, Hex.—No. 10-32—Steel—Hood Hooks (8), Fire Extinguisher Bracket (6)	14
9HC4	Nut, Hex.—1/4"-20—Steel—Door Bead (10), Fuel Tank Bracket (4), End Panel Mtg. (4), Control Panel Mtg. (4), Oil Can Mtg. (2), Funnel Bracket Mtg. (2)	26
9HC5	Nut, Hex. Hd.—5/16"—18 Steel—Fuel Tank Band	4
9HC6	Nut, Hex.—3/8"-24—Steel—Handle Shoulder Screw (4) Engine Mounting (4)	8
9HF6JAM	Nut, Hex. Jam—3/8"-24 Choke Control	1

Contractor's Part Number	Description	Quantity Per Group
9QC4	Nut, Wing—1/4"-20 Steel—Crank Clamp	1
9S623	Nut, Speed—No. 623 for No. 12A SMS—End Panels	10
3941	Washer—Neoprene—Around Fuel Tank Neck (1) Around Oil Filler Neck (1)	2
10779	Outlet, Wire 1" with Spec. Lock nut—Steel—on Rear Panel	1
12868	Knob, Door	1
12869	Fastener, Side Panel	4
12870	Base, Housing	1
12871	Panel, Rear End	1
12872	Panel, Front End	1
12873	Plate, Side—Right Hand	1
12874	Plate, Side—Left Hand	1
12875	Panel, Housing Side—Left Hand	1
12876	Panel, Housing Side—Right Hand	1
12877	Plate, Housing Top	1
12879	Bracket, Fuel Tank	2
12880	Band, Fuel Tank—Fuel Tank Mtg	2
15162	Spring, Crank Clamp	1
75993B	Bracket, Mounting—Oil Can Mtg. (1), Funnel Mtg. (1)	2
75997	Bracket, Fire Extinguisher Mounting	1
76490	Snap, Harness—Canvas Cover	4
76724	Panel, Control	1
76726A	Ring, "D"—7/8"	4
76727	Clamp, Crank	1
76728	Handle, Carrying	2
76729	Screw, Shoulder—Handle to Housing	4
76730	Control Manual Choke	1
76735	Cover, Canvas—Includes Snaps	1
7685	Plate, Meter Hole Cover used only when meters are not available	1
78043	Cover, Bearing Inspection	1

TOOL GROUP

(Figure 80)

2R63208	Screw, Rd. Hd. Mach.—No. 6-32 x 1/2" Steel—Lock Chain	1
3HC520	Screw, Hex. Hd. Cap—5/16"-18 x 1 1/4" Steel—Tool Box Mtg.	2
6L6-5-2	Washer, Spring Lock—No. 6(5/64" x 1/32") Steel—Lock Chain Screw	1
9H632	Nut, Hex. No. 6-32 Steel—Lock Chain Screw	1
9HC5	Nut, Hex. Hd. 5/16"-18—Steel Tool Box Mtg	2
5533	Crank, Starting	1
75666	Funnel	1
75895	Frame, Tool and Parts Box—Steel	1
75895B	Box, Parts—Steel—Fits into Tool and Parts Box	1
75895C	Tray, Tool—Steel—Fits into Tool and Parts Box	1

Contractor's Part Number	Description	Quantity Per Group
75992	Extinguisher, Fire—1 Qt	1
75993	Can, Oil	1
76649	Lock, Includes 2 Keys	1
77500	Hammer, Ball Pein—No. 1	1
77511	Screwdriver 5/16" x 6"	1
77535	Pliers, Combination	1
77560	Wrench, Pipe 10"	1
77570	Wrench, Adjustable 9"	1
77581	Wrench, Breaker Point	1
77588	Wrench, Spark Plug—Includes No. 77589 Handle	1
77589	Handle, Spark Plug Wrench—Furnished only with No. 77588	1
77705	Wrench, for 5/16" Socket Type, Headless Set Screw	1
77709	Wrench, for 7/16" Socket Head Cap Screw	1
77975	Set, Open End Wrench—Includes following openings: 5/16", 3/8", 13/32", 7/16", 1/2", 9/16", 19/32", 5/8", 11/16", 3/4", 25/32", 7/8"	1

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
2B63206B	Screw, Binding Hd.—#6-32x$\frac{3}{8}$"—Brass			100-105	2	.02
2G632-18	Screw, Binding Hd.—#6-32x$\frac{9}{32}$"—Steel—Plated			109	1	.02
2G83204	Screw, Binding Hd.—#8-32x$\frac{1}{4}$"—Brass			109	2	.02
2RC408	Screw, Rd. Hd. Mach.—$\frac{1}{4}$"-20x$\frac{1}{2}$"—Steel			111	22	.01
2RC416	Screw, Rd. Hd. Mach.—$\frac{1}{4}$"-20x1"—Steel			107	1	.01
2RC420	Screw, Rd. Hd. Mach.—$\frac{1}{4}$"-20x1$\frac{1}{4}$"—Steel			110-111	3	.02
2RC528	Screw, Rd. Hd. Mach.—$\frac{5}{16}$"-18x1$\frac{3}{4}$"—Brass			109	1	.04
2R63204	Screw, Rd. Hd. Mach.—#6-32x$\frac{1}{4}$"—Brass			109	4	.02
2R63208	Screw, Rd. Hd. Mach.—#6-32x$\frac{1}{2}$"—Steel			112	1	.01
2R83204	Screw, Rd. Hd. Mach.—#8-32x$\frac{1}{4}$"—Steel			110	2	.01
2R83208	Screw, Rd. Hd. Mach.—#8-32x$\frac{1}{2}$"—Steel			111	1	.01
2R102420	Screw, Rd. Hd. Mach.—#10-24x1$\frac{1}{4}$"—Steel			105	2	.02
2R103205	Screw, Rd. Hd. Mach.—#10-32x$\frac{5}{16}$"—Steel			104	2	.01
2R103206	Screw, Rd. Hd. Mach.—#10-32x$\frac{3}{8}$"—Steel			111	14	.01

2R103208	Screw, Rd. Hd. Mach.—#10-32x$\frac{1}{2}$"—Steel			110-111	8	.01
2R103210	Screw, Rd. Hd. Mach.—#10-32x$\frac{5}{8}$"—Steel			100-109	3	.01
2R103214B	Screw, Rd. Hd. Mach.—#10-32x$\frac{7}{8}$"—Brass—Plated			110	5	.02
2R103220	Screw, Rd. Hd. Mach.—#10-32x1$\frac{1}{2}$"—Steel			109	1	.02
2R103224	Screw, Rd. Hd. Mach.—#10-32x1$\frac{1}{2}$"—Steel			107	2	.02
2R103236	Screw, Rd. Hd. Mach.—#10-32x2$\frac{1}{4}$"—Steel			107	1	.04
3HC408	Screw, Hex. Hd. Cap.—$\frac{1}{4}$"-20x$\frac{1}{2}$"—Steel			111	4	.01
3HC416	Screw, Hex. Hd. Cap.—$\frac{1}{4}$"-20x1"—Steel			104	2	.01
3HC424	Screw, Hex. Hd. Cap.—$\frac{1}{4}$"-20x1$\frac{1}{2}$"—Steel			109	4	.02
3HC510	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x$\frac{5}{8}$"—Steel			104-111	18	.01
3HC512	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x$\frac{3}{4}$"—Steel			100-105	4	.01
3HC514	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x$\frac{7}{8}$"—Steel			100-102	11	.02
3HC516	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x1"—Steel			100	5	.02
3HC520	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x1$\frac{1}{4}$"—Steel			104-112	3	.02
3HC524	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x1$\frac{1}{2}$"—Steel			101	2	.03
3HC528	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x1$\frac{3}{4}$"—Steel			105	1	.03
3HC540	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x2$\frac{1}{4}$"—Steel			100	2	.04

