TM 9-616

WAR DEPARTMENT TECHNICAL MANUAL

Generating Units M5 and M6

US WAR DEPARTMENT • 23 DECEMBER 1943

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*This manual supersedes TM 9-2616, dated 22 April 1942, and TM 9-2617, dated 16 April 1942, and the following paragraphs of Technical Manuals: Paragraphs 108 to 110, TM 9-235, 16 May 1942; Paragraph 53, TM 9-252, 15 April 1942; and Paragraph 85, TM 9-370, 31 December 1942.

WAR DEPARTMENT
Washington 25, D. C., 23 December 1943

TM 9-616, Generating Units M5 and M6, is published for the information and guidance of all concerned.

[A.G. 300.7 (15 Sep 43)
O.O. 461/2482 Raritan Arsenal (R) (23 Dec 43)]

BY ORDER OF THE SECRETARY OF WAR:

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The Adjutant General.

DISTRIBUTION: R 9 (4); Bn 9 (2); C 9 (5); IC 44 (10).

(For explanation of symbols, see FM 21-6.)

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GENERATING UNITS M5 AND M6

PART ONE — OPERATING INSTRUCTIONS

Section I

INTRODUCTION

1. SCOPE.

a. This manual is published for the information and guidance of those responsible for the operation, servicing, and repair of the Generating Units M5 or M6. It is intended specifically for the first and second echelons of the using arm personnel. In addition to a complete description of the units and their component parts, detailed instructions are given for adjusting, making minor repairs, and replacing unit parts. Part One (secs. I through VI) contains information for the guidance of operators. Part Two (secs. VII through XV) is intended primarily for the guidance of the first and second echelons maintenance personnel.

2. CHARACTERISTICS.

a. The Generating Unit M5 (figs. 1, 2, and 5) is a gasoline engine driven a-c generator, delivering 3-phase power at 125 volts, 60 cycles, with provision for supplying power at 130 volts and 50 cycles by changing the position of links on the subpanel and reducing the speed of the engine. It is rated at 3 KVA.

b. The Generating Unit M6 (figs. 3 and 6) is similar in construction and appearance but it is arranged to deliver single-phase power at 60 cycles and 125 volts. The M6 Unit can be readily changed to deliver 3-phase power at 60 cycles and 125 volts. It is rated at 2.5 KVA when operating single-phase, or at 3 KVA for 3-phase operation.

c. The major units are the gasoline engine, the main generator which is coupled to it, and the instrument panel. These are bolted to a steel frame or skid assembly (fig. 4) and are completely covered by a sheet metal housing or canopy.

d. The Generating Unit M5 is used to generate power for the Remote Control Systems M1, M3, M4, and M5.

e. With the Remote Control Systems M1 and M5, it is wired to supply 125 volts at 60 cycles. With the M3 and M4 Systems, it is wired to supply 130 volts at 50 cycles.

