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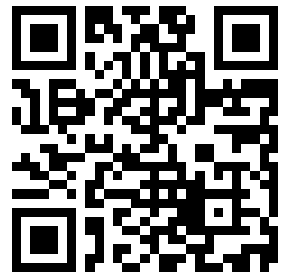

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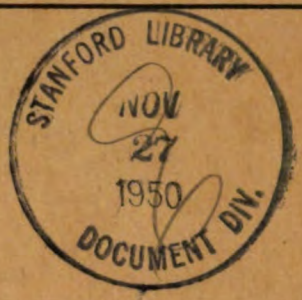

MAINTENANCE INSTRUCTIONS

POWER UNITS PE-88 AND PE-88-A

WAR DEPARTMENT • 5 JULY 1945

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WAR DEPARTMENT
Washington, 25, D. C., 25 June 1947

TM11-997, Handbook of Maintenance Instructions for Power Unit PE-88 and PE-88-A, dated 5 July 1945, is published for the information and guidance of all concerned.

[AG 300.7 (25 June 47)]

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POWER UNITS PE-88 AND PE-88-A

WAR DEPARTMENT • *5 JULY 1945*

United States Government Printing Office
Washington : 1950

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LIST OF ILLUSTRATIONS

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DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:—

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:—

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

★

UNSATISFACTORY REPORT

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Radio model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the inspector of Naval Materiel (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

Form 1022 procedure shall be used when reporting failure of radio equipment.

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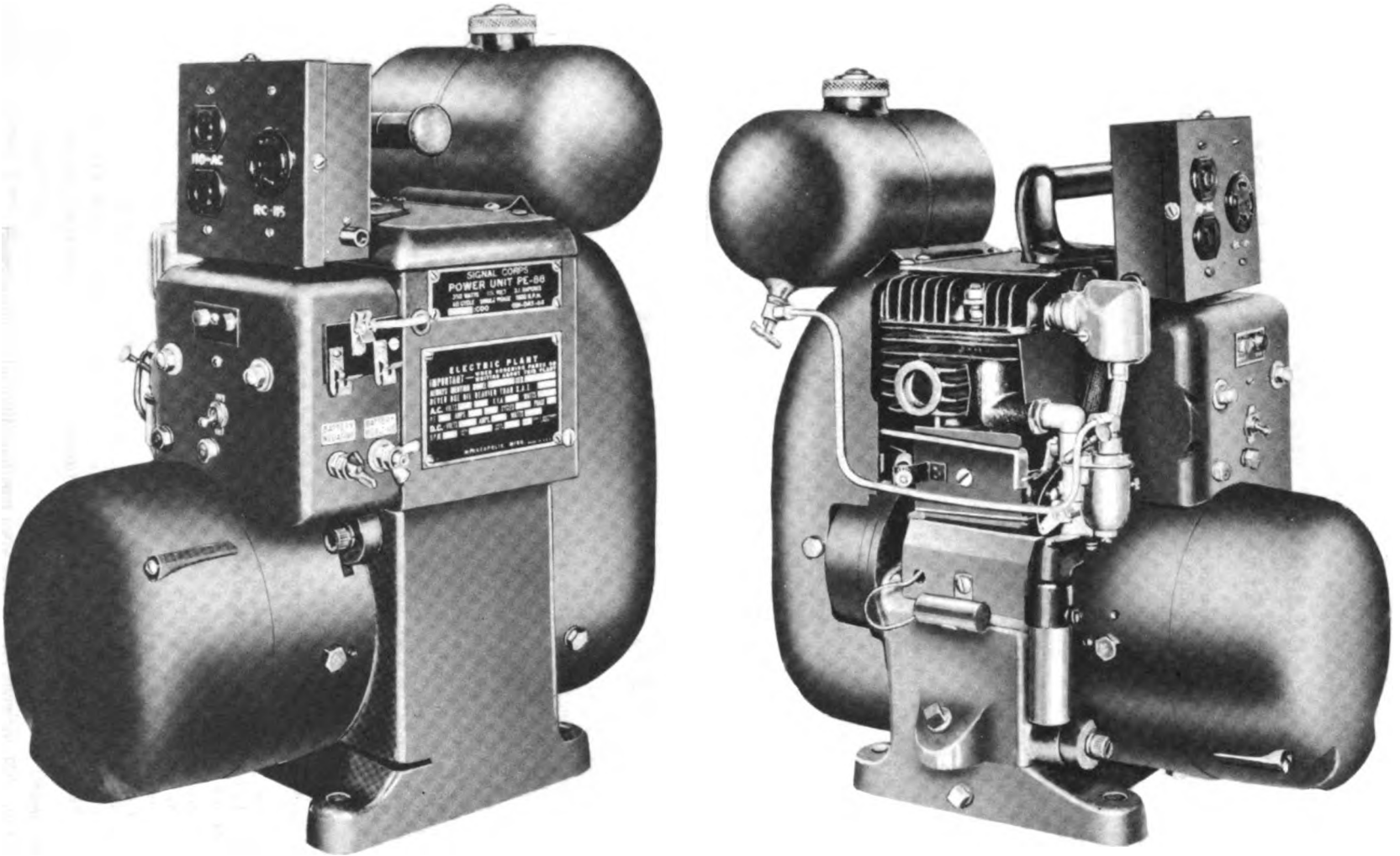

Left Side View *Right Side View*

Figure 1-1. Power Unit PE-88

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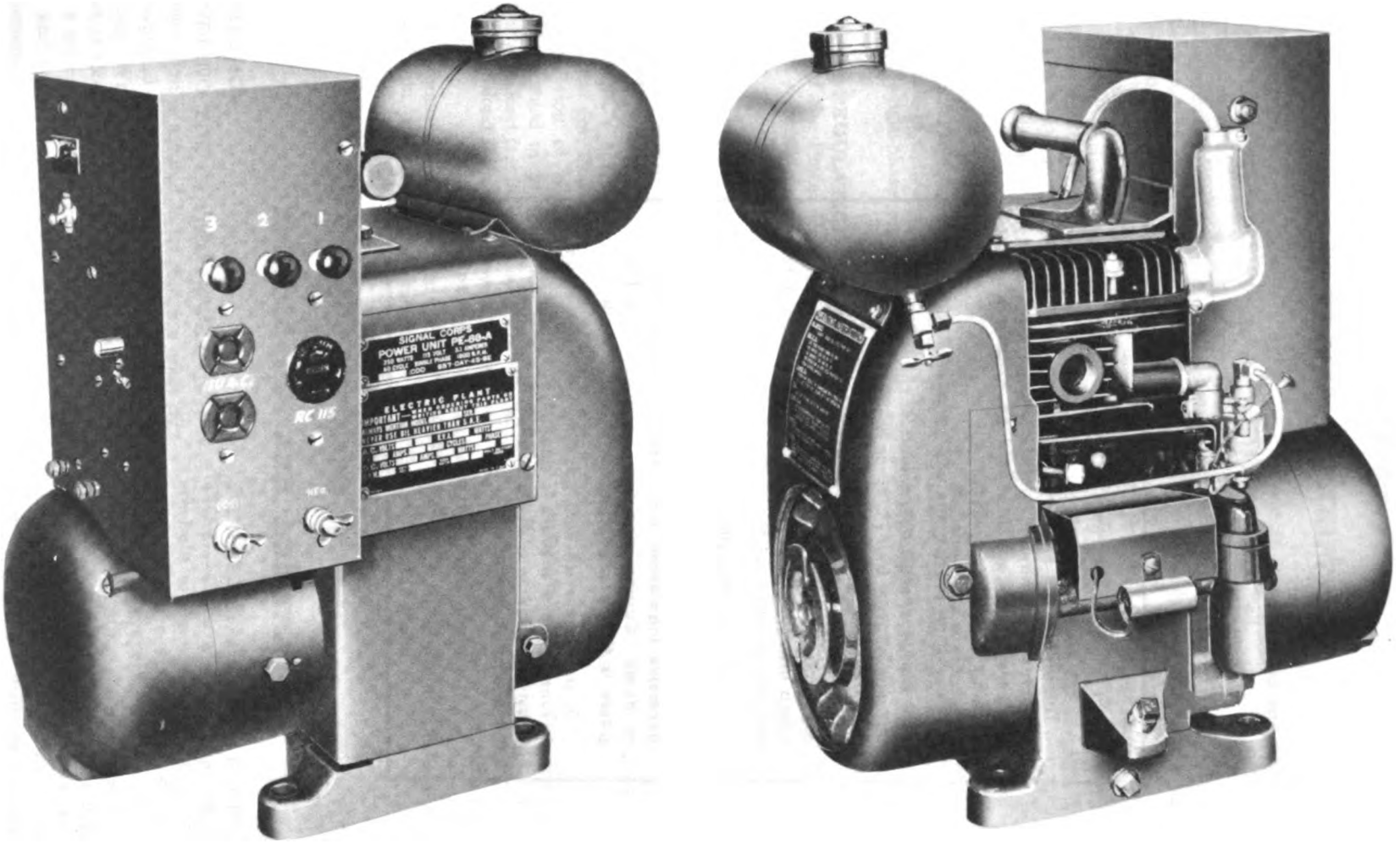

Left Side View **Right Side View**

Figure 1-1A. Power Unit PE-88-A

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SAFETY NOTICE

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Caution should be exercised when working on the equipment.

Observe all precautions and safety regulations:

1. Do not attempt adjustments or changes on wiring while Power Unit PE-88 or PE-88-A is in operation. Each unit generates high voltage, so that severe and possibly fatal shocks may be encountered especially when power unit is operating on wet or damp ground. Always disconnect the battery before working on either of the units.

2. Sufficient and proper ventilation must be provided, if the power unit is operated in a confined space. Exhaust gases produced are poisonous, and excessive inhalations may result in severe sickness or death. Carbon monoxide contained in exhaust gases is tasteless, odorless and a deadly poison.

3. Do not service with gasoline while power unit is running, or if a radio is operating in close proximity to power unit. Avoid spilling of gasoline and oil on a hot engine.

4. Operator should observe every standard safety regulation while operating this power unit.

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SECTION I

GENERAL DESCRIPTION

1. GENERAL.

a. DESCRIPTION.—Power Unit PE-88 and PE-88-A are complete electric generating plants. Each consists of a gasoline engine and a directly-coupled electric generator, with the necessary accessories and controls, all assembled into a single unit.

b. USE.—Power Unit PE-88 or PE-88-A is used to furnish electric power to operate radio equipment, signal systems, lights, heating units, small motors (up to 1/8 h.p.), and other appliances which require 115-volt, 60-cycle, single-phase alternating current. Each is air-transportable, but is intended for ground use.

c. OUTPUT RATING.—Power Unit PE-88 or PE-88-A is capable of delivering a maximum of 350 watts, 60-cycle, single-phase alternating current, at 115 volts.

d. VOLTAGE REGULATION.—The output voltage regulation of the Power Unit PE-88 generator, after reaching normal operating temperature, is within the limits of 130 volts at no load to 112 volts at full load.

The output voltage regulation of the Power Unit PE-88-A generator, after reaching normal operating temperature, is within the limits of 117 volts at a 50-watt load to 109 volts at full load.

e. FREQUENCY REGULATION.—The frequency regulation for Power Unit PE-88 depends upon the regulation of the engine speed and is within a total spread of 3 cycles per second when adjusted for a no-load frequency below 63 cycles per second and a full-load frequency above 58 cycles per second.

The frequency regulation for Power Unit PE-88-A is within the limits of 62 cycles per second at 50-watts load and 58.5 cycles per second at 350-watts load.

2. EQUIPMENT SUPPLIED.

The equipment supplied is one complete power unit, either Power Unit PE-88 or PE-88-A. (Refer to Sec. VI, Par. 8, for detailed information regarding dimensions, weights, and serial numbers.)

3. DESCRIPTION OF MAJOR UNITS.

a. ENGINE.

(1) DESIGN.—The engine is a single-cylinder, 4-stroke cycle, L-head, air-cooled type gasoline engine with a compression ratio of 4.28 to 1. It furnishes the power which drives the generator. The engine and the generator are directly coupled. The engine is designed to operate best on fuels having a 65- to 80-octane rating with a lead content of not more than 3 cubic centimeters per gallon.

(2) STARTING.—The engine may be started either manually by means of a rope or electrically by means of a 12-volt starting winding.

(3) ELIMINATION OF RADIO INTERFERENCE.—The high tension cable from the magneto to the spark plug is covered by special wire shielding to minimize normal radio interference. The spark plug is covered by a two-piece casting for the same purpose. This casting clamps around the wire shielding.

b. GENERATOR.—The generator has an a-c winding and a d-c winding on the same armature. The a-c winding provides the 115-volt a-c output of the power unit. The d-c winding supplies 12 volts d-c to charge the storage batteries and is used as a 12-volt d-c starting winding when the generator is used as a starting motor.

SECTION II

INSTALLATION AND ADJUSTMENT

1. INSTALLATION.

a. HANDLING THE CRATED POWER UNIT.—The power unit is secured in its shipping crate by four bolts placed through four rubber shock-absorbing bushings. Within each crate are a set of spare parts, a set of tools, a muffler, an oil drain nipple and coupling, a starter rope, four rubber shock-absorbing bushings, and an instruction book. These items are securely fastened in place. When they are freed from the crate, take care that they are not damaged or lost.

b. IMPORTANCE OF PROPER INSTALLATION.—Although Power Unit PE-88 and PE-88-A are built to rigid specifications and carefully tested and inspected before leaving the factory, they cannot function properly and give the best service unless the operating conditions are reasonably favorable. Many of these conditions depend entirely on the installation. The instructions which follow apply under usual conditions. When they cannot be followed exactly, use them as a guide and make the best installation that circumstances permit.

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mixture are given in Section V. Refer to figure 5-1, "Lubrication Chart (Assembly Outline)" in connection with crankcase and other lubrication.

(6) AIR CLEANER.—The air cleaner needs freqent cleaning service only. It does not use oil. It is simply a tube containing a screen to clean the air going into the carburetor. Clean it by rinsing in clean gasoline.

(7) THROTTLE CONNECTING LINK.—Place a drop of S.A.E. No. 10 oil on the joint at each end of the governor-to-throttle connecting link.

(8) LOAD WIRES.—Check the load wires for proper connections.

(9) FUEL SHUT-OFF VALVE.—Close the fuel shut-off valve located under the main fuel tank.

(10) FUEL TANK.—Inspect the inside of the fuel tank for foreign material. If it needs cleaning, disconnect the gas line at the shut-off valve and flush out the tank. Replace the fuel line. Fill the tank with a good grade of gasoline, ranging from 65 to 80 octane rating. Refer to Technical Order No. 08-1-21 for gasoline to be used. (Use unleaded fuel if obtainable.) Observe all safety precautions for the handling of this fuel.

(11) FUEL SHUT-OFF VALVE.—Open the fuel shut-off valve to the position which permits the gasoline to flow to the carburetor.

3. AFTER-INSTALLATION OPERATING TEST.

a. After making the necessary installation and following the procedure in paragraph 2 above, make an operating check to see that the unit functions properly.

b. Start the power unit. (See Section III for instructions.)

c. Measure the output voltage with an a-c voltmeter. The voltage at no load should be approximately 115 volts for Power Unit PE-88.

d. Place a load of 350 watts on the generator (use lamps in parallel) and again measure the voltage. If the power unit is operating satisfactorily the voltage should be approximately 112 volts for Power Unit PE-88 and 109 volts for Power Unit PE-88-A. The engine should continue to run smoothly at this load.

SECTION III

OPERATION

1. STARTING THE EQUIPMENT.

a. PRELIMINARY.—When the instructions for installation and preparation for use, Section II, have been complied with, the power unit is ready for use and may be started. If the power unit was prepared for cold weather operation, the initial filling with diluted oil may have been left to be done immediately before starting the power unit. Make sure that the crankcase is filled to the level of the top of the filling hole and that there is at least one quart of gasoline in the gas tank.

b. STARTING THE POWER UNIT ELECTRICALLY.—Press the "START" button (see figs. 1-1, 3-1), firmly until the engine starts, but not for more than 10 or 15 seconds at any one time. At the same time pull out on the choke control knob to close the choke as much as required by temperature conditions. When the engine is cold the choke must be in a nearly closed position to provide a rich enough mixture for starting. When warm, only light choking is required. Use care not to flood the engine by over-choking. If the plant does not start after a few attempts, check the fuel supply and the ignition wires before repeating the starting procedure.

Note

Oil was placed in the cylinders before shipping, and in some cases it may be necessary to remove the cylinder head and by using a lint-free cloth, wipe all excess oil from the piston and cylinder wall.

c. STARTING THE POWER UNIT MANUALLY.—In case the installation does not provide a battery or the starting battery does not furnish sufficient cranking power, the power unit may be started by hand cranking. To start the plant manually proceed as follows:

(1) CHOKING.—Pull out on the choke control knob to close the choke as much as required (explained under subject: "Starting the Power Unit Electrically").

(2) CRANKING.—Wind the starting rope clockwise around the grooved starting sheave on the blower end of the power unit (fig. 3-1) and give a strong pull the full length of the rope. Repeat, if necessary.

d. OPERATING AFTER THE ENGINE STARTS.—After the engine has started, continue to provide a rich fuel mixture until the engine is warm

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as to separate it at least several inches from the inflammable material. If necessary, shield the pipe so that no one will be burned by contact with it.

(4) ELECTRICAL CONNECTIONS.—Make sure that all electric wires entering and within the room or shelter are properly supported and insulated. Connect the load wires to the output receptacles of the power unit box. Make sure that all connections are mechanically and electrically secure.

e. MOBILE INSTALLATION.

(1) MOUNTING.—Attach the power unit securely to the floor or other support member of the vehicle in which it is installed. It should be so installed that it will set approximately level when in normal operation. Take full advantage of the available space in locating the power unit so as to provide proper ventilation and space for servicing.

CAUTION

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 the exhaust gases outside the building. Exhaust gases are poisonous and can cause death if inhaled.

(2) VENTILATION.—If the vehicle is a closed one, proper ventilation must be provided. Improper ventilation will greatly reduce the service life of valves, rings and spark plugs. This will require at least two openings, an inlet and an outlet, near opposite ends of the power unit. Several smaller openings will serve, if necessary, but there should be at least 1-1/2 square feet of opening for the inlet and a similar amount for the outlet, with means provided for closing them as temperature and weather conditions may require.

(3) WIRING.—Support all permanent wiring within the vehicle so that vibration will not destroy the insulation or break the wires. Wire is easily run in any direction. Do not let its location interfere with convenient servicing of the power unit.

CAUTION

Do not store other items on, or against, the power unit, or loosely within the compartment in such manner as to risk damaging the unit while in transit.

(4) LEVELING.—If the power unit is to be operated for hours at a temporary location, locate the vehicle so that the power unit is reasonably level.

2. PREPARATION FOR USE.

a. PROCEDURE.—Comply with the following instructions in the order given:

(1) INSTALLATION.—Recheck to make sure that all instructions for installing the power unit as given in paragraph 1 have been complied with.

(2) CRANK MANUALLY.—Turn the engine over a few times with the rope crank to make sure that the piston is free and that the generator turns freely. There is a crank rope in the tool kit.

(3) BATTERY.—A 12-volt, automotive type storage battery must be provided to supply power for cranking the engine electrically. Make sure that the battery has been prepared for service according to the manufacturer's instructions, and that it is well charged.

(a) Connect the positive (+) post of the battery to the "BATTERY POS." terminal on the control box. Connect the negative (—) post of the battery to the "BATTERY NEG." terminal on the control box. Use automotive type battery cables and make sure that all connections are clean and tight. Correct connections are shown on the wiring diagram, figure 8-8.

(b) Two 6-volt automotive type batteries connected in series may be used instead of one 12-volt battery. If this is done, connect the positive (+) post of one 6-volt battery to the negative (—) post of the other 6-volt battery. Then connect the two remaining posts to the BATTERY terminals on the control box as already described.

(4) ELECTRICAL CONNECTIONS.—Check all electrical connections including the spark plug to make sure they are tight and clean.

(5) CRANKCASE LUBRICATION.—Remove the oil fill plug from the crankcase and fill the crankcase with oil to the level of the top of the filling hole. (See fig. 3-1.) Use U. S. Army Spec. No. 2-104-B oil of proper S.A.E. rating according to the lowest temperature to which the power unit will be exposed, as indicated in the following table.

TEMPERATURE	S.A.E. NUMBER
Above 10° C (50° F).....	S.A.E. No. 20 or 30 (See Note)
Between −17.7° C (0° F) and 10° C (50° F).....	S.A.E. No. 10
Below −17.7° C (0° F).....	S.A.E. No. 10 diluted with 10% kerosene, or Thinning Oil Spec. No. 3601

Note

If grade 20 is not available use grade 30 at temperatures above 26.6°C. (80°F.), or use equal parts of grade 10 and 30 at temperatures above 10°C. (50°F.).

CAUTION

Do not put diluted oil into the engine until ready to start it as it may separate if allowed to stand too long before use. Mix well just before pouring into engine. Special instructions for preparing and using this

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mixture are given in Section V. Refer to figure 5-1, "Lubrication Chart (Assembly Outline)" in connection with crankcase and other lubrication.

(6) AIR CLEANER.—The air cleaner needs freqent cleaning service only. It does not use oil. It is simply a tube containing a screen to clean the air going into the carburetor. Clean it by rinsing in clean gasoline.

(7) THROTTLE CONNECTING LINK.—Place a drop of S.A.E. No. 10 oil on the joint at each end of the governor-to-throttle connecting link.

(8) LOAD WIRES.—Check the load wires for proper connections.

(9) FUEL SHUT-OFF VALVE.—Close the fuel shut-off valve located under the main fuel tank.

(10) FUEL TANK.—Inspect the inside of the fuel tank for foreign material. If it needs cleaning, disconnect the gas line at the shut-off valve and flush out the tank. Replace the fuel line. Fill the tank with a good grade of gasoline, ranging from 65 to 80 octane rating. Refer to Technical Order No. 08-1-21 for gasoline to be used. (Use unleaded fuel if obtainable.) Observe all safety precautions for the handling of this fuel.

(11) FUEL SHUT-OFF VALVE.—Open the fuel shut-off valve to the position which permits the gasoline to flow to the carburetor.

3. AFTER-INSTALLATION OPERATING TEST.

a. After making the necessary installation and following the procedure in paragraph 2 above, make an operating check to see that the unit functions properly.

b. Start the power unit. (See Section III for instructions.)

c. Measure the output voltage with an a-c voltmeter. The voltage at no load should be approximately 115 volts for Power Unit PE-88.

d. Place a load of 350 watts on the generator (use lamps in parallel) and again measure the voltage. If the power unit is operating satisfactorily the voltage should be approximately 112 volts for Power Unit PE-88 and 109 volts for Power Unit PE-88-A. The engine should continue to run smoothly at this load.

SECTION III

OPERATION

1. STARTING THE EQUIPMENT.

a. PRELIMINARY.—When the instructions for installation and preparation for use, Section II, have been complied with, the power unit is ready for use and may be started. If the power unit was prepared for cold weather operation, the initial filling with diluted oil may have been left to be done immediately before starting the power unit. Make sure that the crankcase is filled to the level of the top of the filling hole and that there is at least one quart of gasoline in the gas tank.

b. STARTING THE POWER UNIT ELECTRICALLY.—Press the "START" button (see figs. 1-1, 3-1), firmly until the engine starts, but not for more than 10 or 15 seconds at any one time. At the same time pull out on the choke control knob to close the choke as much as required by temperature conditions. When the engine is cold the choke must be in a nearly closed position to provide a rich enough mixture for starting. When warm, only light choking is required. Use care not to flood the engine by over-choking. If the plant does not start after a few attempts, check the fuel supply and the ignition wires before repeating the starting procedure.

Note

Oil was placed in the cylinders before shipping, and in some cases it may be necessary to remove the cylinder head and by using a lint-free cloth, wipe all excess oil from the piston and cylinder wall.

c. STARTING THE POWER UNIT MANUALLY.—In case the installation does not provide a battery or the starting battery does not furnish sufficient cranking power, the power unit may be started by hand cranking. To start the plant manually proceed as follows:

(1) CHOKING.—Pull out on the choke control knob to close the choke as much as required (explained under subject: "Starting the Power Unit Electrically").

(2) CRANKING.—Wind the starting rope clockwise around the grooved starting sheave on the blower end of the power unit (fig. 3-1) and give a strong pull the full length of the rope. Repeat, if necessary.

d. OPERATING AFTER THE ENGINE STARTS.—After the engine has started, continue to provide a rich fuel mixture until the engine is warm

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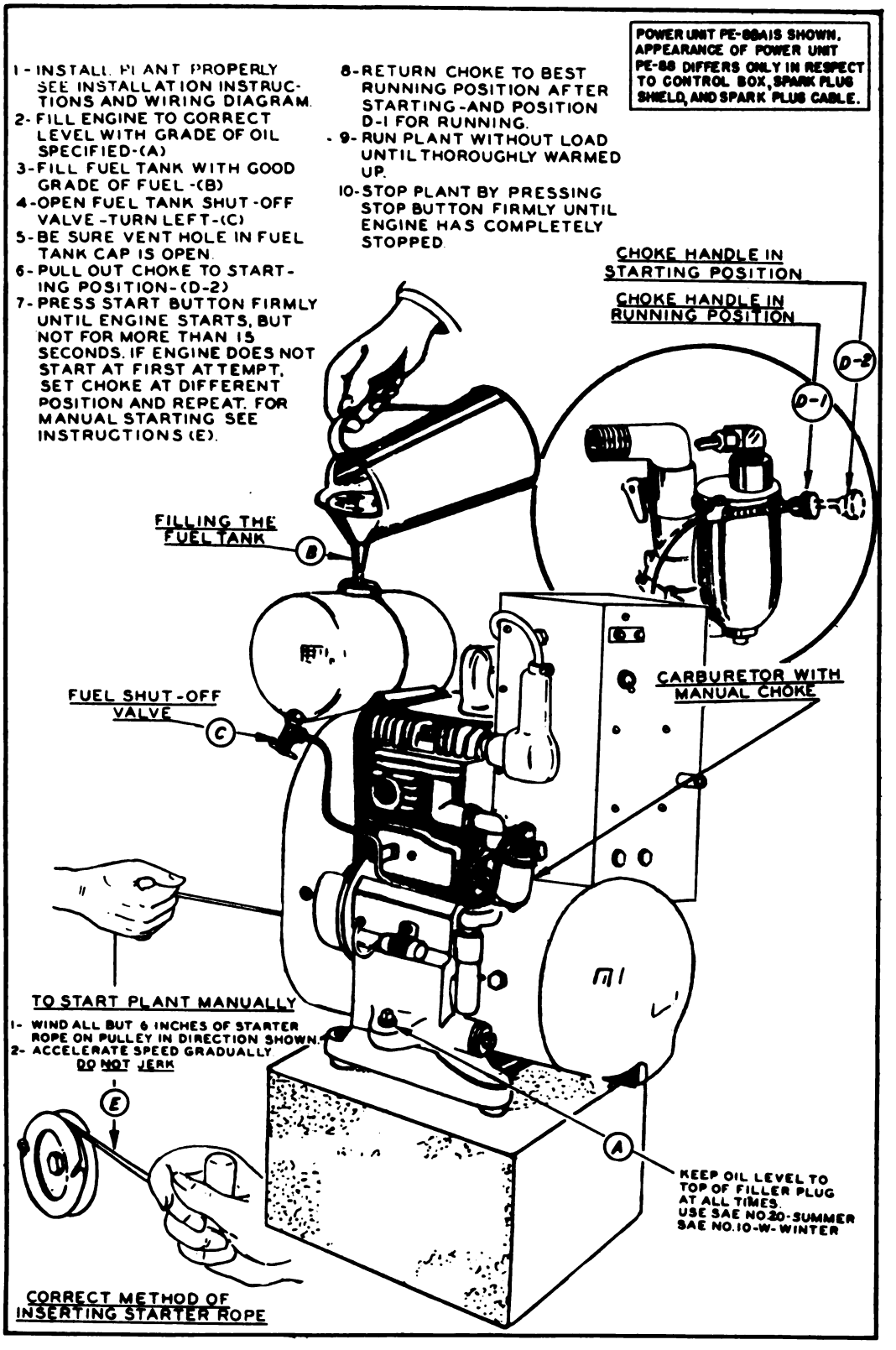

Figure 3-1. Operating Instructions

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enough to operate smoothly without choking. During the first few minutes push the choke control in gradually until the full open position is reached without the engine's running unevenly because of a too rich mixture or misfiring because of a mixture that is too lean. Do not connect the load until the engine is warm enough to operate smoothly without choking.

2. STOPPING THE EQUIPMENT.

To stop the power unit press the "STOP" button on the control panel. The high tension magneto on this power unit will produce a firing spark even at a low speed; therefore, it is necessary to press the "STOP" button firmly until the engine has stopped rotating.

3. ABNORMAL OPERATING CONDITIONS.

Abnormally cold or abnormally hot temperatures require special attention regarding lubrication and cooling. Unusually dirty and dusty operating conditions and the use of highly-leaded fuels also require extra attention. To attain satisfactory performance under these various conditions requires special maintenance of the equipment. For details refer to Section V.