TM 5-5404

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
3HC544	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x2$\frac{3}{4}$"—Steel			105	1	.05
3HC620	Screw, Hex. Hd. Cap.—$\frac{3}{8}$"-16x1$\frac{1}{4}$"—Steel			105-107	3	.03
3HC644	Screw, Hex. Hd. Cap.—$\frac{3}{8}$"-16x3"—Steel			107	1	.06
3HF708	Screw, Hex. Hd. Cap.—$\frac{7}{16}$"-20x$\frac{1}{2}$"—Steel			100	1	.02
3HC720	Screw, Hex. Hd. Cap.—$\frac{7}{16}$"-14x1$\frac{1}{4}$"—Steel			100	6	.04
3HC5024	Screw, Hex. Hd. Cap.—$\frac{5}{16}$"-18x1$\frac{1}{2}$"—Steel			110	14	.03
3DC7012	Screw, Socket Head Cap.—$\frac{7}{16}$"-14x1$\frac{1}{2}$"—Steel			110	4	.13
4A14A6	Screw, Sheet Metal—#14Ax$\frac{3}{4}$"—Steel			105	4	.01
4R203	Screw, Sheet Metal—Blunt Point—#2-$\frac{3}{16}$"—Steel—Plated			109	10	.01
4A808	Screw, Sheet Metal—#8x$\frac{1}{2}$"—Flathead—Type "Z"—Steel			100-105	4	.01
5R12A 10	Screw, Sheet Metal—#12x$\frac{5}{8}$"—Type A—Rd. Hd.			111	10	.01
6L4-4-2	Washer, Spring Lock—#4 ($\frac{1}{16}$"x$\frac{1}{32}$")—Steel			109	8	.01
6L6-3-2	Washer, Lock—#6 ($\frac{3}{64}$"x$\frac{1}{32}$")			109	1	.01
6L6-5-2	Washer, Spring Lock—#6 ($\frac{5}{64}$"x$\frac{1}{32}$")—Steel			112	1	.01
6L7-1001	Washer, Spring Lock—$\frac{7}{16}$" ($\frac{5}{32}$"x$\frac{1}{16}$")—Steel			105-110	3	.01

6L7-1002	Washer, Spring Lock—$\frac{7}{16}$" ($\frac{5}{32}$"x$\frac{1}{8}$")—Steel			100-110	10	.01
6L10-4-3	Washer, Spring Lock—#10 ($\frac{1}{16}$"x$\frac{3}{64}$")—Steel			107	3	.01
6L10-6-3	Washer, Spring Lock—#10 ($\frac{3}{32}$"x$\frac{3}{64}$")—Steel			111	6	.01
6L10-301	Washer, Spring Lock—#10 ($\frac{3}{64}$"x$\frac{1}{16}$")—Steel			111	14	.01
6L-16-601	Washer, Spring Lock—$\frac{1}{4}$" ($\frac{3}{32}$"x$\frac{1}{16}$")—Steel			104-107-109-111	37	.01
6L-20-8-6	Washer, Spring Lock—$\frac{5}{16}$" ($\frac{1}{8}$"x$\frac{3}{32}$")—Steel			111	4	.01
6L-20-801	Washer, Spring Lock—$\frac{5}{16}$" ($\frac{1}{8}$"x$\frac{1}{16}$")—Steel			101-102-105-109	16	.01
6L-24-2-6	Washer Spring Lock—$\frac{3}{8}$" ($\frac{1}{8}$"x$\frac{3}{32}$")—Steel			105-107-110-111	14	.01
6L-24-801	Washer, Spring Lock—$\frac{3}{8}$" ($\frac{1}{8}$"x$\frac{1}{16}$")			104	1	.01
6L-40-13-6	Washer, Spring Lock—$\frac{5}{8}$" ($\frac{13}{64}$"x$\frac{3}{32}$")—Steel			105	1	.01
6L4-4-2	Washer, Lock—#4 ($\frac{1}{16}$"x$\frac{1}{32}$")—Steel			109	8	.01
6L-48-1602	Washer, Spring Lock—$\frac{3}{4}$" ($\frac{1}{4}$"x$\frac{1}{8}$")—Steel			111	4	.01
7K 1108	Washer, Ext. Shakeproof Lock—#8			110-111	3	.01
7K 1110	Washer, Ext. Shakeproof Lock—#10			109	1	.01
7K 1124	Washer, Ext. Shakeproof—#10—Steel—Plated			109	2	.02
7K 1210	Washer, Int. Shakeproof—Steel			100-104-110	16	.01
7K 1214	Washer, Int. Shakeproof Lock—$\frac{1}{4}$"—Steel			104-111	4	.01

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
7K 1218	Washer, Int. Shakeproof Lock—5/16"—Steel—Plated			109-111	19	.02
7K 1220	Washer, Int. Shakeproof Lock—3/8"—Steel			111	1	.01
8W507-3F	Washer, Insulating—5/16" I.D. x 7/16" O.D. x 3/64"—Fibre			109	2	.01
8W820-5	Washer, Plain—1/2" I.D. x 1 1/4" O.D. x 3/64"—Steel			111	4	.01
8W-905-2B	Washer, Plain—9/64" I.D. x 5/16" O.D. x 1/32"—Brass			109	2	.02
8W-1106-2	Washer, Plain—11/64" I.D. x 3/8" O.D. x 1/32"—Steel			109	1	.01
8W-1307-2	Washer, Plain—.200" I.D. x 7/16" O.D. x 1/32"—Brass			109	2	.02
8W-1307-3	Washer, Plain—13/64" I.D. x 7/16" O.D. x 3/64"—Brass			109	2	.02
8W-1709-2	Washer, Plain—17/64" I.D. x 9/16" O.D. x 1/32"—Steel			101	2	.01
8W-18901	Washer, Plain—9/32" I.D. x 9/16" O.D. x 1/16"—Steel			110	2	.01
8W 51401F	Washer, Insulating—5/16" I.D. x 7/8" O.D. x 1/16"			109	6	.02
8W-140801	Washer, Plain—3/16" I.D. x 1/2" O.D. x 1/16"—Steel			104	2	.01
8W-140801B	Washer, Plain—7/32" I.D. x 1/2" O.D. x 1/16"—Brass—Plated			110	9	.02
8W-181001	Washer, Plain—9/32" I.D. x 5/8" O.D. x 1/16"—Steel			103-111	7	.01