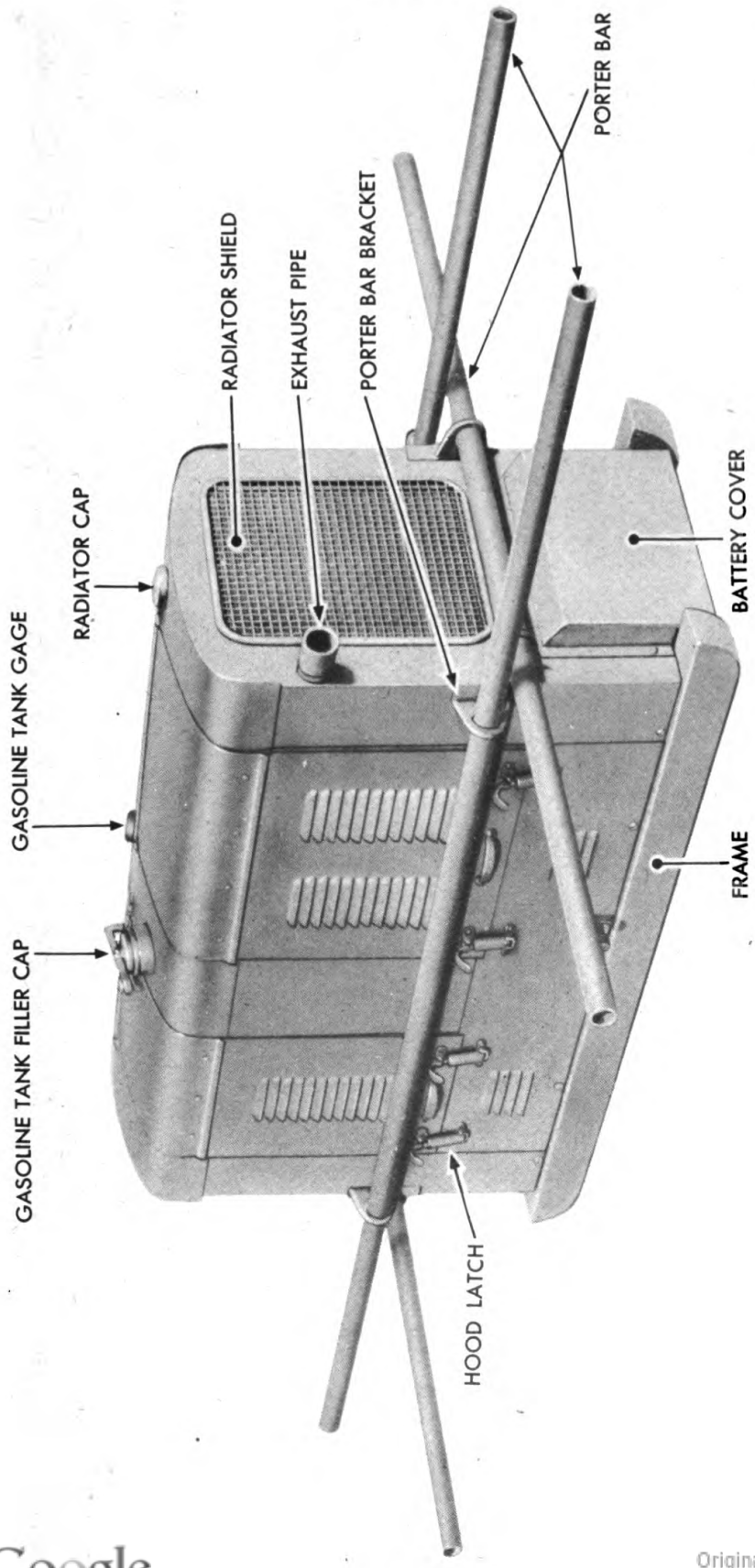


Figure 1 — Generating Unit M5 — Porter Bars in Place — Right Front View

GENERATING UNITS M5 AND M6

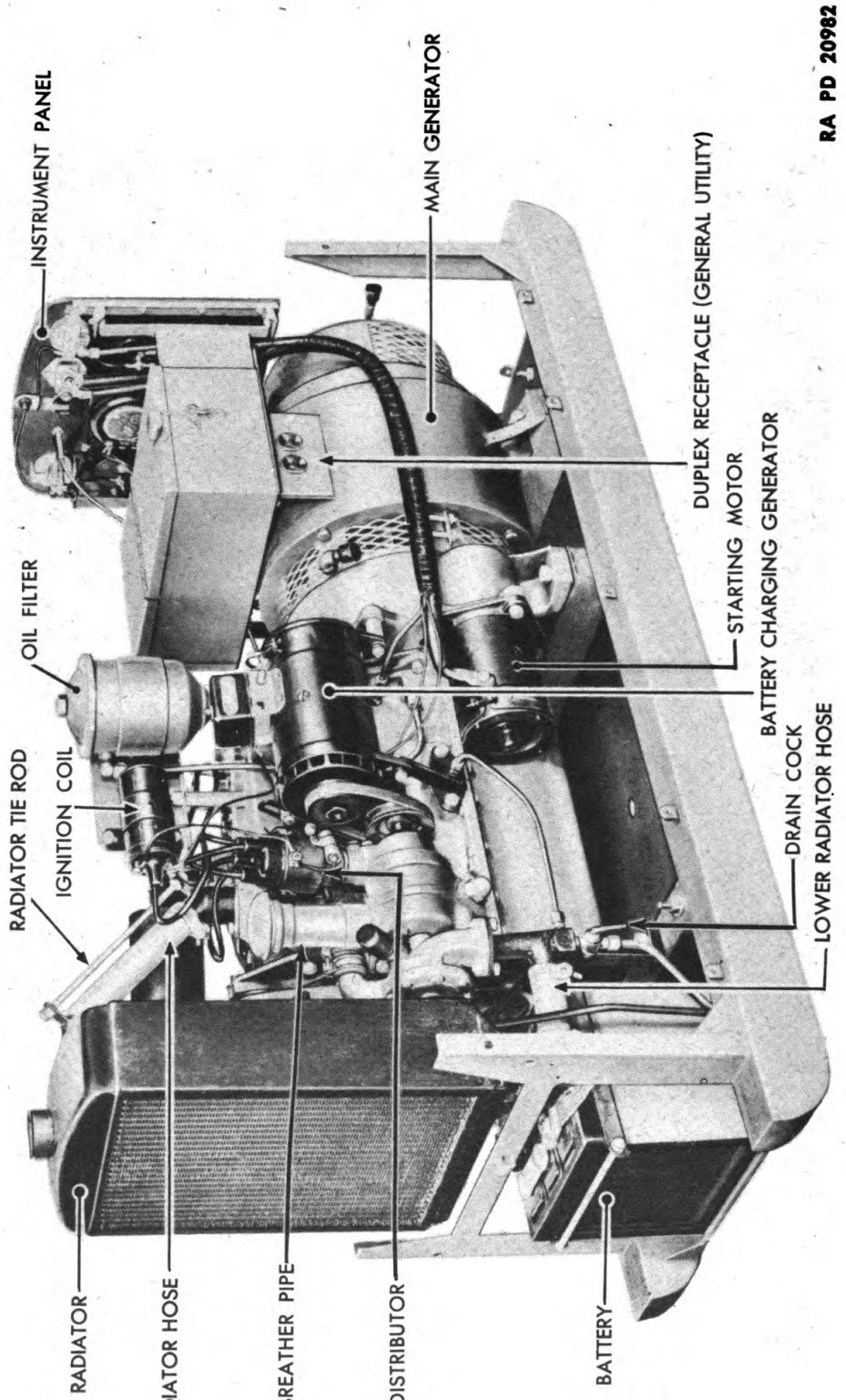


Figure 2 — Generating Unit M5 — Canopy Removed — Left Front View

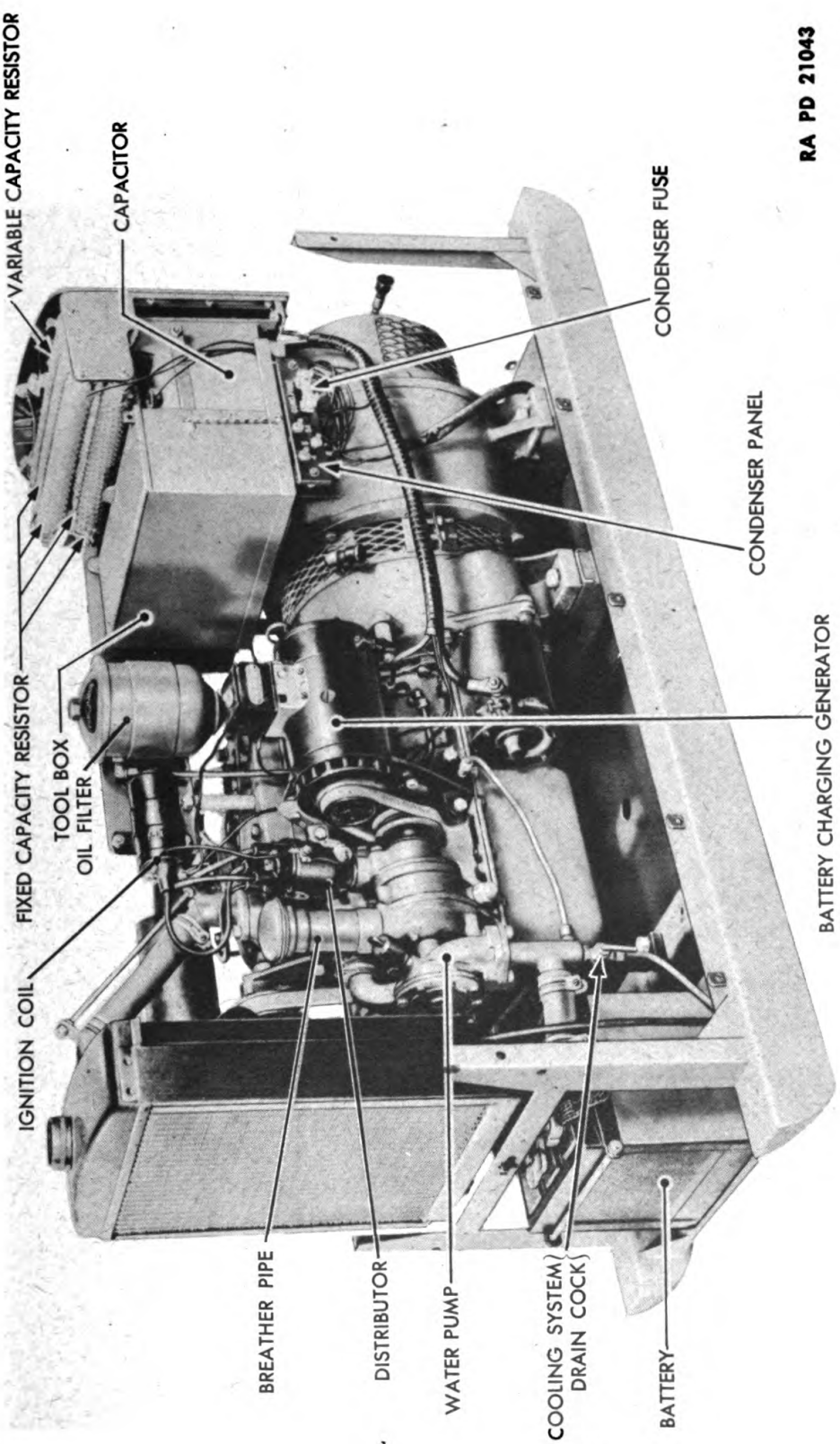


Figure 3 — Generating Unit M6 — Canopy Removed — Left Front View

GENERATING UNITS M5 AND M6

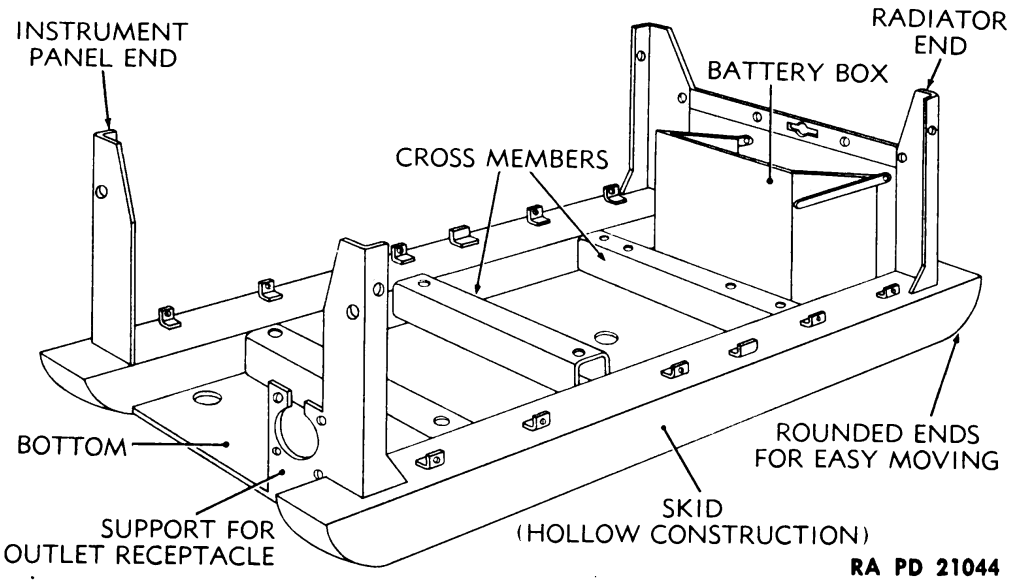


Figure 4 — Frame Assembly

f. When connected to the Remote Control System M1, the generator supplies power for the automatic control of the 37-mm AA Gun Carriage M3A1 and Director M5. When connected to the Remote Control System M5, it supplies power for the automatic control of the 40-mm AA Gun Mount M2 and Director M5.

g. The Generating Unit M5 is also used to supply power for the automatic control of the British 37-mm and 40-mm antiaircraft gun mounts, and Director M6. It is connected to the Remote Control System M3 for the 37-mm mount and to the Remote Control System M4 for the 40-mm mount.

h. The Generating Unit M6 is designed primarily to replace Generating Unit M4 as a source of single-phase power for Directors M4 and M7 when used with Data Transmission Systems M4, M4A1, and M6. When changed over to deliver three phases, it may be used as a source of power for Remote Control Systems M1 and M5, and the Director M5.

i. Each generating unit is furnished with four porter bars to facilitate lifting and carrying the units a short distance by manpower. Collars are being designed to fit on the bars to prevent slipping. Proper positioning of the bars is shown in figure 1.

3. DIFFERENCES AMONG MODELS.

a. In appearances and in general construction, the Generating Units M5 and M6 are alike. The chief differences are as follows:

(1) ELECTRICAL SPECIFICATIONS.

INTRODUCTION

(a) Generating Unit M5 delivers 3-phase power at 60 cycles and 125 volts. By altering the positions of links on the subpanel, and changing the engine speed, the unit can be made to deliver 3-phase power at 50 cycles and 130 volts.

(b) Generating Unit M6, as usually arranged, delivers single-phase power at 60 cycles and 125 volts. By making certain changes, the unit will deliver 3-phase power at 60 cycles and 125 volts.

(c) The generators of the two models are similar; the difference in the power specifications is obtained by connections outside the generator. The M6 Unit has condensers for power factor correction, a time delay-relay, time delay resistors, and a resistor for obtaining lower voltage at a nearby point. This electrical equipment is not part of the M5 Unit.

(2) POWER OUTLET RECEPTACLES.

(a) The outlet receptacle for the M5 Unit has three poles for the reception of a 3-prong plug.

(b) M6 Units having serial numbers from 1 to 266 inclusive, and from 367 to 376 inclusive were equipped with a 19-pole outlet receptacle for single-phase take-off. This receptacle can be replaced by a 3-pole receptacle, provided proper changes are made in the wiring connections.

(c) Later M6 Units have been provided with both 3- and 19-pole outlet receptacles, and a subpanel to facilitate changing over from the single-phase operation with the 19-pole receptacle to 3-phase operation with the 3-pole receptacle, and vice-versa. These machines have serial numbers 267 to 366 inclusive, and 377 to 726 inclusive.

(3) SPEED REGULATION. The engines used in the two units are alike with but one exception, the M6 Unit has an auxiliary governor which is linked to the carburetor throttle to aid in the close regulation of speed demanded by the single-phase operation.

(4) FREQUENCY METER.

(a) The Generating Unit M5 having two speed ranges (50 and 60 cycles), has a frequency meter with 10 vibrating reeds.

(b) The Generating Unit M6 operates only at 60 cycles and has a frequency meter with five vibrating reeds.

(5) MANUFACTURERS. These generating units have been assembled by different manufacturers who have used standard parts and accessories made by still other manufacturers. Working drawings have been furnished by the Ordnance Department and similar parts will be found reasonably interchangeable regardless of where they are made. On the door which covers the instrument panel on both machines is a metal plate which carries the name of the manufacturer or prime contractor responsible for the construction of that par-

GENERATING UNITS M5 AND M6

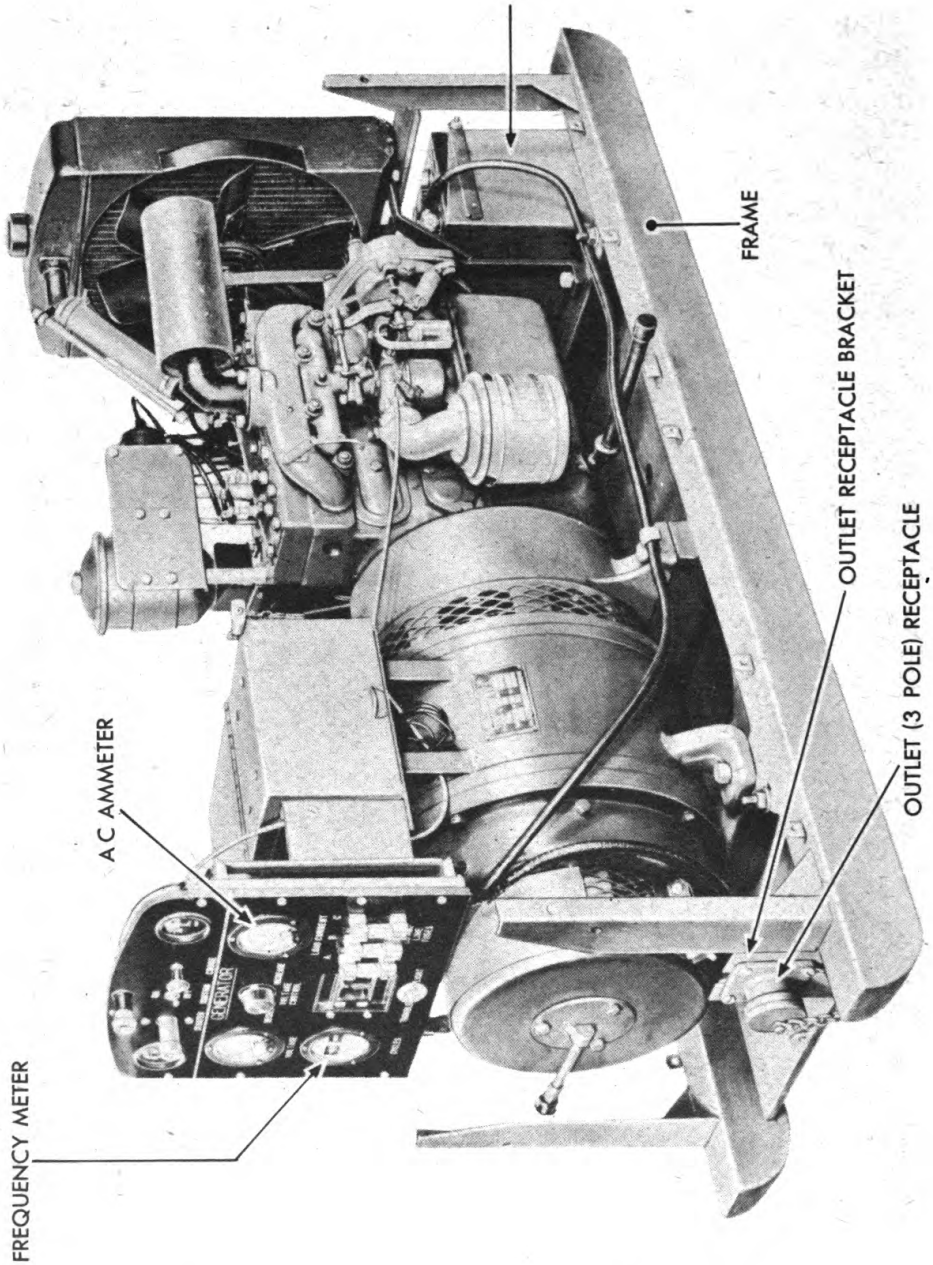


Figure 5 — Generating Unit M5 — Canopy Removed — Right Rear View

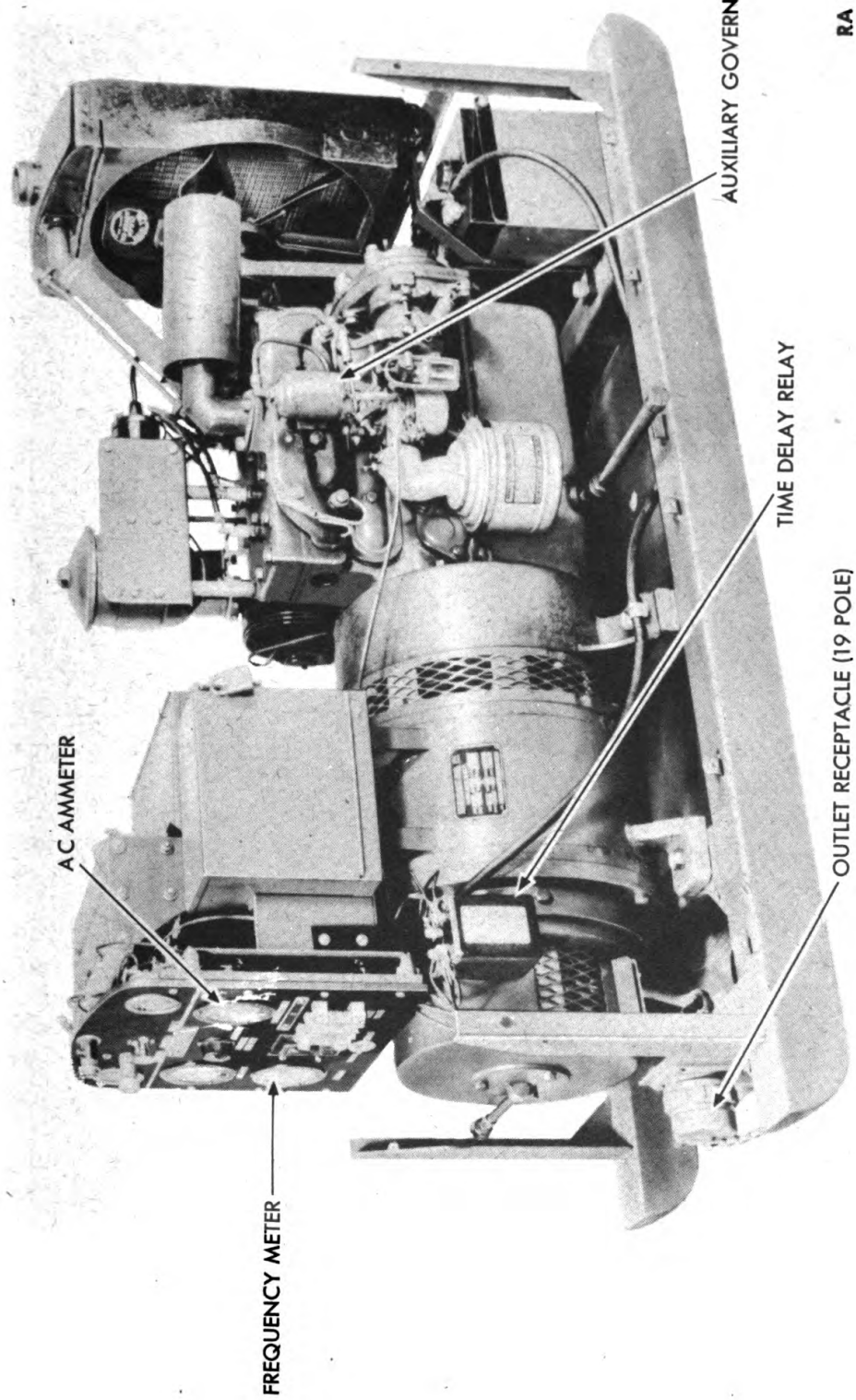


Figure 6 — Generating Unit M6 — Canopy Removed — Right Rear View

ticular unit. If required to make a record of this, be sure to copy the name exactly as it appears, because firm names are sometimes similar. For example, M5 Units have been made by The Hobart Manufacturing Company and by the Hobart Brothers Company, two entirely unrelated companies, both in Troy, Ohio.