SECTION IV

THEORY OF OPERATION -- FUNCTIONING OF PARTS

1. GENERAL.

Power Unit PE-88 or PE-88-A is a complete electric generating plant consisting of a gasoline engine and a directly coupled electric generator, with the necessary accessories and controls, all assembled into a single unit.

2. ENGINE.

a. FOUR STROKE CYCLE.—The engine is an internal-combustion gasoline engine. Such engines develop their power by burning a compressed mixture of gasoline and air in the cylinders and apply the resulting expanding force on the head of the piston. The resulting downward motion of the piston is transmitted through the connecting rod to the crankshaft. The engine operates on the usual four-cycle principle, the action of which may be considered as being a repetition of a cycle of four different strokes. The four strokes are performed in two complete revolutions of the engine crankshaft.

(1) 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, intake manifold, and intake valve port. As the air passes through the carburetor, the proper proportion of gasoline is mixed with it. At the end of the intake stroke the intake valve closes, sealing the cylinder.

(2) COMPRESSION STROKE.—The piston travels upward with both valves closed and compresses the fuel mixture in the combustion chamber (the upper part of the cylinder head). As the piston reaches the top of the stroke, the ignition spark occurs at the spark plug and burning of the fuel mixture begins.

(3) POWER STROKE.—Burning of the fuel mixture continues, developing great heat and pressure. Since both valves are closed, the expanding gases force the piston downward transmitting its power through the connecting rod to the crankshaft.

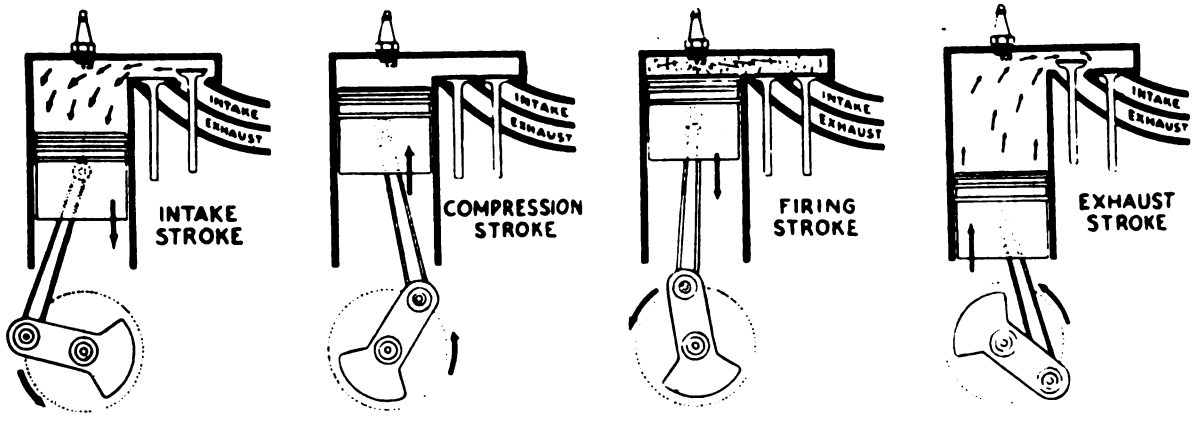

Figure 4-1. 4-Cycle Principle

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

b. POWER.—The amount of power developed by the engine, and hence its speed under a given load, is largely determined by the position of the throttle valve in the carburetor, which regulates the amount of fuel mixture that enters the cylinder. The throttle valve is automatically controlled by the engine governor.

c. VALVES AND CAMSHAFT.—There are two poppet-type valves located in the cylinder; one an intake valve, which uses the cylinder proper as a seat, the second, the exhaust valve, which uses a special inserted ring in the cylinder as a seat. The valves are operated by tappets riding on the camshaft and are adjusted by screws in the ends of the tappets. The valve timing is determined by the correct angular positioning of the crankshaft gear with respect to the camshaft gear. On each gear is a mark. These marks must match to give the correct valve timing.

d. COOLING SYSTEM.—The engine is air cooled and therefore needs a large amount of cool, clean air circulating around it. The air is forced over the cylinder and cylinder head by a flywheel type centrifugal blower. An air-cooled engine will normally operate at a higher temperature than a liquid-cooled engine (such as an automobile engine).

e. LUBRICATION.—A pump and splash lubricating system is used. A piston type pump lifts oil from a one-quart oil base to a dip-trough. An agitator on the connecting rod dips into the trough and sprays oil to all internal parts of the engine. (See figures 4-2 and 5-7.)

3. ENGINE GOVERNOR.

The engine has a fly-ball type governor. The purpose of the governor is to control the speed of the engine under various loads and to hold the output frequency and voltage within the limits desired for operating the intended equipment.

When the plant is started, eight steel balls located in the camshaft gear are moved by centrifugal force up short inclines in the gear casting and forced against the governor cup. The cup acts upon the paddle and shaft which is connected to the governor arm. The governor arm is link-connected to the carburetor throttle lever. A governor regulating spring is attached to the arm to balance the centrifugal force of the balls.

The tension of this spring is set by means of a screw adjustment on one end of the spring to keep the plant running at approximately the same speed under varying load conditions.

4. CARBURETOR.

This power unit is equipped with a Zenith Model 59-B3 adjustable carburetor. A float regulates the level of gasoline in the carburetor. The function of the carburetor is to deliver a proper mixture of fuel and air to the engine under all load conditions.

a. FLOAT FUNCTION.—Gasoline enters the carburetor bowl through the float-operated needle valve assembly, the level to which it rises being controlled by the float. This carburetor has no strainer or screen. The gasoline is strained before it reaches the carburetor by a screen located on the end of the fitting screwed into the bottom of the fuel tank.

b. FUEL MIXTURE ADJUSTMENT.—Gasoline rises to the same level in the jet passage as in the bowl. When the engine is in operation, the passage of intake air through the venturi of the carburetor reduces the pressure at the end of the fuel nozzle to less than the pressure in the bowl. Then fuel flows from the bowl, out the nozzle, and into the intake air stream where it is mixed with the air as it travels on toward the cylinder. The richness of the mixture is adjustable by means of a needle valve which restricts the flow of fuel to the nozzle.

5. AIR CLEANER.

The air cleaner (see figure 5-2) cleans the air which enters the carburetor intake. It does not use oil. It contains a screen which strains the air going into the carburetor. The cleaner requires frequent cleaning only. A dirty air cleaner causes excessive fuel consumption, rapid cylinder and piston wear, and may keep the plant from running.

6. IGNITION SYSTEM.

a. PURPOSE.—The compressed gases (fuel mixture) in the cylinder are ignited by a spark which jumps the gap between the spark plug electrodes. The high voltage required to produce this spark is furnished by the magneto (see fig. 5-10). The spark must occur at the proper time with respect to the upward travel of the piston on the compression stroke.

b. BREAKER MECHANISM.—The breaker points are connected in series with the primary winding of the magneto coil. They are opened and closed once each revolution of the cam which is a part of the crankshaft. Each time the contacts open, a spark occurs at the spark plug gap within the cylinder. The mechanism is so timed that the spark occurs when the piston, traveling upward on the compression stroke, has reached a point 1/8 inch (0.125") from the top of its stroke. Thus the engine fires 24° to 26° of crankshaft travel ahead of top center.

c. CAPACITOR.—The ignition capacitor is connected in parallel with the breaker contacts. Its action is to increase greatly the intensity of the spark and to increase the life of the breaker contacts.

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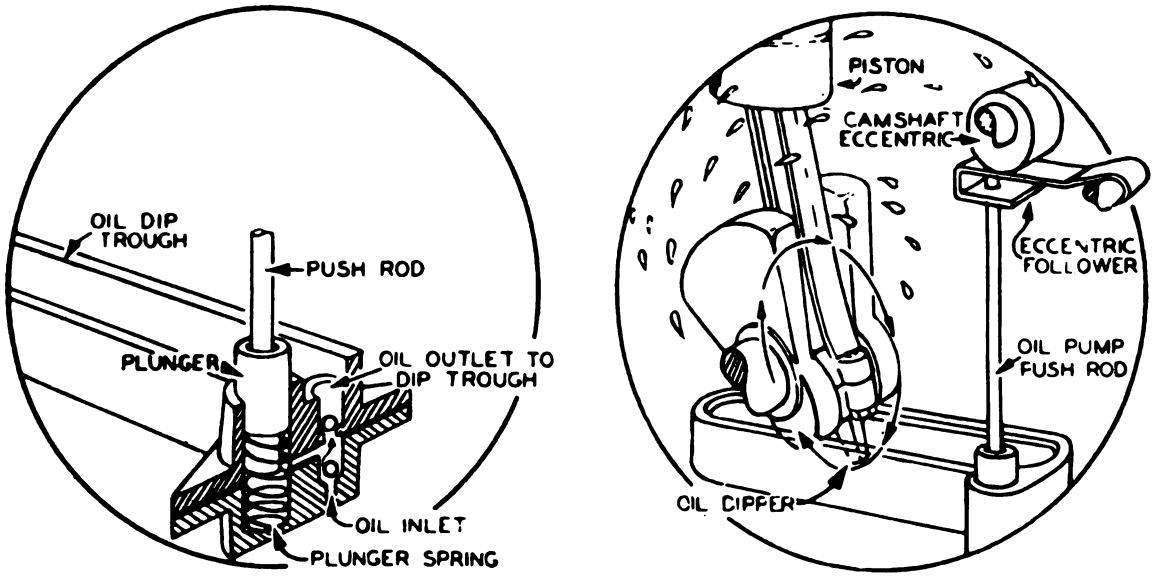

Figure 4-2. Pump and Splash Lubrication

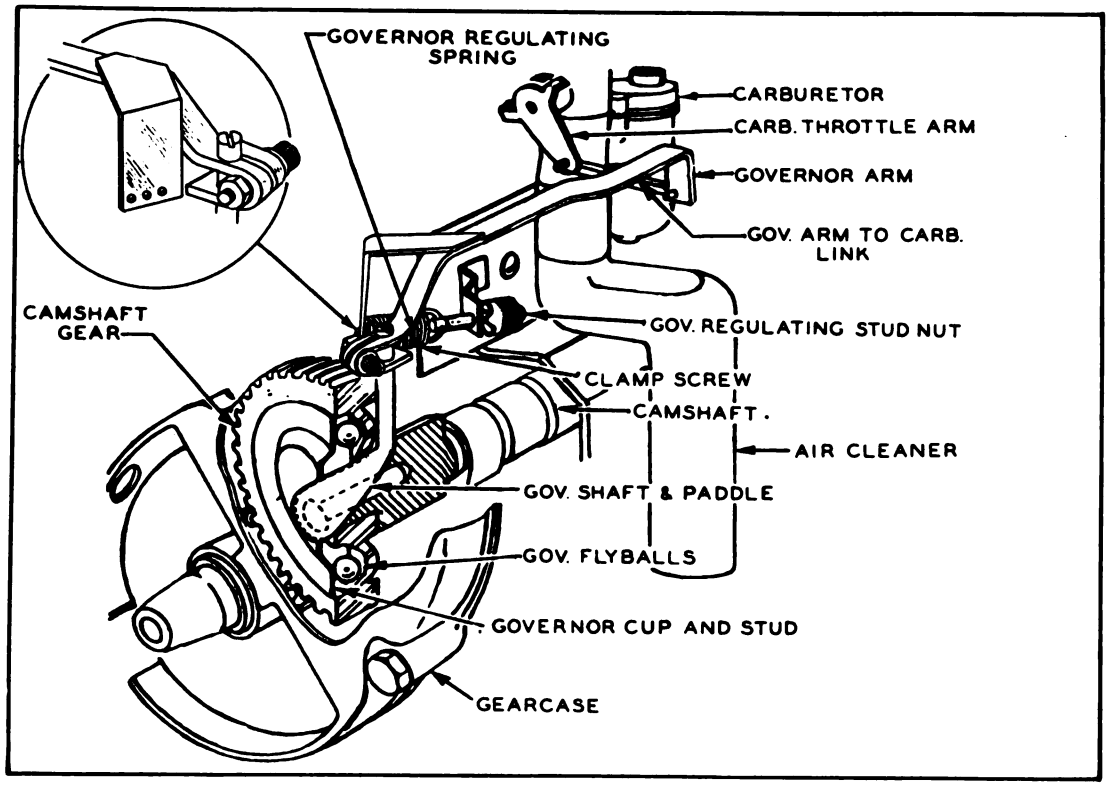

Figure 4-3. Governor Operation

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7. SPARK PLUG.

The spark plug (see fig. 5-3) is an important part of the ignition system. It consists of a center electrode highly insulated from the base, which carries the second electrode. The ignition spark jumps across the gap between the electrodes. It is important that this gap be kept adjusted close to .025 inch.

8. ELECTRICAL CONTROL SYSTEM.

(See figures 8-8, 8-9 and 8-9A.)

a. GENERAL.—The purposes of the control system are to control the starting and stopping of the unit and to control the charging current from the generator to the battery. The control system has a start circuit, a stop circuit, and a charge circuit.

b. STARTING.

(1) The storage battery supplies the power for electric starting. When the "START" button is pressed the start-relay coil is energized and the start-relay contacts close, thus connecting the battery to the generator. The generator, having a voltage applied to it, now acts as a motor, and cranks the gas engine.

(2) The magneto supplies ignition current when the engine is rotating. The engine will continue to run until the "STOP" button is pressed.

(3) When the "START" button is released, the circuit to the start-relay coil is no longer energized, its contacts open, and cranking ceases.

c. STOPPING CIRCUIT.—Pressing the "STOP" button grounds the magneto and causes the engine to stop.

d. CHARGING CIRCUIT.

(See figure 4-4.)

(1) When the "START" button is pressed and the start relay closes, coil (1) of the charge relay is energized. This causes the relay to close. When the engine starts and the "START" button is released, the charging current from the generator, passing through coil (2), holds the charge relay closed.

(2) When the engine stops, the generator voltage falls to zero, the battery tries to operate the generator as a motor which causes the current in relay coil (2) to reverse, discharging from the battery. The magnetic force of coil (2) then acts against that of coil (1), releasing the relay.

9. STORAGE BATTERY.

The 12-volt storage battery, required to supply power for electric cranking, may consist of two 6-volt automobile type batteries connected in series. While the plant is in operation the battery is recharged by the generator through a 1.5-ohm resistance unit. A charging rate switch is mounted on the control panel. With the switch in the "LO" position the charging rate will be a maximum of three amperes. With the switch in the "HI" position the charging rate will be a maximum of about eight amperes. Further adjustment of the high rate may be made by removing the control-panel lid and adjusting the slide-wire resistor.

10. GENERATOR.

a. PURPOSE.—The generator (see figs. 4-3 and 5-11) receives mechanical power from the engine and converts it to electrical power. The generator may be used as a cranking motor when the power unit installation includes a battery.

b. FUNCTION.—The generator develops 12 volts d-c and 115 volts a-c. These voltages are produced in the armature windings due to its rotation in the magnetic fields produced by the field coils. The direct current is taken from the armature by d-c brushes which ride on the commutator. The alternating current is taken from the armature by two round brushes which ride on the collector rings.

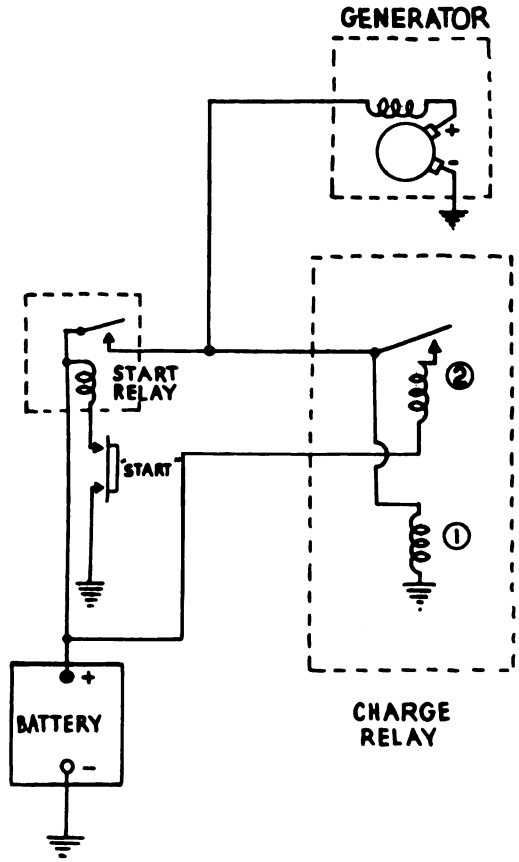

Figure 4-4. Functional Schematic of Charge Relay Circuit

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c. FIELD WINDINGS.—Power Unit PE-88 has a shunt field winding, which provides the excitation for generating purposes and a series field winding to provide additional cranking torque for electric starting. Power Unit PE-88-A has a shunt field winding which furnishes most of the excitation for generating purposes, a series field winding to provide additional cranking torque, and an auxiliary series field winding to provide closer regulation of the output voltage. A current transformer mounted in the control box has its primary winding connected in series with the a-c output circuit. The secondary winding of this transformer supplies current to the auxiliary field winding. This current passes through a rectifier where it is changed to direct current before it reaches the auxiliary field. Due to the series connected primary winding of transformer, the amount of current in the auxiliary field circuit varies with variations in load.

d. CONSTRUCTION.—The generator is a common type having four field coils and pole pieces, a commutator, a-c collector rings, a brush rig assembly, a-c brushes, and d-c brushes. The generator frame assembly is bolted directly to the engine. The armature has no bearings, but depends upon the engine crankshaft for support. The tapered end of the armature fits into the engine crankshaft.

11. FLICKER MECHANISM.

a. A breaker mechanism and a field resistor are used to compensate for the surge in voltage that otherwise would result from the increased engine speed during the power stroke of the engine. (See fig. 8-8.)

b. The breaker contacts are located in a recess in the side of the crankcase below the valve tappet cover. The movable contact is operated by a fiber plunger which rides on the camshaft. The contacts are so connected across the flicker resistor circuit as to make the resistor inoperative while the contacts are closed. The opening of the contacts is so timed with the power stroke of the engine that during the period of increased speed caused by the power stroke the contacts are open and the field strength is reduced, thus preventing the momentary increase in voltage that otherwise would result.

SECTION V

MAINTENANCE

1. PERIODIC INSPECTION AND SERVICE.

CAUTION

Avoid trouble by disconnecting the battery before working on Power Unit PE-88 or PE-88-A.

IMPORTANT

It is important to follow a *definite schedule* of inspection and service operations to maintain a high level of operating efficiency. The keeping of a log book as a continuous operating check is advised. Figure 8-11 is a sample service log form.

a. DAILY INSPECTION.—Make the following inspections at least once a day:

(1) OIL LEVEL.—Check the crankcase oil level at least once every 8 operating hours and whenever the gas tank is filled. Never operate the power unit when the oil level is so low that oil does not extend out into the filler neck. Fill to the top of the oil filler hole. Never check or refill with oil while the engine is running.

(2) FUEL SUPPLY.—Check for a full tank. Be sure of a sufficient fuel supply at all times. The tank holds 2¾ quarts, enough for about 4½ hours of operation. Never add gasoline when the engine is running.

b. WEEKLY INSPECTION.—In addition to the daily inspection, check the following each week, or every 50 operating hours, whichever occurs first:

(1) CRANKCASE OIL.—Check the oil to see if it is discolored (black), or if it is exceptionally thin. If either condition exists drain the oil while the engine is warm, replace and tighten the drain plug securely, and refill with new oil of the correct specification and grade. Oil should be changed every 25 or 50 hours of operation, depending upon the type of service. (Refer to "Preparation For Use," Section II, paragraph 2.)

(2) MINOR LUBRICATION.—Place a drop of light lubricating oil on the choke shaft bearing near the choke lever and on each of the governor-to-throttle connecting link joints.

(3) AIR CLEANER.—If the power unit has been operated under dusty conditions, remove the air cleaner and clean it thoroughly by washing in clean gasoline or suitable solvent. Dip it in light engine oil, allow surplus oil to drain away, wipe the outside of the cleaner dry, and reinstall it. If the power unit is operated under very dusty conditions, clean the air cleaner more often.

(4) SPARK PLUG.—Clean and adjust the spark plug at least once every two weeks.

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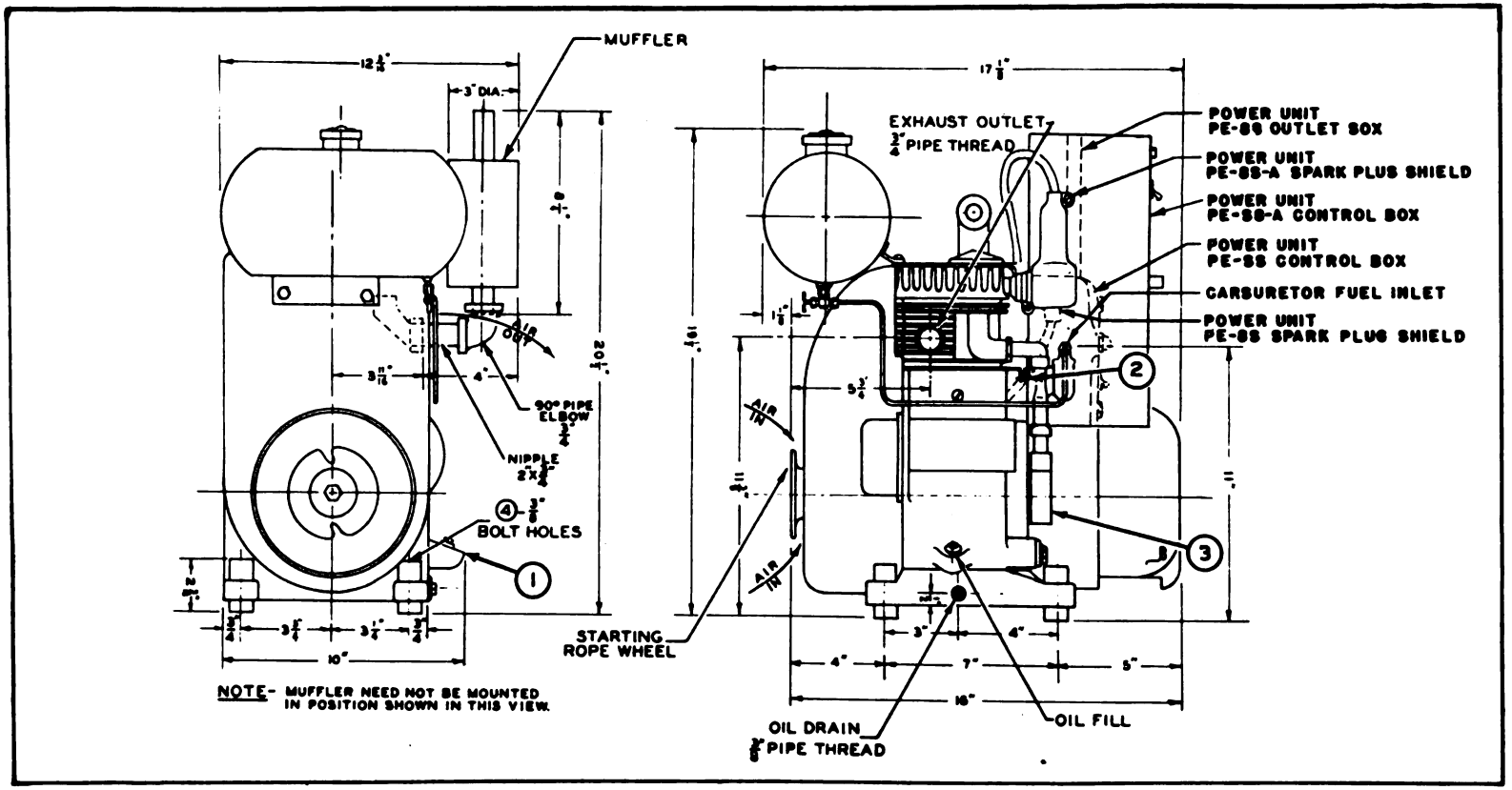

LUBRICATION

NOTE—If operation exceeds 50 hours weekly, give the weekly lubrication every 50 operating hours and the monthly lubrication every 200 operating hours.

1—Crankcase—Check oil level daily or oftener; keep near the top of the oil filler hole. Drain and refill with 1-2/3 pints of new oil monthly,—weekly if using diluted oil. See Section V, Paragraph 1a(1). Use Army No. 204-B oil of proper S.A.E. number as follows:

Above 50° F. .....S.A.E. No. 20 or 30
Between 0° F. and 50° F.....S.A.E. No. 10
Below 0° F. .....S.A.E. No. 10 Diluted as Directed in Section V, Paragraph 3.

2—Governor to Throttle Link Joints—Place a drop of light oil on each joint and a drop on the choke shaft bearing nearer the choke lever weekly.

3—Air Cleaner—Clean the air cleaner weekly, more often under very dusty conditions. See Section V, Paragraph 1a(3).

Figure 5-1. Lubrication Chart (Assembly Outline)

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(5) BATTERY.

(a) Test the battery by means of a hydrometer. All cells should test 1,250 or higher, unless they were filled with 1,200 electrolyte for tropical use. If filled with 1,200 electrolyte for tropical use, the cells should test 1,200 or higher. A test of approximately 1,100 indicates a discharged cell. A difference as great as 500 points between individual cell readings in a 6-volt battery probably indicates that the battery should be replaced with a new one to avoid a definite failure. The same is true when all cells of a battery test uniformly low, unless the low test can be accounted for by excessive starting in comparison with running hours, or by the power unit not having been used for 2 or 3 weeks. In either case, check the battery daily for several days under normal use of at least several hours a day. If its condition does not improve, replace it.

(b) Fill the cells to ⅜ inch above the tops of the separators, using distilled water or water known to be non-injurious to lead-acid batteries. Do not fill high enough to cause overflowing while charging.

c. MONTHLY INSPECTION.—In addition to the daily and weekly inspections, check the following each month, or every 200 operating hours, whichever occurs first:

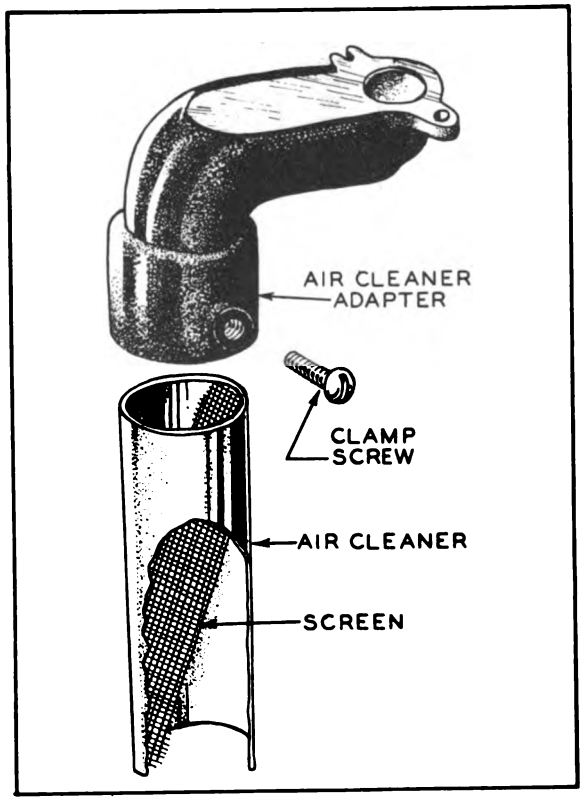

Figure 5-2. Air Cleaner

Figure 5-3. Spark Plug

(1) CRANKCASE OIL.—Drain oil from crankcase while the engine is warm. Replace the plug and refill with one quart of fresh oil of the correct grade.

(2) SPARK PLUG.—Remove the shield and the plug from the cylinder head. Clean the plug and inspect it for cracked or badly eroded porcelain. Discard the plug if not in good condition and replace with a new one. Adjust the spark gap to .025 inch. When replacing the plug make sure its gasket is in place and that the plug is tightened securely.

(3) BATTERY TERMINALS.—Check the battery terminals, cleaning and tightening them if needed. When they are clean and secure, apply a coating of petroleum jelly to the outside. Replace the cables if they are not in good condition.

(4) FUEL.—Remove the combination fuel valve and screen from the fuel tank and clean the strainer screen.

(5) GENERATOR.—Remove the cover from the end bell on the generator every 200 operating hours and inspect the commutator, collector rings, and brushes. Clean, if necessary, with a lint-free cloth. Check the brushes to make sure that they make good contact, can move freely in their holders, and that they have uniformly good spring tension. Replace any brush worn to less than ⅝ inch in length. New brushes must be sanded-in to fit the commutator (for instructions on sanding-in, refer to "Detailed Service and Repair," Section V).

(6) GENERAL.—Inspect the power unit thoroughly for leaks, loose electrical connections, and other external parts which may need attention. Make needed corrections. Always investigate any unusual noises in your plant. Knocks are usually due to too

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much clearance in bearings, piston pin, or similar points. First inspect the oil level and the condition of the oil. Check for carbon in the cylinder. Never run the power unit without making needed corrections for the damage may develop into more serious trouble.

d. SIX-MONTH INSPECTION.—After each six months or 500 hours of operating, whichever comes first, recheck all points under *a*, *b*, and *c* above, and in addition, inspect and service as follows:

(1) GENERATOR.—Replace all worn brushes and springs. If necessary, clean the commutator and collector rings with grade 00 sandpaper. Remove all grease and grime with a cloth dipped in carbon tetrachloride.