8W-210901C	Washer, Plain—21/64" I.D. x 9/16" O.D. x 1/16"—Copper			100-102-105	18	.02
8W-211101B	Washer, Plain—21/64" I.D. x 11/16" O.D. x 1/16"—Brass—Plated			109	2	.02
8W-211201	Washer, Plain—21/64" I.D. x 3/4" O.D. x 1/16"—Brass—Plated			109-110	15	.02
8W-221101	Washer, Plain—5/16" S.A.E.—11/32" I.D. x 11/16" O.D. x 1/16"—T.—Steel			104	1	.01
8W-291201C	Washer, Plain—7/16" I.D. x 3/4" O.D. x 1/16"—Copper			100-101	2	.02
9HC4	Nut, Hex.—1/4"-20—Steel			104-109-110-111	36	.01
9HF4B JAM	Nut, Hex.—Jam—1/4"-28—Brass			109	4	.02
9QC4	Nut, Wing—1/4"-20—Steel			107-111	2	.05
9HC5	Nut, Hex.—5/16"-18—Steel			105-110-111	14	.02
9HC5B JAM	Nut, Hex.—Jam—5/16"-18—Brass—Plated			109	4	.02
9HC6	Nut, Hex.—3/8"-24—Steel			110-111	10	.02
9HF5	Nut, Hex.—5/16"-24—Brass—Plated			105-109	8	.02
9HF5B JAM	Nut, Hex.—Jam—5/16"-24—Brass—Plated			109	4	.02
9QC5	Nut, Wing—5/16"-18—Steel—Plated			109	2	.05
9HF10	Nut, Hex.—#10-32—Steel			107	1	.01
9HF6 JAM	Nut, Hex.—3/8"-24—Steel			104-105-107-111	6	.02
9H 348	Nut, Hex.—#3-48—Steel			100	1	.01
9H 440	Nut, Hex.—#4-40—Brass—Plated			109	8	.02
9S 623	Nut, Speed—#623—For #12a SMS			111	10	.01
9H 632	Nut, Hex.—#6-32—Steel			100-112	2	.01
9H 1018	Nut, Hex.—5/8"-18—Steel			105	1	.02
9X1024	Nut, Square—3/16"-24—Steel			105	2	.01

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
9H1032	Nut, Hex.—#10-32—Steel	.....	.....	109-111	15	.01
9H1032B	Nut, Hex. Hd.—#10-32—Brass—Plated	.....	.....	109-110	10	.02
9S623	Nut, Speed—No. 623 for No. 12A SMS—End Panels	.....	.....	111	10	.01
9S1434	Nut, Speed—.034"—Special Steel	.....	.....	105	4	.01
15-186W	Spring, Drive	Wico Electric Co.	15-186	108	1	.55
16-449W	Plug, Oil	Wico Electric Co.	16-449	108	1	.05
16-463W	Nut, Distributor Cap Terminal	Wico Electric Co.	16-463	108	3	.10
16-561BW	Washer, Distributor Arm Dust	Wico Electric Co.	16-561B	108	1	.05
16-738W	Screw	Wico Electric Co.	16-733	108	4	.05
18A108	Key, Cotter—$\frac{1}{16}$"x$\frac{1}{2}$"—Steel	.....	.....	104-108	3	.01
27DC512	Screws, Socket Hd. Set—$\frac{5}{16}$"-18x$\frac{3}{4}$"—Steel	.....	.....	102	2	.07
M-31XW	Screw, Fixed Contact Insulator Block	Wico Electric Co.	M-31X	108	1	.05
33AA	Key, Woodruff—#A	.....	.....	102	1	.05
33A9	Key, Woodruff—#9	.....	.....	102-103	2	.05
33A61	Key, Woodruff—#61	.....	.....	102	1	.05
M-39XAW	Washer, Oil Plug	Wico Electric Co.	M-39XA	108	1	.05
M-42XAW	Washer, Driven Flange Spacing	Wico Electric Co.	M-42XA	108	1	.05
M-55XAW	Washer, Lock	Wico Electric Co.	M-55XA	108	13	.05
M-58XW	Washer, Lock—Distributor Cap Shield Screw	Wico Electric Co.	M-58X	108	3	.05
M-90XW	Washer, Lock Condenser Screw	Wico Electric Co.	M-90X	108	2	.05
99-185	Plate, Name.—(Panel Light)	.....	.....	109	1	.20
99-189	Plate, Name.—(A.C. Voltmeter)	.....	.....	109	1	.20
99-190	Plate, Name.—(A.C. Voltmeter)	.....	.....	109	1	.20
99-191	Plate, Name.—(Trouble Lamp)	.....	.....	109	1	.20
99-192	Plate, Name.—(Circuit Breaker)	.....	.....	109	1	.20
M-126XBW	Screw, Coil Core Clamp	Wico Electric Co.	126XB	108	2	.05
A-179XW	Arm, Trip	Wico Electric Co.	A-179X	108	1	.25

200X4	Connector, Inverted Male—Steel	Weatherhead Co.	200X4	104	1	.12
A-243XW	Ring, Snap	Wico Electric Co.	A-243X	108	1	.05
IXA-256W	Washer, Fixed Contact Screw	Wico Electric Co.	IXA-256	108	1	.05
IXA-345W	Plug, Oil	Wico Electric Co.	IXA-345	108	2	.05
400X4	Elbow, Inverted Male—Filter	Weatherhead Co.	400X4	105	1	.16
504A	Assembly, Cam Shaft Gear	.....	.....	103	1	5.50
523	Bearing, Camshaft Rear	.....	.....	103	1	.65
527	Washer, Camshaft Gear Spacer—1$\frac{11}{16}$" I.D. x 2$\frac{5}{16}$" O.D. x $\frac{1}{16}$"	.....	.....	103	1	.20
528	Spring, Valve Lifter Spacer	.....	.....	103	2	.15
529	Plug, Welch—Cam Shaft—2"	.....	.....	103	1	.05
542	Valve, Intake	.....	.....	101	2	.30
543	Valve, Exhaust	.....	.....	101	2	.80
544	Seat, Exhaust Valve	.....	.....	101	2	.50
545	Spring, Valve	.....	.....	101	4	.15
546	Washer, Valve Spring—#45S	.....	.....	101	4	.05
547	Lock, Valve Spring	.....	.....	101	4	.05
559	Ball, Bearing Lock—$\frac{5}{16}$"—Stee	.....	.....	110	1	.05
IVA-583W	Spacer, Drive Cup	Wico Electric Co.	IVA-583	108	2	.10
609	Ring, Piston Pin Lock	.....	.....	102	4	.05
614	Pin, Dowel—$\frac{1}{4}$"x1"	.....	.....	101-102	5	.10
670	Plug, Spark	Champion Spark Plug Co.	6M	107	2	.65
695	Plate, Name—(Stop)	.....	.....	109	1	.10
737	Stud, Carburetor Mounting—$\frac{5}{16}$"x1$\frac{1}{8}$"	.....	.....	101	2	.10
758	Bearing, Valve Lifter	.....	.....	103	4	.45
760A	Lifter, Valve	.....	.....	103	4	.65
761	Screw, Hex. Hd. Cap.—$\frac{1}{4}$"-28x$\frac{3}{4}$"—Steel	.....	.....	103	4	.05
773	Shim, Crank Gear—.022"x1$\frac{1}{2}$" I.D. x 2" O.D.	.....	.....	102	1	.05
841	Brush, D.C.—M—46—$\frac{7}{8}$"	.....	.....	110	2	.65