4. DATA.

a. Generating Unit M5.

Length, over-all	53 in.
Width, over-all	25¼ in.
Height, over-all	31½ in.
Weight, dry (includes porter bars)	800 lb
Fuel capacity	5 gal
Cooling system capacity	5 qt
Crankcase capacity	4 qt
Rated generator output	3 KVA

b. Generating Unit M6.

Length, over-all	53 in.
Width, over-all	25¼ in.
Height, over-all	31½ in.
Weight, dry (includes porter bars)	850 lb
Fuel capacity	5 gal
Cooling system capacity	5 qt
Crankcase capacity	4 qt
Rated generator output (single-phase)	2.5 KVA
Rated generator output (3-phase)	3 KVA

Section II

OPERATION AND CONTROLS

5. STARTING THE ENGINE.

a. In starting the engine, the same sequence of operations is followed as in starting an automobile engine.

(1) Open the shut-off cock at the gasoline tank.

OPERATION AND CONTROLS

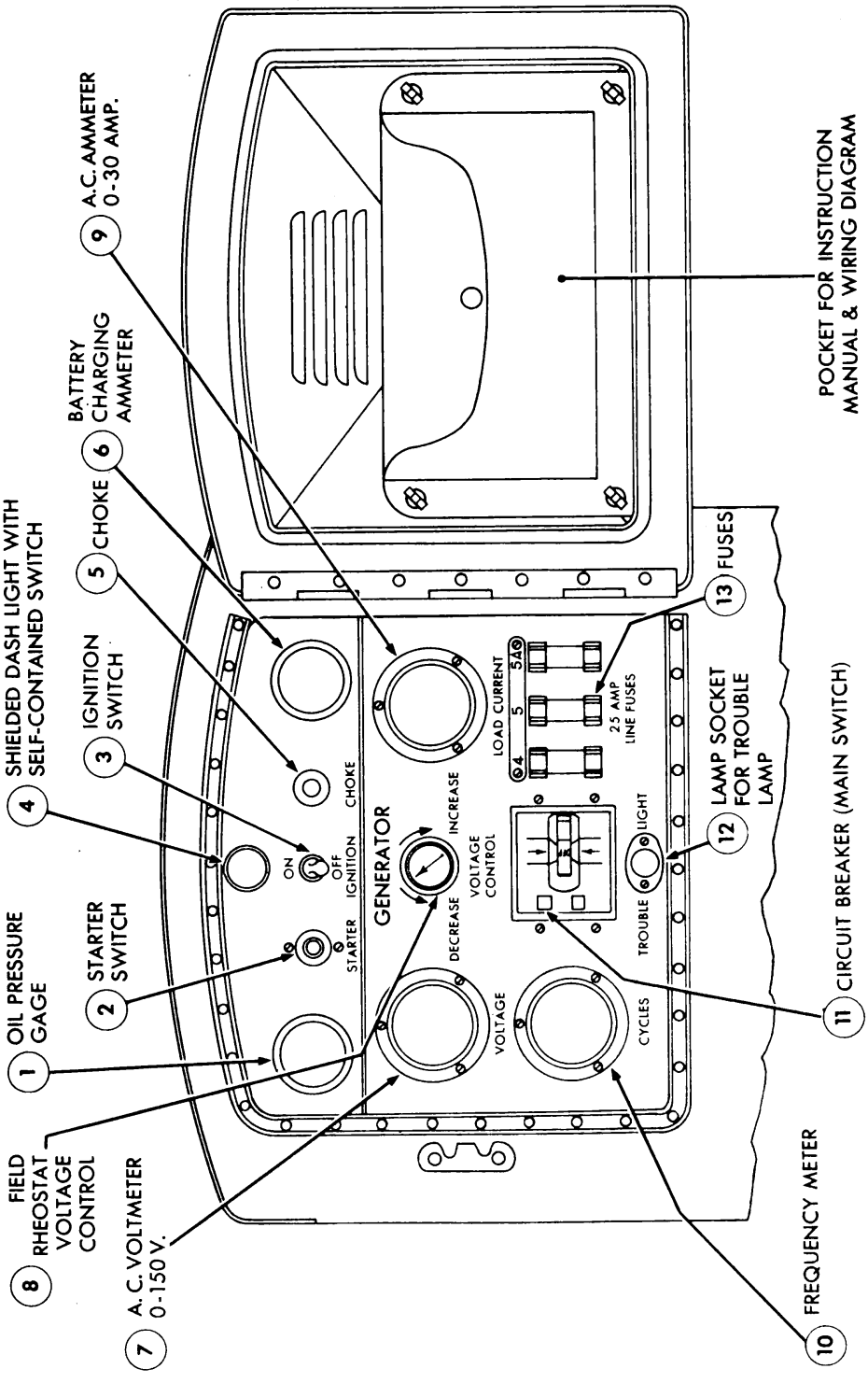


Figure 7 — Instrument Panel

(2) Pull out the choke button if the engine is cold (5, fig. 7).

(3) Snap on the ignition switch (3, fig. 7).

(4) Push in the starter switch button (2, fig. 7).

b. As soon as the engine starts, the manual choke control should be pushed in until it is only about one-fourth of the way out. As the engine warms up, the choke should be gradually returned to its normal or "IN" position. Use choke as sparingly as possible. If the engine has been shut down recently and is still warm, it will not be necessary to use the choke in starting.

c. The hand crank is provided to make starting possible when the battery lacks sufficient power for both ignition and starting. When necessary to hand crank, grasp handle of crank with your thumb on the same side as your fingers. This allows the handle to be jerked out of your hand in case of backfiring.

d. Failure To Start. If the engine fails to start after 15 to 20 seconds of cranking, or if it should suddenly stop, shut off the ignition switch and look for the cause.

6. OPERATING UNDER LOAD.

a. Circuit Breaker. After the engine has been started and is operating satisfactorily, the electrical load may be applied by throwing the circuit breaker to "ON" position (11, fig. 7). The circuit breaker will automatically disconnect the generator from the load should any trouble develop. It resets immediately when thrown to the "ON" position again, and throws out if the trouble still exists. The trouble, generally a short circuit, should be cleared before further use.

b. Fuses. To guard against the circuit breaker sticking, or failing to throw out for any reason, there are three fuses (13, fig. 7), one in each line which will save the generator from a continuous overload.

c. Voltmeter. The voltmeter (7, fig. 7) is connected in the circuit ahead of the main switch and will indicate the line voltage at all times unless the fuses are out. If the machine is running and the voltmeter does not register, check the fuses before looking further.

d. Controlling Voltage. The field rheostat (8, fig. 7) may be manually operated to change the voltage in the line. To increase the voltage, turn the knob to the right as shown by the arrow on the panel; to decrease, turn to the left. By controlling the voltage in the d-c exciter, this rheostat varies the excitation of the a-c generator, and thus controls the voltage of the entire unit. It is generally advisable to adjust the voltage to the rated or desired value after the machine reaches a steady operating condition at its normal load. As an initial

setting, the no-load voltage (circuit breaker in "OFF" position) may be set about as follows:

For M5 Unit, 60-cycle operation ..... set to 125 volts
For M5 Unit, 50-cycle operation ..... set to 135 volts
For M6 Unit ..... set to 125 volts

Make the final adjustment after the load has been applied. If this adjustment is made in the first few minutes of operation, it may be necessary to increase the rheostat setting slightly to compensate for the normal rise in temperature as the machine approaches a steady operating temperature.

e. Ammeter. The ammeter (9, fig. 7) is placed in one phase (one line) of the load circuit, and gives a direct indication of the load if the load is properly balanced between phases. Since some of the load may be single phase, it is advisable to check each phase occasionally with a portable ammeter and, if necessary, reconnect the load so that it is more evenly balanced. The rated full load for the M5 Unit, 3-phase, 60-cycle, 125-volts, is 13.9 amperes. For the M5 Unit, 3-phase, 50-cycle, 130-volts, the rated load is 13.3 amperes. For the M6 Unit, single-phase, 60-cycle, the rated load will be 20 amperes. The generator will not be harmed if it is operated for as long as 2 hours at 25 percent overload or 25 percent more current.

f. Frequency. The frequency meter is of the vibrating-reed type. When the reed marked "60" is vibrating and appears longer than the adjacent reeds, the frequency in the circuit is 60 cycles and the engine speed is 1,200 rpm. If the frequency registered is not the desired figure, the engine speed must be corrected.

g. Temperature.

(1) ENGINE. The temperature of the engine is automatically controlled by a thermostat in the cooling system. When a cold engine is first started, the thermostat will retard the circulation of water until the cylinders become warm. It will then gradually open to admit some of the cooler water and permit a limited circulation. The normal operating temperature range is from 160 to 180 degrees.

(2) GENERATOR. The generator will become warm during operation, but as long as you can hold your hand on it, no harm will result.

7. STOPPING.

a. To shut down, throw the circuit breaker to "OFF" position. This will take the load off the generator. Then snap off the ignition switch (3, fig. 7). Shut off the gasoline at the tank. In cold weather, pull out the choke as you turn off the ignition. A rich mixture will thus be drawn into the cylinders, making easier starting the next time the unit is put in operation.

8. LIGHTS.

a. The panel light is on the battery circuit, and will operate whether the engine is running or not.

b. A socket at the bottom of the instrument panel (12, fig. 7) is for plugging in the trouble light extension. This also operates off the battery and is independent of the generator. The trouble lamp is kept in the tool box.

c. An ordinary house extension with a 2-prong plug and a 115-volt lamp can be used when the unit is operating. Plug it into the utility receptacle on the side of the generator. An electric drill, electric soldering iron, or any light appliance suitable for 115 volts may also be plugged into this socket.

Section III

INSPECTION

9. PURPOSE.

a. To ensure proper operation of the unit and forestall possible trouble and shut-downs at critical times, it is imperative that inspections be made regularly and systematically.

10. PRESTARTING INSPECTION.

a. Fuel. The gasoline tank must be filled. A gage on top of the unit, near the middle, registers the amount of fuel in the tank. The tank holds 5 gallons. To fill, unlatch the filler cap and swing it back, then insert the copper funnel in the opening and place one of the little felt filter pads in the bottom of the funnel. Pour the gasoline through this, observing the usual precautions about open flames and possible sparks. After filling, close down the cap and secure the latch. Then return the funnel to its hook in the engine compartment so that it will not be lost, and snap the spring catch in the ring on the side of the funnel to prevent its rattling. Always keep a supply of felt strainer pads in the tool box.

b. Crankcase Oil. Pull up the gage stick and see if the oil level in the crankcase is at the "4/4" mark. The crankcase holds about 4 quarts of oil.

c. Cooling System. Take off the radiator cap and see if the radiator contains water. If not, close the drain cock and fill until the water level can be seen in the top of the radiator. Use clean rain water in preference to water that contains much lime or other solids. In cold weather, use an antifreeze solution (par. 24).

d. Battery. When starting a new unit, check to see that the battery has been put into operating condition. Service battery as specified in paragraph 56.

e. Wiring. Check wiring for loose connections, and tighten where necessary.

f. Inspect for Leaks.

(1) Gasoline — at tank, carburetor, sediment bowl, or gas lines.

(2) Oil — under unit, indicating loose engine oil pan mounting bolts.

(3) Water — under radiator and at hose connections.

g. Starter. Turn on the panel light and press the starter button momentarily. If the light goes out or is dimmed unduly, the battery may be undercharged, or there may be a loose or corroded terminal. Examine the ground cable.

11. INSPECTION DURING OPERATION.

a. Sound Inspection during Operation. An experienced operator can tell by sound whether or not the unit is functioning properly. After his ears have become attuned to the normal operation noises, he will no longer notice them, but an unusual sound, vibration, or smell will instantly attract his attention, and should be investigated at once. Stop the unit immediately, and correct the cause.

b. Instruments. The instruments on the control panel give a constant indication of what is going on within the unit, and the operator should look at them frequently. If not familiar with the names of the instruments, see figure 7. Observe the following requirements:

(1) OIL PRESSURE GAGE (1, fig. 7). Reading will usually be between 10 and 20 when the engine is warm.