(2) COOLING.—Clean all dirt from the cooling fins of the engine and the inside of the blower housing.

(3) VALVES.—Check the condition of the valves and grind if necessary. (Refer to "Detailed Service and Repair" under Section V.)

(4) VALVE TAPPETS.—Adjust the valve to valve-tappet clearance. To do this, remove the tappet cover and crank the engine manually one full revolution of the crankshaft after the intake valve begins to open. Then check the valve to tappet clearances with a feeler gauge. The correct clearance at 21.01°C. (70°F.) for the intake valve is 0.008 inch to 0.010 inch, for the exhaust valve 0.010 inch to 0.012 inch. Adjust by loosening the tappet-adjusting screw lock nut and turning the adjusting screw as required. Tighten the lock nut and recheck with the feeler gauge. Replace the tappet cover, using a new gasket if needed.

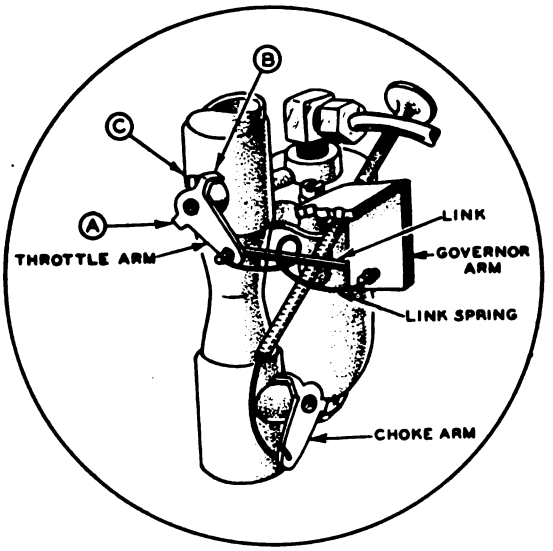

Figure 5-4. Governor To Carburetor Connections

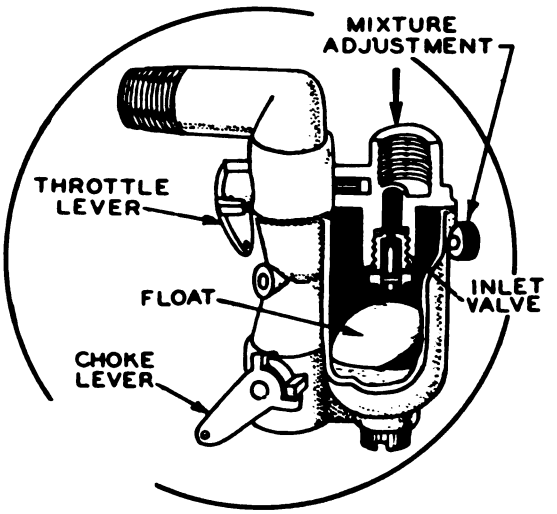

Figure 5-5. Carburetor

WARNING

EXHAUST GASES ARE POISONOUS. If the power unit is operated in a confined space, sufficient and proper ventilation must be provided. Excessive inhalations of the exhaust gases may result in severe sickness or death. Carbon monoxide contained in exhaust gases is tasteless, odorless, and a deadly poison.

(5) EXHAUST SYSTEM.—Inspect all exhaust connections. Replace or tighten all parts requiring attention. Inspect manifold connections and flexible exhaust pipe (if used). Permit no leaks that will allow exhaust gas to escape within a building or closed shelter.

(6) CARBURETOR.—Remove the carburetor and clean it thoroughly with gasoline. Be careful not to damage the float as this part regulates the level of the fuel within the carburetor. Reassemble the carburetor, install it, and adjust the mixture valve so that the engine operates smoothly.

(7) COMPRESSION.—If the compression is poor or oil consumption is high, give the engine a complete overhaul.

2. TROUBLE CHART—SYMPTOM, CAUSE, REMEDY.

Note

This trouble chart is designed to aid maintenance personnel in the isolation and correction of all common conditions of breakdown and poor running of this power unit. Never operate the unit if it is running improperly; always correct any trouble before it can develop into serious damage. If the trouble cannot be located and remedied, disconnect the power unit, and replace it with a spare power unit.

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TROUBLE CHART

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY	REFERENCE
Battery will not crank plant.	Discharged battery.	Hydrometer test.	Recharge or replace battery.	See Sec. V, Par. 1*b*(5)
	Corroded terminals.	Battery terminals.	Clean, and tighten terminal clamps.	See Sec. V, Par 5*a*(16)
	Loose connections.	Cable connections.	Tighten connections.	See Sec. V, Par. 5*a*(19)c or 1c(3)
	Engine frozen.	Try cranking by hand.	Return unit to depot for repairing.	
Engine cranks too slowly. (May use rope crank until trouble is corrected.)	Too heavy oil in crankcase.	Inspect oil.	Drain, refill with lighter oil.	See Sec. V, Par. 3*b*(2)
	Weak battery.	Hydrometer test.	Recharge or replace battery.	See Sec. V, Par. 1*b*(5)
	Corroded terminal.	Battery terminals.	Clean and tighten terminal clamps.	See Sec. V, Par. 5*a*(16)
	Defective cable.	Battery cables.	Install new cable.	See Sec. V, Par. 1c(3)
	Corroded start relay contacts.	Try the manual rope crank.	Clean the relay contacts. Return unit to depot for replacements if necessary.	See Sec. V, Par. 5*a*(15)
Engine is cranked electrically, but will not start	Defective ignition system.	Spark plug and breaker points.	Clean or replace spark plug. Adjust or replace breaker points.	See Sec. V, Par. 5*a*(19)b
	Lack of fuel or faulty carburetion.	Fuel tank empty.	Refill.	See Sec. V, Par. 5*a*(2)
		Clogged fuel line.	Clean.	
		Shut-off cock closed.	Open shut-off cock.	
		Low-grade fuel.	Drain, refill with higher octane fuel.	
		Dirt in carburetor.	Clean.	
		Air cleaner clogged.	Clean.	
		Improper fuel mixture.	Adjust carburetor.	
	Poor compression, usually because of leaky valves.	Turn over by grasping starting sheave with hands, to try for compression.	Tighten or replace head gasket. Tighten spark plug. Adjust tappets. Clean carbon from cylinder head. Grind valves. If still not corrected, return unit to depot for repairing.	See Sec. V, Par. 5*a*(3)
	Wrong timing.	Spark timing.	Retime.	
Uneven running.	Low gasoline level.	Fuel tank.	Refill.	See Sec. V, Par. 1*a*(2)
	Dirty gasoline.	Fuel supply.	Clean carburetor, fuel line, gas tank, and refill tank with clean fuel.	See Sec. V, Par. 1*b*(3) and 5*a*(2)
	Dirt in carburetor.	Carburetor.	Clean the carburetor.	See Sec. V, Par. 5*a*(2)c
	Carburetor adjustment set wrong.	Carburetor.	Adjust.	See Sec. V, Par. 5*a*(2)c
	Faulty ignition.	Fouled spark plug.	Clean and adjust spark plug.	See Sec. V, Par. 5*a*(18)
		Spark plug gap too narrow.	Set gap at .025".	
		Pitted or improper adjusted breaker contact.	Adjust or replace.	
		Defective ignition capacitor.	If breaker contacts are badly pitted and spark weak and yellow, replace the capacitor.	
		Magneto coil.	Replace.	
	Tappets adjusted too close.	Tappets.	Adjust.	See Sec. V, Par. 1*d*(4)
	Sticking valve.	Valve.	Return unit to depot for repairing.	
	Broken valve spring.	Valve spring.	Replace.	See Sec. V, Par. 5*a*(3)b
Engine stops running unexpectedly.	Fuel tank empty.	Fuel tank.	Refill.	See Sec. V, Par. 1*a*(2)

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TROUBLE CHART (Continued)

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY	REFERENCE
	Overheated.	Cooling system and ventilation provisions.	Remove any material around the engine cylinder. Clean air cleaner and vent louvers.	See Sec. V, Par. 5a(12)
	Fuel tank air vent clogged.	Fuel tank cap.	Clean.	
	Clogged fuel line.	Fuel line at carburetor.	Clean.	See Sec. V, Par. 5a(2)
	Air lock in fuel line.	Fuel line.	Disconnect momentarily at carburetor to displace bubble.	
	Frozen piston due to lack of oil.	Turn egine over with rope crank.	Drain and refill with fresh oil. If this does not correct fault, return to depot for repairing.	
	Sticking piston due to excessive carbon.	Inside cylinder head and top of piston.	Clean away all carbon, especially from rings and grooves.	
	Defective or short circuited stop button.	Stop circuit and stop button.	Repair any shorts in wiring, or replace defective stop button.	
	Magneto breaker arm sticking.	Magneto breaker arm.	Repair or replace.	See Sec. V, Par. 5a(18)
Engine back-fires at carburetor.	Lean fuel mixture.	Carburetor.	Adjust carburetor.	See Sec. V, Par. 5a(2)c
		Air leaks at intake manifold.	Replace gaskets, tighten.	
	Spark too late.	Spark timing.	Retime.	
	Intake valve leaking.	Hiss through carburetor.	Adjust tappets. If this does not correct, return unit to depot for servicing.	See Sec. V, Par. 5a(3)a
Excessive oil consumption; light blue, smoky exhaust.	Poor compression.	Crank by grasping starting sheave with hands to check compression.	Tighten or replace head gasket. Tighten spark plug. Adjust tappets. Check for broken or improperly fitted rings, or cylinder bore scored or out of round.	See Sec. V, Par. 1d(7)
	Oil leaks from oil base.	Inspect visually for leaks.	Replace gasket. Tighten screws and connections. Drain, refill with correct oil.	See Sec. V, Par. 5a(11)
Black, smoky exhaust, excessive fuel consumption. Fouling of spark plug with black soot, possible lack of power under heavy load.	Fuel mixture too rich.	Carburetor float for leak, needle valve for leak, jets for wear and damage, gasket washers for leaks.	Install needed carburetor part. Be sure all jet gaskets are in place and tight and needle valve gasket is in place and tight.	See Sec. V, Par. 5a(2), (3)
	Choke not open.	Choke.	Open choke.	
	Dirty carburetor or clogged air cleaner.	Carburetor air cleaner.	Clean with gasoline.	See Sec. V, Par. 1d(6) and 1a(3)
Dull, metallic thud, if not very bad, may disappear after few minutes operation. If bad, it will increase with load.	Loose crankshaft bearing.	Accelerate under load.	Return unit to depot for repairing, unless one of the next three remedies permanently corrects trouble.	See Sec. V, Par. 5a(10)
Sharp, metallic thud, especially when cold plant is first started.	Low oil supply.	Oil supply.	Add oil.	See Sec. V, Par. 1a(1)
	Oil badly diluted.	Inspect oil.	Change oil.	See Sec. V, Par. 1b(1)
Pinging sound when engine is rapidly accelerated, or heavily loaded.	Thick deposits of lead or carbon in cylinder.	Compression pressure. Inspect combustion chamber through spark plug hole.	Remove carbon.	See Sec. V, Par. 4

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TROUBLE CHART (Continued)

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY	REFERENCE
	Spark too early.	Check timing.	Retime.	
	Wrong spark plug.	Spark plug.	Install Champion J-10.	See Sec. V, Fig. 5-3
	Spark plug burned or carbonized.	Spark plug.	Install new plug.	See Sec. V, Par. 5a(18)c
	Valves hot.	Tappet clearance.	Adjust tappets.	See Sec. V, Par. 5a(5)
	Lean fuel mixture.	Carburetor.	Clean and adjust.	See Sec. V, Par. 5a(2)c
Clicking sound.	Tappet clearance too great.	Tappet clearance.	Adjust tappets.	See Sec. V, Par. 1d(4)
	Broken valve spring.	Valve springs.	Install new spring.	See Sec. V, Par. 5a(3)b
Hollow clicking sound with cool engine under load.	Loose piston.	Put tablespoonful heavy oil in cylinder. Crank engine to lubricate piston. 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 repairing.	See Sec. V, Par. 5a(7)
Voltage drops under heavy load.	Engine lacks power.	Poor compression.	Tighten or replace head gasket. Tighten spark plug. Adjust tappets.	See Sec. V, Par. 5a(2) and 1d(4)
		Carburetor.	Clean.	
		Air cleaner.	Clean with gasoline.	
		Choke.	See that it opens wide.	
		Carbon in cylinder.	Remove carbon.	
		Restricted exhaust line.	Clean, or increase the size.	
Generator overheating.	Overloaded.	Check load.	Reduce load.	
	Field coil short-circuited.	Field coil.	Repair or replace.	See Sec. V, Par. 5b(6)
	Grounds in armature windings or in commutator or collector rings.	Armature and commutator or collector rings.	Repair or replace.	See Sec. V, Par. 5b(2), (3), (4)
	Poor commutation.	Brushes, commutator and collector ring surfaces.	Replace brushes, sandpaper or turn commutator.	See Sec. V, Par. 5b(1), (2), (3)
Voltage unsteady, but engine not misfiring.	Poor commutator, or poor brush contact on slip rings.	Commutator and brushes.	See that brushes seat well on commutator, are free in holders, are not worn shorter than ½" and have good spring tension. If commutator is rough or badly grooved, return unit to depot for repair.	See Sec. V, Par. 5b(2), (5)
	Loose connections.	Check for loose connections.	Tighten connections.	
	Fluctuating load.	Check load.	Correct any abnormal load condition causing trouble.	
	Defective line capacitor.	Check capacitor.	Replace.	See Sec. V, Par. 5b(8)d
Engine runs, but a-c voltage does not build up.	Poor commutation.	Commutator and brushes.	See that brushes seat well on commutator, are free in holders, are not worn shorter than ½" and have good spring tension. If commutator is rough or badly grooved, return unit to depot for repair.	See Sec. V, Par. 5b(2), 4c
	Open circuit, short circuit, or ground in generator.	No simple test.	Return unit to depot for repairs.	See Sec. V, Par. 5b(4), (6)
	Poor seating of brushes on slip rings.	Slip rings and brushes.	Give slip ring brushes same attention as commutator brushes.	See Sec. V, Par. 5b(3), (5)

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3. MAINTENANCE UNDER SPECIAL TEMPERATURE AND ATMOSPHERIC CONDITIONS.

a. OPERATING TEMPERATURES.—The optimum temperature range of cooling air for this power unit is from 0 °C. (32 °F., freezing point of water) to 37.7 °C. (100 °F.). Whenever possible the cooling air temperature should be maintained within this range.

b. COLD WEATHER OPERATION.

(1) COOLING.—If practicable, regulate the ventilation of the room, or other enclosure in which the power unit is installed so as to maintain a moderate room temperature while the power unit is in operation. Starting will be made easier if the temperature of the power unit is kept above 0 °C. (32 °F.), either by heating the room in which it is installed or by storing it in a warm place when not in use.

(2) LUBRICATION.—If the power unit is to be exposed to starting temperatures below —17.8 °C. (0 °F.), use diluted oil in the crankcase to aid in starting and to assure proper lubrication. If the crankcase is already filled with undiluted oil, run the engine until warm. Then drain the oil and replace the drain plug. Thoroughly mix 1 part kerosene (or thinning oil, Spec. No. 3601) with 9 parts of Army No. 2-104-B oil, SAE No. 10. A good grade of distillate may be substituted for the kerosene if necessary. Do not use heavier than SAE 20 oil, or separation may occur when the engine is stopped. Fill the crankcase with the diluted oil to the top of the filling hole. Run the engine 10 minutes to distribute the oil inside the engine.

CAUTION

Never add kerosene alone to the crankcase. This applies also to the addition of oil between changes. When using diluted oil, change the oil every 50 operating hours and check the oil level every 8 operating hours. The frequent changing is necessary to prevent excessive sludge formation in the crankcase. Water condenses in the crankcase when the engine cools down, and sludge is formed by water mixing with oxidized oil.

c. HOT WEATHER OPERATION.

(1) Make sure that the engine is in good mechanical condition and that the carburetor and the ignition are properly timed.

(2) Keep the cooling fins of the engine clean.

(3) Avoid overloads.

(4) Provide sufficient ventilation.

d. DUST AND DIRT.—When the power unit is operated under dusty conditions, it is necessary to check and service it more often.

(1) Keep the plant as clean as possible.

(2) Keep supplies of fuel and oil in air-tight containers.

(3) Clean the air cleaner in gasoline as often as necessary. Check daily.

(4) Clean the generator commutator, slip rings, and brushes often. See that the brushes ride easily in their holders.

4. SPECIAL MAINTENANCE WHEN USING HIGH OCTANE FUELS.

Activities under AAF should comply with T. O. 08-1-21.

a. The performance of gasoline engines normally falls off 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, on the valve seats, and on the spark plugs, the use of such fuels causes the engine performance to fall off 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, or less, of lead per gallon there is little such effect. However, as the proportion of lead is increased the drop in engine performance is greatly accelerated.

b. Under normal operating conditions with unleaded fuel it may be necessary to remove carbon each 500 operating hours, grind valves each 1000 operating hours, clean spark plug each 100 operating hours, and change crankcase oil each 50 operating hours.

c. When using leaded fuels, inspect the engine more often and give it the more frequent service required. When using Army 80-octane fuel, aviation 100 octane fuel, or other fuel containing more than 2 cubic centimeters of lead per gallon, change the crankcase oil each 25 operating hours. When using such highly leaded fuels it may be necessary to remove carbon and lead deposits and grind valves each 100 operating hours, clean spark plug each 35 operating hours. If carbon and lead deposits are removed every 50 operating hours, the periods between valve grinding jobs usually can be considerably lengthened.

5. DETAILED SERVICE AND REPAIR.

a. ENGINE.

Note

Lubricate well with engine oil all working parts throughout the engine when assembling after servicing or replacing parts.

(1) ENGINE GOVERNOR.

(a) SPEED ADJUSTMENT.—The speed of the engine, and therefore the output voltage and fre-

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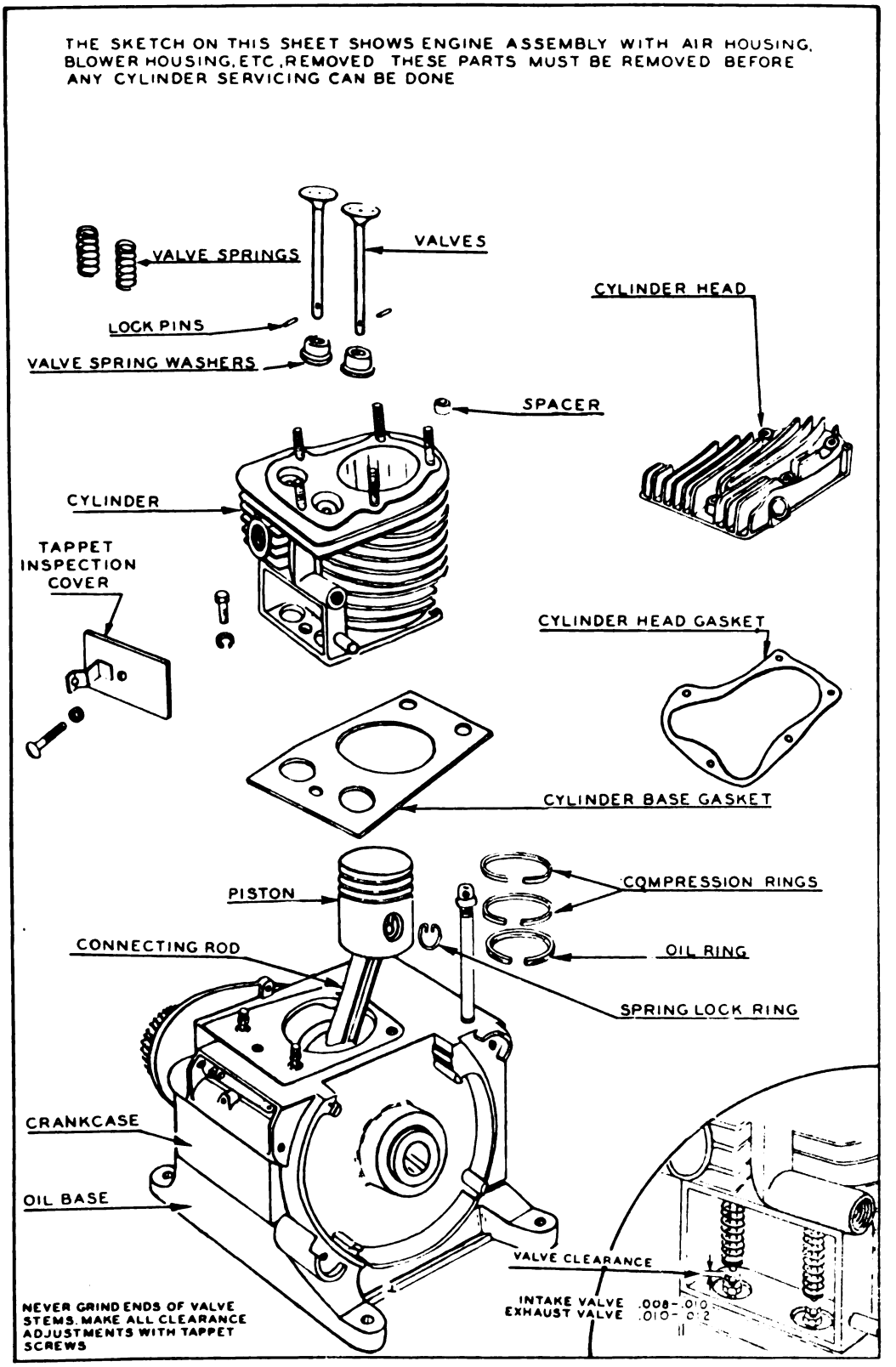

Figure 5-6. Cylinder and Valve Maintenance

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quency, are controlled by the governor. To keep the engine running at the proper speed under various loads, the governor regulating spring must be set to the proper tension. The spring has a screw adjustment on one end. Increase the spring tension to increase the speed of the engine (i.e., raise the voltage and frequency). Decrease the spring tension to decrease the engine speed (i.e., lower the voltage and frequency). Final adjustment must be made with the engine at normal operating temperature.

(b) DISASSEMBLY AND READJUSTMENT.—If the governor is disassembled, or if the carburetor is removed from the engine, resetting of the governor is necessary. Proceed as follows:

(1) On power units not fitted with a blower housing cover plate, close the fuel shut-off valve, disconnect the fuel line and remove the blower housing and fuel tank assembly to gain access to the front end of the governor arm. Power Unit PE-88-A has a plate on the blower housing which may be removed to gain the necessary access to the governor. These two housings have the same part numbers and are completely interchangeable.

(2) Loosen the hollow head screw which clamps the governor arm to the end of the governor shaft at the top of the gearcase. With the throttle connecting link installed (connecting the governor arm and the carburetor throttle arm), work the arm back and forth through its full normal travel and make sure there is no binding condition. If there is binding at any point, bend the end of the governor arm or the end of the throttle arm to remove the binding condition. Then close the throttle by pushing the governor arm toward the cylinder. While holding in that position insert a screwdriver in the slot at the top of the governor shaft and turn the shaft clockwise as far as possible. Tighten the clamp screw but not enough to prevent moving the arm on the shaft. Then pull the governor arm outward carefully until the throttle is open wide. In this position the projection B in figure 5-4 will be almost against the boss C. Tighten the clamp screw. When the arm is properly set, the projection B will rest about 1/16 inch from the boss C when the engine is not running.

(3) There are two types of governor arms, one (used only on power units with serial numbers 232,251 and higher) has three spring attaching holes at various distances from the fulcrum of the lever, the other has only one such hole. Speed and frequency regulation are closest when the spring is hooked in the hole nearest to the governor shaft. However, if hunting occurs when that hole is used, it may be necessary to use one of the other holes.

(4) Final adjustment of the governor should be made by adjusting the spring tension as explained in paragraph 5*a* (1) *(a)*, this section.

(2) FUEL SYSTEM.

(a) GENERAL.—The most important servicing required is to keep the fuel tank, carburetor, connecting fuel line, shut-off valve, and strainer free of dirt, water and leaks. This requires care in handling of the fuel and periodic cleaning of the line and strainer.

Note

To prevent the gummy residue in gasoline from depositing and hardening in the fuel system, the fuel tank should be completely drained when the engine is not used at least once a week.

(b) FUEL TANK.—To remove, close the shut-off valve, disconnect the fuel line, and remove the screws from the tank bracket.

(c) CARBURETOR.

(1) The carburetor requires little attention other than cleaning and this can be kept to a minimum by using clean fuel and keeping the screen at the bottom of the gas tank clean. If the engine is not performing correctly, do not hastily jump to the conclusion that the carburetor is at fault. First check carefully the ignition system, the valve action, the compression, the fuel system other than the carburetor, the fuel supply, the oil level, and the load.

(2) To give the carburetor a thorough cleaning, remove it from the engine and dismantle it. Remove the screw plug, adjusting needle and float. Examine the float to see if it is dented or is punctured in any manner. It is essential that the float be in good condition because it regulates the level of gasoline within the carburetor bowl. Wash all parts thoroughly in clean gasoline.

(3) Clean the jet holes by blowing air through them. The jet holes are made quite small and very exact; therefore, never clean them with a wire or drill.

(4) To adjust the carburetor, run the plant near full load and close the jet until the engine speed is slightly reduced, then carefully open the jet a little at a time until the engine has picked up speed again. This will be the best setting for all-around operation. The final adjustment should be made with engine at normal operating temperature.

(3) VALVES.

(a) WHEN TO GRIND VALVES.

(1) Lack of power in an engine may be caused by poor seating of the valves in the valve seats. This allows gases in the compression chamber to escape through the intake or the exhaust port. By the use of a cylinder compression gauge one can readily determine whether or not the valve is properly seated. Compression gauge readings should show approximately 60 pounds or more.

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Note

When testing the compression, be sure that the tappets are properly adjusted.

(2) If no gauge is available, turn the engine by hand and note whether the compression seems great enough. When the engine is well up on the compression stroke, if the flywheel is released, the compression should rock the crankshaft backward forcibly. Compressed gases leaking past an exhaust valve cause a hissing noise at the exhaust outlet. If they are leaking past the intake valve, a hissing noise can be heard through the carburetor.

(3) With tappets properly adjusted, any valve leak present should be corrected by cleaning the carbon from the cylinder head and grinding the valves.

(b) GRINDING VALVES.—Whenever the valves are ground, care should be taken to maintain factory limits and clearances, as only by maintaining these can the best engine performance be obtained. (Refer to Section VI, par. 9.) Proceed as follows:

(1) Close the fuel shut-off valve and disconnect the fuel line at the carburetor.

(2) Remove the blower housing and fuel tank as an assembly. This assembly is held in place by five binder head machine screws and two hexagon head cap screws.

(3) Loosen but do not remove the two hexagon head screws which hold the control box to its bracket. This will loosen the control box so it does not press against the cylinder air housing or the cylinder cover.

(4) Remove the two flat head machine screws which hold the carrying handle and box bracket to the cylinder head. Remove the handle and lay the box aside without disconnecting the wires from it.

(5) Disconnect the magneto ground wire at the control box.

(6) Remove the cylinder air cover and the cylinder air housing as one assembly.

(7) Remove the spark plug shield; disconnect the wire from the spark plug.

(8) Remove the cylinder head nuts and spacers. Then remove the cylinder head and the cylinder head gasket.

(9) Remove the governor spring adjusting nut after noting the number of exposed threads, so as to be able to later replace the nut at an approximately correct position.

(10) Remove the tappet cover.

(11) Turn the crankshaft to a position where both valves are closed. Loosen the tappet adjusting screw lock nuts and turn the screws down a turn or more in order to provide plenty of clearance when grinding the valves.

(12) Compress the valve springs and remove the valve spring retainer lock pins. Remove the springs and the valves.

(13) Clean the carbon from the valve ports, the valve guides, the top of cylinder, the top of piston, the cylinder head, and the valves.

(14) Inspect the valves carefully. If the stems are warped or badly worn, replace with new valves. Check the clearance of each valve in its guide and discard any having excessive clearance. Valves having badly pitted or burned faces will require a refacing on a valve refacer. The face should be finished to a 45° angle with the stem. If the valves are in such a bad condition that refacing will produce a thin edge, the valve should be replaced with a new one.

(15) If the valve seats are burned uneven, or are pitted, they should be refinished with a suitable reseating tool. If the exhaust valve seat (an insert ring) is in a condition too bad to be refinished, remove it and press a new seat firmly into place, peening the *cylinder casting* lightly and *carefully* all around the seat to hold it securely. Refinish the new seat with the reseating tool.

(16) Use a fine grade of valve grinding compound and grind each valve into its own seat. Use a vacuum type tool and a light pressure. With a light coat of grinding compound on the valve face, place the valve into its proper seat. Turn it back and forth several times about one-third of a turn. Then raise it far enough to clear the seat and turn it about one-fourth turn to a new position and repeat. After several cycles of these operations, remove the valve and clean the compound from valve and seat. Inspect both and, if necessary, repeat the grinding until a band of uniform width, 3/64 inch to 1/16 inch wide, extends entirely around the valve seat and face. This ground surface should be an even gray color and have no pitted or burned spots.

(17) Thoroughly clean all grinding compound from all surfaces.

(c) REASSEMBLING.