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
842	Spring, D.C. Brush			110	2	.25
1036	Gasket, Gear Case Cover			100	1	.30
1041A	Cup, Governor & Stud Assy.—20 Ga. CRS			103	1	.65
1085W	Screw, Distributor Cap Shield	Wico Electric Co.	1085	108	3	.05
1097	Assembly, Fuel Filter			105	1	1.25
1098	Bowl, Filter—Glass	Tillotson Mfg. Co.	OW-363	105	1	.30
1099	Gasket, Filter Bowl			105	1	.10
1194W	Pad, Cam Oil	Wico Electric Co.	1194	108	1	.05
1196	Washer, Plain—$^{25}/_{64}$" I.D. x $^{3}/_{8}$" O.D. x $^{1}/_{8}$"—Steel			105-107	4	.05
1197W	Washer, Breaker Arm Spacing	Wico Electric Co.	1197	108	1	.05
1197TW	Washer, Breaker Point Spacing	Wico Electric Co.	1197T	108	1	.05
1207W	Washer, Breaker Arm Clamp	Wico Electric Co.	1207	108	1	.05
1248W	Screw, Identification Plate	Wico Electric Co.	1248	108	4	.05
1260	Support, Generator Bearing			110	1	5.00
1261	Bearing, Ball, Armature	Hoover Ball and Bearing Co.	7205	110	1	3.00
1262	Spring, Ball Bearing Lock			110	1	.10
1266	Plate, Generator Bearing			110	1	.25
1267	Gasket, Generator Bearing Plate			110	1	.15
1379W	Pad, Main Oil	Wico Electric Co.	1379	108	1	.10
1383W	Screw, Condenser	Wico Electric Co.	1383	108	2	.05
1418W	Spacer, Breaker Arm	Wico Electric Co.	1418	108	1	.05
X1487W	Scraper, Oil Assembly	Wico Electric Co.	X1487	108	1	.25
X1503W	Clip, Distributor Cap	Wico Electric Co.	X1503	108	2	.25
1533W	Gasket, Condenser Case	Wico Electric Co.	1533	108	1	.05
1760W	Gasket, Coil	Wico Electric Co.	1760	108	2	.05
1835	Bearing, Crankshaft			102	2	.75

1902W	Screw, Distributor Cap Shield Cover	Wico Electric Co.	1902	108	3	.05
2007	Gasket, Rear Bearing Plate			102	2	.25
2015	Shaft, Cam Lifter—$^{1}/_{2}$"x10$^{3}/_{16}$"			103	1	.95
2016	Spacer, Valve Lifter—$^{1}/_{2}$"—Steel			103	As Req.	.10
2017	Spacer, Valve Lifter—$^{9}/_{16}$"—Steel			103	As Req.	.10
2018	Spacer, Valve Lifter—$^{1}/_{16}$"—Steel			103	1	.10
2018B	Spacer, Valve Lifter—$^{3}/_{8}$"—Steel			103	As Req.	.10
2018E	Spacer, Valve Lifter—$^{3}/_{32}$"—Steel			103	As Req.	.10
2018F	Spacer, Valve Lifter—$^{1}/_{8}$"—Steel			103	As Req.	.10
2018H	Spacer, Valve Lifter—$^{1}/_{4}$"—Steel			103	As Req.	.10
2040W	Cup, Drive	Wico Electric Co.	2040	108	1	2.00
2076W	Nut, Impulse Lock	Wico Electric Co.	2076	108	1	.35
2106	Outlet, Exhaust			109	1	.45
2121	Pin, Piston—$^{3}/_{4}$"x2$^{7}/_{16}$"	Aluminum Industries	P-444	102-108	2	.50
2121W	Spacer, Impulse	Wico Electric Co.	2121	108	1	.05
2122W	Spacer, Driven Flange	Wico Electric Co.	2122	108	1	.10
2200L	Block, Cylinder—3" Bore			101	1	20.00
2201	Gasket, Cylinder Base			101	1	.30
2202	Stud, Cylinder Block—$^{7}/_{16}$"x7$^{3}/_{8}$"			101	2	.30
2203	Stud, Cylinder Block—$^{7}/_{16}$"x7$^{5}/_{8}$"			101	2	.30
2206	Plug, Welch—1$^{1}/_{4}$" O.D. Cyl. Block	M. D. Hubbard Spring Co.		101	2	.05
2211	Gasket, Cylinder Head	Detroit Gasket & Mfg. Co.	1001	101	1	.85
2212	Cap, Cylinder Head			101	1	.35
2213	Gasket, Cylinder Head Cap			101	1	.10
2216	Gasket, Water Outlet—Lower			101	1	.15
2217	Stud, Cylinder Head, Center—$^{7}/_{16}$"x3$^{13}/_{16}$"			101	1	.25
2218	Stud, Cylinder Head—$^{7}/_{16}$"x2$^{11}/_{16}$"			101	3	.25
2223	Gasket, Water Inlet			105	1	.10
2226	Gasket, Exhaust Outlet Flange	Victor Gasket & Mfg. Co.	5133AM	109	1	.10