(2) PANEL LIGHT. Turn on the panel light (4, fig. 7) with the switch contained in its base. (Failure to light may be due to a burned-out bulb.)

(3) CHOKE (5, fig. 7). The choke should be all the way in as soon as the engine will operate properly without its use.

(4) ENGINE AMMETER (6, fig. 7). The needle should be to the right or "+" side of the "0" to show that the generator is charging the battery.

(5) A-C VOLTMETER. The a-c voltmeter (7, fig. 7) shows the voltage in the line. During 60-cycle operation it should be 125. During 50-cycle operation it should be 130. A variation of about 3 volts from these readings is to be expected. A constant variation can be corrected with the rheostat. If the needle vibrates back and forth, the engine governor may need attention.

(6) A-C AMMETER (9, fig. 7). The a-c ammeter measures the load on the generator. Normal full load is 13 amperes for 3-phase machines, 20 amperes for M6 single-phase.

(7) FREQUENCY METER (10, fig. 7). The reed that looks fuzzy and appears longer than its neighbors indicates the frequency of the current in cycles.

(8) THE EXHAUST GASES SHOULD BE CLEAR. Smoke in the exhaust indicates faulty carburetion, or perhaps the choke has not been pushed in. A light steam in the exhaust on frosty days may be expected. An irregular exhaust may indicate ignition faults, sticking, or incorrectly adjusted valves.

12. DAILY INSPECTION.

a. Oil. Pull up the gage stick and examine it to determine the amount of oil in the crankcase, and its condition.

b. Gasoline. Wipe off the outside of the glass sediment bowl and look for the presence of dirt or water in the gasoline.

c. Battery. Take off the cell caps and see that the electrolyte covers the plates to a depth of about ⅜ inch. Test the specific gravity of the electrolyte with a hydrometer. Clean the terminals if there is any deposit of sulphate.

d. Cooling System. Check radiator for sufficient coolant. In cold weather, test the antifreeze in the radiator with a suitable hydrometer, making whatever correction in the reading the temperature requires to protect the system against the lowest anticipated temperature.

e. Wiring. Inspect wiring for loose connections or worn insulation. This includes the links on the subpanel.

f. Leakage. Inspect gasoline and oil tube lines for leaking connections.

13. INSPECTION AFTER SHORT OPERATION.

a. In addition to daily inspection, the following inspections should be made:

(1) OIL LEAKS. Open the canopy hoods and look for leaks. Look

under the engine for fresh looking oil spots. Look along the joint between the engine block and the oil pan for possible leakage past the gasket. Follow up the brass oil lines to the oil filter and the oil pressure gage on the control panel, examining the elbows and couplings for drops of oil.

(2) COOLING SYSTEM. Inspect the following for water leaks:

(a) Radiator.

(b) Water pump.

(c) Hose connections.

(d) Drain cock and drain line.

(e) Cylinder head gasket.

(3) GASOLINE LEAKS. These can usually be detected by smell. Be sure to examine the following:

(a) The shut-off valve at the gas tank, and the gas line compression coupling.

(b) Gas line connections at the carburetor and the sediment bowl gasket.

(c) Carburetor Body Gaskets. Overflowing of the carburetor is usually caused by a sticking float or needle valve. Notify ordnance maintenance.

(4) WATER LEVEL. Unscrew the radiator cap and inspect the height of the water. It should be in sight above the baffle. CAUTION: If the engine has been running and the radiator is hot, use caution in taking off the cap. Steam and hot water may gush out.

(5) TOOLS AND EQUIPMENT. Check the tools and spare parts that are regularly kept with unit to be sure that they are in their proper places.

14. WEEKLY AND MONTHLY INSPECTION.

a. In addition to the inspections in paragraph 13 (which also should be made weekly), make the following inspections about once a month or every 250 hours.

(1) DRIVE BELTS. Check the condition and tightness of the fan belt and the belt that drives the battery-charging generator. You should be able to deflect the fan belt an inch in either direction without effort, and the generator belt half an inch.

(2) COMPRESSION. Test the compression in each cylinder independently. If equipment is lacking, this may be done by removing all spark plugs except the one in the cylinder being tested; with the ignition off, turn the engine through its cycle with the hand crank. Then repeat this process for the other cylinders. If the crankshaft turns too easily at any cylinder, a leakage of the compression is indi-

cated. A more accurate way of checking compression is with a pressure gage that can be screwed into a spark plug hole. All cylinders should register the same, but a variation of not more than 5 pounds is permissible for normal service operation.

(3) OIL PUMPING. This is usually caused by worn or sticking piston rings. It is indicated by a gummy deposit which quickly forms on the spark plugs, and a characteristic blue cloud of smoke which comes from the exhaust pipe.

(4) COMMUTATORS AND SLIP RINGS. Inspect commutators and slip rings to see if their surfaces are clean and that the brushes make proper contact on the surfaces. This inspection should be made at each of the following points:

(a) Commutator for exciter on main generator.

(b) Slip rings on main generator.

(c) Commutator on battery-charging generator.

(d) Commutator on starting motor.

(5) DISTRIBUTOR. Check the distributor points for alinement and proper gap. The maximum gap should be 0.022 inch.

(6) MOUNTING BOLTS. Check tightness of bolts that secure the engine and generator to the skid assembly.

(7) CLEAN. Inspect the unit for general cleanliness.

(8) INSPECT THE PAINT. Look for rusty spots or places that have scaled off and need touching up. If unit or canopy needs repainting to protect it from the weather, repaint.

Section IV

LUBRICATION

15. INTRODUCTION.

a. Lubrication is an essential part of preventative maintenance, determining to a great extent the serviceability of parts and assemblies. Materiel must be lubricated in accordance with the latest instructions contained in Technical Manuals and Ordnance Field Service Bulletins. Lubricating fittings are readily identified by a red circle ¾ inch in diameter.

LUBRICATION

16. LUBRICATION GUIDE.

a. General. Lubrication instructions for this materiel are consolidated in a Lubrication Guide (fig. 8). These specify the points to be lubricated, the periods of lubrication, and the lubricant to be used. In addition to the items on the guide, other small moving parts, such as hinges and latches, must be lubricated at frequent intervals.

TABLE OF CAPACITIES AND LUBRICANTS TO BE USED

UNIT	CAPACITY (Approx.)	LOWEST EXPECTED AIR TEMPERATURE		
		+32° F. and above	+32° F. to 0° F.	Below 0° F.
Crankcase	4 qt.	OE SAE 30	OE SAE 10	Refer to OFSB 6-5

b. Lubrication Notes. The following notes apply to the Lubrication Guide (fig. 8). All note references in the guide itself are to the subparagraph below having the corresponding number:

(1) INTERVALS. The intervals indicated are for normal service. For extreme conditions of heat, water, sand, dust, etc., reduce interval by one-third or one-half, or more, if conditions warrant.

(2) AIR CLEANER. The air cleaner is located on the right side of the engine. Daily, check level and refill oil reservoir to bead level with used crankcase oil, or OIL, engine (crankcase grade). Every 100 hours or daily, when operating in extreme dust conditions, remove cleaner and wash all parts. Proper maintenance of air cleaners is essential to prolonged engine life.

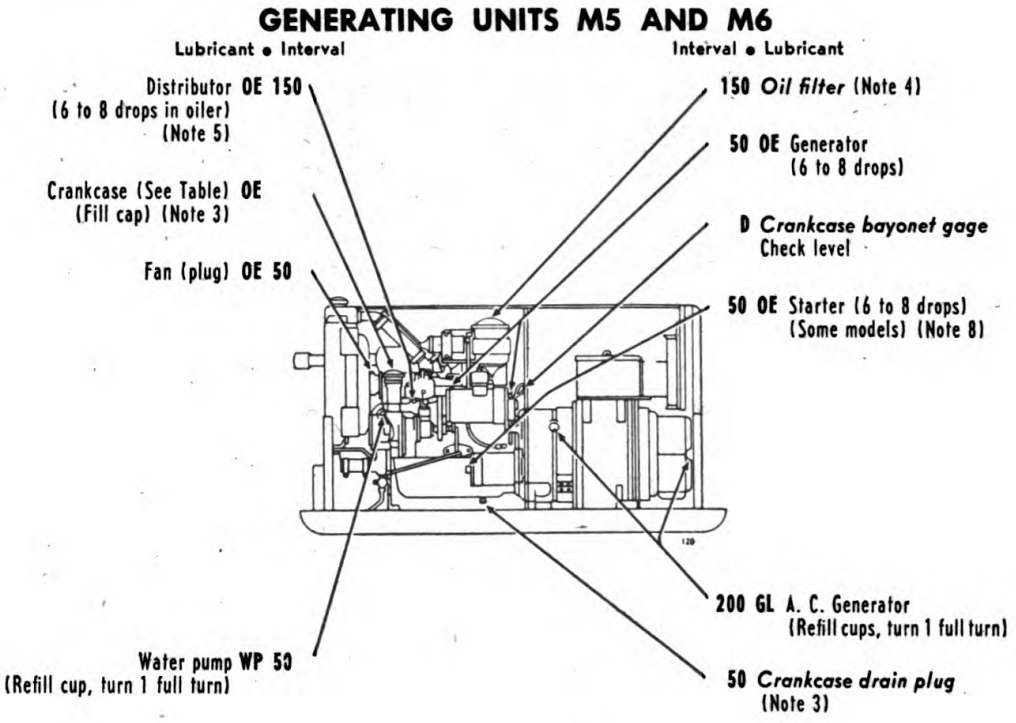
(3) CRANKCASE. Drain only when engine is hot. Every 50 hours, drain and refill to "FULL" mark on gage. Run engine a few minutes, and recheck oil level. CAUTION: Be sure pressure gage indicates oil is circulating.

(4) OIL FILTER. Every 150 hours, or more often if filter becomes clogged, renew filter element. After renewing element, refill crankcase to "FULL" mark on gage. Run engine a few minutes, recheck level and add oil to "FULL" mark.

(5) DISTRIBUTOR. Every 50 hours, wipe distributor breaker cam lightly with GREASE, general purpose (seasonal grade), and apply 1 or 2 drops of OIL, engine (crankcase grade), to wick under rotor. Lubricate breaker arm pivot with 1 or 2 drops of OIL, engine (crankcase grade). Every 150 hours, apply 6 to 8 drops of OIL, engine (crankcase grade) to distributor shaft oiler.

(6) FUEL FILTER. The fuel filter is located on the right side of the engine. Check fuel filter bowl daily. When necessary, remove and wash bowl.

(7) OILCAN POINTS. Every 50 hours, lubricate throttle connections and governor linkage with OIL, engine (crankcase grade).



KEY

LUBRICANTS		INTERVALS
OE—OIL, engine Crankcase grade	WP—GREASE, water pump	D—DAILY
	GL—GREASE, lubricating, special	50— 50 HOURS
CG — GREASE, general purpose No. 1 (above +32° F.) No. 0 (below + 32° F.)		150—150 HOURS
		200—200 HOURS
		CHECK DAILY Crankcase Air cleaner

RA PD 81199

Figure 8 — Lubrication Guide — Generating Units M5 and M6

(8) STARTER (SOME MODELS). Once each year, disassemble, clean and repack armature bearings with GREASE, general purpose, No. 2. Wash Bendix drive parts in SOLVENT, dry-cleaning, coat lightly with OIL, engine (crankcase grade), and reassemble.

(9) COOLING FAN. After every 50 hours of operation, unscrew the slotted plug in the hub of the fan and fill the hub with OIL, engine, until it drips from the shaft.

c. Cold Weather. For lubrication and service below zero F, refer to OFSB 6-5.

Section V

CARE AND PRESERVATION

17. CLEANING.

a. Keep the exterior of the unit clean by wiping off dust or mud daily. If oil or grease is inadvertently spilled while lubricating, wipe it off immediately so that dust or grit will not accumulate on the spot.

18. PAINTING (GENERAL).

a. Ordnance materiel is painted before issue to the using arms and one maintenance coat per year will ordinarily be ample for protection. With but few exceptions, this materiel will be painted with **ENAMEL**, synthetic, olive-drab, lusterless. The enamel may be applied over old coats of long oil enamel and oil paint previously issued by the Ordnance Department if the old coat is in satisfactory condition for repainting.

b. Paints and enamels are usually issued ready for use and are applied by brush or spray. They may be brushed on satisfactorily when used unthinned in the original package consistency or when thinned no more than 5 percent by volume with **THINNER**, for synthetic enamels. The enamel will spray satisfactorily when thinned with 15 percent by volume of thinner. (Linseed oil must not be used as a thinner, since it will impart a luster not desired in this enamel.) If sprayed, it dries hard enough for repainting within ½ hour, and dries hard in 16 hours.

c. Complete information on painting is contained in TM 9-850.

19. PREPARATION FOR PAINTING.

a. If the base coat on the materiel is in poor condition, it is more desirable to strip the old paint from the surface than to use sanding and touch-up methods. After stripping, it will then be necessary to apply a primer coat.

b. **PRIMER**, synthetic, rust-inhibiting, for bare metal, should be used as a base coat. It may be applied either by brushing or spraying.