(1) Lubricate the valve stems and faces with engine oil. Install the valves. Be sure each valve is placed in its correct seat. Compress the springs and install the spring retainer lock pins. Make sure that the washer fits down over the ends of the pins so as to hold them in place. These pins are made of hardened steel, and, if lost, must be replaced with pins of similar hardness and strength.

(2) Adjust the valve tappet clearances. (See Section VI, par. 9.)

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(3) Clean the gasket surfaces of the cylinder and the cylinder head; then install the gasket and head. Tighten the nuts evenly, each nut a little at a time, then tighten securely. If a torque-indicating wrench is available, tighten to a tension of 22 ft.-lbs.

(4) Clean, adjust, and install the spark plug.

(5) Complete the reassembly, reversing the order of disassembly.

(6) Start the engine. After it reaches normal operating temperature, adjust the carburetor and the governor. (See paragraph 5*b*(1) and (2), this section.)

(7) After several hours of operation, stop the engine and retighten the cylinder head nuts.

(4) VALVE TIMING.—The valve timing is determined by the angular position of the crankshaft gear with respect to the camshaft gear. On each gear will be found a mark. These marks must match to give the correct valve timing.

(5) CAMSHAFT AND VALVE TAPPETS.—The cast iron camshaft rotates in the steel-backed, babbit-lined camshaft bearings which are lubricated by oil sprayed by the connecting rod. The valves are operated by tappets riding on the cams. Clearance adjustments are provided between valves and tappets by screws in the ends of the tappets. If the camshaft is worn and needs to be replaced, it is best to return the unit to a depot for repair. New camshaft bearings must be line-reamed after installing. (See Section VI for correct clearance.)

(6) TAPPET BUSHINGS.—The tappet bushings are made of bronze and are pressed into the crankcase. After being installed, they are reamed just large enough to allow the tappets to drop by their own weight.

(7) PISTON AND PISTON RINGS.

(a) GENERAL.—The piston of this engine is a 2¼-inch aluminum piston especially made for this plant. It has two compression rings and one oil ring. The piston pin is fitted to a hand push fit in the piston when at room temperature (21.01° to 37.7°C., 70° to 100°F.). It is fitted into the connecting rod a tight hand push fit at room temperature. The piston pin is held in at each end by a spring lock ring which is fitted into a groove in the piston. Be sure the lock rings are in place when assembling. The standard cylinder size is 2.250 inches. Correct piston to cylinder clearance as measured with a narrow feeler gauge is 0.004 inch to 0.005 inch. Should the cylinder be scored for any reason, it can be bored or honed to a standard oversize dimension of 0.005, 0.010, or 0.025 inch oversize, depending on the amount necessary to clean up. Piston and rings can be furnished by the manufacturer in these oversizes.

(b) SERVICING.

(1) To remove the piston, first remove the cylinder. Bring the piston to the top of its stroke when the cylinder is removed, and wrap a clean cloth around the connecting rod, large enough to prevent losing the piston pin lock rings in the crankcase while removing them. The piston rings can be left on the piston. *Use care to avoid damage to the aluminum connecting rod when pushing the pin from the piston.* If the piston pin is tight in the connecting rod, carefully heat the rod below the piston with a torch. If the pin is tight in the piston, heat the piston. The compression rings and oil rings can be removed by spreading them just enough to slide them off the piston.

(2) When installing new rings be sure they are free in the grooves of the piston. Be sure the oil ring is clean, and the oil holes in the piston are open. Check rings for correct diameter by pushing them into the cylinder squarely and seeing that the gap between the ends is 0.005 to 0.010 inch. Measurement should be made with the ring about an inch from the *bottom* of the cylinder. When reassembling, remember to install the piston pin lock rings with considerable tension so they will not move in the piston while in use. Use oil freely and keep parts clean when reassembling.

(8) CYLINDER BORES.

(a) CHECKING.—The best method for determining the condition of the cylinder bore preparatory to reconditioning is the use of a proper dial gauge. The dial gauge will instantly and automatically indicate the slightest variation of the cylinder bores. To use the gauge simply insert it in the cylinder bore and move up and down its full length. It is then partially rotated and readings are taken at various points. In this manner all variations in the cylinder bore from top to bottom may be determined.

(b) REFINISHING.

(1) When a cylinder is more than 0.005 inch out of true it is best to install a new cylinder. However, it is possible to refinish the cylinder and use it with oversize piston and rings. The instructions furnished by the manufacturer of the boring equipment should be carefully followed.

(2) After the cylinder has been rebored within 0.002 inch of the size desired, it should be finished or polished with a cylinder hone. Do not use a piston as a hone. In operating, the hone is placed in the cylinder bore and run up and down the full length of the cylinder wall. This procedure should be followed until the proper piston-to-cylinder clearance of 0.004 to 0.005 inch is obtained.

(9) CONNECTING ROD.

(a) GENERAL.—The connecting rod of this engine is a special aluminum alloy casting and does not contain any bushings or babbit lining. The pis-

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ton pin bearing is reamed to size. The crank pin bearing is cut in half, and the lower half, or cap, is bolted to the rod by two cap screws. Two oil holes are drilled in the large bearing end, to lubricate the crankpin bearing and one hole in the top of the rod for lubricating the piston pin. The connecting rod cap has a projection cast as part of the cap, which dips into the oil trough and sprays the crankcase with oil.

(b) REPLACEMENT.—Should it be necessary to replace the piston pin, it can be furnished in standard oversize of 0.002 inch, which makes it possible to save the connecting rod by simply reaming it oversize. Should the large bearing of the connecting rod be scored, however, it will be necessary to replace the rod with a standard new one.

(10) CRANKSHAFT AND BEARINGS.

(a) GENERAL.—The crankshaft rotates in steel-backed, babbit-lined bearings. They are pressed into the crankcase and the bearing plate and are then line-reamed. The crankshaft supports the generator armature.

(b) SERVICING.—The bearings can be replaced, but great care is required. A new bearing may be used to press out an old one. Be sure that each bearing is installed so that its oil hole matches the corresponding hole in the crankcase or bearing plate. It is the best practice to push the bearings in with the use of an arbor press, but if this is not available, they can be tapped in with a block of wood and a hammer. Use moderate force. New bearings always have to be line-reamed after being pressed into place. Refer to Section VI for correct clearances. End play clearance may be adjusted by carefully filing the inner end of the bearing plate boss. If this clearance is too great, install a new bearing plate and file it to obtain correct clearance. Check the work carefully and be sure no shavings or dirt is left in the engine. Lubricate the bearing surfaces well when assembling.

(11) OIL SEALS.

(a) REAR OIL SEAL.—An oil seal is pressed into the crankcase between the engine and the generator to prevent oil from leaking out around the crankshaft. Should it ever become necessary to replace the oil seal, first remove the old oil seal by using a small chisel or screwdriver and prying outward, thereby raising the edge of the oil seal so that it may be gripped with pliers and pulled outward. It may be necessary to chisel all around the seal to break it loose, but be very careful not to damage the crankshaft. When fitting a new seal, cover the seal with lubricating oil and fit the leather or composition over the crankshaft evenly so that there are no folds or injured edges and so that the seal is not damaged in any way. Tap the oil seal into place,

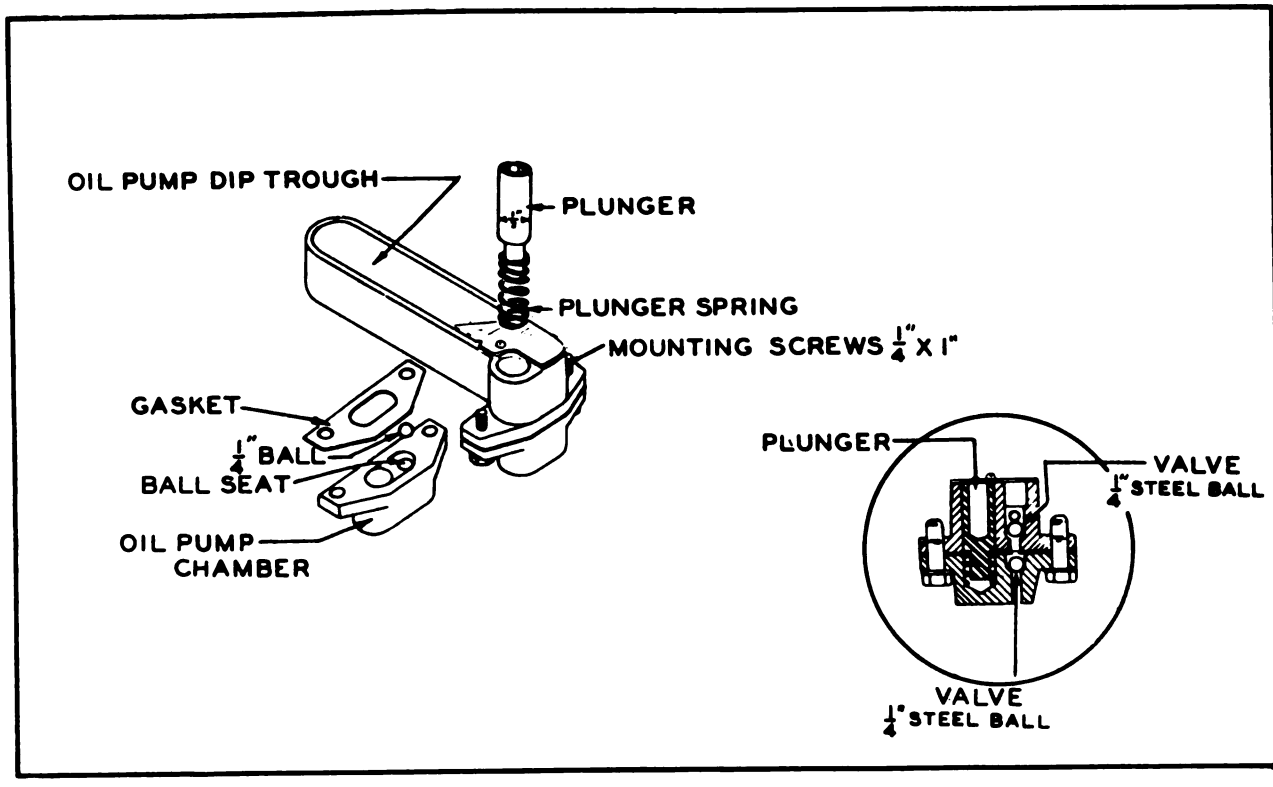

Figure 5-7. Oil Pump Assembly

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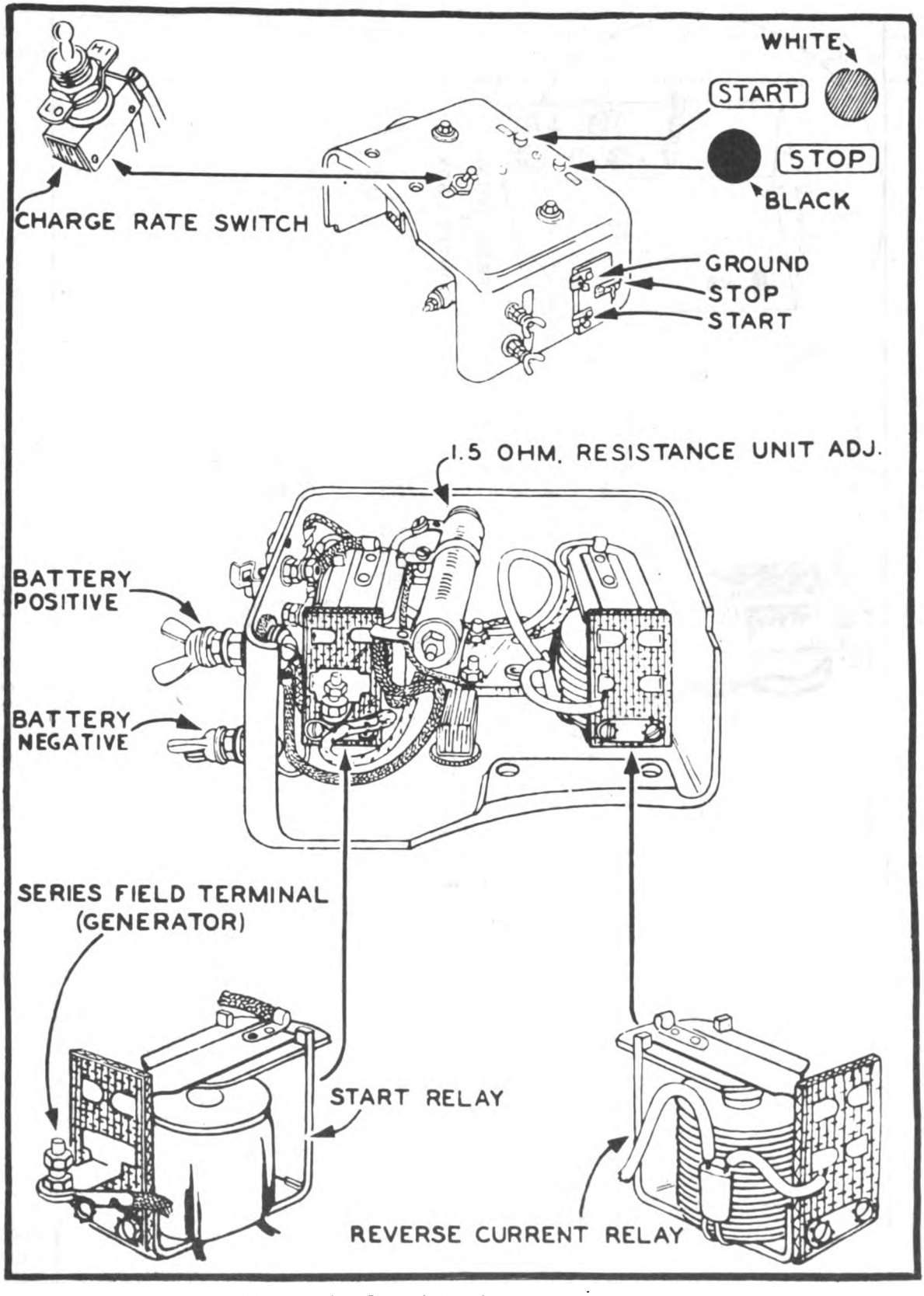

Figure 5-8. Control Box for Power Unit PE-88

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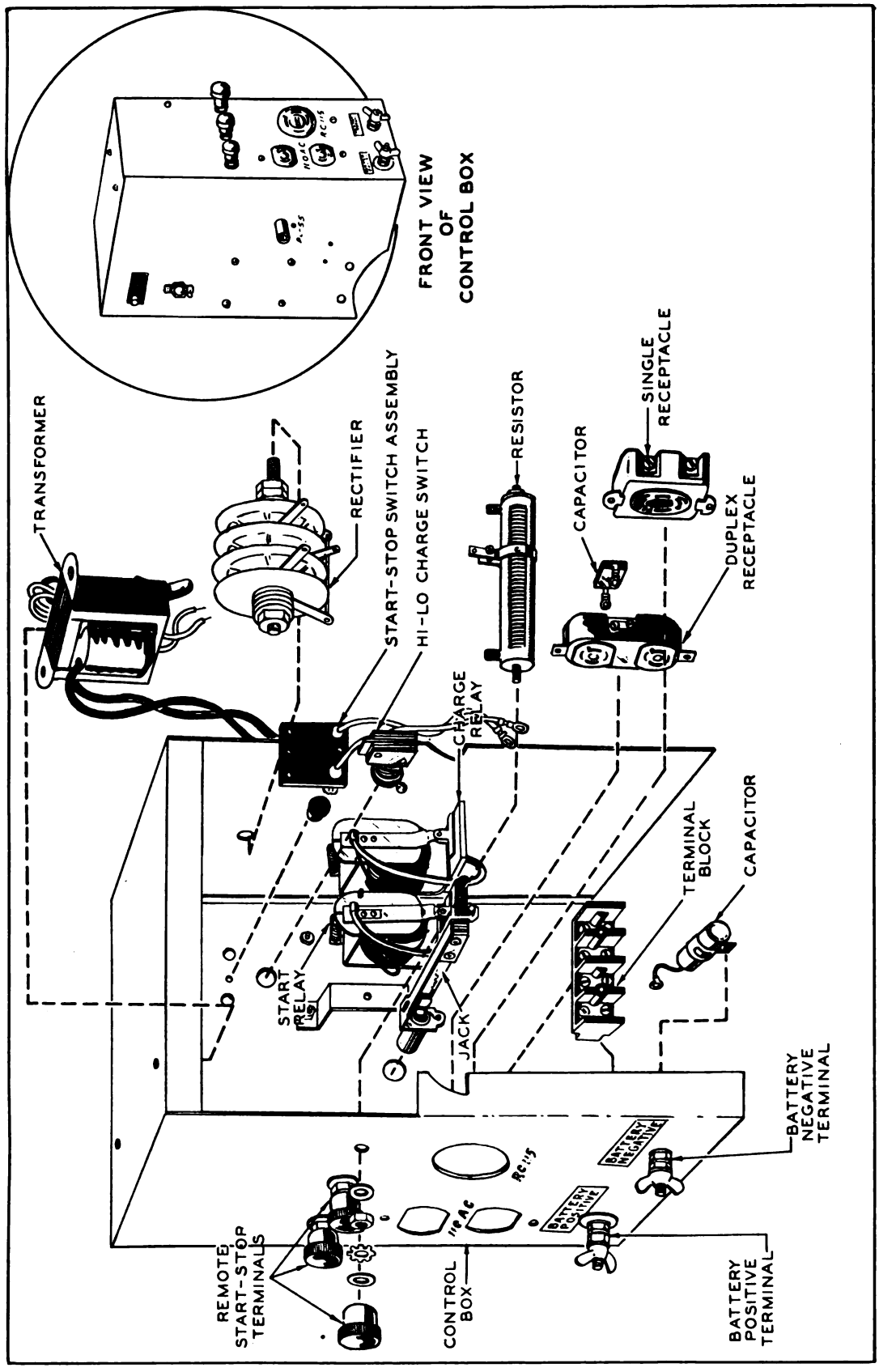

Figure 5-8A. Control Box for Power Unit PE-88-A

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using a solid wood or metal bar against the seal to prevent damage. Make sure that the seal fits tightly and squarely into place.

(b) FRONT OIL SEAL.—A second seal made of cork impregnated with graphite is located inside the front gearcase cover around the crankshaft. This is to prevent oil from the crankcase leaking into the magneto. If oil leaks into the magneto it may cause failure of the ignition system. When replacing, cement the new seal into the gearcase with shellac.

(12) COOLING SYSTEM.—The performance of an engine is dependent to a great extent upon the proper operation of its cooling system. This engine is air-cooled and the proper amount of cool, clean air is very essential. Cooling air is forced over the cooling fins of the cylinder and cylinder head by a flywheel-type centrifugal blower. The unit must *not* be confined in a small compartment without ample provision being made for ventilation. The cooling fins and the blower housing must be kept free of dirt.

(13) EXHAUST SYSTEM.

(a) MUFFLER.—The exhaust muffler is connected to the cylinder unless exhaust tubing is run to some distant location, such as when the power unit is mounted in a building or vehicle.

CAUTION

Do not operate the power unit inside a closed room without first having connected an exhaust line that will carry *all* the exhaust gases out of doors. Exhaust gases are poisonous and may cause death.

(b) SERVICING.—If the exhaust system becomes clogged with carbon it will create a back pressure on the engine that will prevent its developing full power, and will cause the combustion chamber and the valves to become covered with carbon to the extent that a carbon removal and valve grinding job will be necessary. Keep all joints tight. If the flexible exhaust line leaks, replace it.

(14) OIL CIRCULATING SYSTEM.

(a) OILING SYSTEM.—All points in the engine are lubricated by oil being thrown by the connecting rod which dips into an oil trough located in its path. This trough is kept filled by a pump located with its inlet near the bottom of the oil base.

(b) OIL PUMP.—The oil pump (see figs. 4-2 and 5-7) is operated as follows: an eccentric follower operates off the camshaft and drives the push rod which fits into the pump plunger. As the plunger rises due to the action of the plunger spring, oil is taken in through the inlet and past the lower steel ball valve. When the plunger is forced down the pressure forces the lower steel ball down, closing the inlet opening. The oil in the chamber is forced up through the upper chamber past the upper ball valve and into the oil pump dip trough. From there it is splashed throughout the inside of the crankcase by the oil dipper on the end of the connecting rod bearing cap.

(15) RELAYS.

(a) GENERAL.—There are only two relays in the control box; the start relay and the reverse current relay. They should require no attention under normal conditions. In case of failure of the start relay the power unit may be started manually.

(b) SERVICING.—The correct spring tension is a very important factor in the good operation of a relay. If any work is done on the relay such as replacement of a part, avoid stretching the spring or bending the clip to which it is hooked. Keep the contacts clean with a lint-free cloth. If the contacts become pitted, replace with new ones.

(16) BATTERY.—The battery requires certain routine attention. Follow the battery manufacturer's instructions when available, otherwise check as follows:

(a) Keep the water level about ⅜ inch above the separators of the cell. Use distilled water, clean rain water that has not been handled in metallic containers, or water that is known to be harmless to batteries.

(b) Keep the top of battery and terminals clean. A coating of petroleum jelly on the terminals helps to prevent harmful corrosion.

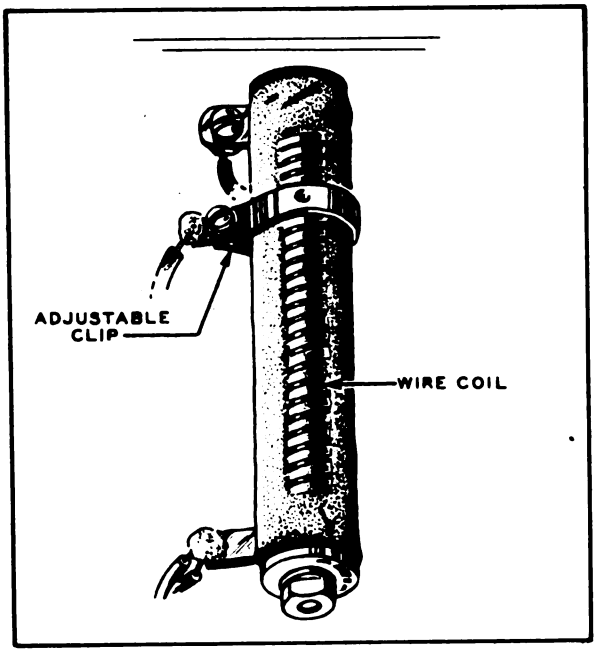

Figure 5-9. Battery Charging Resistor

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(c) Keep the battery in a fully charged condition. If allowed to remain in a low state of charge, sulphation of the plates will reduce the capacity and greatly shorten the life of the battery. A discharged battery will freeze at 6.6°C. (20°F.).

(17) BATTERY CHARGING RESISTOR.—The battery charging resistor has a value of 1.5 ohms and is of the slide wire type. If the charging rate does not rise higher than 2 amperes when the battery is known to be in a low state of charge and the charge rate switch is in HI position, the resistor should be adjusted to increase the rate of current flow. If this fails a replacement of the resistor should be made. See figure 5-9.

(18) MAGNETO.

(a) BREAKER CONTACT.—The breaker contacts eventually become pitted and must be replaced. When not too badly pitted they may be resurfaced by means of a carborundum hone. Surfaces should be finished to a very slightly convex form, almost flat. When properly adjusted they must open 0.018 inch and when closed they should make contact at the central areas of their surfaces. The breaker point tension can be measured by connecting a spring tension gauge to the point end of the breaker arm, and pulling upward until the points barely open, then taking the reading from the gauge. The correct tension is 24 to 26 ounces, or approximately 1½ pounds. Each time the points are adjusted, the breaker arm rubbing block and the crankshaft cam should be greased with a lubricant that will not sling off the shaft when the plant becomes warm.

(b) CAPACITOR.—If the ignition spark is weak and the breaker contacts are badly burned and have a sooty appearance, it is probable that a new capacitor is required. The capacitor, however, can fail without such symptoms. A replacement capacitor should have a capacity of 200,000 mmf (.2 mf).

(c) SPARK FAILURES.—Other causes for failure of the magneto to produce any spark are:

(1) Primary wiring grounded or shorted.

(2) Breakdown of insulation in the high tension side of the coil.

(3) Spark plug may be fouled or not properly adjusted. When the porcelain cracks or becomes eroded, or when electrodes are badly burned, install a new spark plug.

(19) SUPPRESSION EQUIPMENT.

(a) GENERAL.—To reduce interference with radio equipment, the power unit is equipped with a metal cover over the spark plug and a metallic covering over the spark plug cable. A complete tune-up of the power unit includes a visual inspection of the suppression equipment to make sure none of it is missing and that all connections are clean and tight. In case of excessive radio interference, a more thorough check-up must be made.

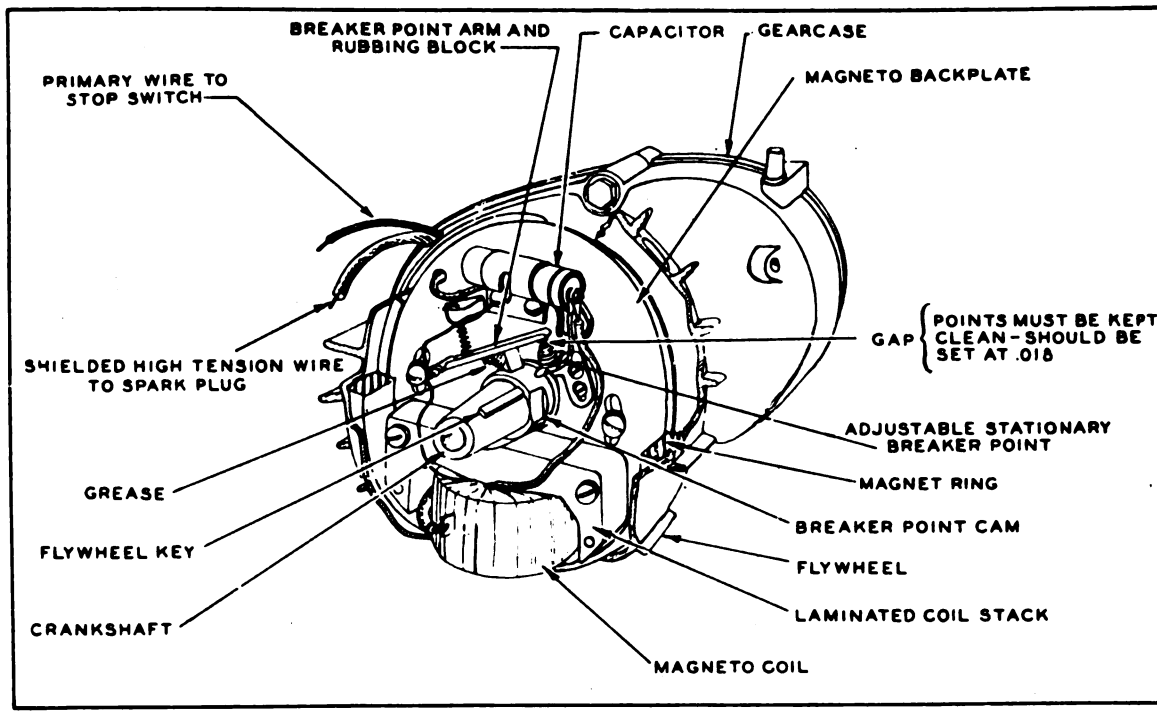

Figure 5-10. Magneto Assembly

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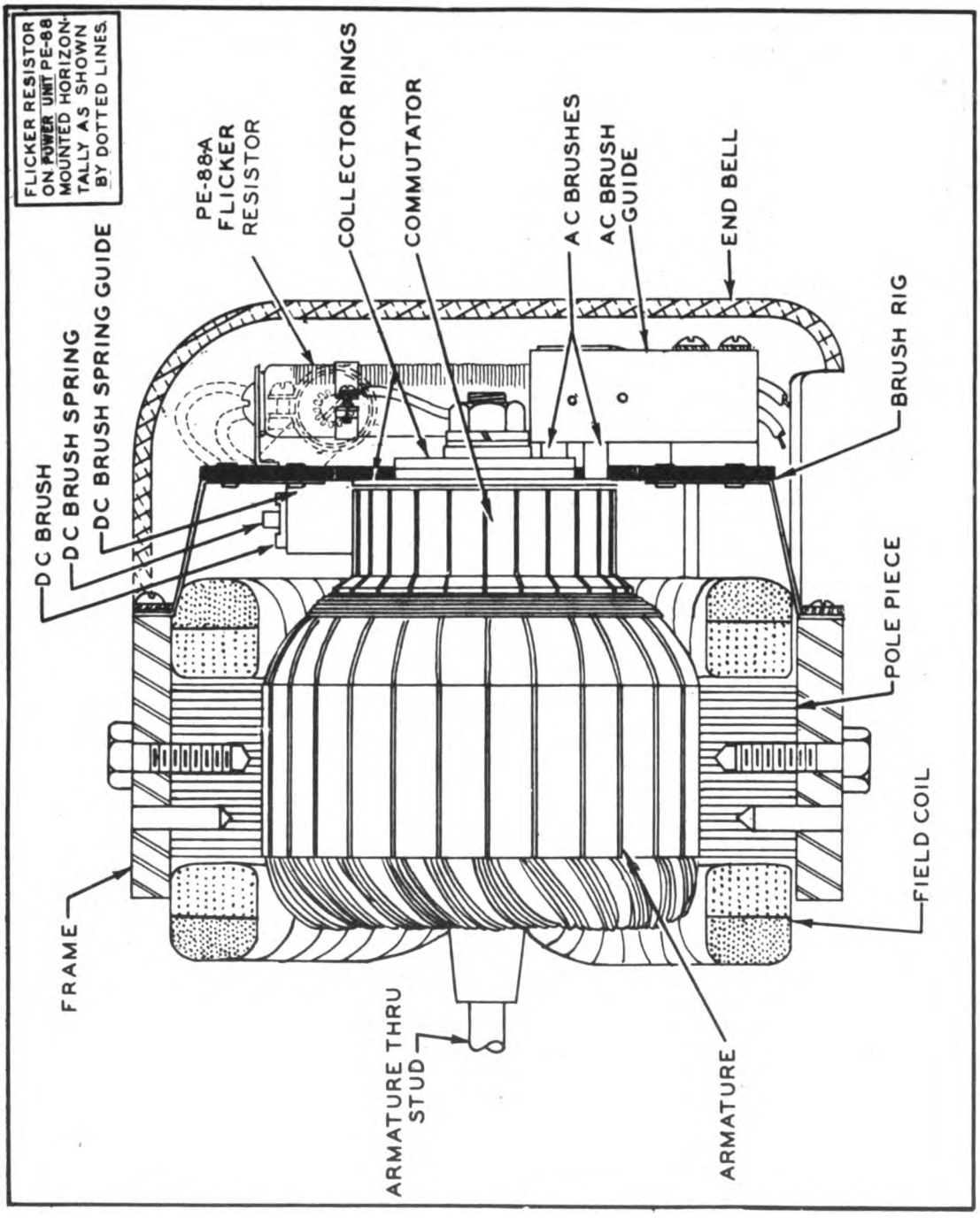

Figure 5-11. Cross Section View of Generator

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(b) IGNITION SYSTEM. — Check, clean, and adjust the complete ignition system, including spark plug. Pay particular attention to the high tension lead, the capacitor and the breaker points. If any parts are not in good order, replace with new ones.