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
2264A	Cap, Radiator—With Chain & Gasket	Eaton Mfg. Co.	1E-1304	105	1	.75
2265	Gasket, Radiator Cap	.....	.....	105	1	.10
2268	Clamp, Hose—2"	Ideal Clamp Mfg. Co.	.....	105	2	.10
X2287W	Flange, Driven	Wico Electric Co.	X2287	108	1	.50
2288W	Retainer, Drive Spring	Wico Electric Co.	2288	108	1	.05
2495W	Bushing, Rotor Shaft	Wico Electric Co.	2495	108	2	.20
2496W	Gasket, Impulse Stop	Wico Electric Co.	2496	108	1	.05
2503W	Clamp, Coil Core	Wico Electric Co.	2503	108	2	.05
2505W	Plate, Oil Pad Spring	Wico Electric Co.	2505	108	1	.05
2506W	Plate, Identification	Wico Electric Co.	2506	108	2	.20
2537W	Screw, Gear Housing	Wico Electric Co.	2537	108	2	.05
2538W	Screw, Housing Shield Clamp	Wico Electric Co.	2538	108	4	.05
2573W	Washer, Lock—Breaker Arm Spring Screw	Wico Electric Co.	2573	108	1	.05
2590A	Coils, Field	.....	.....	110	1	20.00
2591	Coil, Field	.....	.....	110	4	5.00
2635W	Washer, Lock—Gear Housing Screw	Wico Electric Co.	2635	108	2	.05
2641W	Screw, Impulse Stop	Wico Electric Co.	2641	108	4	.05
X2706W	Core, Coil	Wico Electric Co.	X2706	108	1	.55
X2732W	Housing, Gear—Includes Gears	Wico Electric Co.	X2732	108	1	4.95
2745W	Disc, Oiling	Wico Electric Co.	2745	108	1	.05
2749W	Washer, Lock—Impulse Stop Screw	Wico Electric Co.	2749	108	4	.05
X2927W	Rotor, Assembly	Wico Electric Co.	X2927	108	1	6.60
3300X2	Coupling, Pipe	Weatherhead Co.	3300X2	104	1	.17
3327X2	Nipple, Pipe—⅛"x1½"—Iron	Weatherhead Co.	3327X2	104	1	.18
3400X2	Elbow, Street—⅛"	Weatherhead Co.	3400X2	105	2	.21
X3413W	Stop, Impulse	Wico Electric Co.	X3413	108	1	1.50
3497AW	Wedge, Coil	Wico Electric Co.	3497A	108	2	.05
3729W	Grommet, Ground Lead	Wico Electric Co.	3729	108	1	.05
3941	Washer, Neoprene	.....	.....	111	2	.15
4965W	Cover, Distributor Cap Shield	Wico Electric Co.	4965	108	1	1.25
X4973W	Shield, Distributor Cap	Wico Electric Co.	X4973	108	1	4.00
X5018W	Coil	Wico Electric Co.	X5018	108	1	3.75
X5026W	Coupling, Impulse Assembly	Wico Electric Co.	X5026	108	1	3.30
X5071W	Housing, Main	Wico Electric Co.	X5071	108	1	6.70
X5074W	Lead, Ground	Wico Electric Co.	X5074	108	1	.50
X5084W	Shield, Housing	Wico Electric Co.	X5084	108	1	2.75
5533	Crank, Starting	Walker Mfg. Co.	50186	112	1	1.25
5562C	Nipple, Iron Pipe—½"x5"	.....	.....	100	1	.25
5656	Gasket, Carburetor Flange	.....	.....	105	2	.10
5928	Condenser—0.1 M.F.D.	Electrical Utilities	EUC10289	110	2	.50
8735	Switch, Two Wire Toggle	Arrow Hart & Hegeman Elec. Co.	20994	109	1	.75
10183	Nut, Hex. Cap.—7/16"—Steel—Plated	.....	.....	101-110	9	.08
10697	Elbow, Inverted	Weatherhead Co.	400x4	104	1	.16
10702	Plug, Iron Pipe—Sq. Hd.—⅜"	.....	.....	107	1	.10
10703	Plug, Iron Pipe—Sq. Hd.—½"	.....	.....	100	1	.15
10715	Plug, Iron Pipe—⅛" Slotted	.....	.....	110	1	.05
10775	Nipple, Pipe—⅛"x2¾"—Brass	.....	.....	105	1	.13
10779	Outlet, Wire—1"—Steel	All Steel Equipment Co.	1010	111	1	.20
12004BA	Crankcase	.....	.....	100	1	50.00
12005B	Plate, Front Bearing	.....	.....	102	1	2.75
12008B	Gear, Crankshaft—Steel	.....	.....	102	1	3.25
12009	Seal, Crankshaft Oil, Rear—Leather	National Motor Bearing Co.	50269	102	1	1.00
12010	Plate, Rear Bearing	.....	.....	102	1	3.50
12010A	Plate, Rear Bearing Assy.—Includes 12010 Bearing Plate and 1835 Bearing	.....	.....	102	1	4.25
		.....	.....	100	1	.40

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
12012B	Crankshaft			102	1	14.00
12021	Plate, Crankcase Inspection			100	1	.50
12022	Gasket, Crankcase Inspection Plate			100	1	.15
12027	Gasket, Valve Inspection Plate			100	1	.30
12029A	Guard, Oil Rod, Assembly			100	1	.35
12030	Gasket, Oil Filler Neck			100	1	.10
12031A	Assembly, Oil Level Float			100	1	.40
12038A	Cap, Oil Filler Tube			100	1	.50
12043	Pulley, Fan Drive—Includes Crank Dog			102	1	2.50
12044	Washer, Crankshaft Gear—Special			102	1	.20
12045	Nut, Hex.—⅞"-14x1½"x$^{11}/_{32}$"—Steel—Crankshaft			102	1	.20
12047A	Assembly, Connecting Rod—Includes Bushing and Bearing Insets			102	2	4.75
12049	Insert, Connecting Rod Bearing			102	4	.50
12050	Camshaft			103	1	6.50
12051	Bearing, Camshaft Front			103	1	.70
12057B	Piston, Standard with Pin			102	2	5.50
12060	Base, Oil			100	1	12.00
12061	Gasket, Oil Base			100	1	.40
12062	Cushion, Plant Mtg. Rubber (Lower)			100	4	.20
12063	Cushion, Plant Mtg. Rubber (Upper)			100	4	.20
12074A	Assembly, Oil Pump Outlet Tube			104	1	.60
12077	Nipple, Iron Pipe—⅛"x5⅛"			104	1	.15
12079	Tee, Oil Line	Weatherhead Co.	3600x2	104	1	.36
12080A	Body, Oil Pump			104	1	2.25
12081B	Gear, Oil Pump Drive			104	1	2.00
12084	Screen, Oil Pump Intake			104	1	.30
12085	Cup, Oil Pump Intake			104	1	.80
12086	Gear, Oil Pump Driven			104	1	1.25
12087BA	Assembly, Oil Pump Driven Gear and Shaft			104	1	1.75
12089	Gasket, Oil Pump Body—.012" Thick			104	As Req.	.05
12089B	Gasket, Oil Pump Body—.002" Thick			104	1	.05
12089C	Gasket, Oil Pump Body—.004" Thick			104	As Req.	.05
12089D	Gasket, Oil Pump Body—.006" Thick			104	1	.05
12092	Seal, Gearcase Oil	National Motor Bearing Co.	50027	100	1	.50
12094	Gasket, Mag. Flange			107	1	.15
12096	Case, Mag. Drive Gear			107	1	8.50
12097	Gear, Mag. Drive			107	1	2.75
12100A	Cover, Gear Case			100	1	4.50
12101	Gasket, Magneto Drive Gear Case			107	1 or more	.15
12106	Plate, Valve Inspection			100	1	1.25
12107	Stud, Magneto Drive Gear Case Mtg.—⅜"x2"—1" U. S. Thd. One End—½" S.A.E. Other End			100	2	.10
12108	Gear, Magneto Drive Idler—Textolite			107	1	1.75
12108A	Gear, Magneto Drive Idler and Bushing, Assembly			107	1	2.25
12109	Bushing, Magneto Drive Idler Gear			107	1	.60
12110	Shaft, Magneto Idler Gear			107	1	.35
12115	Link, Governor Arm to Carburetor			104	1	.25
12118	Cleaner, Air	Donaldson Co., Inc.	2XB-451	107	1	3.50
12121	Gasket, Air Cleaner—Cork	Armstrong Cork Co.	G-744	107	1	.10
12122	Stud, Air Cleaner—¼"x$^{1}/_{64}$"—⅜" U. S. Thd. One End—⅞" Other End			107	1	.15
12132	Elbow, Vapor Trap Adapter			107	1	.60
12133	Tube, Breather			107	1	.50
12134	Trap, Vapor			107	1	.60