It will brush satisfactorily as received or after the addition of not more than 5 percent by volume of THINNER, for synthetic enamels. It will be dry enough to touch in 30 minutes, and hard in 5 to 7 hours. For spraying, it may be thinned with not more than 15 percent by volume of thinner. Lacquers must not be applied to the primer within less than 43 hours.

c. The success of a job of painting depends partly on the selection of a suitable paint, but also largely upon the care used in preparing the surface prior to painting. All parts to be painted should be free from rust, dirt, grease, kerosene, oil, and alkali, and must be dry.

d. If metal parts are in need of cleaning, they should be washed in a liquid solution consisting of ½ pound of SODA ASH in 8 quarts of warm water, or an equivalent solution, then rinsed in clear water and wiped thoroughly dry.

20. TOUCHING UP.

a. When equipment is in fair condition and only marred in spots, the bad places should be touched with ENAMEL, synthetic, olive-drab, lusterless, and permitted to dry. The whole surface will then be sandpapered with PAPER, flint, No. 1, and a finish coat of ENAMEL, synthetic, olive-drab, lusterless, applied and allowed to dry thoroughly before the materiel is used. If the equipment is in bad condition, all parts should be thoroughly sanded with PAPER, flint, No. 2, or equivalent, given a coat of PRIMER, synthetic, refinishing, and permitted to dry for at least 16 hours. They will then be sandpapered with PAPER, flint, No. 00, wiped free from dust and dirt, and a final coat of ENAMEL, synthetic, olive-drab, lusterless, applied and allowed to dry thoroughly before the materiel is used.

21. PAINT AS A CAMOUFLAGE.

a. Camouflage is now a major consideration in painting ordnance vehicles, with rust prevention secondary. The camouflage plan at present employed utilizes three factors; color, gloss, and stenciling.

(1) COLOR. Units are painted with ENAMEL, synthetic, olive-drab, lusterless, which was chosen to blend in reasonably well with the average landscape.

22. REMOVING PAINT.

a. After repeated paintings, the paint may become so thick as to crack and scale off in places, presenting an unsightly appearance. If such is the case, remove the old paint by use of a lime-and-lye solution (see TM 9-850 for details) or REMOVER, paint and varnish. It is important that every trace of lye or other paint remover be com-

pletely removed and that the equipment be perfectly dry before repainting is attempted.

23. PAINTING LUBRICATING DEVICES.

a. A circle, ¾ inch in diameter, will be painted around each oil cup, grease fitting, oilhole, and similar lubricating device with ENAMEL, synthetic, gloss-red, in order that they may be readily located. NOTE: Do not paint the fittings themselves.

Section VI

OPERATION UNDER UNUSUAL CONDITIONS

24. COLD WEATHER OPERATION.

a. General. Whenever the unit is to be exposed to freezing weather, special precautions will have to be taken to protect the cooling water, crankcase oil, and battery against freezing.

b. Radiator.

(1) Antifreeze must be added to the cooling water in varying proportions dependent upon the lowest temperature anticipated. The table below shows the approximate quantities of antifreeze necessary for various degrees of temperature.

TEMPERATURE F	Compound Antifreeze (Pints)	Water (Pints)
+20	2	8
10	2½	7½
0	3½	6½
−10	4	6
−20	4½	5½
−30	5	5
−40	5½	4½
−50	6	4

GENERATING UNITS M5 AND M6

(2) The cooling system holds about 5 quarts of water. Before putting in the antifreeze solution, flush out the system thoroughly and check for leaks. Tighten the hose connections, or replace if necessary.

c. Crankcase Oil.

(1) Use OIL, engine, SAE 10, in the engine when temperature is between +32°F. and 0°F.

(2) At low temperatures, the gasoline engines of generator units require careful attention to lubrication to assure quick, positive starting, and trouble-free operation. Engine lubricating oil will be OIL, engine, SAE 10, diluted with gasoline or SOLVENT, dry-cleaning. Since the diluent will tend to evaporate when the oil becomes warm, the oil level may go down rapidly and must be maintained by adding makeup oil and diluent.

(3) The following procedure should be followed to provide the engine with properly diluted engine oil for cold starting (OFSB 6-5):

(a) With the oil level at "FULL" mark and the engine warm, add a quantity of gasoline or SOLVENT, dry-cleaning, equal to 20 percent (⅕) of the normal crankcase capacity, for operation between 0°F. and –30°F., and 30 percent for temperatures below –30°F. Example: With a 5-quart capacity crankcase, add 1 quart of diluent for temperatures between 0°F. and –30°F., or 1½ quarts of diluent for temperatures below –30°F.

(b) Run engine 5 to 10 minutes to mix oil and diluent thoroughly, and then stop the engine.

(c) After stopping, note level of crankcase oil on oil level gage stick. Level will be above normal "FULL" mark. It is advisable to mark this increased level on the gage for future reference. CAUTION: Do not add diluent while engine is running. If any diluent is spilled on the engine, it must be wiped dry before starting.

d. Grease. In cold weather, lubricate sparingly. Consult the Lubrication Guide (fig. 8).

e. Battery. Battery efficiency decreases sharply at sub-zero temperatures and becomes practically nil at –40°F. At temperatures of –10°F. and below, the battery must be heated before starting. A full charge must be maintained at all times, with hydrometer reading between 1.275 and 1.300. A fully charged battery will not freeze, but a discharged battery may freeze and rupture at temperatures near 0°F. Do not add fresh water to the battery unless it is to be charged immediately, either by a charger or by running the engine, as the water will lie on top of the acid and freeze before it can mix with the acid (OFSB 6-5).

OPERATION UNDER UNUSUAL CONDITIONS

f. Operation.

(1) If the engine is so stiff that it cannot be cranked by the starting motor, turn it through several revolutions with the hand crank. Keep the ignition switch turned off while doing this. If the engine is too stiff to turn by hand, remove the spark plugs to relieve the compression in each cylinder and proceed to crank by hand, until engine is free. Replace spark plugs, turn on ignition switch, pull out choke, and try to start the engine again. NOTE: To facilitate starting under these conditions, set the spark plug gap to approximately 0.015 inch before replacing them. Reset to 0.025 after engine has warmed up. If the engine does not start immediately, do not continue cranking as such action will only flood the cylinders with gasoline making starting impossible. To clear flooded cylinders, push in choke button, open the throttle to its full open position and crank engine over several revolutions.

(2) If the engine has to stand idle in very severe winter weather, have it started every hour or two, whether it is needed or not. This will help to maintain a more normal temperature and make starting easier. If the unit has been standing in sub-zero temperature for a long time, it may be necessary to warm it up by some external application of heat before it can be started. Move the entire unit into a warm building. Be sure to provide a leakproof pipe to carry the exhaust gases outside in order to prevent carbon monoxide poisoning.

(3) At the end of each operating period, check oil level. If oil level is below normal "FULL" mark, add necessary quantity of undiluted OIL, engine, SAE 10, to bring level to "FULL" mark. Then add the necessary quantity of gasoline, or SOLVENT, dry-cleaning, to raise level to the mark recorded in subparagraph **c** (3) *(c)* above. If oil level on stopping is at, or above "FULL" mark, add enough gasoline or SOLVENT, dry-cleaning, to bring level to mark recorded in subparagraph **c** (3) *(c)*, above. Start engine again, and run 5 to 10 minutes to mix oil and diluent thoroughly, then stop engine. Crankcase oil is then properly diluted to provide the necessary oil fluidity for the next cold start (OFSB 6-5).

(4) Oil pressure should be noted immediately after each start. If no pressure is indicated, engine must be shut down immediately to determine the cause.

(5) Excessive starting and stopping of the engine will tend to run down the battery. To overcome this, run the engine for at least 30 minutes every time it is operated.

(6) The radiator should be covered to give rapid warm-up, and the cover removed as soon as operating temperature is reached. After the engine is stopped, the cover should be replaced to keep engine temperature as high as possible during the shut-down period.

(7) Filter bowl should be drained after each operation of the engine to prevent cracking of the bowl and to drain whatever water may have accumulated in the gasoline tank.

(8) If difficulty is experienced with water in the gasoline, causing freezing in tank or in lines, add ½ pint of ALCOHOL, denatured, grade 3, to the fuel tank each time it is filled. This will reduce the hazard of ice formation in the fuel.

25. HOT WEATHER OPERATION.

a. General. Operation in very hot climates calls for extreme care in maintaining correct engine temperature, proper level of the electrolyte in the storage battery, and the prevention of condensation on metal parts.

b. Doors. The instrument panel door shall be open while the engine is running. The hoods may experimentally be opened and closed until satisfactory arrangement is worked out to maintain the engine at proper operating temperature. It will probably be found that closing the hoods will create the best direct air circulation condition, with the air drawn by the action of the fan up through the frame, across the engine, and out through the radiator.

c. Battery. The specific gravity of the battery electrolyte should be maintained at approximately 1.245. Battery charging rate should never be so great as to cause excessive bubbling of electrolyte or to overheat the battery.

d. Fuel Tank. The humidity that often goes with extreme heat creates condensation on metal. For this reason, it is best to keep the fuel tank filled to capacity at all times. If the tank is allowed to remain partially empty, considerable condensation water will collect. Water may be drained from the tank through the drain cock.

e. Ignition System. In humid atmospheres, spark plugs, ignition coil, distributor, and wire cable terminals should be frequently wiped dry of condensation moisture.

26. DUST OR SAND OPERATION.

a. General. The unit is shielded to some extent against dirt and grit, but when it must be operated in sand storms or in places where the air is charged with an excess of dust or sand, extra precautions must be taken.

b. Gasoline. Exclude dust from gasoline containers, to the best of your ability. When filling the tank, always strain the gasoline through the felt pad in the funnel.

OPERATION UNDER UNUSUAL CONDITIONS

27. RAIN AND FOG OPERATION.

a. General.

(1) The unit is weatherproof under normal climatic conditions. Additional protection is necessary when the unit is exposed to excessive rain and fog conditions.

(2) One of the worst weather conditions is a change from cold weather to fog. If the engine has not been running, it may have become very cold, and fog or mist will condense on the spark plug insulators and in the distributor, thus effectually short-circuiting the ignition system. It will then be impossible to start the engine until it has dried out. Lacking a compressed air hose, wipe off surface moisture about the plugs and distributor with dry cloths. A final wiping with alcohol will hasten the drying. When the unit is not in operation, it should be protected by covering it with a tarpaulin.

PART TWO — ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section VII

ORGANIZATIONAL SPARE PARTS AND TOOLS

28. ORGANIZATIONAL SPARE PARTS.

a. A set of organizational spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set is kept complete by requisitioning new parts for those used. Organizational spare parts are listed in pertinent Standard Nomenclature Lists.

29. TOOLS.

a. Each generating unit is furnished with necessary tools and accessories to make minor adjustments and replacements, and for general care and preservation. The accessories should not be used for purposes other than prescribed, and, when not in use, should be stored in places or receptacles furnished. The following tools and accessories are furnished:

Adjustable wrench, 6 in.
Felt strainer pads for funnel
Gasoline funnel
Hand crank
Open-end wrench for spark plug
Pair of pliers, slip joint
Screwdriver, 10 in.
Set of open-end wrenches (6)
Spark plug gage
Spark plug wrench with handle
Trouble lamp

30. CARE OF TOOLS.

a. An accurate record of all tools and equipment should be kept, in order that their location and condition may always be known. From time to time, changes are made in the number and type of tools and equipment furnished. The list given in paragraph 29 is therefore only tentative; each operator or inspector should prepare an inventory of his own. Keep tools clean and return them to their proper places when you have finished with them. Items used, lost, or rendered unserviceable, should be replaced promptly.

Section VIII

ENGINE

31. DESCRIPTION AND TABULATED DATA (fig. 9).

a. The engine in this unit is the Hercules, Model ZXB. It is a vertical, 4-cylinder, 4-cycle engine of the following specifications:

Rated horsepower (at 1,200 rpm)	11
Number of cylinders (cast in block)	4
Bore	2⅝ in.
Stroke	3 in.
Piston displacement	64.9 cu in.
Firing order	1-2-4-3
Cooling	Water pump and radiator with fan

Lubrication—Forced feed by gear pump to connecting rods and main bearings.

Cylinder head	Detachable
Valve arrangement	L-head
Spark plug, size	14-mm metric

b. The accessories provided with the engine are listed with the systems of which they are a part. The units are covered in their pertaining sections in this manual.

(1) FUEL SYSTEM. The fuel system consists of a gasoline tank, fuel lines, gasoline strainer, carburetor, intake manifold, and governor.

(2) ELECTRICAL SYSTEM. The 6-volt electrical system consists of a 6-volt battery, ignition switch, ignition coil, condenser, distributor, spark plugs, and connecting cables and wires, a battery-charging generator with a generator regulator to provide means of keeping the battery properly charged, and a starting motor and starter switch to facilitate starting the engine.

(3) COOLING SYSTEM. The cooling system accessories are the radiator, fan, water pump, thermostat, and connecting hoses and lines.

(4) LUBRICATION SYSTEM. The oil pump, oil filter, oil pressure gage, oil pressure regulating valve, and connecting lines make up the engine lubrication system.