(c) LOOSE CONNECTIONS. — Check the entire power unit for loose electrical connections, loose bolts, nuts, and screws of any kind. Keep all these tight at all times.

(d) CAPACITORS.—Make sure all capacitors are in place and tight. They may be removed and tested individually like any radio capacitor. Replace all defective capacitors.

(e) COMMUTATOR, COLLECTOR-RINGS AND BRUSHES.—Make sure that there is no abnormal arcing of brushes. Commutator and collector rings must be smooth and clean. Mica must be properly undercut and the brushes must seat correctly, with the proper spring tension and in the proper position.

b. GENERATOR.

(1) SANDING BRUSHES.—Sand new brushes to a good seating contact. This may be done by drawing a strip of No. 00 sandpaper around the commutator, sanded side out, while the brush rests on the sanded surface of the paper with normal spring tension. (See figure 5-12.) Make certain that the sandpaper contacts a large area of the commutator. Draw the sandpaper in the normal direction of the armature rotation. Raise the brush for the return stroke. Repeat until a proper seating surface is obtained.

(2) COMMUTATOR. — 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 corrected by holding a piece of No. 00 sandpaper against the surface while the armature is revolving slowly. Brushes should be lifted in their holders while the commutator is being sanded. A badly worn, burned, or pitted commutator will require refinishing in a lathe. Whenever the copper bars have worn down flush with the mica insulation which is between the bars, the mica must be undercut 1/32 inch as shown in figure 5-12. After this operation, inspect the commutator thoroughly to see that there are no metal particles between the copper bars, for if the plant is started with the commutator shorted in this manner, it will burn out the armature winding.

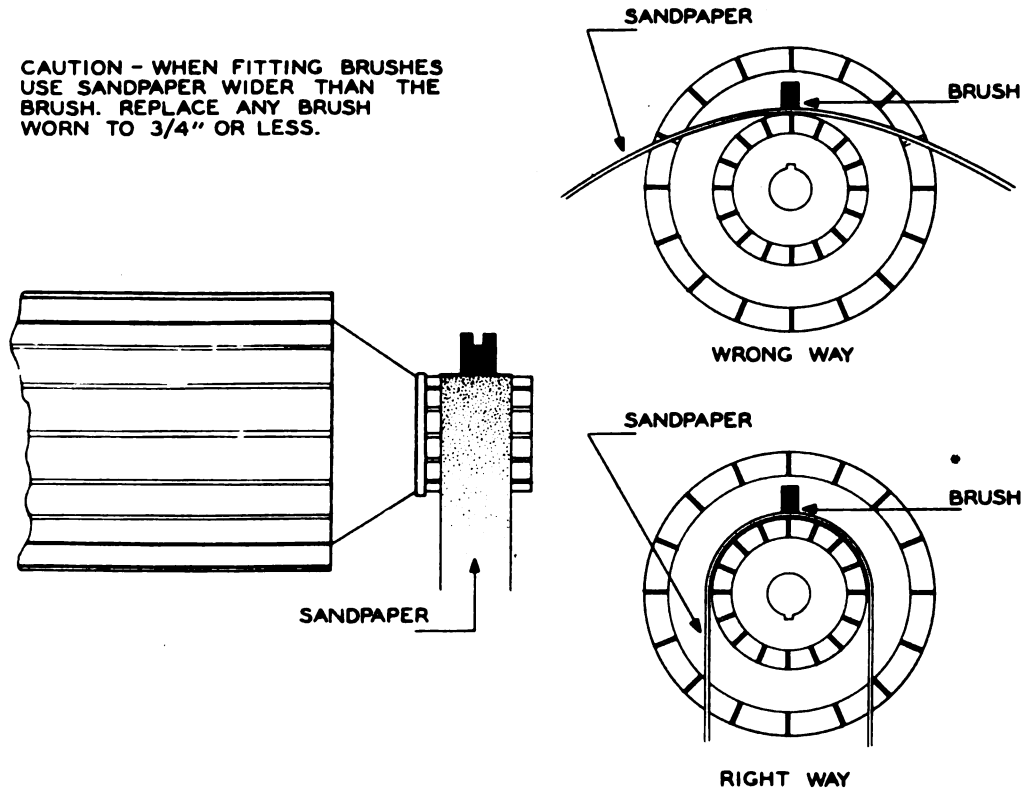

Figure 5-12. Fitting Brushes to Commutator

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(3) COLLECTOR RINGS.—The collector rings must be kept clean of accumulated carbon or dirt. They can become pitted by the flashing or arcing of the a-c (round) brushes, caused by the brush rig being out of position or the brushes sticking in the brush guides.

(4) TESTING ARMATURE WINDINGS.

(a) GENERAL.—The following testing instructions may be used without disassembling the generator. The test requires the use of a 6-volt battery, a 6-volt lamp and socket, two test prods, and the necessary connecting wire as shown in figure 5-13.

(b) D-C WINDING.—To test the d-c winding of the armature, first disconnect the battery from the power unit, then raise all the brushes off the commutator. Place one of the test prods on the surface of the commutator and the other prod on the nut on the armature stud. If the bulb lights the commutator or armature is grounded. To correct this trouble the armature must be rewound or commutator must be repaired. The practical field repair is to install a new armature.

(c) A-C WINDING.—To test the a-c winding of the armature, first disconnect the battery from the power unit, then raise all the brushes off the commutator and collector rings. Place one test prod on each of the collector rings on the end of the armature. If the bulb fails to light the a-c winding circuit is open and a new armature is required. Place one test prod on the armature stud nut and the other prod on either of the collector rings. If the bulb lights the a-c winding is grounded and a new armature should be installed.

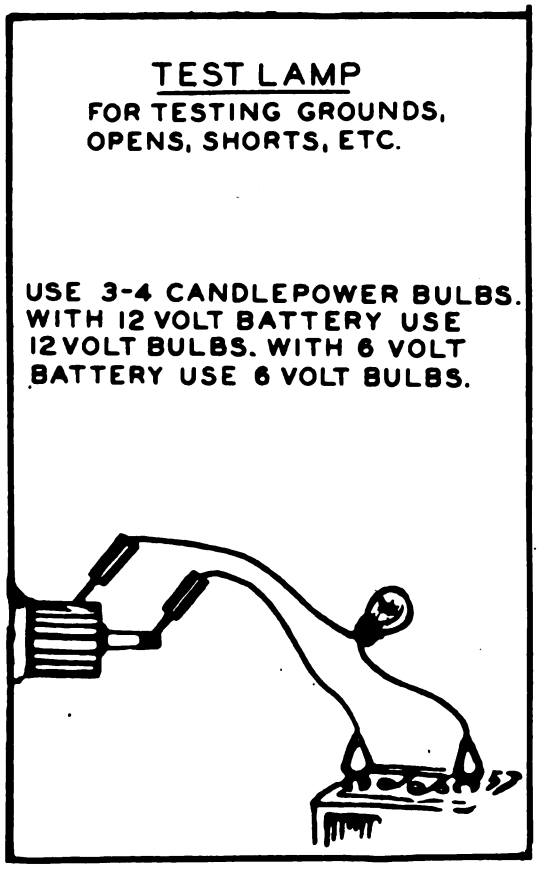

Figure 5-13. Testing Windings

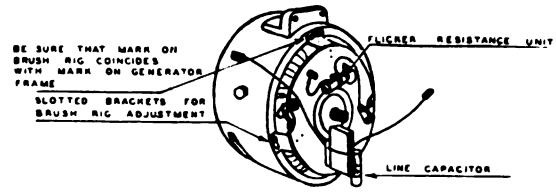

Figure 5-14. Brush Rig Assembly

(5) BRUSH RIG.

(a) GENERAL.—The brush rig assembly consists of a black composition ring supported by four slotted brackets on the back of the generator. This rig supports the brushes and brush guides. The brackets are slotted so that the brush rig can be adjusted to the position of best commutation. This position is located at the factory and a mark is put on the brush rig to coincide with a mark on the generator frame. These marks should always match. If they do not match the brushes will arc and the generator will not develop the correct voltage.

(b) BRUSHES.—The brushes are of a special material and only those supplied by the manufacturer should be used for replacement. Never oil the brushes because oil will form a sticky compound between brushes and the guides, and cause the brushes to stick in the guides. Brushes should be replaced before being worn shorter than $\frac{5}{8}$ inch.

Be sure that d-c brushes are always in their guides with the wire side of the brush on the same side as the slot in the guide. Brush spring tension

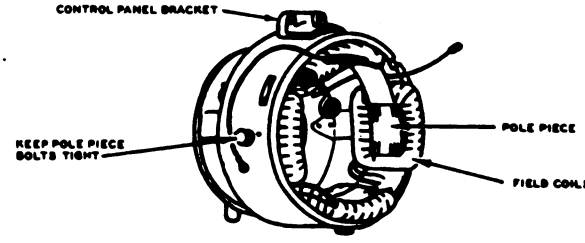

Figure 5-15. Generator Frame and Field Coil Assembly

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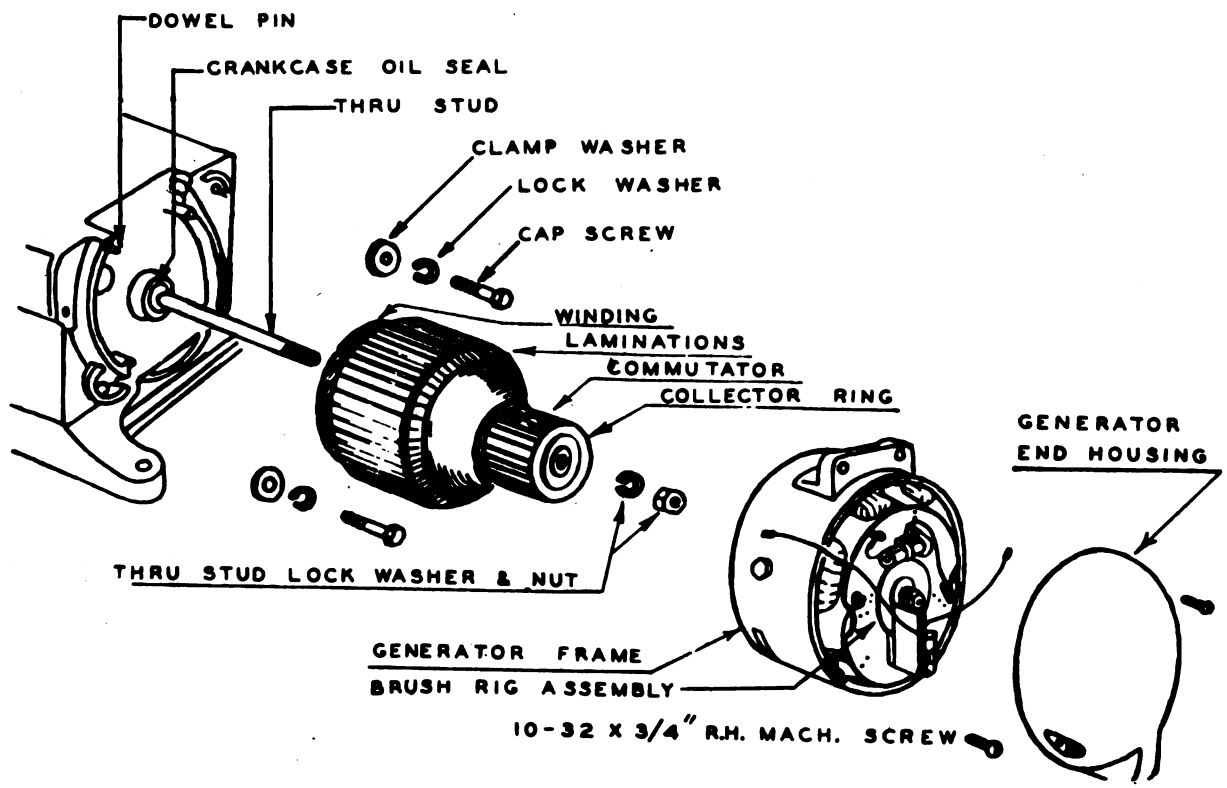

Figure 5-16. Generator Assembly

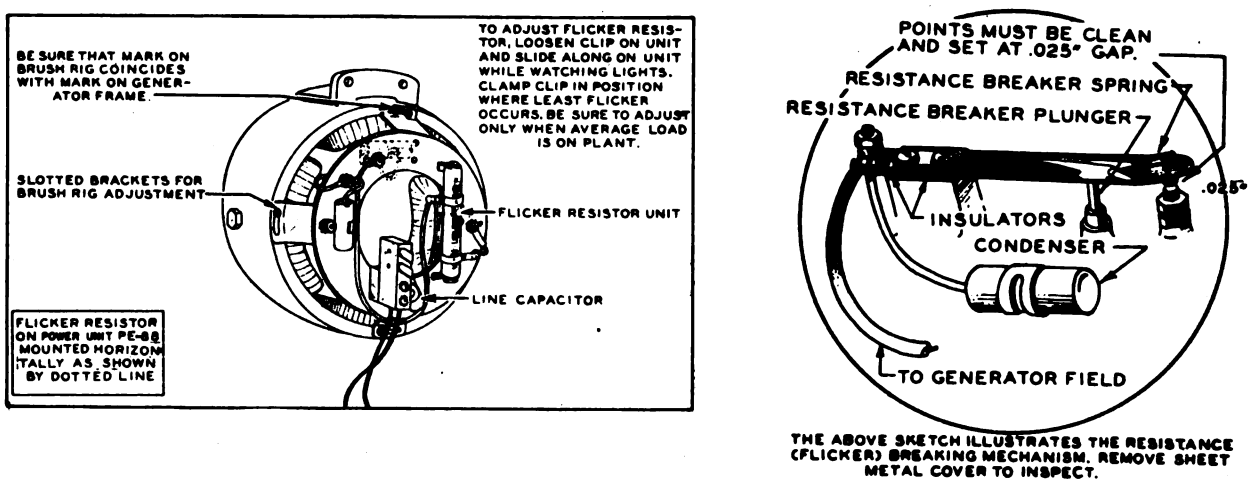

Figure 5-17. Flicker Mechanism

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should never be changed for any reason, especially to overcome sticky brushes. When it is necessary to remove the generator from the engine, always pull the brushes up in the guides until the springs rest against their sides and hold them up. This will prevent breaking the brushes. The brush lead wire is molded into the brush and cannot be disconnected from it.

(6) FIELD COILS.—The field coils are form wound and connected together. Four are used in the generator and are held in place by the four pole shoes, which in turn are held in place by bolts through the generator frame. Field coils are subject to expansion and contraction caused by the normal heat of operation. This action over a long period of time may cause a wearing at some point on the field coils, resulting in a short circuit of the field coils to either the generator frame or pole shoes. This can be corrected by locating the trouble and taping the coil at this point. If a short has occurred inside the field coil, it cannot be repaired, and the coil must be replaced with a new one. Before testing the coil circuit, disconnect the leads on the brush rig. Test for shorts by using a test light. Touch one prod to a field lead and the other prod to the generator frame. If the bulb lights the coils are grounded. A short circuit inside a field coil can best be located by temperature. Compare the operating temperatures of all the coils by feeling the generator frame at each coil location. A location much cooler than the rest would indicate a shorted coil.

(7) POLE SHOES.—The pole shoes are made up of laminations of special electrical steel stacked and riveted together. After the riveting operation, they are drilled and tapped for the mounting screw holes which hold them to the generator frame. In order to remove the field coils, the pole shoes must be removed. It is essential that an accurate clearance be maintained between the pole shoes (when assembled in the generator frame) and the revolving armature. Therefore, when reassembling the field coils and pole pieces in the generator frame, be sure to check the inside of the generator frame and the contact surfaces of the pole shoes, making sure that there is no dirt between their surfaces. Also tighten the pole shoe bolts very firmly to keep them from becoming loose.

CAUTION

After having done any assembly work on the generator always crank the engine manually to make sure that everything is clear before starting the power unit. Never try to start the engine against resistance such as might be caused by lack of proper clearances.

(8) FLICKER MECHANISM.

(a) GENERAL.—A breaker mechanism and a field resistor are used to compensate for surge voltage during the power stroke of the engine. The breaker contacts are located in a recess in the side of the crankcase below the valve tappet cover. The movable contact is operated by a fiber plunger which rides on the camshaft.

(b) BREAKER ADJUSTMENT.—The breaker gap is adjustable and should be 0.025 in. when open wide.

(c) RESISTOR ADJUSTMENT.—Further adjustment to reduce the flicker may be made by changing the position of a sliding clip on the resistor mounted on the brush rig. Power Units PE-88 (serial numbers below 223,601) have only one adjustable clip on the flicker resistor. (See fig. 5-17.) Power Units PE-88-A (serial numbers 223,601 and higher) have two adjustable clips, the lower one for flicker control and the upper one for adjusting the output voltage.

(d) CAPACITOR.—A 0.5 mfd. capacitor is connected across the breaker contacts to reduce the arcing and to prolong the life of the contacts. Excessive arcing indicates a faulty capacitor. A new one should be installed to correct this condition.

SECTION VI

SUPPLEMENTARY DATA

1. POWER.

a. DRIVING POWER: 1 horse-power gasoline engine.

CHARACTERISTICS (Power Unit PE-88 and PE-88-A)
Single cylinder
4-stroke cycle
L-head
Air-cooled

CHARACTERISTICS (Power Unit PE-88 and PE-88-A)
Compression ratio: 4.28 to 1
Designed for low octane fuels: 65- to 80-octane
Normal operating speed: 1800 rpm
Ball type mechanical governor
Splash oil system
2-3/4 quart fuel tank
Adjustable jet type carburetor—Zenith Model 59-B3
High tension flywheel-type magneto

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b. OUTPUT POWER: Electric Generator.

CHARACTERISTICS (Power Unit PE-88)
A-C Winding
115-volt
60-cycle
Single-phase
Rated output: 350 watts
4-pole
Self-excited
Regulation: 130 volts at no load
112 volts at full load
3 cycles-per-second when adjusted for a no load frequency below 63 cycles-per-second, and a full load frequency above 59 cycles-per-second.
D-C Winding
Has a series field winding to provide additional starting torque.

CHARACTERISTICS (Power Unit PE-88-A)
A-C Winding
115-volt
60-cycle
Single-phase
Rated output: 350 watts
4-pole
Self-excited
Regulation: 117 volts at 50-watt load
109 volts at 350-watt load
Frequency within the limits of 62 cycles-per-second at 50-watt load to 58.5 cycles-per-second at 350-watt load.
D-C Winding
A series field winding, supplied with direct current by a rectifier connected with a current transformer, improves voltage regulation. Another series field winding provides additional cranking torque.

2. FIRING.

On the compression stroke, the spark occurs at the spark plug when the piston has reached a point ⅛" (0.125") from the top of its stroke. The engine fires 24 to 26 degrees of crankshaft rotation ahead of top center.

3. INSTALLATION.

a. Installation requires a minimum space 6 feet by 6 feet, and at least 24 inches from the nearest wall.

b. The installation base should be able to support at least 100 pounds.

4. CHARGING RATE.

Charging rate through the 1.5-ohm charging resistor:

When the switch is in the "LO" position, the rate will be a maximum of 3 amperes.

When the switch is in the "HI" position, the rate will be a maximum of 8 amperes.

5. ELECTRICAL STARTING.

Electrical starting requires a 12-volt battery. This can be two 6-volt automotive type batteries connected in series.

6. CRANKCASE LUBRICATION.

a. For crankcase lubrication use U. S. Army Spec. No. 2-104-B oil of proper S.A.E. grade according to the chart below.

TEMPERATURE	S.A.E. NUMBER
Above 10°C (50°F)	S.A.E. No. 20 or 30 (See Note).
Between −17.7°C (0°F) and 10°C (50°F)	S.A.E. No. 10.
Below −17.7°C (0°F)	S.A.E. No. 10 diluted (See *b* below).

Note

If grade 20 is not available use grade 30 at temperatures above 26.6°C. (80°F.), or use equal parts of 10 and 30 at temperatures above 10°C. (50°F.).

b. For diluting crankcase oil use thinning oil Spec. No. 3601 or 10% kerosene.

7. BATTERY TEST.

Battery test with hydrometer:

a. Each cell 1250 or higher—charged cell.

Each cell 1100 or lower—discharged cell.

b. With electrolyte for tropical use each cell 1200 or higher—charged cell.

8. WEIGHT AND SIZE.

a. POWER UNIT PE-88 (SERIALS NOS. BELOW 223,601).

ARTICLE	WIDTH	LENGTH	HEIGHT	WEIGHT IN LBS.
Complete Power Unit PE-88	*18-3/4"	16-1/2"	19-1/4"	84.5
Engine with Accessories	*18-1/4"	13"	19-1/4"	55
Complete Generator	7-5/8"	7-1/4"	7-5/8"	29.5
Fuel Tank	5-1/4"	9-1/2"	6-5/8"	3
Control Box Assembly	6-3/4"	3-1/2"	5-3/4"	3
Junction Box Assembly	4-5/8"	5-3/8"	4-5/8"	2.5
Complete Power Unit PE-88 packed for shipment	20"	25"	24"	139

*If muffler is removed 2-1/4" may be deducted from this dimension.

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b. POWER UNIT PE-88-A (SERIAL NOS. 223,-601 AND ABOVE).

ARTICLE	WIDTH	LENGTH	HEIGHT	WEIGHT IN LBS.
Complete Power Unit PE-88-A	*14-3/16"	17-1/8"	19-1/2"	90
Engine with Accessories	*12-3/16"	13"	19-1/2"	55
Complete Generator	7-5/8"	7-1/4"	7-5/8"	29.5
Fuel Tank	5-1/4"	9-1/2"	6-5/8"	3
Control Box Assembly	5-1/2"	8-1/4"	11-1/4"	11
Complete Power Unit PE-88-A packed for shipment	20"	26"	23"	146

*If muffler is removed 2-1/4" may be deducted from this dimension.

9. TABLE OF STANDARD CLEARANCES.

	MINIMUM	MAXIMUM
Valve Tappet Clearance (Intake)	0.008"	0.010"
Valve Tappet Clearance (Exhaust)	0.010"	0.012"
Valve Seat Width	3/64"	1/16"
Valve Stem Clearance in Guide (Intake)	0.0010"	0.0015"
Valve Stem Clearance in Guide (Exhaust)	0.0010"	0.0015"
Camshaft Bearing (Diameter)	0.0015"	0.002"
Crankshaft Main Bearing (Diameter)	0.0015"	0.0025"
Crankshaft End Play	0.006"	0.008"
Connecting Rod Bearing (Diameter)	0.0015"	0.0025"
Connecting Rod Bearing (End Play)	0.005"	0.007"
Timing Gear Backlash	0.003"	0.005"
Piston-Cylinder Clearance	0.004"	0.005"
Piston Pin in Piston	Hand Push Fit at 21.01°C (70°F)	
Piston Pin in Connecting Rod	0.0002"	0.0003"
Piston Ring Gap	0.005"	0.010"
Magneto Breaker Contact Gap	0.018"	0.018"
Resistance Breaker Contact Gap (Flicker Mech)	0.025"	0.025"
Spark Plug Gap	0.025"	0.025"

SECTION VII

TABLE OF REPLACEABLE PARTS

Introduction

The parts listed in this table do not constitute a complete electrical and mechanical breakdown of the equipment. The table lists all electrical parts together with such operative mechanical parts as are subject to loss or failure, with the exception of structural and minor parts such as standard bolts, screws, nuts, and the like. In some instances individual detail parts of a subassembly may not be listed as separate items, since replacement of such items is impractical.

ORDERING OF SPARE PARTS

Each Service using this list has established certain depots and service groups for the storage and issue of spare parts to its organizations requiring them. The regulations of each Service should be studied to determine the method and source for requisitioning spare parts. The information in this list, as to manufacturer's or contractor's name, type, model, or drawing number, is not to be interpreted as authorization to field agencies to attempt to purchase identical or comparable spare parts directly from the manufacturer or a wholesale or retail store except under emergency conditions as covered by existing regulations of the Service concerned.

U. S. Army Personnel: This table is for information *only* and is not to be used as a basis for requisitioning parts. Authorities for obtaining maintenance items are as follows: 1. For using organizations: applicable Service publications of the 00-30 series of AAF Technical Orders. 2. For higher maintenance and supply echelons: applicable Service publications of the 16-55 series of AAF Technical Orders.

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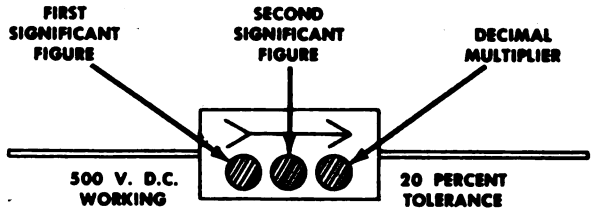
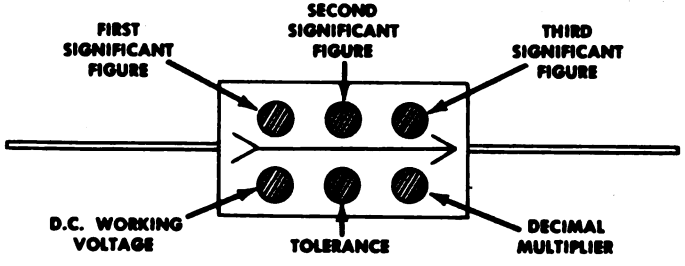
RMA-COLOR CODE

CAPACITORS (MMFD)



COLOR	NUMERAL	VOLTS	MULTIPLIER	TOLERANCE
BLACK	0		1	
BROWN	1	100	10	1%
RED	2	200	100	2%
ORANGE	3	300	1,000	3%
YELLOW	4	400	10,000	4%
GREEN	5	500	100,000	5%
BLUE	6	600	1,000,000	6%
VIOLET	7	700	10,000,000	7%
GRAY	8	800	100,000,000	8%
WHITE	9	900	1,000,000,000	9%
GOLD		1000	0.1	5%
SILVER		2000	0.01	10%
NO COLOR		500		20%

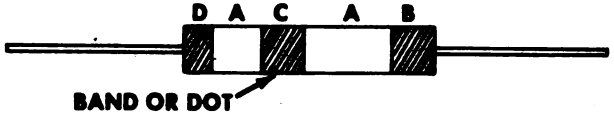


RESISTORS (OHMS)

COLOR	A 1ST DIGIT	B 2ND DIGIT	C MULTIPLIER
SILVER			0.01
GOLD			0.1
BLACK		0	1.0
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
PURPLE	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	

D - TOLERANCE CODE:

GOLD = 5% SILVER = 10% NO COLOR = 20%



OLD COLOR ARRANGEMENT

NEW COLOR ARRANGEMENT

BODY COLOR (NEW COLOR ARRANGEMENT ONLY) INDICATES TYPE OF RESISTOR, AS FOLLOWS:

BLACK - COMPOSITION, NON-INSULATED
TAN, OLIVE OR WHITE - COMPOSITION, INSULATED
DARK BROWN - WIRE-WOUND, INSULATED

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1. INDEX TO TABLE OF REPLACEABLE PARTS.