TM 5-5404

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
12142	Bolt, Connecting Rod—Special	.....	.....	102	4	.10
12143	Nut, Connecting Rod Bolt—Special	.....	.....	102	4	.05
12143B	Nut, Connecting Rod Bolt Lock	.....	.....	102	4	.05
12159	Support, Air Cleaner	.....	.....	107	1	.15
12160	Carburetor	Zenith Carburetor Div.	.....	105	1	9.75
12169	Plate, Distribution	.....	.....	105	1	.10
12180	Arm, Governor	.....	.....	104	1	1.50
12186	Screw, Governor Spring Adjusting—$\frac{1}{4}$"x2$\frac{1}{4}$"—Special	.....	.....	104	1	.15
12187	Bracket, Governor Adjusting Screw	.....	.....	104	1	.35
12189	Cover, Governor Spring	.....	.....	104	1	.20
12191	Screw, Sensitivity Adjusting—$\frac{1}{4}$"x2$\frac{3}{4}$"	.....	.....	104	1	.15
12192	Washer, Felt—$\frac{5}{16}$" I.D. x $\frac{3}{4}$" O.D. x $\frac{3}{32}$"	.....	.....	104	1	.10
12193	Spring, Governor	.....	.....	104	1	.20
12199	Magneto	Wico Electric Co.	C2-1656	107	1	35.00
12208	Support, Radiator	.....	.....	105	1	2.00
12209	Gasket, Radiator Base—Cork	.....	.....	105	1	.35
12217	Ornament, Radiator Cap	.....	.....	105	1	.85
12220	Cock, #185	Weatherhead Co.	185	105	1	.50
12222	Inlet, Water	.....	.....	105	1	1.25
12223	Outlet, Water	.....	.....	101	1	2.50
12225	Gasket, Water Outlet	.....	.....	101	1	.10
12226	Hose, Radiator—1$\frac{5}{8}$"x5$\frac{1}{8}$"	.....	.....	105	1	.40
12240L	Head, Cylinder	.....	.....	101	1	7.50
12251	Bracket, Fan	.....	.....	105	1	.75
12255A	Fan, Complete—Includes Shaft, Hub, and Blades	Schwitzer Cummins Co.	B-107369	105	1	7.50
12255B	Body, Fan—Includes Hub and Shaft	Schwitzer Cummins Co.	B-107369	105	1	4.00
12256	Blades, Fan	Schwitzer Cummins Co.	B-107363	105	1	4.00
12273A	Assembly, Oil By-pass Valve	.....	.....	104	1	1.00
12317A	Assembly, Spark Plug Shield	.....	.....	107	2	.75
12354	Stud, Radiator Support—$\frac{7}{16}$"x3$\frac{9}{16}$"	.....	.....	105	2	.20
12394B	Cable, High Tension, Shielded—17" Long	.....	.....	107	1	.65
12395B	Cable, High Tension, Shielded—15" Long	.....	.....	107	1	.65
12412	Stud, Exhaust Flange—$\frac{5}{16}$"x1$\frac{1}{4}$"—$\frac{5}{16}$" Thd. One End—$\frac{9}{16}$" Other End	.....	.....	101	2	.10
12501	Stud, Armature Through—$\frac{7}{16}$"x12$\frac{15}{16}$"—Steel	.....	.....	110	1	.50
12508	Shoe, Pole	.....	.....	110	4	3.50
12514	Washer, Plain—$\frac{1}{16}$" ($\frac{29}{64}$"x$\frac{7}{8}$")—Steel	.....	.....	110	1	.05
12515-3M	Armature—Incl. Ball Bearing	.....	.....	110	1	65.00
12561X	Flywheel	.....	.....	102	1	6.50
12600B	Frame, Generator Assembly with Coils	.....	.....	110	1	65.00
12622	Stud, Bearing Support—Steel—Special	.....	.....	110	2	.10
12623	Washer, Generator Frame Mtg.	.....	.....	110	4	.15
12672	Spider, Brush Rig	.....	.....	110	1	1.75
12677	Lead, Brush Connector—10$\frac{3}{4}$"	.....	.....	110	1	.20
12678A	Assembly, Brush Ring	.....	.....	110	1	8.00
12679	Lead, Condenser to A.C. Brush—3$\frac{1}{4}$"	.....	.....	110	2	.15
12681A	Rig, Brush	.....	.....	110	1	9.75
12868	Knob, Door	American Cabinet Hdwe. Corp.	666A	111	1	.25
12869	Fastener, Side Panel	Bassick Co.	C-2185	111	4	.20
12870	Base, Housing	.....	.....	111	1	15.00
12871	Panel, Rear End	.....	.....	111	1	8.50
12872	Panel, Front End	.....	.....	111	1	10.00
12873	Plate, Side, Right Hand	.....	.....	111	1	5.00