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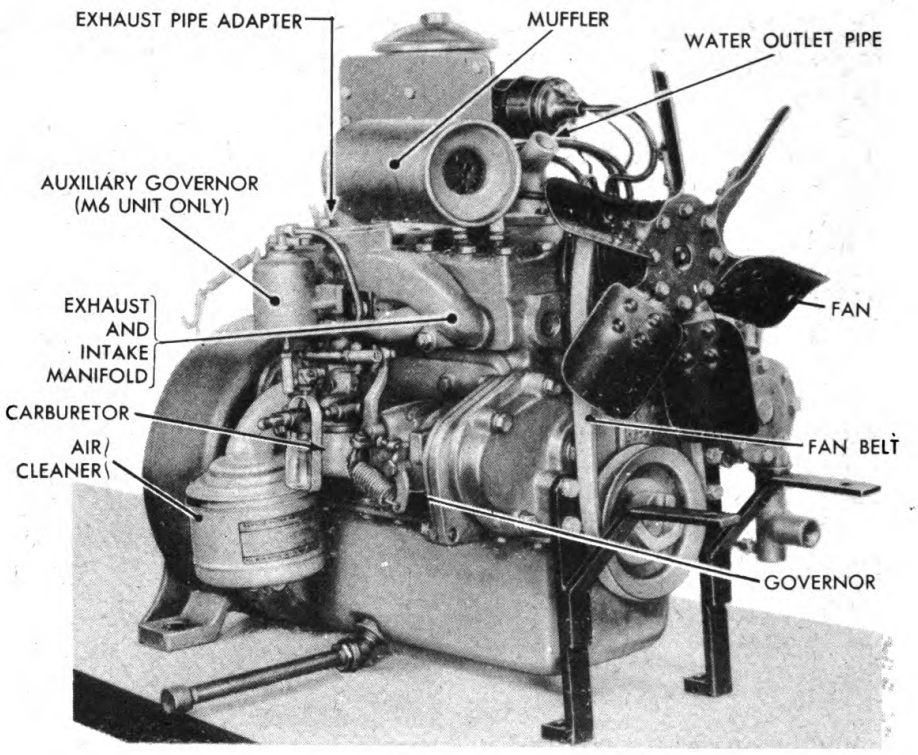

Figure 9 — Engine with Accessories

32. FUNCTIONING.

a. The engine is of the internal combustion, 4-stroke cycle, automotive-type. The gasoline tank being mounted in a position higher than the carburetor allows fuel to be supplied to the carburetor by gravity. Air drawn through the air cleaner passes through the carburetor where it is mixed with the correct quantity of gasoline vapor to provide the fuel mixture (air and gasoline) required for proper combustion. This mixture is drawn into the intake section of the manifold and into each cylinder at the proper time by the down or intake stroke of each piston. It is then compressed by the upward or compression stroke, and ignited by a spark across the spark plug points as the piston reaches the top of its travel. The expansion of the burning gases forces the piston down for the power stroke. Before the piston reaches the bottom of its stroke, the exhaust valve opens, and as the piston returns on the exhaust stroke, it forces the burned gases through the opened exhaust valve into the exhaust section of the manifold and out by the way of the muffler. The complete cycle of four piston strokes (intake, compression, firing, and exhaust) results in two revolutions of the engine crankshaft and flywheel. Successive firing in 1-2-4-3 cylinder order (firing order) results in a steady impelling force on the engine crankshaft and flywheel. This mechanical force is utilized to revolve the field coils and exciter armature of the main generator.

ENGINE

33. MAINTENANCE.

a. Section III covers general inspections which include the engine. Be sure these inspections are made at the specified intervals.

b. The following paragraph lists specific checks for various engine faults.

34. TROUBLE SHOOTING.

a. Engine Fails To Start.

Possible Cause	Possible Remedy
Lack of fuel.	Supply fuel.
Clogged fuel line.	Clean fuel line.
Defective ignition system.	Check wiring, spark plugs, distributor points, condenser, and ignition coil, in order mentioned.

b. Engine Stops.

Too heavy load on cold engine.	Remove load and warm up engine.
Lack of fuel.	Supply fuel.
Clogged fuel line.	Clean fuel line.
Fuel leak.	Check fuel line.
Defective ignition system.	Check wiring, spark plugs, distributor points, condenser, and ignition coil, in order mentioned.

c. Runs Irregularly, Misfires.

Dirt or water in fuel line.	Clean fuel line, strainer, sediment cup.
Defective spark plugs.	Replace spark plugs.
Too rich mixture.	Adjust carburetor.
Manifold air leak.	Replace gasket or manifold.
Faulty governor adjustment.	Adjust governor.

d. Overheats.

Clogged oil line.	Clean oil line.
Thermostat stuck closed.	Replace thermostat.
Inoperative cooling system.	Check radiator, fan, water pump.
Improper timing.	Report to ordnance personnel.

GENERATING UNITS M5 AND M6

e. Popping, Spitting, Spark Knock.

Possible Cause	Possible Remedy
Excessive carbon deposits.	Notify ordnance personnel.
Spark plug gaps too wide.	Adjust gaps to 0.025 inch.
Dirt on spark plug porcelains.	Clean outside of spark plugs.

f. Poor Compression.

Leaky spark plugs.	Tighten spark plugs or replace.
Cylinder head loose.	Tighten head.
Leaking cylinder head gasket.	Report to ordnance personnel.
Valves not seating.	Report to ordnance personnel.
Piston rings worn.	Report to ordnance personnel.

g. Lack of Power.

Poor compression.	Subparagraph f, above.
Air cleaner restricted.	Clean element.
Engine overheating.	Subparagraph d, above.
Improper mixture.	Check operation of choke control.

h. Engine Backfires.

Gas mixture too lean.	Report to ordnance personnel.
Inlet valve not closing.	Report to ordnance personnel.
Retarded spark.	Report to ordnance personnel.

i. Explosion in Muffler.

Retarded spark.	Report to ordnance personnel.
Faulty spark plug.	Service or replace plug.

j. Smoky Exhaust.

Too much oil.	Check oil in crankcase.
Oil too thin.	Replace oil with correct grade.
Flooded carburetor.	Have carburetor checked for sticking float valve.

Section IX

COOLING SYSTEM

35. DESCRIPTION (fig. 10).

a. General. The cooling system consists of the radiator, thermostat, fan assembly, water pump, and connecting hoses and lines. The water capacity is 5 quarts. The system may be drained by opening a drain cock located just below the water pump.

b. Functioning. The water pump circulates cooled water from the bottom of the radiator through the channels in the engine water jacket and cylinder head. The heated water is forced out of the engine through the water outlet pipe, mounted on the engine cylinder head, and into the upper radiator tank. The water continues to flow down the radiator tubes where it is cooled and redrawn into the water pump to complete the water circulation cycle. The action of the fan causes air to circulate about the engine and forces air through the radiator, cooling the engine and the water circulating through the radiator. A thermostat, extending into the engine cylinder head, is mounted on top of the engine beneath the water outlet pipe (fig. 13). Its function is to prevent water circulation through the radiator until the engine has reached a normal operating temperature (160 to 180 deg F). A bypass pipe from the water pump to the engine block permits water circulation through the pump while the thermostat shuts off the water circulation through the radiator.

36. TROUBLE SHOOTING.

a. Overheating.

Possible Cause	Possible Remedy
Leaks in system.	Service or replace faulty hose, hose clamps, gaskets, or pipes.
Radiator dirty inside or out.	Clean radiator thoroughly.
Dirty water.	Drain and refill with clean water.

Possible Cause	Possible Remedy
Clogged system.	Flush system, from top of engine down.
Clogged radiator.	Service.
Leaking radiator.	Notify ordnance personnel.
Thermostat stuck closed.	Replace thermostat.
Loose fan belt.	Adjust fan belt.
Broken fan belt.	Replace fan belt.
Inoperative pump.	Report to ordnance personnel.
b. Overcooling.	
Thermostat stuck open.	Replace thermostat.

37. CLEANING.

a. General. The cooling system should be cleaned at least twice a year. It should be cleaned before the COMPOUND, antifreeze (ethylene glycol type), is put into the system, and again after it is removed. If the cooling system is very dirty or clogged, so that overheating occurs, ordnance personnel should be notified. The entire system should be examined for leaks both before and after cleaning and flushing. The cleaning solution should never be mixed with antifreeze solutions or inhibitors.

b. Cleaning.

(1) Run the engine until the temperature is within operating range. Stop the engine, remove the radiator cap, and drain the system by operating the drain cock. Do not depend upon the small drain cock, it may be clogged by the scale and sediment. If necessary, use a wire to keep open any drain hole which tends to become clogged, or better yet, remove the drain cock and the lower hose (fig. 10), and wash out thoroughly. The battery-charging generator support bracket which covers an opening into the lower part of the cylinder jacket (fig. 10) may also be removed to assure a good job of cleaning. Coolants containing ethylene glycol must be saved or discarded as outlined in War Department Circular No. 137, V. dated 16 June 1943.

(2) Allow the engine to cool. Replace the drain cock and close. Replace the lower hose and battery-charging generator support bracket. If the hose and gasket under the bracket are not in good condition replace before continuing cleaning operation. Start the engine at idling speed, and start immediately to pour water slowly into the radiator until it is nearly full. Add the COMPOUND, cleaning (Federal stock No. 51-C-1568-500), in the proportion of 1 container of cleaner to every 4 gallons of cooling system capacity, then fill the

system with water. Never mix the water and the cleaning compound before putting them into the system.

(3) Place a clean drain pan in a position to collect overflow, and use it to maintain the level in the radiator when necessary.

(4) Replace the radiator cap and run the engine at moderate speed. Covering the radiator if necessary, until the coolant reaches a temperature above 180°, but not over 200°F. Do not allow the level in the radiator to drop low enough to interfere with the water circulation.

(5) Stop the engine after it has run for 30 minutes within the 180-degree-to-200-degree range. Remove the radiator cap and drain the system completely.

c. Neutralizing.

(1) Allow the engine to cool. Close the drain cock, run the engine at idling speed and commence immediately to pour water slowly into the radiator. Pour until it is nearly full. Add the neutralizer compound (Federal stock No. 51-C-1568-500) in the proportion of 1 container of neutralizer to every 4 gallons of cooling system capacity. Fill the system with water.

(2) With the radiator covered, run the engine for at least 5 minutes at operating temperature. Stop the engine.

(3) Drain the system completely by removing the radiator cap and opening the drain cock.

d. Flushing.

(1) Allow the engine to cool. Close the drain cock, start the engine, and fill the system with water immediately.

(2) Run the engine until the coolant is heated to operating temperature.

(3) Drain the system by removing the radiator cap and opening the drain cock. Repeat the flushing operation until the drain water is clean.

(4) Clean all sediment from the radiator cap valves and the overflow pipe. Blow insects and dirt from radiator core air passages with compressed air, blowing from the rear. Use water if necessary to soften obstructions.

e. Leaks. After completing the flushing operation and before pouring the appropriate coolant into the cooling system, allow the engine to cool. Start the engine and immediately fill the system with coolant. Stop the engine when the cooling system is completely full. Examine the entire cooling system for leaks. The cleaning solution often uncovers leaks which already exist but are plugged with rust or corrosion.

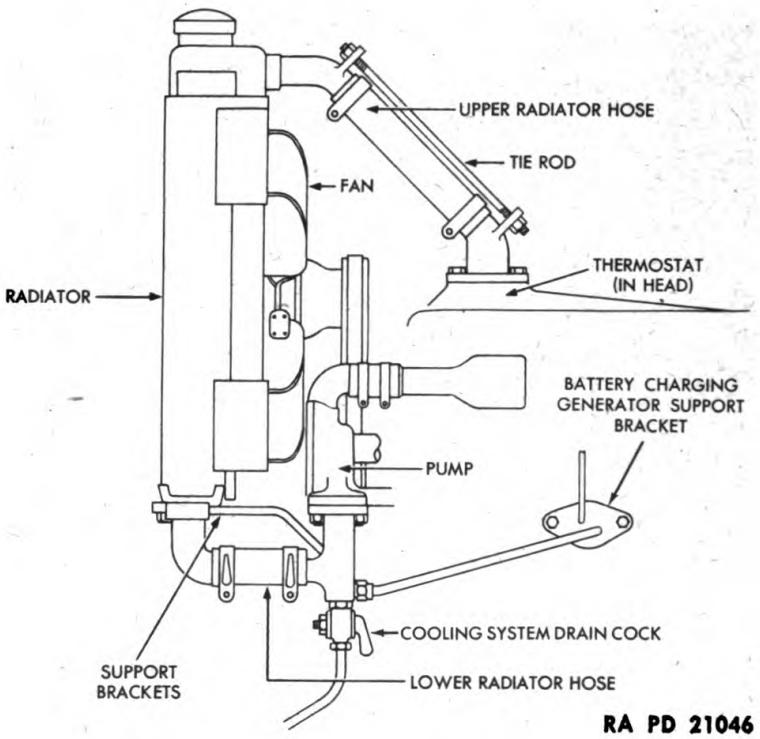

Figure 10 — Cooling System

f. Coolant Service.

(1) When servicing for summer, fill the system with clean water. Add COMPOUND, inhibitor, corrosion (Federal stock No. 51-C-1600) in the proportion of 1 container of inhibitor to each 4 gallons of cooling system capacity. Then fill the system with water.

(2) When servicing for winter, fill the system about one-quarter full of clean water. Add sufficient COMPOUND, antifreeze (ethylene glycol type), for protection against the lowest temperature likely to be encountered (par. 24). Fill the system with water and run the engine until normal operating temperature is reached. Then add sufficient water to fill the system to the proper height.