Power Unit		Part	Page
PE-88	PE-88-A	Camshaft group.	
PE-88	PE-88-A	Carburetor group.	
PE-88		Control group.	
	PE-88-A	Control box group.	
PE-88	PE-88-A	Crankshaft and connecting rod group.	
PE-88	PE-88-A	Cylinder group.	
PE-88	PE-88-A	Flicker resistance group.	
PE-88	PE-88-A	Fuel supply group.	
PE-88	PE-88-A	Gearcase group.	
PE-88		Generator group.	
	PE-88-A	Generator group.	
PE-88	PE-88-A	Governor group.	
PE-88	PE-88-A	Magneto group.	
PE-88	PE-88-A	Miscellaneous group.	
PE-88	PE-88-A	Oil pump and base group	
PE-88	PE-88-A	Piston group.	
	PE-88-A	Relay group.	
PE-88	PE-88-A	Valve group.	

2. MANUFACTURERS' NAMES.

Symbol	Name	Symbol	Name
ACC	Armstrong Cork Corp.	HA	Haynes Stellite Co.
ACS	American Coil Spring	HEL	Helwig Co.
AD	Audio Development Co.	HO	Hoover Ball & Bearing Co.
AE	Auto Engine Works, Inc.	HU	Harvey Hubbell, Inc.
AHH	Arrow Hart & Hegeman Electric Mfg. Co.	HUB	Hubbard Mfg. Co.
AI	Aluminum Industries	ICS	Illinois Coil Spring Co.
AL	The Electric Auto Lite Co.	MO	Monmouth Products Co.
AN	Anaconda Wire & Cable Co.	NM	National Motor Bearing Co.
ASW	American Spring & Wire Specialty Co.	ON	D. W. Onan & Sons
AVC	Advance Spring Corp.	PC	Pure Carbon Co.
CGB	Cleveland Graphite Bronze	PH	Pheoll Mfg. Co.
CH	Champion Spark Plug Co.	PM	Precision Machine Works
CJH	C. J. Hoigaard & Co.	PO	Powell Muffler Co.
CL	Clum Mfg. Co.	RSP	Rockford Screw Products Co.
CR	Chrysler Corporation—Oilite Division	SF	Spaulding Fibre Co.
EU	Electric Utilities Co.	TD	Tobe Deutschmann Corp.
F	Fitzgerald Mfg. Co.	V	Vellumoid Co.
FIP	Firestone Ind. Products Co.	VT	Vichek Tool Co.
GW	Gardner Wire Co.	WE	Weatherhead Company
H	R. C. Hitchcock & Sons	WM	Wausau Motor Parts Co.
		ZEN	Zenith Carburetor Mfg. Co.

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CYLINDER GROUP (SEE FIG. 8-1)			
1	3H1908-2/C40	HEAD: cylinder.	Engine cylinder group.	ON	8075
2	3HK4596A/G4	GASKET: cylinder head.	Engine cylinder group.	F	8076
3	3H1908-2/S30	STUD: cylinder head.	Engine cylinder group.	ON	8074
4	3H1908-2/C41	SPACER: cylinder head stud.	Engine cylinder group.	ON	8078
5	3H1908-2/C45	CYLINDER: includes valve seat inserts.	Engine cylinder group.	ON	8080
6	3H1908-2/G10	GASKET: cylinder base.	Engine cylinder group.	ON	8081
7		COVER: cylinder air; PE-88.	Engine cylinder group.	ON	8115
7		COVER: cylinder air; PE-88-A.	Engine cylinder group.	ON	134C48
8		HOUSING: cylinder air; PE-88.	Engine cylinder group.	ON	8116
8		HOUSING: cylinder air; PE-88-A.	Engine cylinder group.	ON	134C47
9		FLAG: air discharge.	Engine cylinder group.	ON	8117
		GROMMET: air cover.	Engine cylinder group.	ON	1053
		SCREW: hex. hd. cap—3/8"-16 x 1".	Cyl. base to crankcase.		
		SCREW: rd. hd. mach.—1/4"-20 x 3/8".	Air discharge flag.		
		SCREW: rd. hd. mach.—6-32 x 1/4".	Cylinder air housing.		
		SCREW: binder hd. 10-32 x 5/16".	Cylinder air housing.		
		WASHER: lock—1/4"-3/32" x 1/16".	Air discharge flag.		
		WASHER: lock—3/8"-1/8" x 3/32".	Cylinder to crankcase.		
		NUT: hex.—5/16"-24.	Cylinder head.		
		CRANKSHAFT AND CONNECTING ROD GROUP (SEE FIG. 8-1)			
1	3H1908-2/C15	CRANKSHAFT.	Crankshaft & connecting rod group.	ON	8000
		Order by New Number.		ON	104B39
2	3H1908-2/G50	GEAR: crankshaft timing.	Crankshaft & connecting rod group.	AE	8001
3	3H1908-2/N30	NUT: crankshaft timing gear.	Crankshaft & connecting rod group.	ON	8002
		Order by New Number.		ON	18009
4	3H1908-2/S9	SEAL, oil: crankshaft gear.	Crankshaft & connecting rod group.	NM Part No. 50163	8007
5	3H1908-2/B30	BEARING: crankshaft front main.	Crankshaft & connecting rod group.	CGB	8010
6	3H1908-2/B32	BEARING: crankshaft rear main.	Crankshaft & connecting rod group.	CGB	8011
7		PLATE: front bearing.	Crankshaft & connecting rod group.	'N	8013

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CRANKSHAFT AND CONNECTING ROD GROUP (SEE FIG. 8-1) (CONT'D)			
8	3H1908-2/R32	ROD, assembly: connecting, with bolts.	Crankshaft & connecting rod group.	H	8017A
9	3H1908-2B25	BOLT: connecting rod—hardened—1/4"-20 x 1-1/4".	Crankshaft & connecting rod group.	PH	8019
		WASHER: crankshaft spacer.	Crankshaft & connecting rod group.	ON	8003
		SCREW: hex. hd. cap; 5/16"-18 x 3/4".	Front bearing plate.		
		WASHER: lock; 5/16" (1/8" x 1/16").	Front bearing plate.		
		WASHER: plain—9/16" (9/32" x 1/16").	Connecting rod.	ON	19221
		WASHER: lock; 1/4" (3/32" x 1/16").	Connecting rod.		
		KEY: woodruff #9.	Crankshaft & connecting rod group.		
		KEY: woodruff #3.			
		PISTON GROUP (SEE FIG. 8-1)			
1		RING: piston oil; 3/16" x 2-1/4"; not sold separately.	Piston group.	WM	535
2	3H4582B/K16	PIN: piston—5/8" standard.	Piston group.	AI	536
3	3H4532B/K22	RING: piston pin lock.	Piston group.	ACS	537
4	3H1908-2/P25	PISTON AND PIN: assembly.	Piston group.	AI	8021B
5		RING: piston compression; 3/32" x 2-1/4"; not sold separately.	Piston group.	WM	8024
6	3H1908-2/R25	RING SET: piston, includes one No. 535 and two 8024.	Piston group.	WM	79454
		CAMSHAFT GROUP (SEE FIG. 8-1)			
1	3H1908-2/C7	CAMSHAFT.	Camshaft group.	ON	8038
2	3H1908-2/G51	GEAR: camshaft timing.	Camshaft group.	ON	8073
3	3H1908-2/W1	WASHER: camshaft spacer.	Camshaft group.	ON	8042
4	3H1908-2/B33	BEARING: camshaft front.	Camshaft group.	CGB	8047
5	3H1908-2/B31	BEARING: camshaft rear.	Camshaft group.	CGB	8048
6	3H1908-2/C6	PLUG: camshaft rear, hubbard.	Camshaft group.	HUB	8049
		KEY: woodruff #3.	Camshaft group.		
		GOVERNOR GROUP (SEE FIG. 8-1)			
1		ARM: governor.	Governor group.	ON	8050
2		ARM, assembly: governor.	Governor group.	ON	8050A

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		GOVERNOR GROUP (SEE FIG. 8-1) (CONT'D)			
3		BRACKET: governor arm spring.	Governor group.	ON	8050B
		ARM: governor (New Style Replaces Items 1, 2, and 3 above).	Governor group.	ON	8050
4	3H1908-2/S24	SPRING, governor regulator.	Governor group.	ASW	8051
5		STUD: governor adjusting #10-32.	Governor group.	ON	8057
6		NUT: governor adjusting #10-32.	Governor group.	ON	8058
7	3H1908-2/L40	LINK: connecting.	Governor arm to carb.	ON	8059
8	3H1908-2/S23	SPRING: connecting link.	Governor group.	ASW	8059-1
9	3H1908-2/G2	GASKET: tappet cover and spring bracket cover.	Governor group.	V	8084
10		COVER: tappet cover and spring bracket.	Governor group.	ON	8085A
11	3H1908-2F27	FLYBALL: governor.	Governor group.	HO	19114
12		SPACER: governor cup screw.	Governor group.	ON	19118
13		CUP, assembly: governor.	Governor group.	ON	19119A
		SCREW: binder hd. #6-32 x 5/8".	Governor cup stop.		
		SCREW: socket hd. #10-32 x 3/4".	Governor arm.		
		WASHER: plain; 1/2" OD x .200" ID x 1/16".	Governor arm.		
		SCREW: rd. hd. mach. 1/4"-20 x 1-1/2".	Tappet cover.		
		WASHER: plain, copper; 17/64" x 7/16" x 1/16".	Tappet cover.		
		VALVE GROUP (SEE FIG. 8-1)			
1	3H1908-2/S20	SPRING: valve.	Valve group.	GW	8030
2	3H1908-2/W2	WASHER: valve spring retainer.	Valve group.	ON	8031-1
3	3H1908-2/L35	PIN: valve spring lock; 3/32" x 1/2".	Valve group.	ON	8032
4		INSERT: exhaust valve seat—stellite.	Valve group.	HA	110A13
		Order Under New Number.		ON	110A52
5	3H1908-2/T6	TAPPET: valve; hardened steel.	Valve group.	MO	8035
6	2H1908-2/B60	BUSHING: valve tappet; brass.	Valve group.	CR	8036
7	SCREW:	SCREW: valve tappet adjusting—hardened—1/4"-28 x 3/4".	Valve group.	ON	8037
8		VALVE: exhaust; stellite.	Valve group.	ON	18029
9	3H1908-2/V10	VALVE: intake.	Valve group.	AI	19030
		NUT: tappet lock; hardened—1/4"-28.	Valve group.		
		OIL PUMP AND BASE GROUP (SEE FIG. 8-2)			
1		CUSHION: mounting; upper.	Oil pump & base group.	FIP	726
2		DRAIN, assembly: oil.	Oil pump & base group.	ON	730A

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		OIL PUMP AND BASE GROUP (SEE FIG. 8-2) (CONT'D)			
3		TROUGH, assembly: oil pump dip (includes pin and ball).	Oil pump & base group.	ON	8061A
	3H1908-2/P30	PUMP, assembly: oil—not illustrated.	Oil pump & base group.	ON	8060A
4		CHAMBER: oil pump inlet.	Oil pump & base group.	ON	8062
5		PLUNGER: oil pump.	Oil pump & base group.	ON	8063
6	3H1908-2/R30	ROD: oil pump push.	Oil pump & base group.	ON	8064
7	3H1908-2/S21	SPRING: oil pump.	Oil pump & base group.	ASW	8065
8	3H1908-2/621	GASKET: oil pump.	Oil pump & base group.	V	8066
9	3H1908-2/F40	FOLLOWER: cam.	Oil pump & base group.	ON	8067
10		SHAFT: follower.	Oil pump & base group.	ON	8068
11	3H1908-2/S22	SPRING: follower retainer.	Oil pump & base group.	AVC	8072
12	3H1908-2/B2	BASE: oil.	Oil pump & base group.	ON	8100
13	3H1908-2/G6	GASKET: oil base.	Oil pump & base group.	V	8101
14		PLUG: 3/8" wing pipe (not used, see item 16).			
15	3H4582B/H20	CUSHION: mounting.	Oil pump & base group.	FIP	8920
16		PLUG: 3/8" pipe; oil fill and drain.	Oil pump & base group.		
17	3H1908-2/B1	BALL: 1/4" steel.	Oil pump check.	HO	8069
		COVER: oil pump trough.	Oil pump group.	ON	120A43
		BOLT: carriage; 5/16"-18 x 3-1/2".	Plant mounting.		
		BOLT: hex. hd. 1/4"-20 x 1".	Oil pump mounting.		
		WASHER: plain; 3/8" ID x 1" OD.	Plant mounting.		
		WASHER: lock; 5/16".	Plant mounting.		
		WASHER: lock; 1/4" (3/32" x 1/16").	Oil pump mounting.		
		WASHER: lock; #6 (3/64" x 1/32").	Oil pump trough cover.		
		WASHER: plain; copper, 25/64" x 9/16" x 1/16".	Oil base.		
		SCREW: hex. hd. cap 3/8"-16 x 7/8".	Oil base.		
		SCREW: rd. hd. mach. #6-32 x 3/4".	Trough cover.		
		CRANKCASE GROUP (SEE FIG. 8-2)			
1	3H1908-2/C20	CRANKCASE: includes brgs., brg. plate, hubbard plug, dowel pins and tappet bushings.	Crankcase group.	ON	8090A
2		TUBE: crankcase breather.	Crankcase group.	ON	8092
3		CAP: breather tube.	Crankcase group.	ON	8093
		PLATE: air baffle.	Crankcase group.	ON	8099

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		FLICKER RESISTANCE GROUP (SEE FIG. B-2)			
1		REINFORCING STRIP: for insulating block.	Flicker resistance group.	ON	1031
2	3H4588/C1	CAPACITOR: resistance flicker 0.5 mfd.	Flicker resistance group.	EU Part No. 10196	1220
3		BLOCK: insulator 1/2" x 7/8".	Flicker resistance group.	ON	1030
4	3H1908-2/P20	CONTACT: point set.	Flicker resistance group.	ON	8974
5		PLUNGER: breaker.	Flicker resistance group.	ON	8205
		Order Under New Number.		ON	160A33
6		TUBE: breaker plunger.	Flicker resistance group.	ON	8206
7		COVER: breaker.	Flicker resistance group.	ON	8210
		BUSHING: insulating, 0.195" ID x 5/64" OD x 3/64".	Flicker resistance group.		
		SCREW: rd. hd. mach. #8-32 x 1/2".	Flicker resistance group.		
		SCREW: rd. hd. mach. #8-32 x 5/16".	Flicker resistance group.		
		SCREW: binder hd. mach. #10-32 x 3/8".	Flicker resistance group.		
		CARBURETOR GROUP (SEE FIG. B-2)			
18		SHAFT and LEVER: assembly.	Air shutter.	Zen Part No. C10855	8894
19		PLATE: air shutter.	Air shutter.	Zen Part No. C102-40	8895
20		PLUG: bowl drain.	Carb. group.	Zen Part No. C138-39	8896
21		SPRING: air shutter return.	Carb. group.	Zen Part No. C117-4	8897
22		PACKING: needle.	Carb. group.	Zen Part No. CT58-1	8898
23		CONTROL ROD: manual choke.	Carb. group.	CL	8957
24		CLIP: choke control.	Carb. group.	ON	666
		GEARCASE GROUP (SEE FIG. B-2)			
1		GEARCASE: includes gov. shaft and paddle.	Gearcase group.	ON	8125A
2	3H1908-2/G7	GASKET: gearcase cover.	Gearcase group.		8126
3	3H4582B/011	SEAL: gearcase cover oil; cork, graphite.	Gearcase group.	ACC	8127
		PADDLE: governor.	Gearcase group.	ON	8032
		SCREW: hex. hd. cap 5/8"-16 x 1-1/2".	Gearcase cover.		
		WASHER: plain; copper, 21/64" x 9/16" x 1/16".	Gearcase cover.		
		WASHER: plain 1/4".	Governor paddle.		
		PIN: cotter; 1/16" x 1/2".	Governor paddle.		

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		MISCELLANEOUS GROUP (SEE FIG. B-2)			
1	3H1908-2/R31	ROPE and Handle: manual starter.	Starting.	ON	1057A
2		SHIELD: intake manifold.	Intake manifold.	ON	8118
3		SHEAVE: starting rope.	Starting.	ON	8402
4		GASKET: spark plug.	Spark plug.	CH	8911
5		HANDLE: carrying.	Carrying.	ON	8916
6	3HK4596A/SP1 or 3H4415	SPARK PLUG: J-10 Champion—14 m. m.	Ignition.	CH	8910
7	3H1908-2/S18	SHIELD ASSEMBLY: spark plug, for power units with serial numbers below 194-040.	Radio shield.	ON	8921A
		SHIELD ASSEMBLY: spark plug, for power units with serial numbers 194-050 or above.	Radio shield.	ON	17853A
		SCREW: flat hd. mach. 1/4"-20 x 1-1/4".	Carrying handle.		
		SCREW: flat hd. mach. 1/4"-20 x 1/2".	Carrying handle.		
		SCREW: rd. hd. mach. #10-32 x 1-3/8".	Spark plug shield 8921A.		
		SCREW: rd. hd. mach. #10-32 x 3/4".	Spark plug shield 17853A.		
		WASHER: lock #10.	Spark plug shield.		
		NUT: hex. #10-32.	Spark plug shield.		
		FUEL SUPPLY GROUP (SEE FIG. 8-3)			
	3H1908-2/M50	MUFFLER: not shown in parts group.	Exhaust.	PO	8930
1		CAP, assembly: fuel tank, includes gasket and chain.	Fuel supply group.	ON	1092A
2		TANK: fuel, 2-3/4" qts.	Fuel supply group.	ON	8156
3		COCK, assembly: shut-off, with screen.	Fuel supply group.	ON	8159A
4		ELBOW: compression male.	Carburetor inlet.	WE Part No. W69X3	8161
5		SLEEVE: compression.	Fuel supply group.	WE Part No. W60X3	8162
6		NUT: compression.	Fuel supply group.	WE Part No. 61X3	8163
7		LINE, assembly: fuel.	Fuel supply group.	ON	8166A
		MAGNETO GROUP (SEE FIG. 8-3)			
1		HOUSING: blower, includes 134A10 cover attached.	Magneto group.	ON	8110
		COVER: blower housing (not illustrated).	Magneto group.	ON	134A10
2	3H1908-2/F25	FLYWHEEL: magneto, includes magnet ring and pole shoe.	Magneto group.	ON	8400A

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88 AND PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		MAGNETO GROUP (SEE FIG. 8-3) (CONT'D)			
3		BOLT: magneto flywheel.	Magneto group.	ON	8403
4		SHOE: magneto coil, laminated.	Magneto group.	ON	8408A
5	34582B/014	COIL: magneto.	Magneto group.	AN	8410
6	3H1908-2/C1	CABLE: high tension, for power units with serial numbers below 194-040.	Magneto group.	ON	8412
		CABLE: high tension, for power units with serial numbers 194-040 or above.	Magneto group.	ON	167B1020
7		PLATE: magneto back.	Magneto group.	ON	8435
		PLATE ASSEMBLY: magneto back, not illustrated.	Magneto group.	ON	8435A
8	3H4582B/07	BRACKET: breaker point.	Magneto group.	ON	8438
9	3H4582B/019	POINT SET: breaker.	Magneto group.	ON	8975
10	3H4582B/09	STUD: breaker arm.	Magneto group.	ON	8441
11	3H4582B/08	SPRING: breaker arm.	Magneto group.	ICS	8443
12	3H4582B/04	CAPACITOR: magneto.	Magneto group.	EU Part No. 10238	8444
13		LEAD: magneto to capacitor connector.	Magneto group.	ON	8445
14		WIRE: magneto primary ignition.	Magneto group.	ON	8446
		WIRE and FILTER, assembly: stop; used on power units with serial numbers 194-040 or above.	Magneto group.	ON	314A4
		SUPPRESSOR: high tension; used on power units with serial numbers 194-040 or above.	Magneto group.	CO CODE C11	17415C
		CLAMP: high tension cable; used on power units with serial numbers 194-040 or above.	Magneto group.	ON	1814
		SCREW: hex. hd. cap; 5/16"-18 x 5/8".	Blower housing.		
		SCREW: rd. hd. mach.; 1/4"-20 x 1/2".	Magneto mounting.		
		SCREW: rd. hd. mach.; #12-24 x 7/8".	Pole shoe mounting.		
		SCREW: binder hd.; #10-32 x 5/8".	Blower housing.		
		SCREW: binder hd.; #10-32 x 3/8".	Stop wire.		
		SCREW: rd. hd. mach.; #8-32 x 3/8".	Capacitor mounting.		
		SCREW: rd. hd. mach.; #8-32 x 5/16".	Contact point bracket.		
		SCREW: rd. hd. mach.; #8-32 x 1/4".	Capacitor mounting.		
		WASHER: plain; 13/32" ID x 13/16" OD x 1/16".	Flywheel to crankshaft.		
		WASHER: plain; #12.	Pole shoe mounting.		
		WASHER: plain,; #8.	Contact point bracket.		
		WASHER: plain; #6.	Contact point.		

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		MAGNETO GROUP (SEE FIG. 8-3) (CONT'D)			
		WASHER: lock; 5/16" (1/8" x 1/16").	Blower housing.		
		WASHER: lock; #12 (1/16" x 1/16").	Pole shoe mounting.		
		WASHER: lock; #6 (5/64" x 3/64").	Contact point.		
		WASHER: lock; int. tooth shakeproof #1210.	Stop wire mounting.		
		WASHER: lock; int. tooth shakeproof #1214.	Backplate mounting.		
		WASHER: lock; int. tooth shakeproof #1208.	Capacitor mounting.		
		NUT: hex. #8-32.	Capacitor mounting.		
		CONTROL GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-4)			
1		RELAY ARMATURE AND BLADE ASSEMBLY.	Control parts.	ON	1446
2		CHARGE RESISTOR: 1.5-ohm; 4" adj.	Control parts.	PM	1470
3		START SWITCH COIL.	Control parts.	AN Part No. 158	1479
		SPRING BRACKET.	Control parts.	ON	1510
4		COIL CORE: 1/2" x 1-1/4" (1-1/2" overall).	Control parts.	ON	1514
5		RELAY ARMATURE RETURN SPRING: heavy.	Control parts.	AVC	1517
6		FIBRE COIL INSULATOR WASHER: 1/16" x 1-1/2".	Control parts.	ON	1513
		CONTACT POINT BRACKET.	Control parts.	ON	1531
7		RELAY CONTACT INSUL. PANEL: with contact points.	Control parts.	ON	1553A
8		REINFORCING STRIP: for insul. panel.	Control parts.	ON	1554
		ARMATURE AND BLADE, RELAY, ASSEMBLY.	Control parts.	ON	1569A
9		RELAY ARMATURE SPRING: light.	Control parts.	AVC	1630
10		RELAY FRAME, ONLY.	Control parts.	ON	1646
	3H4600-129A/R2	CHARGE RELAY ASSEMBLY: not illustrated.	Control parts.	ON	8706
11	3H1908.2/P1	CONTROL BOX ASSEMBLY: 115 v. a-c; remote aluminum.	Control parts.	ON	8707-1A
12		CONTROL BOX MOUNTING BASE.	Control parts.	ON	8710
13		TERMINAL BLOCK: 1/8" x 1-1/4" x 2-3/16"; with terminal clips.	Control parts.	ON	8715
14	3Z9858-8.1	TWO WIRE TOGGLE SWITCH: hi-lo charge SPST; on-off; fiber insulation; solder lug terminals.	Control parts.	AHH Part No. 20994	8735

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CONTROL GROUP FOR POWER UNIT PE-88 (SEE FIG. B-4) (CONT'D)			
15		CHARGE RESISTANCE UNIT LEAD: #16; remote-black.	Control parts.	ON	8736
16		START STOP SWITCH PANEL SPACER: 1/4"; 18 ga. brass tube.	Control parts.	ON	8739
17	3H1908-2/B70	PUSH-BUTTON: natural (color).	Control parts.	SF	8740
18	3H1908-2/B71	PUSH-BUTTON: black (color).	Control parts.	SF	8740-1
19	3Z9824-45.1	START-STOP SWITCH ASSEMBLY.	Control parts.	ON	8743A
20		START RELAY ARMATURE LEAD: #10 flex; 4-3/4" x 1/4".	Control parts.	ON	8750
21		START RELAY TO CHARGE RELAY LEAD: #17; 10-1/4".	Control parts.	ON	8751
22		CHARGE RELAY COIL P.S.: #1065 and core.	Control parts.	AN Part No. PS1065	1720
23		TERMINAL POST ASSEMBLY: ground.	Control parts.	ON	8766A
24		TERMINAL POST ASSEMBLY: insulated.	Control parts.	ON	8772A
25		BOLT: 1/4"-20 x 4-1/2"; for charge resistance unit #1454 with nut and washer.	Control parts.	ON	10346
26		RECEPTACLE BOX: #16 gauge steel.	Control parts.	ON	8781
27		HUBBELL RECEPTACLE.	Control parts.	HU Part No. 7410	18734
28		JACK PIN: voltmeter.	Control parts.	AD Part No. PJ-123	18735
29		TWISTITE RECEPTACLE: steel.	Control parts.	HU Part No. 9200	76800
30	3H4582B/T20	CAPACITOR: 0.5 mfd.	Control parts.	EU Part No. 10195	1219
		SCREW: rd. hd. mach.; #8-32 x 7/8"; steel.	Start-stop switch.		
		NUT: hex.; #8-32.	Start-stop switch.		
		WASHER: shakeproof outside lock—#8-32.	Stop-start switch.		
		WASHER: plain; #8-32 x 3/8"—0.172 x 0.032" brass.	Stop-start switch.		
		WASHER: plain; #10-32 x 7/16" x 0.200" x 0.036" brass.	Stop-start switch.		
		SCREW: binder hd.; #6-32 x 1/4"; brass.	Resistor.		
		WASHER: lock; #6-32 (5/64" x 1/32"); steel.	Resistor.		
		SCREW: rd. hd. mach.; #8-32 x 3/4"; brass.	Terminal block.		

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MODEL: POWER UNIT PE-88

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CONTROL GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-4) (CONT'D)			
		SCREW: rd. hd. mach.; #8-32 x 5/8"; brass.	Terminal block.		
		SCREW: rd. hd. mach.; #8-32 x 5/16"; brass.	Terminal block.		
		WASHER: shakeproof outside lock; #8-32.	Terminal block.		
		WASHER: plain; 3/8" OD x .172" ID x .032"; brass.	Terminal block.		
		NUT: hex.; #8-32; brass.	Terminal block.		
		SCREW: rd. hd. mach.; 1/4"-20 x 1-1/4"; brass.	Battery post.		
		SCREW: rd. hd. mach.; 1/4"-20 x 7/8"; brass.	Battery post.		
		WASHER: plain; 1-1/6" OD x 17/64" x 3/32"; steel.	Resistor.		
		WASHER: shakeproof inside; 1/4".	Battery post.		
		WASHER: insulating; 1/4"—0.064" x 1/4" x 0.752".	Battery post.		
		WASHER: insulating inside; 1/4"—0.048" x 1/4" x 0.375".	Battery post.		
		SCREW: rd. hd. mach.; #10-32 x 5/8"; brass.	Terminal bracket.		
		NUTS: hex.; #10-32; brass.	Terminal bracket.		
		WASHER: shakeproof outside lock; #10-32.	Terminal bracket.		
		WASHER: plain; 7/16" OD x 0.200" ID x .036".	Terminal bracket.		
		SCREW: rd. hd. mach.; #8-32 x 5/16"; steel.	Front panel.		
		WASHER: shakeproof outside lock; #8-32.	Front panel.		
		WASHER: insulated; 0.752" OD x 1/4" ID x 0.064".	Relay mounting & relay battery positive.		
		WASHER: insulated inside; 0.375" OD x 1/4" ID x 0.048".	Relay mounting.		
		WASHER: plain; 9/16" OD x 0.260" ID x 0.040".	Relay mounting.		
		NUT: hex. acorn; 1/4"-20; brass.	Relay mounting.		
		NUT: wing; 1/4"-20; steel.	Battery terminal.		
		SCREW: hex. hd. cap; 5/16" USS x 7/8"; steel.	Control box mounting.		
		WASHER: lock; 5/16" (1/8" x 1/16").	Control box mounting.		
		CONTROL BOX GROUP FOR POWER UNIT PE-88-A (SEE FIG. 8-4A)			
1		BOX: control.	Control box group.		301C189
2		BRACKET: control box.	Control box group.		301B24
3		MTG. BASE: control box.	Control box group.		301B161

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MODEL: POWER UNIT PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CONTROL BOX GROUP FOR POWER UNIT PE-88-A (SEE FIG. 8-4A) (CONT'D)			
4		SWITCH ASSY.: start and stop.	Control box group.		8743
5		SWITCH ASSY.: hi-lo charge.	Control box group.		8735
6		TRANSFORMER.	Control box group.		302-95
7		RECTIFIER.	Control box group.		305-17
8		RESISTOR: 1.5 ohm—4" long.	Control box group.		1470
9		RECEPTACLE: duplex twistite.	Control box group.		76800
10		RECEPTACLE: single, twistlock.	Control box group.		18734
11		JACK.	Control box group.		18735
12		CAPACITOR: 0.01 mfd.	Control box group.		312-16
13		CAPACITOR: 0.5 mfd.	Control box group.		312-17
14		BLOCK: terminal.	Control box group.		332-18
15		PUSH BUTTON: black.	Control box group.		8740-1
16		PUSH BUTTON: fibre.	Control box group.		8740
17		SPACER: start-stop switch panel.	Control box group.		8739
		WASHER: resistor centering.	Control box group.		304-15
		STUD: #10-32 x 4-3/4".	Control box group.		520A86
		STUD: 1/4"-20 x 2".	Control box group.		1413C
		SCREW: rd. hd. mach.; 1/4"-20 x 1-3/4".	Control box group.		
		STUD: 1/4"-20 x 7/8".	Control box group.		520A93
		SCREW: rd. hd. mach.; #10-32 x 3/8".	Control box group.		
		SCREW: rd. hd. mach.; #8-32 x 3/4".	Control box group.		
		SCREW: rd. hd. mach.; #8-32 x 3/8".	Control box group.		
		SCREW: fillister hd.; #6-32 x 1-1/4".	Control box group.		
		SCREW: rd. hd. mach.; #6-32 x 3/8".	Control box group.		
		WASHER: plain 1/4".	Control box group.		
		WASHER: ext. int. tooth lock 1/4".	Control box group.		
		WASHER: spring lock 1/4".	Control box group.		
		WASHER: plain #10.	Control box group.		
		WASHER: ext. tooth lock #10.	Control box group.		
		WASHER: ext. tooth lock #8.	Control box group.		
		WASHER: spring lock #6.	Control box group.		
		WASHER: flat #6.	Control box group.		
		WASHER: insulation #10.	Control box group.		
		BUSHING: insulation .253" x 3/8" x 3/64"	Control box group.		