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
12874	Plate, Side, Left Hand	.....	.....	111	1	5.00
12875	Panel, Housing Door, Left Hand	.....	.....	111	1	5.00
12876	Panel, Housing Door, Right Hand	.....	.....	111	1	5.00
12877	Plate, Housing Top	.....	.....	111	1	7.00
12878	Tank, Fuel	.....	.....	105	1	10.00
12879	Bracket, Fuel Tank	.....	.....	111	2	.50
12880	Band, Fuel Tank	.....	.....	111	2	.50
12898	Nipple, Close Pipe—1"	.....	.....	109	2	.10
12900	Radiator	.....	.....	105	1	35.00
12901	Neck, Oil Filler	.....	.....	100	1	2.50
12902	Tube, Oil Filler Neck	.....	.....	100	1	.85
12903A	Muffler, Exhaust	.....	.....	109	1	4.25
12904	Disc, Muffler	.....	.....	109	1	1.00
12905	Shroud, Fan	.....	.....	105	1	1.90
12906	Belt, Fan	Independent Rubber Co.	2300	105	1	1.25
12909	Guard, Fan—2 Pieces	.....	.....	105	1	4.25
12945	Adapter, Air Cleaner	.....	.....	107	1	.85
12967	Contact, Breaker—Includes #12976 and #12977	Wico Electric Co.		108	1	1.75
12968B	Gasket, Cover	Wico Electric Co.	2504	108	1	.05
12969	Condenser	Wico Electric Co.	X1413	108	1	1.20
12974	Arm, Distributor	Wico Electric Co.	16X-477B	108	1	.45
12976	Contact, Fixed—See 12967	Wico Electric Co.	1196	108	1	.50
12977	Arm, Breaker Group—See 12967	Wico Electric Co.	X1408	108	1	1.25
12978	Cap, Distributor	Wico Electric Co.	X3132	108	1	1.90
12978B	Gasket, Distributor Cap	Wico Electric Co.	2497	108	1	.05
15142	Key, Woodruff—#2	.....	.....	104	1	.10
15162	Spring, Crank Clamp	.....	.....	111	1	.15
15168	Gage, Oil Pressure—0-100 Lbs.	Rochester Mfg. Co.	OPC	104	1	1.50
19652	Brush, A.C.—L-51—5/8"	.....	.....	110	4	.55
19653	Spring, A.C. Brush	.....	.....	110	4	.25
23057	Pin, Taper—Thrust Washer	Zenith Carburetor Div.	CT63-1	106	1	.05
23062	Washer, Lock—1/8" (1/32"x1/32")	Zenith Carburetor Div.	T141-5	106	4	.05
23070	Plug, Bowl Drain	Zenith Carburetor Div.	CT91-3	106	1	.10
23071	Screw, Fill. Hd. Cap.—#10-32x5/8"—Steel—Plated	Zenith Carburetor Div.	T1S10-10	106	1	.05
23072	Washer, Lock—3/16" (1/16"x3/64")—Steel	Zenith Carburetor Div.	T41-10	106	4	.05
23076	Axle, Float	Zenith Carburetor Div.	C121-14	106	1	.10
23083	Washer, Fiber—5/32" I.D. x 17/64" O.D. x 1/32"	Zenith Carburetor Div.	T56-4	106	1	.05
23088	Valve, Fuel—Assembly #35	Zenith Carburetor Div.	C81-2-35	106	1	.75
23090	Washer, Fiber—3/8" I.D. x 9/16" O.D. x .038" Thick	Zenith Carburetor Div.	T56-23	106	2	.05
23100	Body, Throttle—Assembly #16 Venturi	Zenith Carburetor Div.	B2-148B-2	106	1	4.00
23103	Plate, Throttle	Zenith Carburetor Div.	C21-135	106	1	.40
23104	Screw, Rd. Hd. Mach.—#5-40—3/16"—Brass	Zenith Carburetor Div.	T15B5-3	106	4	.05
23105	Screw, Idle Adjusting	Zenith Carburetor Div.	C46-25	106	1	.30
23106	Spring, Adjusting Screw	Zenith Carburetor Div.	C111-9	106	1	.10
23107	Shaft, Throttle or Air Shutter	Zenith Carburetor Div.	C-23-7	106	2	.50
23108	Lever, Throttle Clamp	Zenith Carburetor Div.	CR24-42D	106	1	.75
23109	Screw, Fill. Hd. Cap.—#10-32x1/2"	Zenith Carburetor Div.	T1S10-8	106	5	.05
23110	Lever, Throttle Stop	Zenith Carburetor Div.	C28-27	106	1	.50
23111	Screw, Stop Lever Clamp	Zenith Carburetor Div.	T8S10-9	106	1	.05
23112	Screw, Fill. Hd. Cap.—#10-32x7/8"—Steel	Zenith Carburetor Div.	T1S10-14	106	1	.05
23113	Spring, Stop Screw	Zenith Carburetor Div.	C111-62	106	1	.10
23114	Spacer, Throttle Lever	Zenith Carburetor Div.	CT52-8	106	3	.05
23115	Washer, Plain—Special	Zenith Carburetor Div.	C130-3	106	1	.05
23116	Shutter, Air	Zenith Carburetor Div.	C102-54A	106	1	.25
23120	Bracket, Air Shutter	Zenith Carburetor Div.	C109-48	106	1	.75

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
23121	Clip, Bracket	Zenith Carburetor Div.	C110-1	106	1	.05
23122	Screw, Fill. Hd. Cap.—#8-36x1/2"—Steel—Plated	Zenith Carburetor Div.	T1S8-8	106	1	.05
23123	Lever, Air Shutter—Assembly	Zenith Carburetor Div.	CR106-136X2	106	1	.65
23124	Screw, Fill. Hd. Cap.—#8-36x1/2"	Zenith Carburetor Div.	T1S8-7	106	1	.05
23127	Screw, Swivel	Zenith Carburetor Div.	T8S8-8	106	1	.05
23128	Gasket, Throttle Body to Bowl	Zenith Carburetor Div.	C142-2	106	1	.10
23129	Screw, Hex. Hd. Cap.—1/4"-28x1 1/4"—Steel	Zenith Carburetor Div.	T2S25-20	106	2	.10
23130	Washer, Lock—1/4" I.D. x 39/64" O.D. x 3/32" Thick—Steel	Zenith Carburetor Div.	T43-25	106	2	.05
23131	Bowl Fuel Assembly	Zenith Carburetor Div.	B8-7-2	106	1	2.00
23132	Cover, Fuel Bowl Assembly	Zenith Carburetor Div.	C6-3D	106	1	.75
23135	Float, Assembly	Zenith Carburetor Div.	C85-15	106	1	.60
23136	Gasket, Bowl Cover	Zenith Carburetor Div.	C144-1-1	106	1	.10
23138	Plug, Lower	Zenith Carburetor Div.	C138-23	106	1	.35
23139	Needle, Main Jet Adjusting	Zenith Carburetor Div.	C73-7	106	1	.90
23140	Spring, Main Jet Adjusting	Zenith Carburetor Div.	C111-21	106	1	.10
23141	Well, Metering—#40	Zenith Carburetor Div.	C76-23-40	106	1	.75
23142	Washer, Fiber—13/64" I.D. x 5/16" O.D. x .038"	Zenith Carburetor Div.	T56-24	106	1	.05
23143	Jet, Main—#21	Zenith Carburetor Div.	C59-2-21	106	1	.75
23144	Kit, Gasket	Zenith Carburetor Div.	C181-203	106	1	.50
74703	Wire—#14 Sw. Bd. Solid—10 Ft.	.....	.....	109	1	.50
74704	Wire, Solid—#10 Sw. Bd.—10 Ft.	.....	.....	109	1	.70
75666	Funnel	.....	.....	112	1	.35
75738	Stud—5/16"-18x2 1/2"—Threaded Brass Rod	.....	.....	109	1	.10
75858	Coupling, Iron Pipe—1/2" I.P.S.	.....	.....	100	1	.15
75895	Frame, Tool and Parts Box—Steel	.....	.....	112	1	6.50
75895B	Box, Parts—Steel	.....	.....	112	1	1.25
75895C	Tray, Tool—Steel	.....	.....	112	1	1.25
75992	Extinguisher, Fire—1 Qt.	Pyrene Mfg. Co.	C-21T	112	1	14.00
75993	Can, Oil	Eagle Mfg. Co.	27	112	1	1.30
75993B	Bracket, Mounting	.....	.....	111	2	.50
75997	Bracket, Fire Extinguisher Mtg.-#75998	.....	.....	111	1	1.25
76490	Snap, Harness	.....	.....	111	4	.20
76561	Voltmeter, A.C. 0-150	Simpson Electric Co.	56	109	1	10.00
76569	Receptacle, Twistlock—10 Amp.	Harney Hubbel, Inc.	4112	109	1	1.10
76649	Lock, Includes Two Keys	Yale and Towne Mfg. Co.	3341/2	112	1	2.00
76700	Switch, Stop	Soreng-Manengold Co.	55701A	109	1	.85
76701	Receptacle, Panel Lamp	.....	.....	109	1	.25
76702	Ammeter, A.C.—0-50	Simpson Electrical Co.	56	109	1	13.75
76703	Breaker, Circuit—35 Amp. Single Pole	Square D Co.	971135	109	1	7.00
76713	Lead, A.C. Outlet Terminal to A.C. Brush—24"—White	.....	.....	110	1	.25
76714	Lead, A.C. Ammeter to A.C. Brush—24"—Black	.....	.....	110	1	.30
76723	Assembly, Fuel Tank Cap and Gage	.....	.....	105	1	2.50
76724	Panel, Control	.....	.....	111	1	5.00
76726A	Ring, "D"—7/8"	.....	.....	111	4	.30
76727	Clamp, Crank	.....	.....	111	1	.65
76728	Handle, Carrying	.....	.....	111	2	3.50
76729	Screw, Shoulder	.....	.....	111	4	.75
76730	Control, Manual Choke	Clum Mfg. Co.	25209	111	1	.75
76735	Cover Canvas	.....	.....	111	1	12.00
76736	Band, Generator End Bell—20 Ga.	.....	.....	110	1	2.50
76740B	Line, Fuel Flexible—7"	Weatherhead Co.	85069-W	105	1	.75
76857	Plate, Meter Hole Cover	.....	.....	111	1	.15