38. RADIATOR (fig. 11).

a. Description. The radiator is of the copper fin and tube type, with brass upper and lower tanks. The upper tank is provided with a radiator filler hole, radiator filler cap, overflow tube, and radiator water inlet pipe. The lower tank is fitted with the radiator outlet pipe.

b. Maintenance. The radiator and all hose connections should be frequently checked for leaks. Check condition of hoses attached to radiator. Check the tie rod and radiator mounting screws to assure radiator is securely mounted.

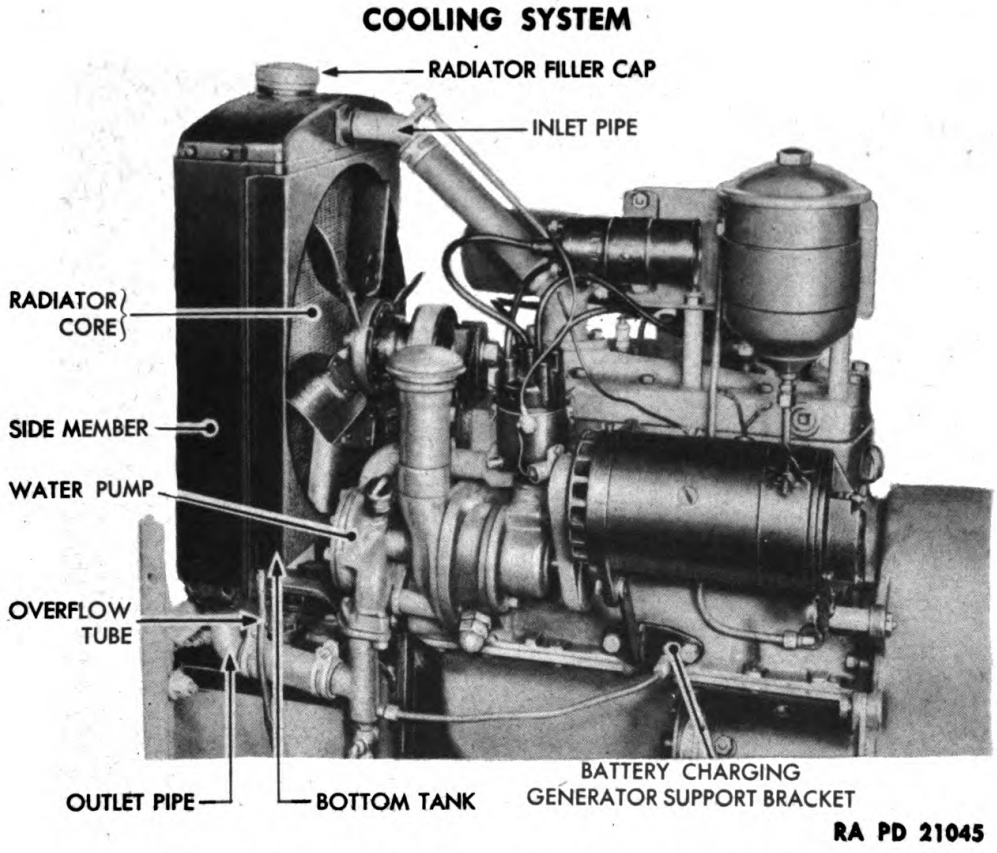

Figure 11 — Radiator Assembly and Connections

39. FAN AND FAN BELT (fig. 12).

a. Description. The fan is of the 6-blade steel pusher type mounted on the fan hub. It is driven by means of a V-type belt directly connected to the fan drive pulley on the front of the engine crankshaft. The outside circumference of the fan belt is $32\frac{7}{16}$ inches.

b. Maintenance.

(1) The fan assembly does not need special attention. The cap screws securing the fan bracket to the engine block must be kept tight and the fan assembly inspected for loose blades. Keep fan hub lubricated as specified in lubrication guide (fig. 8).

(2) The fan belt should be kept free of dirt, grease, and oil. Its adjustment and condition should be checked frequently. Replace worn or oil-soaked fan belt.

c. Fan Assembly Removal.

(1) Remove muffler and exhaust pipe adapter.

(2) Loosen fan spindle nut and allow fan assembly to lower on fan mounting bracket.

(3) Remove fan belt from crankshaft pulley.

(4) Unscrew four cap screws securing fan bracket to cylinder block and lift out fan assembly and fan belt.

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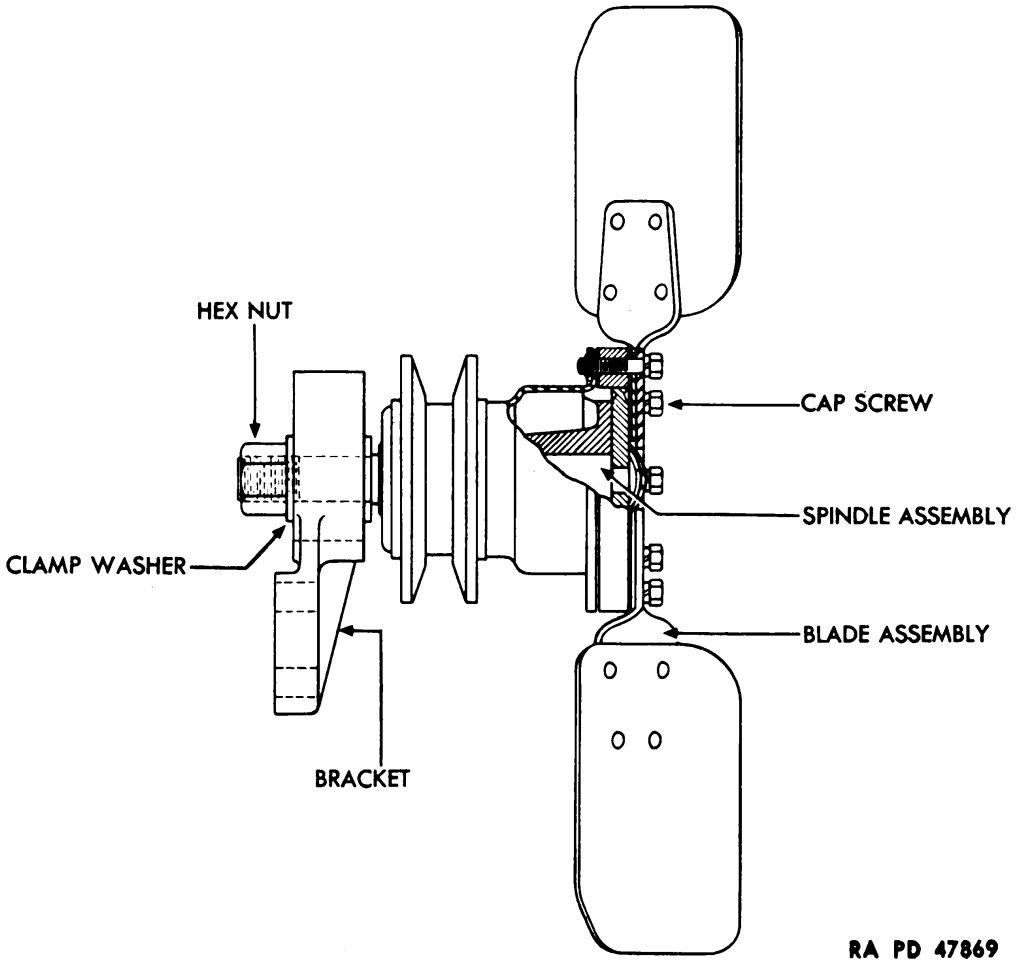

Figure 12 — Fan — Sectionalized View

d. Fan Assembly Installation.

(1) With fan belt in position over fan hub, place assembled fan and fan bracket in position on front end of cylinder block. Install and tighten the four bracket mounting cap screws.

(2) Slip fan belt over crankshaft pulley. Pry up on spindle until proper belt tension is obtained and tighten spindle nut. Belt tension is correct when the belt can be deflected about 1 inch midway between its pulleys.

(3) Install muffler and exhaust pipe adapter.

e. Belt Replacement.

(1) Loosen fan spindle nut and allow spindle to lower. Pry off belt from lower crankshaft pulley.

(2) Push fan belt between fan blades and radiator core, and lift out.

(3) Slip new belt over fan blades and allow it to rest in position on the spindle hub pulley.

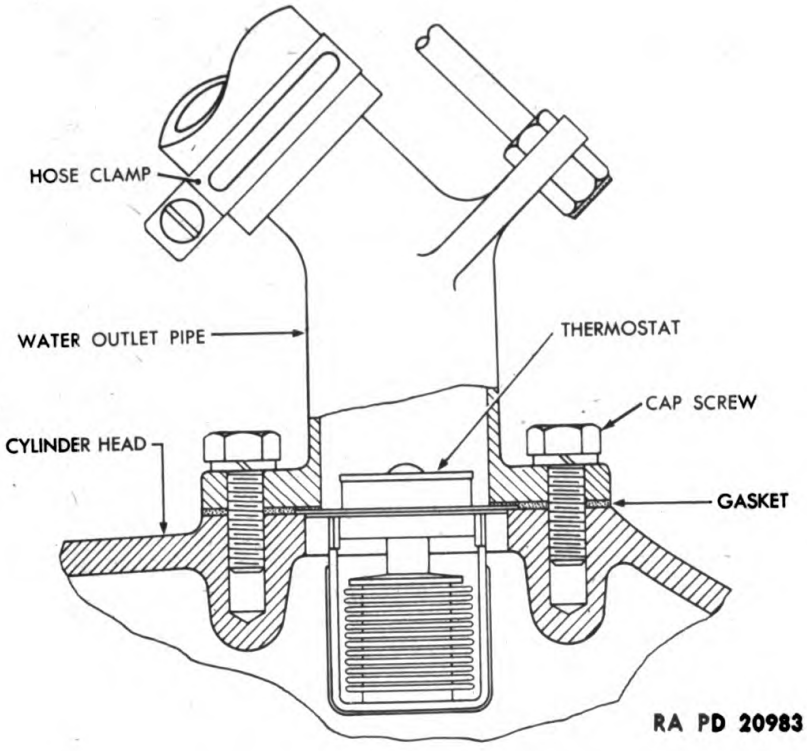

Figure 13 — Thermostat — Sectionalized View

(4) Work belt over lower crankshaft pulley. Pry up on spindle until proper belt tension is obtained and tighten spindle nut. Belt tension is correct when it can be deflected about 1 inch midway between its pulleys.

40. WATER PUMP.

a. Description. The water pump is of the centrifugal type and is mounted on the left front of the engine. An impeller mounted on the pump shaft within the pump body is driven by the accessory drive gear. A grease cup is provided to lubricate the pump shaft.

b. Maintenance. Lubricate water pump as specified in the Lubrication Guide (fig. 8). Check for leaks about the water pump connections. Check for worn or damaged hoses connecting water pump. Replace gasket if leak develops between water pump and outlet pipe. The water pump is of the packless type and any leaks developing on the pump itself should be called to the attention of ordnance personnel.

41. THERMOSTAT (fig. 13).

a. Description. The thermostat is of the conventional automotive bellows type and is mounted beneath the water outlet pipe in the

GENERATING UNITS M5 AND M6

cylinder head. The expansion or contraction of the bellows regulates the water circulation in the cooling system. After the engine has reached a normal operating temperature the thermostat completely opens allowing full water circulation.

b. Maintenance. No repairs can be made to the thermostat. If on testing the unit, it does not function properly, replace it. To check operation of thermostat, remove it from engine cylinder head and place it with a thermometer, into a pan of water and begin to heat water. The thermostat should begin to open at 150° F, and should be fully opened at 180° F.

c. Removal.

(1) Drain cooling system to below cylinder head level into a clean container.

(2) Remove radiator tie rod and disconnect upper radiator hose from cylinder head outlet pipe.

(3) Remove cylinder head water outlet pipe and left thermostat from cylinder head.

d. Installation.

(1) Place thermostat in cylinder head so that bellows enter head (fig. 13).

(2) Using new gasket between water outlet pipe and cylinder head, connect outlet pipe to head.

(3) Attach upper radiator hose to water outlet pipe and replace radiator tie rod.

(4) Refill radiator.

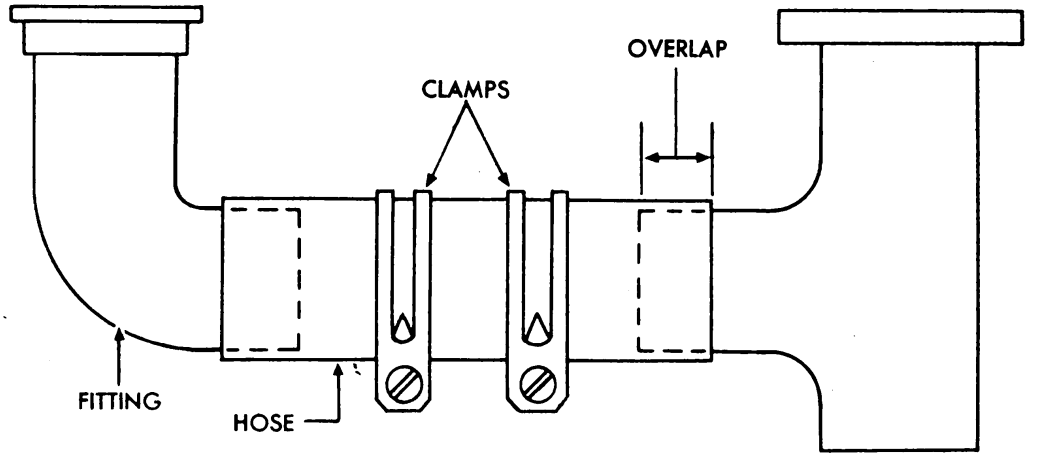

Figure 14 — Water Hose Installation

EXHAUST SYSTEM

42. HOSE REPLACEMENT (fig. 14).

a. Removal. Loosen clamps and move them to middle of hose. This will leave both ends of hose free to be manipulated over end of fittings (fig. 14).

b. Installation. Adjust hose so that there is no sag or twist, and overlap is the same at both ends. Set clamps about center of overlap and tighten clamp screws.