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		CONTROL BOX GROUP FOR POWER UNIT PE-88-A (SEE FIG. 8-4A) (CONT'D)			
		BUSHING: insulating #10 .195" x 5/16" x 3/64".	Control box group.		
		NUT: hex. 1/4"-20.	Control box group.		
		WASHER: ins. 1/4".	Control box group.		
		CLIP: Fahnstock #2.	Control box group.		
		NUT: wing 1/4"-20.	Control box group.		
		NUT: hex. 10-32.	Control box group.		
		NUT: hex. 8-32.	Control box group.		
		NUT: hex. 6-32.	Control box group.		
		NUT: cap 5/16"-18.	Control box group.		
		NUT: cap bakelite 10-32.	Control box group.		
		RELAY GROUP FOR POWER UNIT PE-88-A			
		RELAY ASSEMBLY: start, complete.	Relay group.		8753A
		RELAY ASSEMBLY: charge, complete.	Relay group.		8706
		COIL AND CORE ASSEMBLY: start relay; includes mtg. washers and nut.	Relay group.		1478
		COIL AND CORE ASSEMBLY: charge relay; includes mtg. washers and nut.	Relay group.		1719
		ARMATURE AND BLADE ASSEMBLY: start or charge relay; includes armature; blade; points and lead.	Relay group.		1569A
		SPRING: armature return; start relay.	Relay group.		1517
		SPRING: armature return, charge relay.	Relay group.		1630
		FRAME ASSEMBLY: start relay.	Relay group.		1646BA
		FRAME ASSEMBLY: charge relay.	Relay group.		1646A
		CONTACT PANEL ASSEMBLY: start relay; includes contacts; mtg. screws; term.	Relay group.		1553A
		CONTACT PANEL ASSEMBLY: charge relay; includes contacts; mtg. screws.	Relay group.		1553B
		GENERATOR GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-5)			
1	3H4600-129A/B7	BRUSH: d-c carbon; 5/8"; M30A.	Generator parts.	PC	840
2	3H4582B/S22	BRUSH SPRING.	Generator parts.	ICS	842
3	3H4582B/S2	FIELD RESISTOR: 1.5 ohm; 2" adjustable.	Generator parts.	PM	1131
4		CAPACITOR: 0.1 mfd.	Generator parts.	EU Part No. 10289	5928

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		GENERATOR GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-5) (CONT'D)			
4A	3H4582B/T20	CAPACITOR: 0.5 mfd.	Generator parts.	TD Part No. 10195	1219
5	364600-129A/A2	ARMATURE ASSEMBLY.	Generator parts.	ON	8517
6		ARMATURE ARBOR THROUGH STUD: a-c.	Generator parts.	ON	8501
7		ARMATURE THROUGH STUD WASHER: 7/8" OD x 13/32" ID x 1/8".	Generator parts.	ON	1196
8	3H4600-129A/B6	BRUSH RIG ASSEMBLY: with brushes.	Generator parts.	ON	8550A
9	3H4600-129A/B8	A-C BRUSH WITH SPRING: round; 5/16"; L51.	Generator parts.	HEL	8554
10		A-C BRUSH GROUND JUMPER: #12; solid copper tin.	Generator parts.	ON	8558
11		RESISTOR TERMINAL TO BREAKER LEAD: 11-3/4" #14; 2 conq. braid, black; two #10-32 eye terminals.	Generator parts.	ON	8582
12		D-C POSITIVE BRUSH JUMPER: # 14 rockbestos.	Generator parts.	ON	8585
13		A-C LINE LEAD: 115-volt a-c, 27"; white; #16 SCE.	Generator parts.	ON	336-32
14		A-C LINE LEAD: 115-volt a-c, 27"; black; #16 SCE.	Generator parts.	ON	336-33
15		GENERATOR FRAME.	Generator parts.		8600
16		GENERATOR FRAME ASSEMBLY.	Generator parts.	ON	8600A
17		GENERATOR FRAME SCREW WASHER: 1/4" x 13/32" x 1/4".	Generator parts.	ON	8604
18		GENERATOR BELL HOUSING.	Generator parts.	ON	8610
19		POLE PIECE ASSEMBLY: 1-3/4", 115-volt a-c and d-c, 32-volt d-c.	Generator parts.	ON	8623
20	3H4600-129A/C10	FIELD COIL ASSEMBLY: 115-volt a-c, SS and remote start.	Generator parts.	ON	8635A
21		FIELD COIL ONLY: 115-volt a-c, AA and remote start.	Generator parts.	ON	8636
		CAPACITOR: 0.5 mfd.; brush rig.	Generator parts.	ON	1220B
		SCREW: hex. hd.; cap; 3/8" USS x 1".	Pole shoe to frame.		10032
		SCREW: rd. hd.; mach.; #8-32 x 1/2" brass.	Condenser mounting.		10418
		WASHER: plain; 3/8" OD x .172" ID x 0.032"; brass.	Condenser mounting.		10631
		WASHER: internal toothed lock; #8-32.	Condenser mounting.		10616
		NUT: hex.; #8-32; brass.	Condenser mounting.		10496

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MODEL: POWER UNIT PE-88

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		GENERATOR GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-5) (CONT'D)			
		SCREW: rd. hd; mach.; #10-32 x 7/8"; brass.	A-C brush terminal.		10436
		WASHER: plain; 7/16" OD x 0.200" ID x 0.036"; brass.	A-C brush terminal.		10632
		NUT; hex.; #10-32; brass.	A-C brush terminal.		10552
		WASHER: internal toothed lock; #10-32.	A-C brush terminal.		10617
		SCREW: rd. hd.; mach.; #10-32 x 5/8"; brass.	Flicker resistor terminal.		10434
		WASHER: plain; 1/16" OD x 0.200" ID x 0.036"; brass.	Flicker resistor terminal.		10632
		NUT: hex.; #10-32; brass.	Flicker resistor terminal.		10497
		WASHER: inside shakeproof lock; #10-32.	Flicker resistor terminal.		10617
		WASHER: outside shakeproof lock; #10-32.	Flicker resistor terminal.		10617
		SCREW: rd. hd.; mach.; #10-32 x 2-1/2".	Flicker resistor terminal.		10445
		WASHER: plain; 3/4" OD x 13/64" ID x 1/16".	Flicker resistor.		
		WASHER: internal toothed lock; #10-32.	Flicker resistor.		10617
		NUT: hex.; #10-32; brass.	Flicker resistor.		10497
		SCREW: rd. hd.; mach.; #8-32 x 5/8"; brass	Flicker resistor.		10419
		WASHER: plain; 3/8" OD x .172" ID x 0.032"; brass.	A-C brush bracket.		10631
		SCREW: rd. hd.; mach.; #10-32 x 1-1/2"; brass.	Brush mounting block.		10441
		WASHER: internal toothed lock; #10-32.	Brush mounting block.		10617
		NUT: hex.; #10-32.	Brush mounting block.		10497
		SCREW: rd. hd.; mach.; #10-32 x 1-1/2"; brass.	Brush rig mounting.		
		SCREW: socket hd.; cap; 3/8" USS x 1-1/4".	Engine to generator.		10033
		WASHER: spring lock; 3/8" (1/8" x 3/32").	Engine to generator.		10602
		SCREW: rd. hd.; mach.; #10-32 x 3".	Brush cover mounting.		
	6R37980	TOOL KIT ASSEMBLY.	Tool group.	ON	77905
		CANVAS TOOL BAG.	Tool group.	CJH	77974
		PLIERS: 6".	Tool group.	VT	77535
		SCREWDRIVER: 3".	Tool group.	VT	77510
		OPEN END WRENCH: 3/8" x 7/16".	Tool group.	VT	77623
		OPEN END WRENCH: 1/2" x 7/16".	Tool group.	VT	77624

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		GENERATOR GROUP FOR POWER UNIT PE-88 (SEE FIG. 8-5) (CONT'D)			
		OPEN END WRENCH: 9/16" x 5/8".	Tool group.	VT	77625
		BREAKER POINT WRENCH.	Tool group.	AL	77581
		ALLEN HEAD WRENCH: for 3/8" cap screw.	Tool group.	RSP	77709
		ALLEN HEAD WRENCH: for 10/32" cap screw.	Tool group.	RSP	77705
		ALLEN HEAD WRENCH: for 1/4" cap screw.	Tool group.	RSP	77706
		FUNNEL.			75666
1		BRUSH: d-c.	Generator parts.		214A4
2		SPRING: d-c brush.	Generator parts.		212A1003
3		FIELD RESISTOR: 2.5 ohm adjustable.	Generator parts.		304-16
4		CAPACITOR: 0.1 mfd.	Generator parts.		312A15
4A		CAPACITOR: 0.5 mfd.	Generator parts.		312A17
5		ARMATURE: assembly.	Generator parts.	ON	201A153
6		STUD: armature through.	Generator parts.	ON	8501
7		WASHER: armature through stud.	Generator parts.	ON	1196
8		BRUSH RIG: assembly with brushes.	Generator parts.	ON	212C71
9		BRUSH: a-c, with spring.	Generator parts.	ON	214A21
16		FRAME: assembly.	Generator parts.	ON	210A1117
17		WASHER: generator frame clamp.	Generator parts.	ON	8604
18		END BELL.	Generator parts.	ON	211C24
19		POLE SHOE: assembly.	Generator parts.	ON	8623
20		FIELD COIL SET: assembly.	Generator parts.	ON	222A1121
		WASHER: centering.	Resistor mounting.	ON	304-15
		SCREW: socket hd.; mach.; 3/8"-16 x 1-1/4".	Eng. to generator.		
		SCREW: hex. hd.; mach.; 3/8"-16 x 1"	Pole shoe mounting.		
		SCREW: rd. hd.; mach.; 1/4"-20 x 4-1/2".	Resistor mounting.		
		SCREW: rd. hd.; mach.; 10-32 x 3".	Bell mounting.		
		SCREW, rd. hd.; mach.; 10-32 x 1-1/2".	Brush rig.		
		SCREW: rd. hd.; mach.; 10-32 x 3/4".	Brush rig.		
		SCREW: rd. hd.; mach.; 10-32 x 5/8".	Brush rig.		
		SCREW: rd. hd.; mach.; 8-32 x 5/8".	Brush rig.		
		SCREW: rd. hd.; mach.; 8-32 x 1/2".	Brush rig.		
		WASHER, lock, split ring: 3/8".	Generator.		
		WASHER, lock, split ring: 1/4".	Resistor mounting.		
		WASHER, lock, split ring: #10.	Brush rig.		

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TABLE OF REPLACEABLE PARTS

MODEL: POWER UNIT PE-88-A

Reference Symbol	Army Stock Number / Navy Stock Number / British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or Standard Type	Cont. or Govt. Dwg. or Spec. No.
		GENERATOR GROUP FOR POWER UNIT PE-88-A (SEE FIG. 8-5) (CONT'D)			
		WASHER, lock, split ring: #8.	Brush rig.		
		WASHER: lock ext. tooth shakeproof #1110.	Brush rig.		
		WASHER: lock ext. tooth shakeproof #1108.	Brush rig.		
		NUT: hex.; 3/8"-24.	Armature through stud.		
		NUT: hex.; 1/4"-20.	Resistor mounting.		
		NUT: hex.; 10-32.	Brush rig.		
		NUT: hex.; 8-32.	Brush rig.		

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SECTION VIII

DRAWINGS

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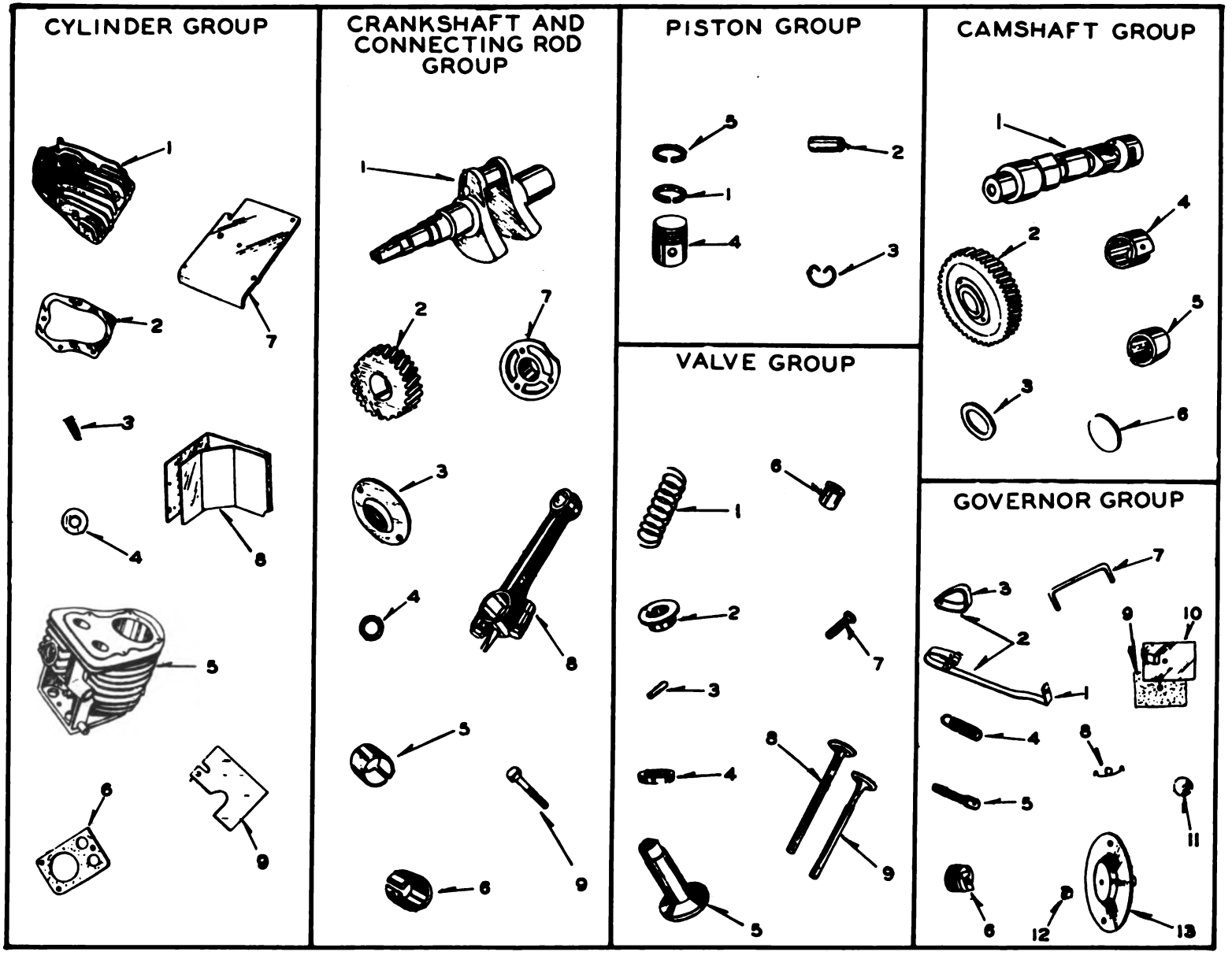

Figure 8-1. Engine Parts

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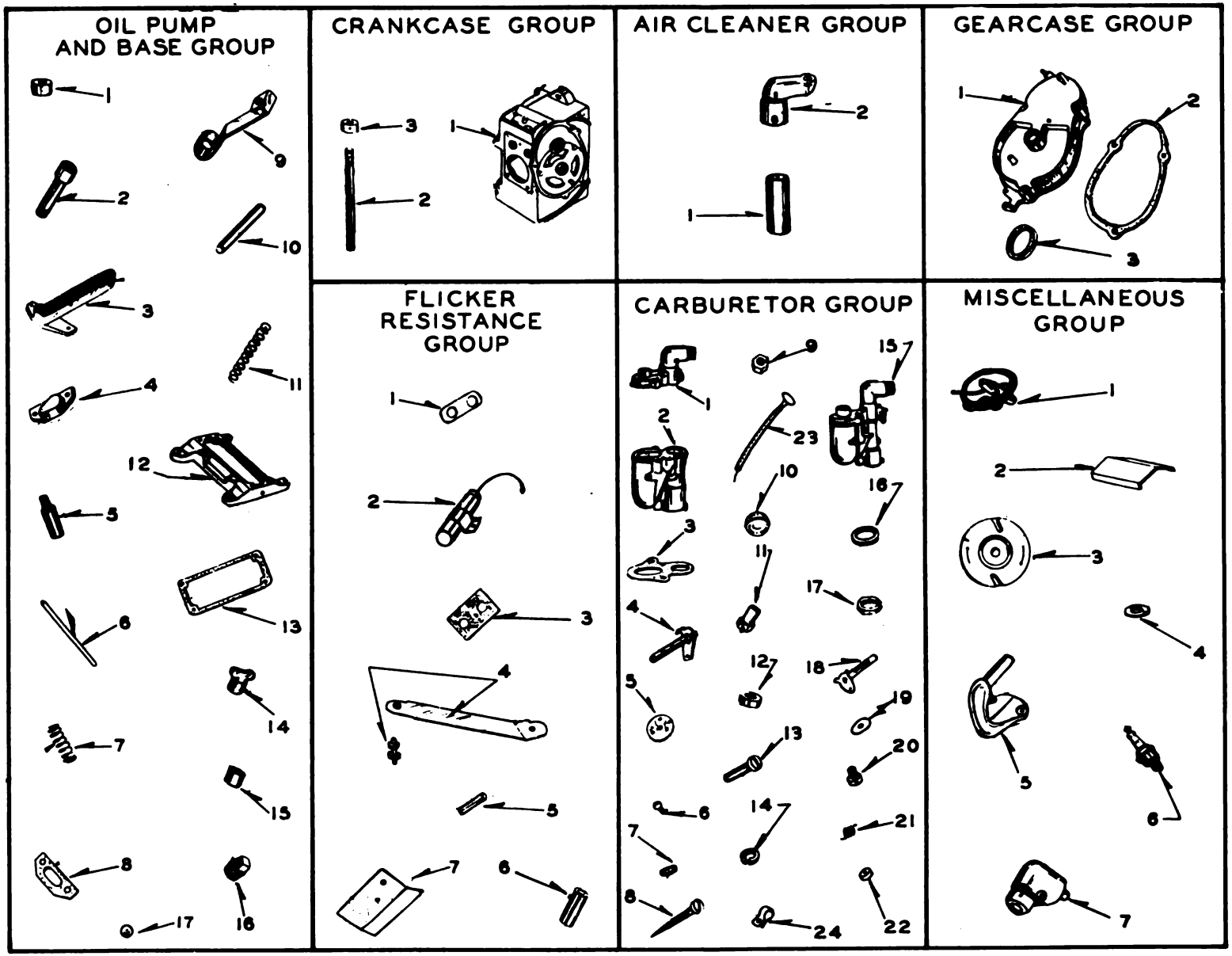

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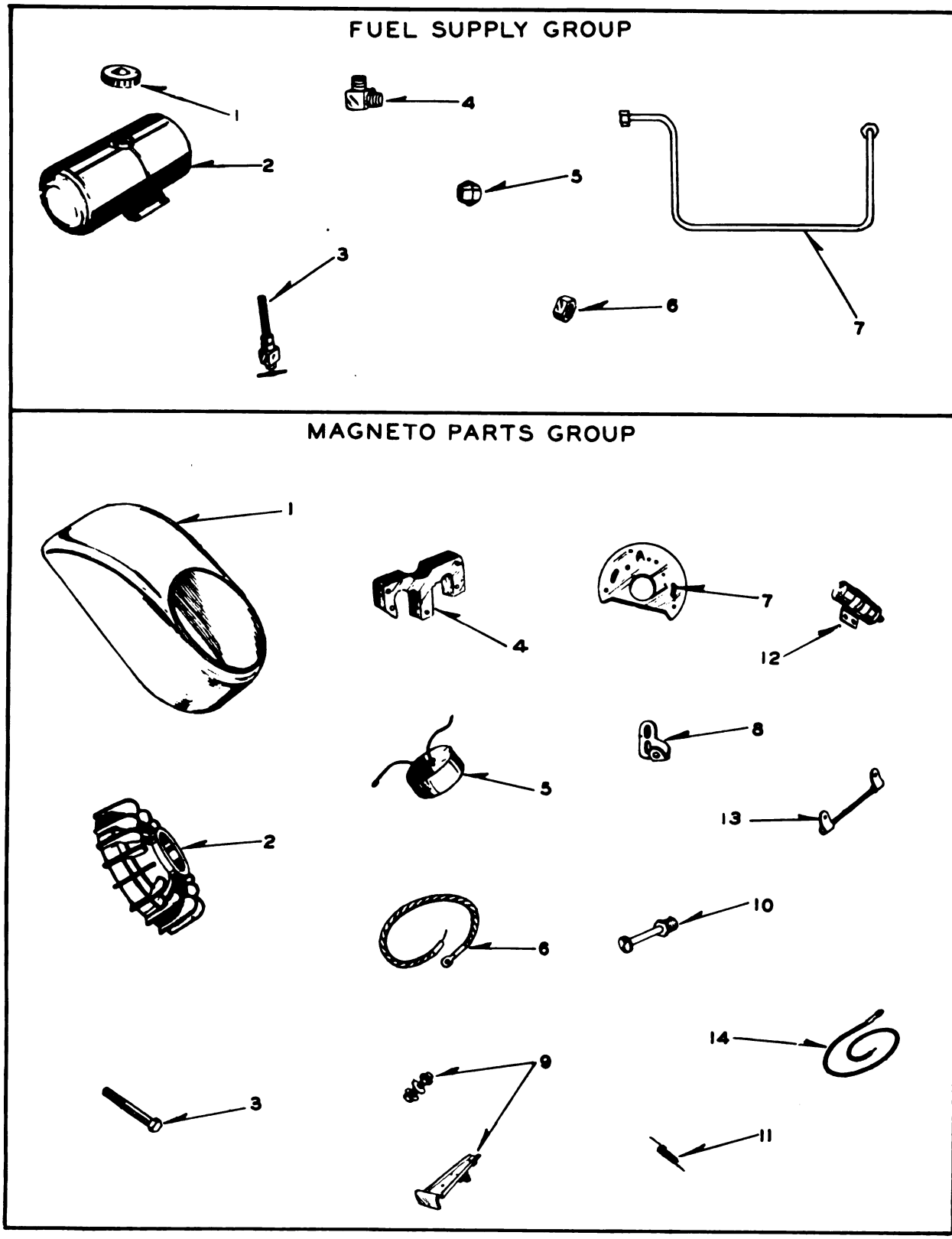

Figure 8-3. Engine Parts

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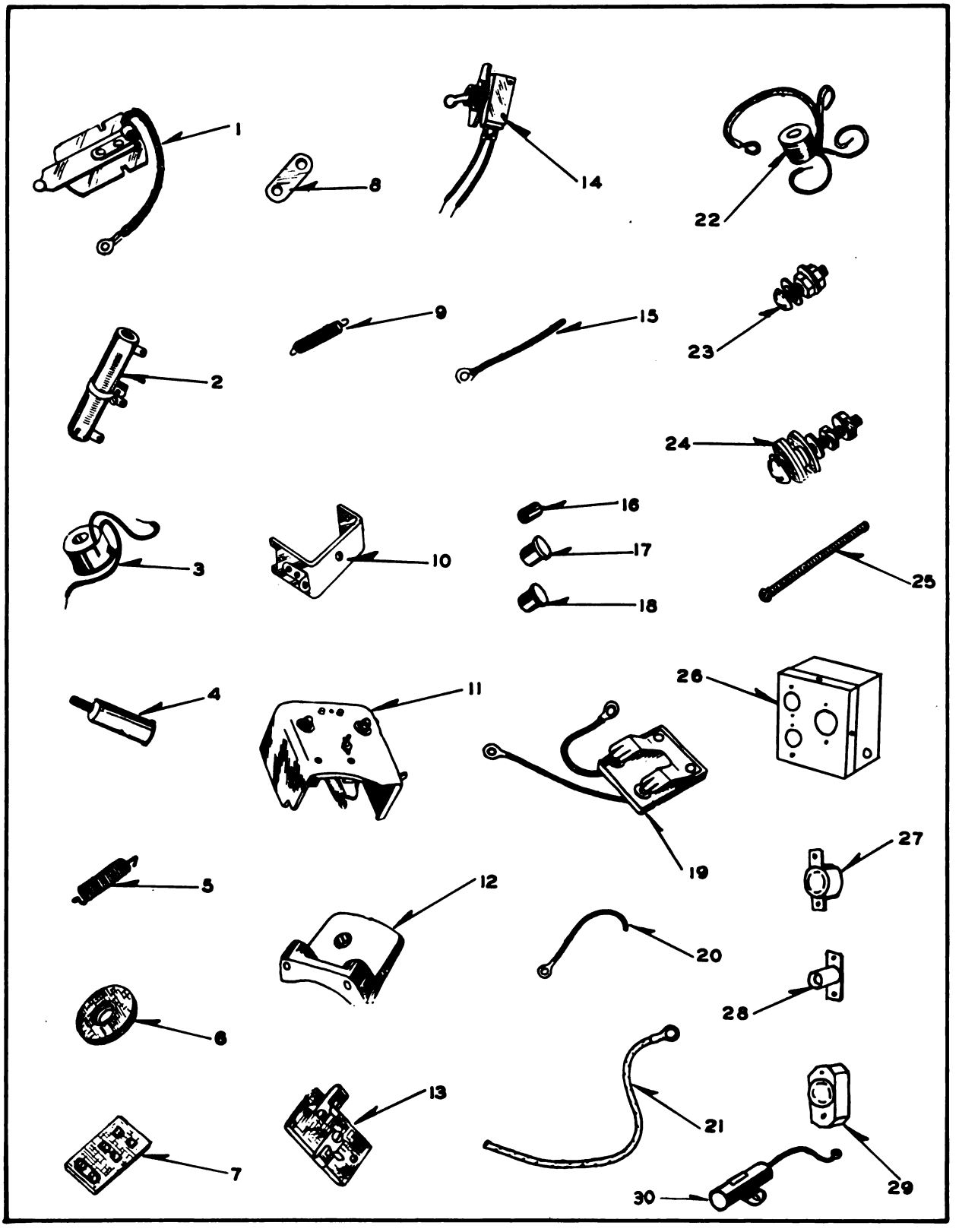