Contractor's Part Number	Description	Manufacturer	Mfg. No.	Page No.	Qty. per Unit	Price
77500	Hammer, Ball Pein—#1	Vlchek Tool Co.	X-164	112	1	.80
77511	Screwdriver—#742-5/16"x6" Rd.	Vlchek Tool Co.	742	112	1	.40
77535	Pliers, Combination	Vlchek Tool Co.	PR-206	112	1	.30
77560	Wrench, Pipe—10"	....	....	112	1	1.90
77570	Wrench, Adjustable—9"	Vlchek Tool Co.	40	112	1	.60
77581	Wrench, Breaker Point	Electric Auto-lite Co.	X-41	112	1	.10
77588	Wrench, Spark Plug—Inc. 77589—Handle	Vlchek Tool Co.	X-13	112	1	.60
77589	Handle, Spark Plug Wrench	....	....	112	1	Incl. in 77588
77705	Wrench, for 5/16" Socket Type Headless Set Screw	Pheoll Mfg. Co.	....	112	1	.15
77709	Wrench, for 7/16" Socket Head Cap Screw	Pheoll Mfg. Co.	....	112	1	.15
77975	Set, Open End Wrench	Barcalo Mfg. Co.	4006R	112	1	1.50
78043	Cover, Bearing Inspection	....	....	111	1	.45
79450	Set, Piston Rings—One Set per Piston	....	....	102	2	1.20
	Plug, Pipe—3/8" I. P. S.	....	....	—	1	.10
	Tubing, Black Insulating—2"	....	....	—	1	30 Ft.
	Wire, Stove Pipe—10" Oil Screen	....	....	—	1	.05
	Bulb, Light—50 Watt—Rough Service	....	....	—	1	.15

61. LIST OF PRIMARY MANUFACTURERS

All Steel Equipment Co.
Aurora, Ill.

Aluminum Industries
Keller & Beekman Sts.
Cincinnati, Ohio

American Cabinet Hardware Corp.
416 S. Main St.
Rockford, Ill.

Armstrong Cork Co.
1010 Concord St.
Lancaster, Pa.

Arrow Hart and Hegeman Co.
Laurel and Peck Sts.
Hartford, Conn.

Barcola Mfg. Co.
225 Louisiana St.
New York, N. Y.

Bassick Co.
Austin St.
Bridgeport, Conn.

Brighton Advance Corp.
Brighton, Mich.

Champion Spark Plug Co.
Toledo, Ohio

Clum Mfg. Co.
600 W. National Ave.
Milwaukee, Wis.

Detroit Gasket & Mfg. Co.
12640 Burt Road
Detroit, Mich.

Donaldson & Co., Inc.
666 Pelham
St. Paul, Minn

Dunlap Mfg. Co.
Newton, Iowa

Eagle Mfg. Co.
Charles St.
Wellsburg, W. Va.

Eaton Mfg. Co.
Cleveland, Ohio

Electric Autolite Co.
Moto-Meter Div.
LaCrosse, Wis.

Electric Utilities Co.
2902 S. Michigan Ave.
Chicago, Ill.

Harvey Hubbell, Inc.
Bridgeport, Conn.

Hoover Ball & Bearing Co.
Ann Arbor, Mich.

Hubbard Spring Co., M. D.
221 Central Ave.
Pontiac, Mich.

Ideal Clamp Mfg. Co
435 Liberty Ave.
Brooklyn, N. Y.

Independent Rubber Co.
665-667 W. Washington Blvd.
Chicago, Ill.

National Motor Bearing Co
Broadway & National Ave.
Redwood City, Calif.

Pheoll Mfg. Co.
405 2nd Ave. N.
Minneapolis, Minn

Pyrene Mfg. Co.
540 Belmont Ave.
Newark, N. J.

Rochester Mfg. Co.
201 Rockwood St.
Rochester, N. Y.

Schwitzer, Cummins Co.
22nd & Yander St.
Indianapolis, Ind.

Simpson Electric Co.
Chicago, Ill.

Soreng Manigold Co.
1903 N. Clybourn Ave.
Chicago, Ill.

Square D Co.
4041 N. Richards St.
Milwaukee, Wis.

Tillotson Mfg. Co.
Toledo, Ohio

Victor Gasket & Mfg. Co.
5150 W. Roosevelt Rd.
Chicago, Ill.

The Vlcheck Tool Co.
3001 E. 87th St.
Cleveland, Ohio

Walker Mfg. Co.
Racine, Wis.

The Weatherhead Co.
Cleveland, Ohio

Wico Electric Co.
Springfield, Mass.

The Yale & Towne Mfg. Co.
200 Henry St.
Stanford, Conn.

Zenith Carburetor Div.
Bendix Aviation Corp.
696 Hart Ave.
Detroit, Mich.

TM 5-5404 GENERATOR SET, PORTABLE, GASOLINE ENGINE-DRIVEN, SKID-MOUNTED, [illegible] KW, 115-VOLT, 1-PHASE, 60-CYCLE, AC, ONAN, MODEL W3M-19 (Engine: Onan, Model W2C) MODEL XRB