Figure 8-4. Control Parts

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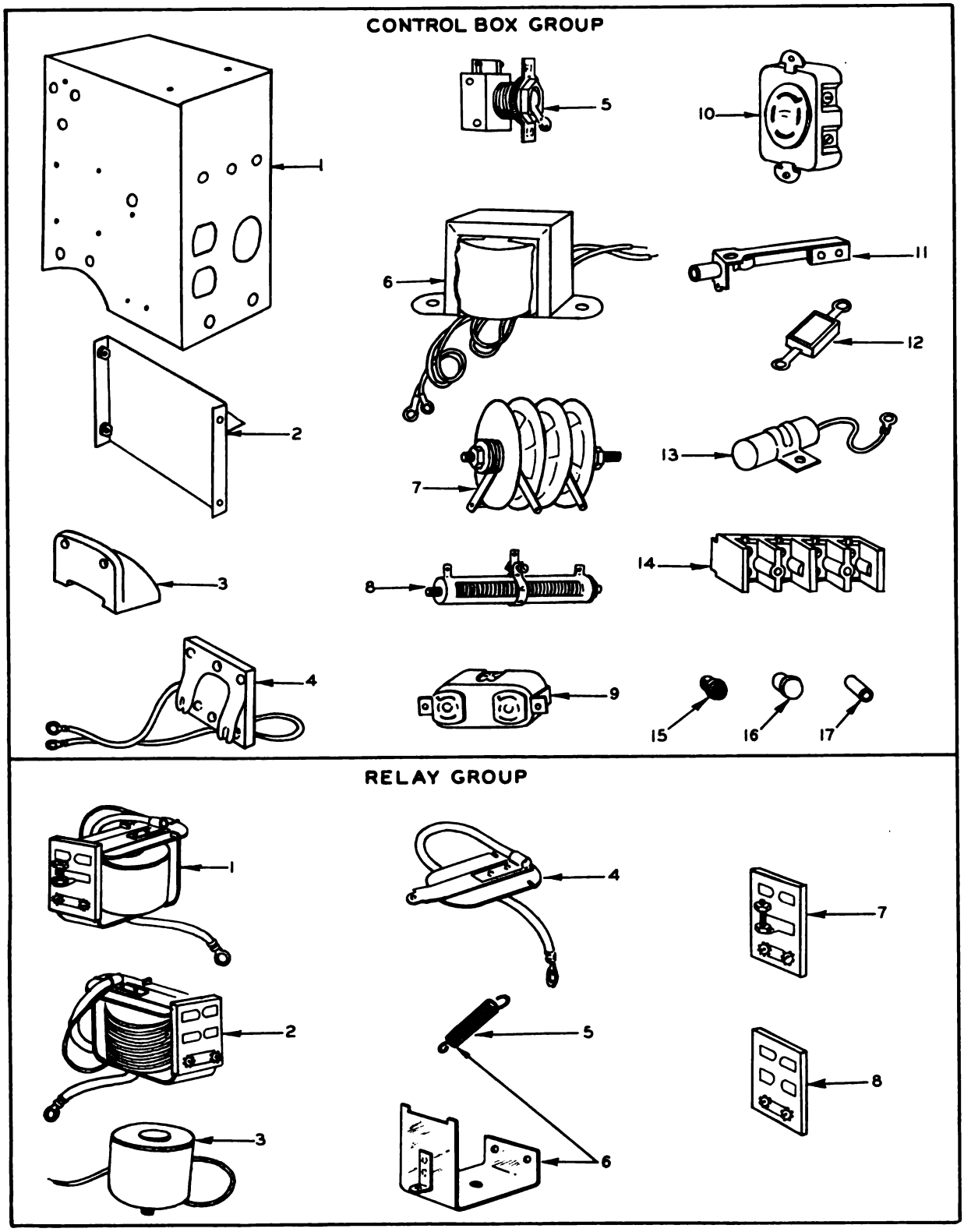

Figure 8-4A. Control and Relay Parts

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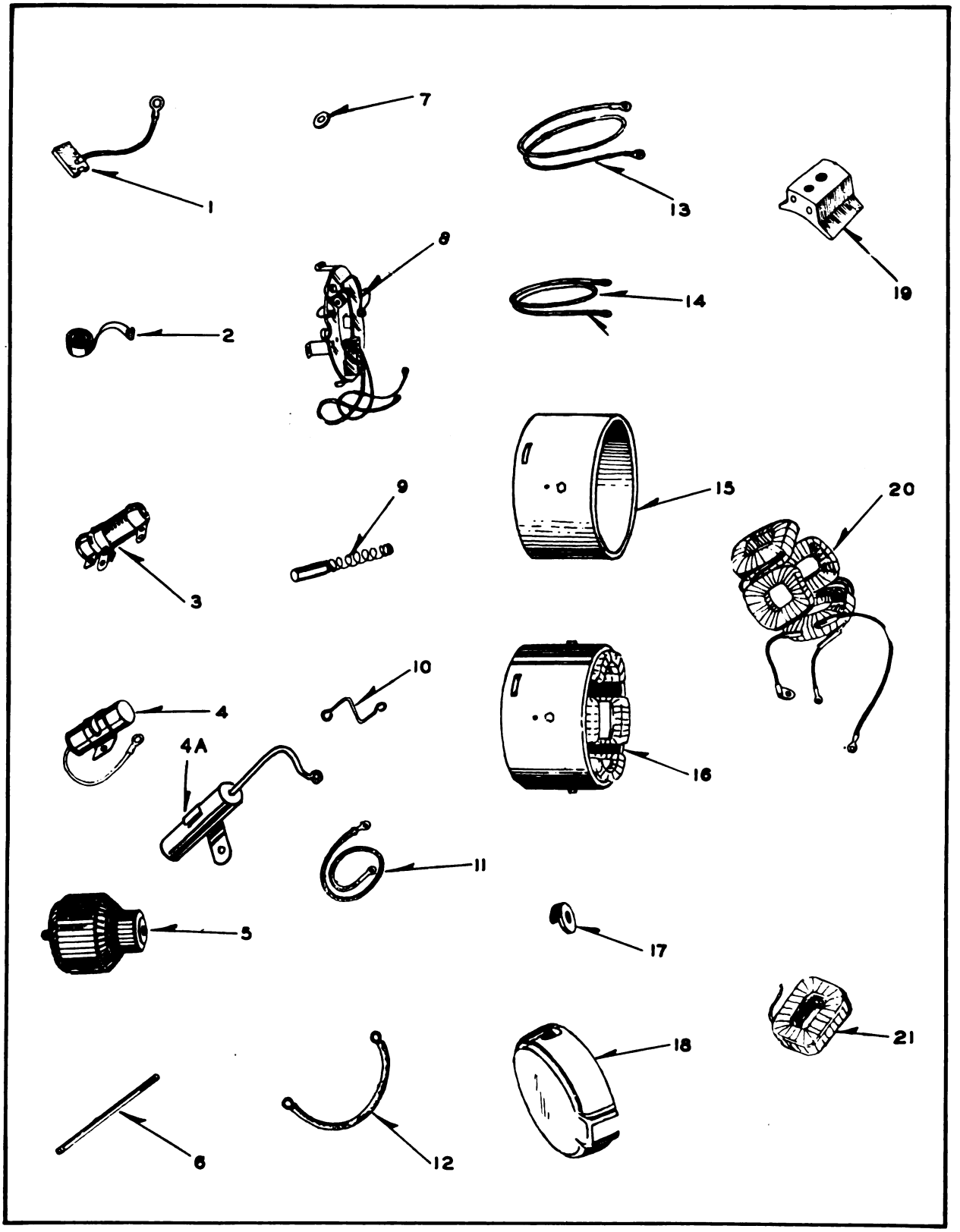

Figure 8-5. Generator Parts

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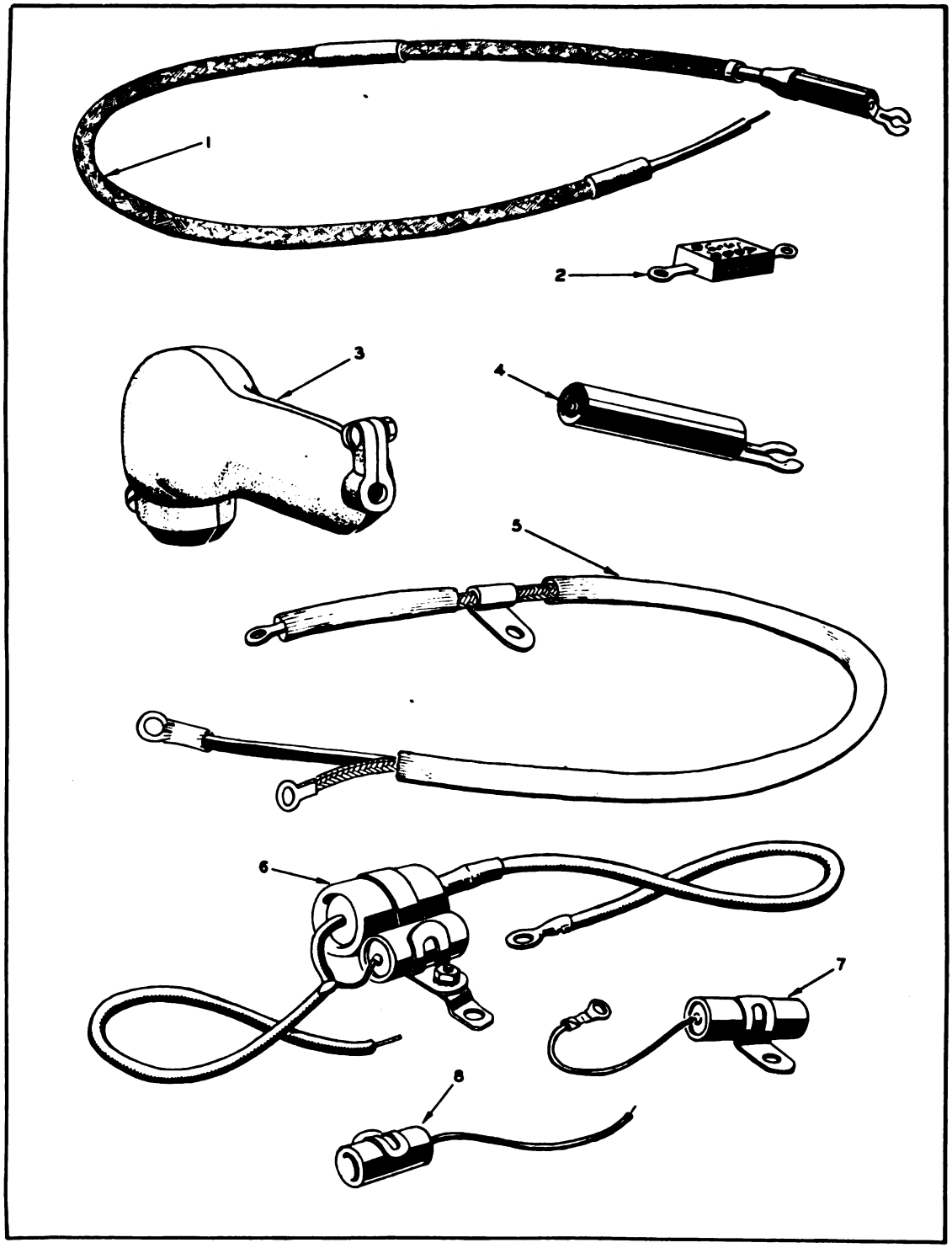

Figure 8-6. Supplementary Suppression Equipment

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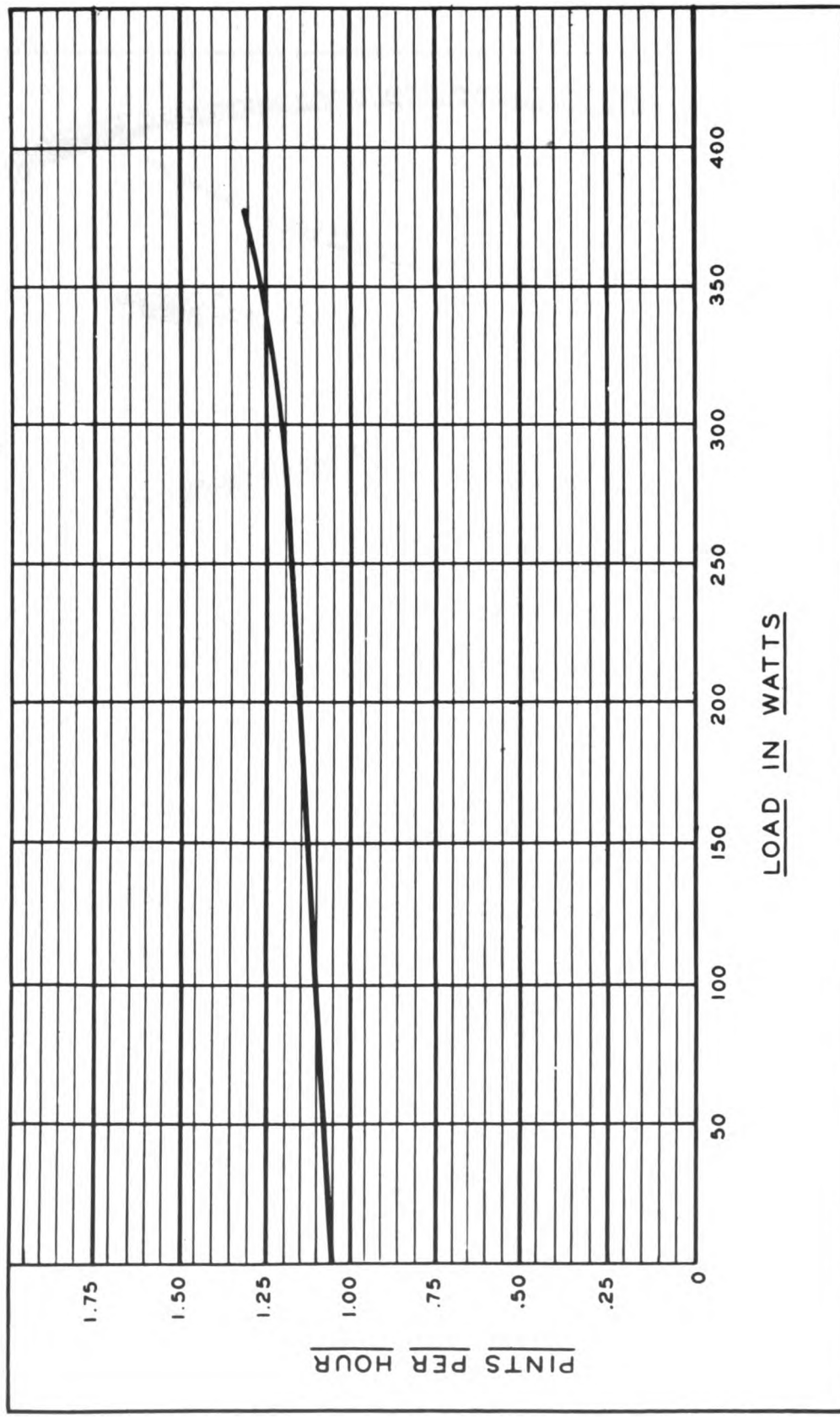

Figure 8-7. Fuel Consumption

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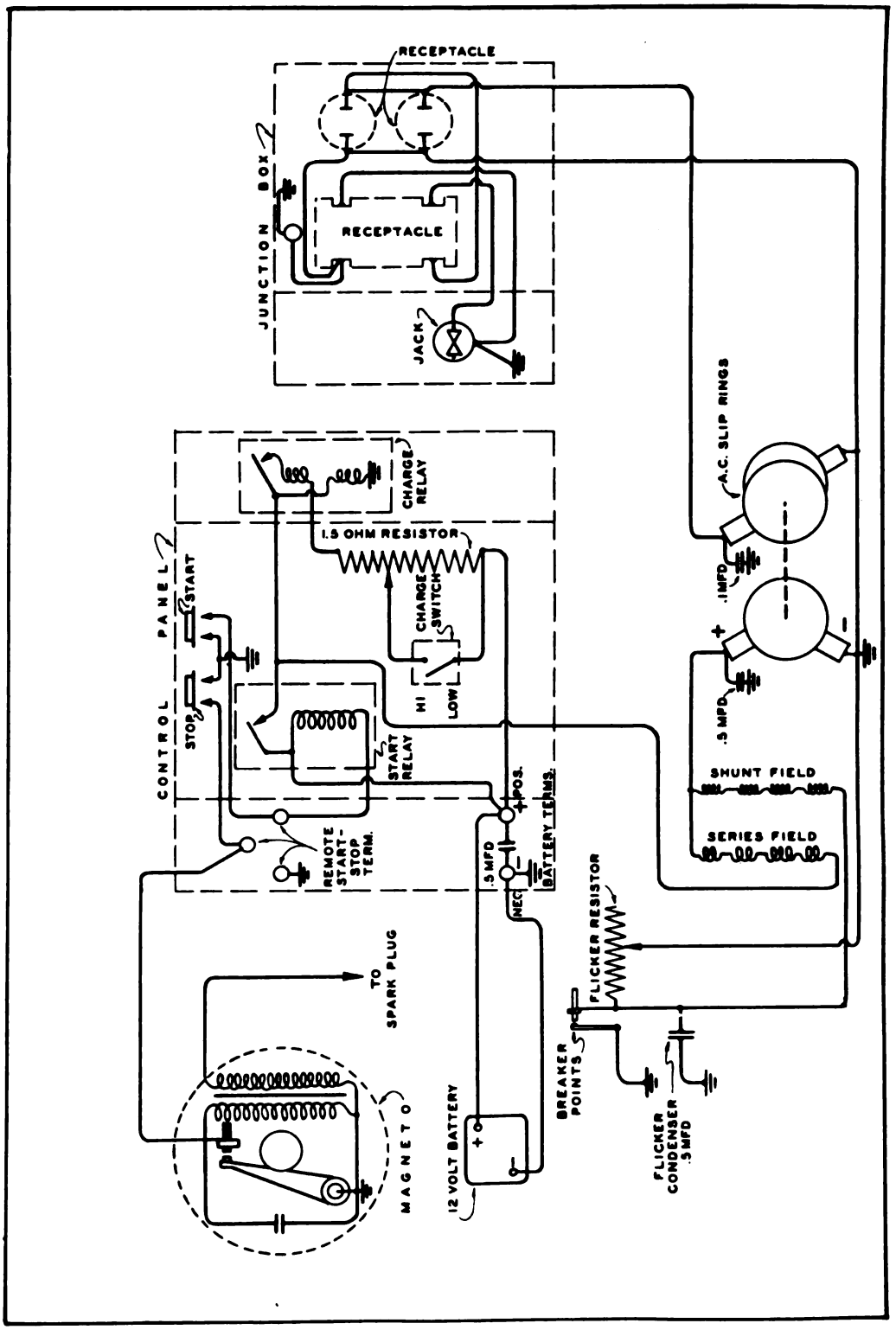

Figure 8-8. Wiring Diagram

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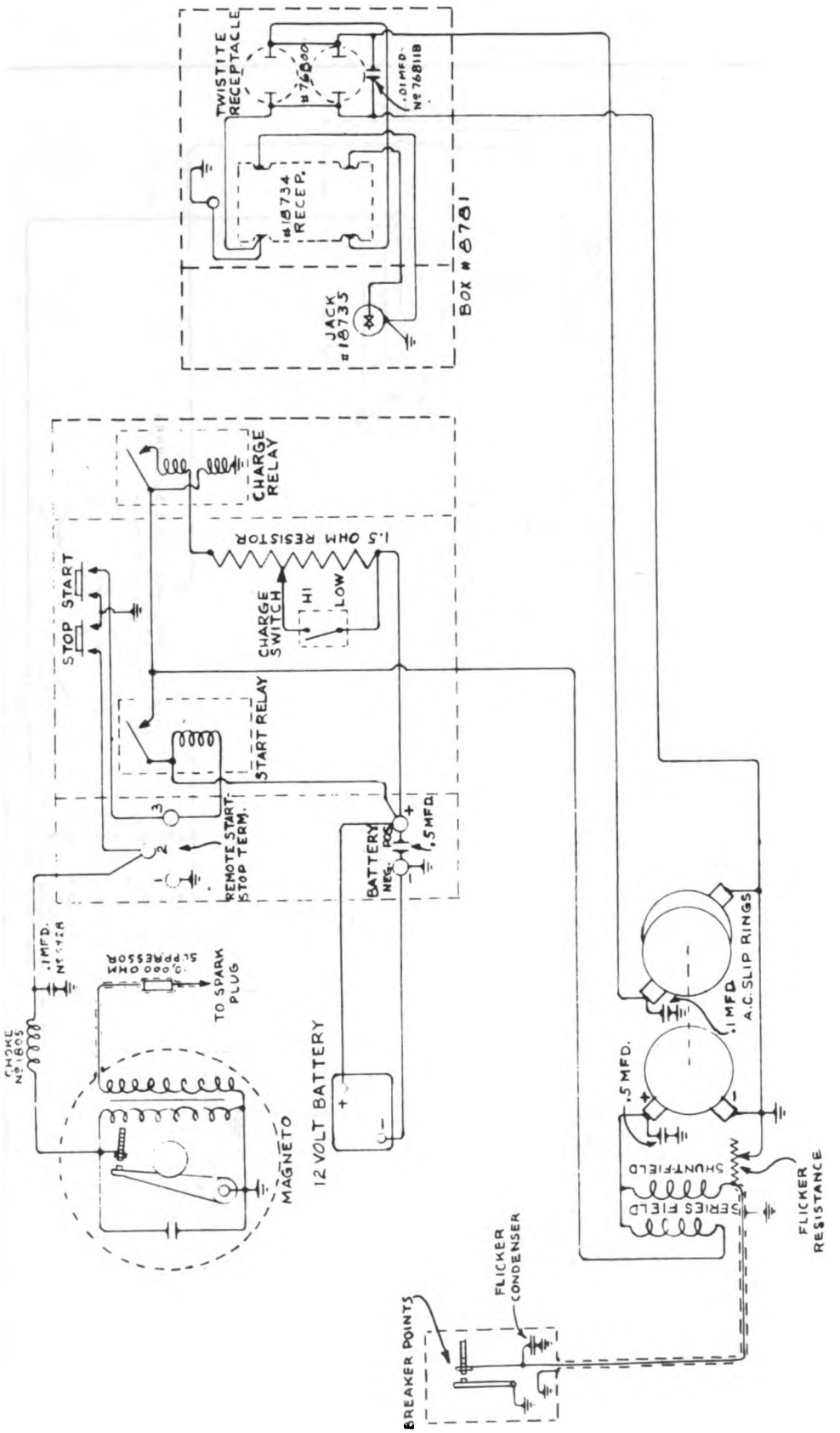

Figure 8-9. Power Unit PE-88—Wiring Diagram Including Suppression Equipment

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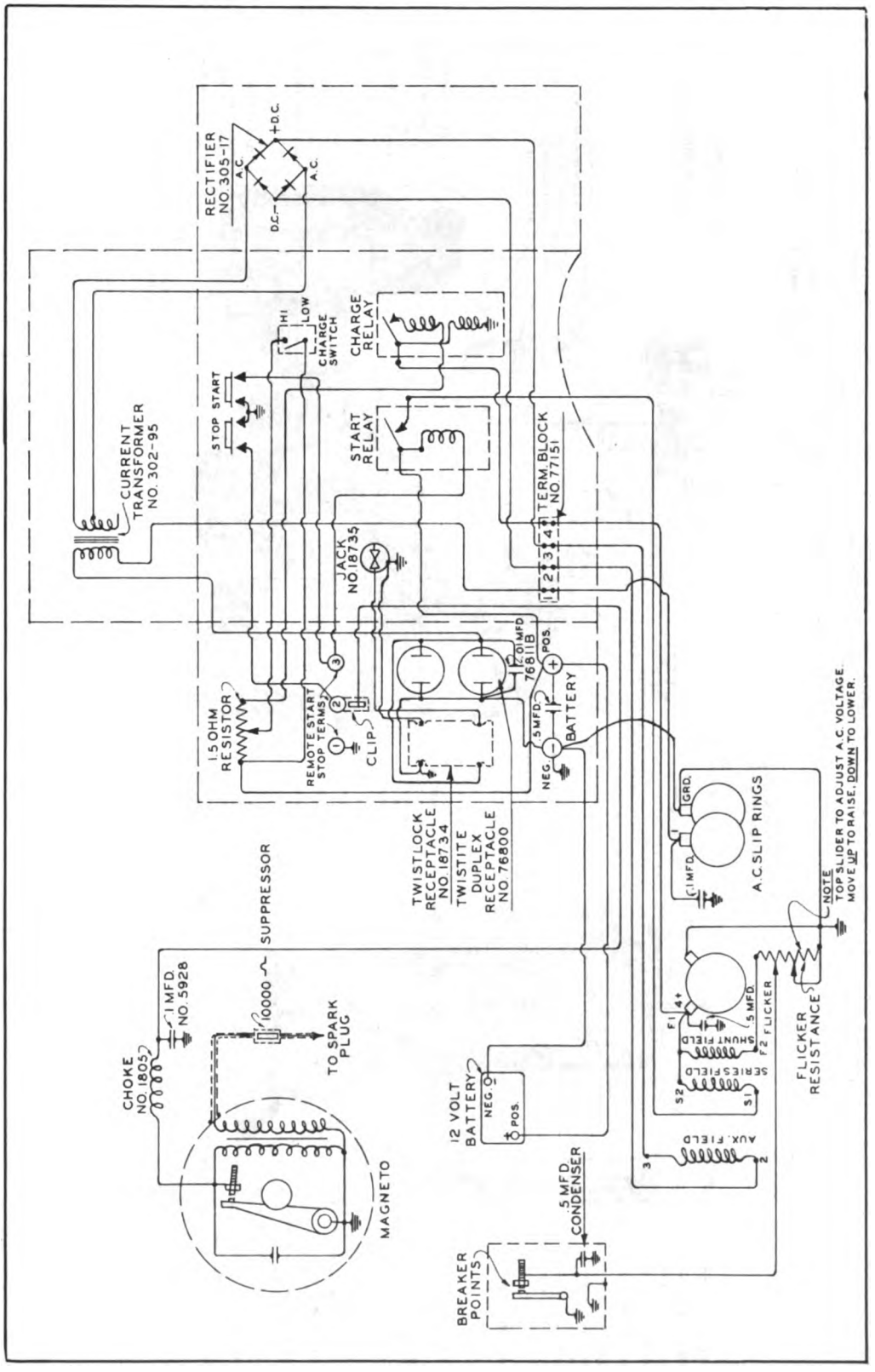

Figure 8-9A. Power Unit PE-88-A—Wiring Diagram including Suppression Equipment

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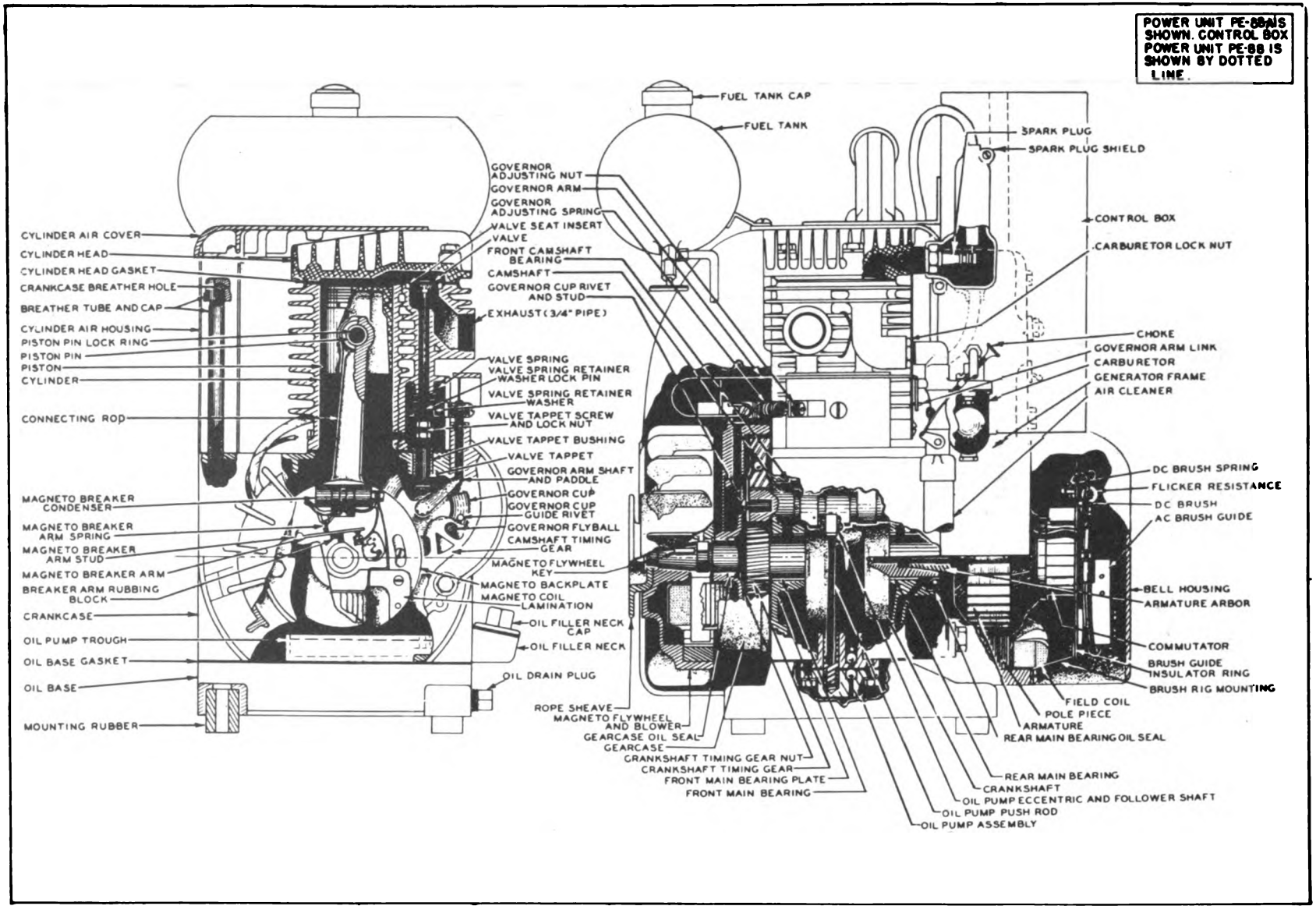

Figure 8-10. Cutaway Views

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AVOID NEGLECT BY KEEPING THIS LOG

The periodic checkups of engine and generator as recommended in this handbook are vital to long life and uninterrupted service of the power plant. Keep an accurate service log on this page, and avoid unduly long periods between service and overhauls by checking against previous dates.

Date	*Hours Run*	*Hrs. Run To Date*	*Service Performed*	*By Whom*	*Date*	*Hours Run*	*Hrs. Run To Date*	*Service Performed*	*By Whom*
Total									

Figure 8-11. Sample Service Log

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