Section X

EXHAUST SYSTEM

43. GENERAL.

a. Description. The exhaust system is made up of the exhaust section of the manifold, exhaust pipe adapter, muffler, and the exhaust pipe with a 1¼-inch pipe coupling.

b. Functioning. The burned gases resulting from the ignition of the mixture of the gasoline and air in the cylinders are forced out of the cylinders by the exhaust stroke of the pistons. These gases are forced through the manifold into the muffler and out through the exhaust pipe. The muffler deadens the sound and shock of the exhaust gases by means of an arrangement of tubes, baffles, and passages within it.

c. Maintenance. Frequently apply a wrench to the hexagonal nuts securing manifold to the cylinder block and to the cap screws securing exhaust pipe adapter to manifold. Replace gasket between exhaust pipe adapter and manifold if it shows any signs of leaking. Replace muffler if it shows signs of being clogged, burned out, or if the unit is cracked.

44. MUFFLER REPLACEMENT (fig. 15).

a. The ends of the muffler are sprung out of line slightly at the time of assembly to permit the exhaust pipe to come near to and yet miss the radiator. The exhaust pipe should be screwed into the muffler by hand so that it can be taken out without a pipe wrench, for it must be removed every time the hood is taken off. If it ever becomes necessary to put on a new muffler, it must be sprung as follows:

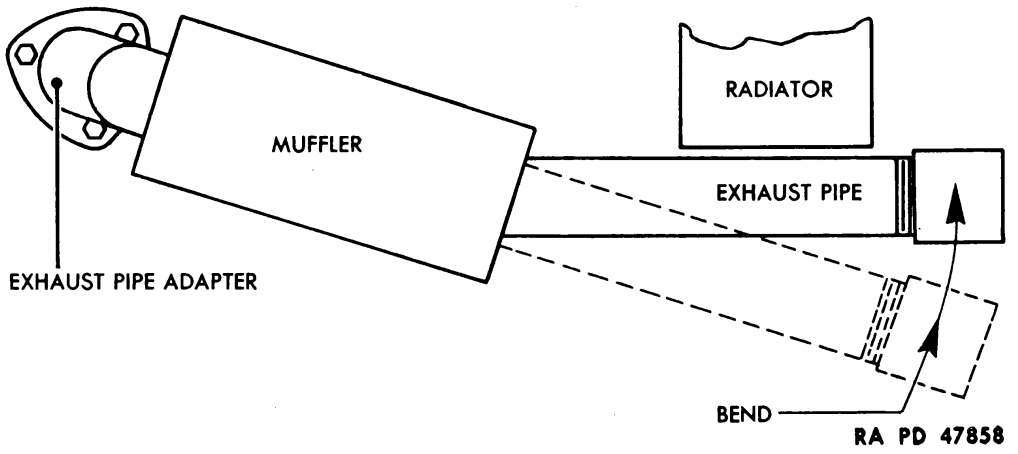

Figure 15 — Muffler Installation

(1) Screw the new muffler onto the exhaust pipe adapter, then install the exhaust pipe. By putting pressure on the end of the pipe, spring it over as shown in figure 15.

Section XI

FUEL SYSTEM

45. DESCRIPTION (fig. 45).

a. Construction. The fuel system consists of a 5-gallon gasoline tank, gasoline line, gasoline strainer assembly, carburetor, air cleaner, governor, and choke controls.

b. Functioning. Fuel from the gasoline tank passes through the line to the gasoline strainer assembly where it is filtered before entering the carburetor. The fuel entering the carburetor is converted into a highly explosive gasoline vapor and air mixture, and is drawn into the engine cylinders through the intake manifold by the downward intake strokes of the pistons. Air drawn into the carburetor to

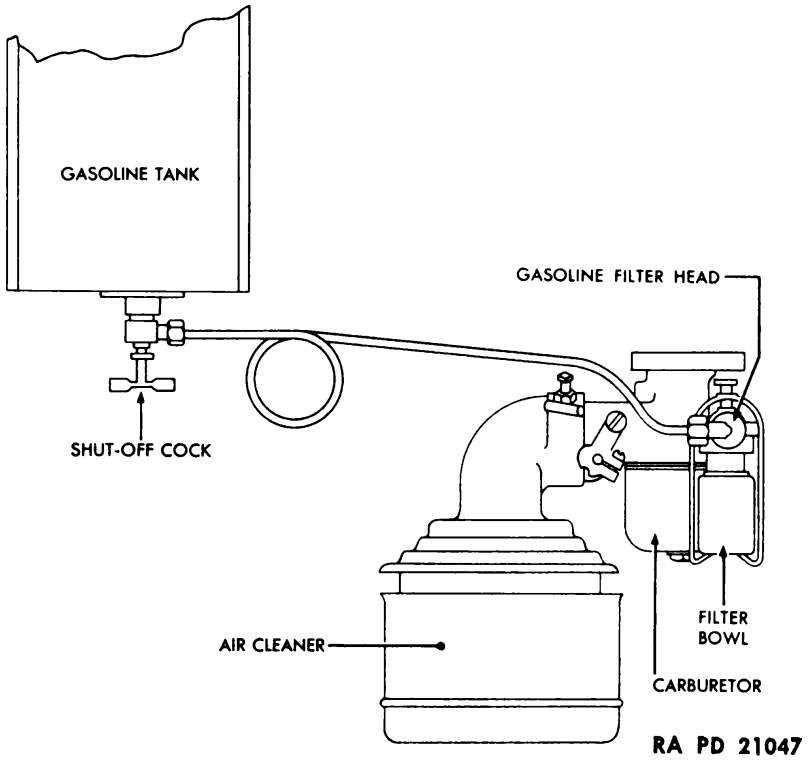

Figure 16 — Fuel System

make up the mixture is filtered by the air cleaner. The governor, linked to the carburetor throttle valve lever, controls the amount of fuel entering the intake manifold to the cylinders. The choke control button, mounted on the instrument panel, controls the ratio of the fuel mixture by increasing the gasoline vapor content as is required during cold weather starting or starting the unit after long periods of inoperation.

46. GASOLINE TANK (fig. 17).

a. General. The gasoline tank is mounted on the center part of the housing. It is of sheet metal construction and is equipped with a safety filler cap and a float-type gasoline gage.

b. Gasoline Gage Replacement. To remove the gasoline gage, unscrew the cap having a spring lid and lift off the cover glass and gaskets. The gage mechanism is not fastened and can now be removed. To facilitate removal, hold the mechanism so that the dial points to the "FULL" mark and lift the assembly out (fig. 18). Do not use force when removing gage. New gage can be installed by reversing the procedure used in removing old gage.

c. Filler Cap Assembly Replacement. The filler cap assembly is shown in figure 19. To detach it from the gasoline tank, open up

GENERATING UNITS M5 AND M6

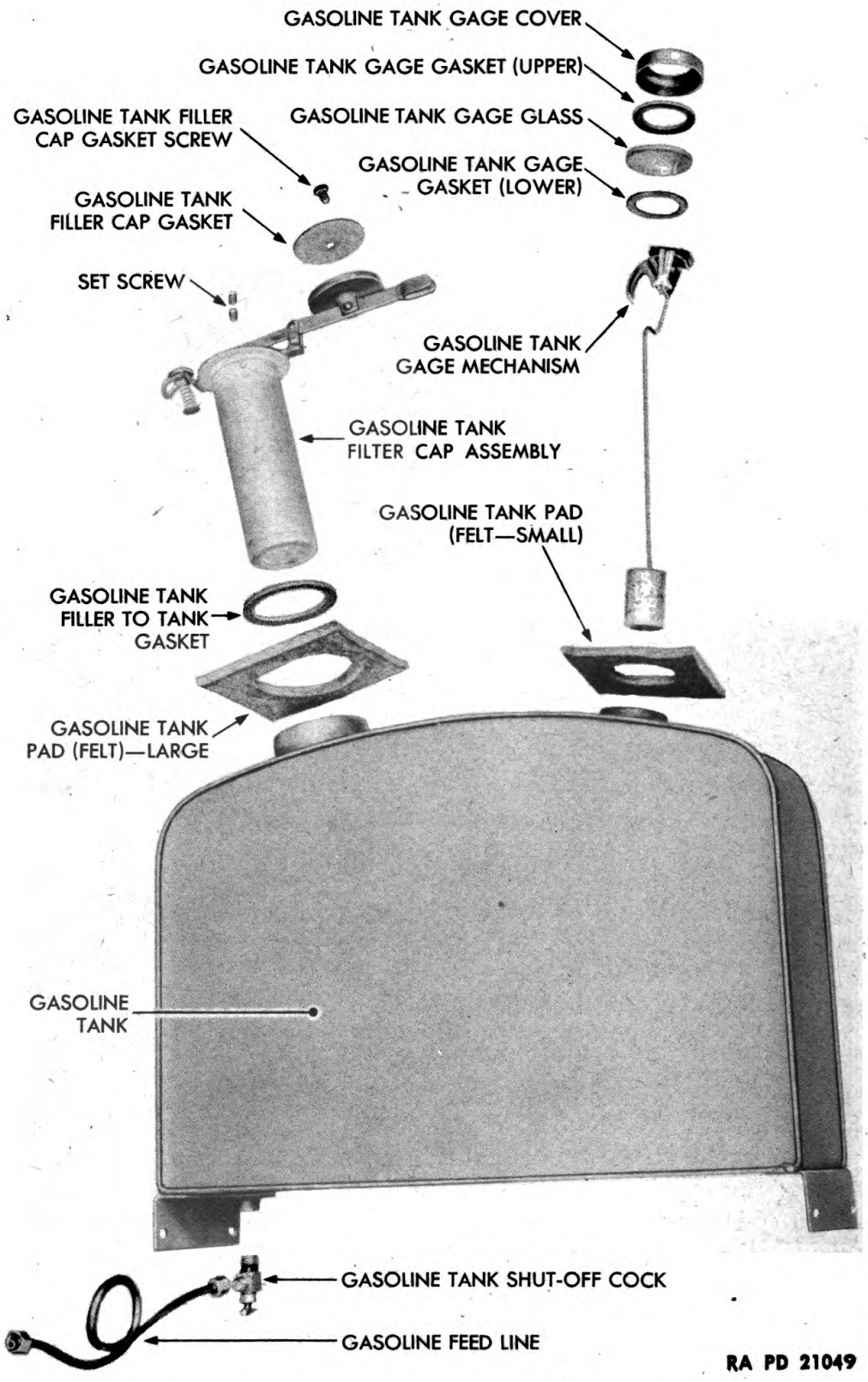

Figure 17 — Gasoline Tank Assembly — Exploded View

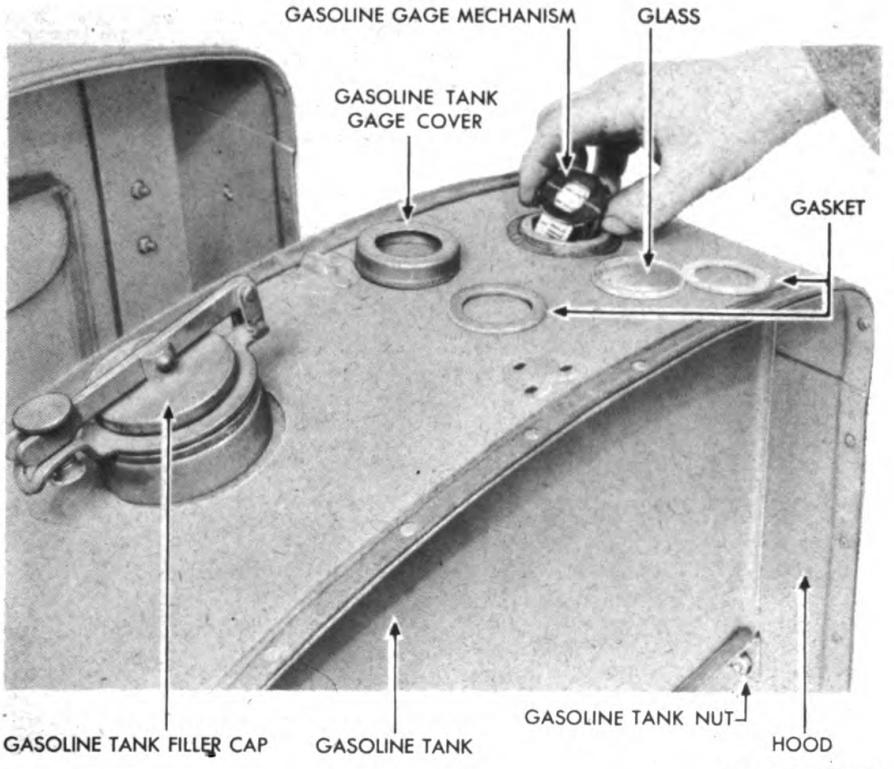

Figure 18 — Gasoline Gage Removal

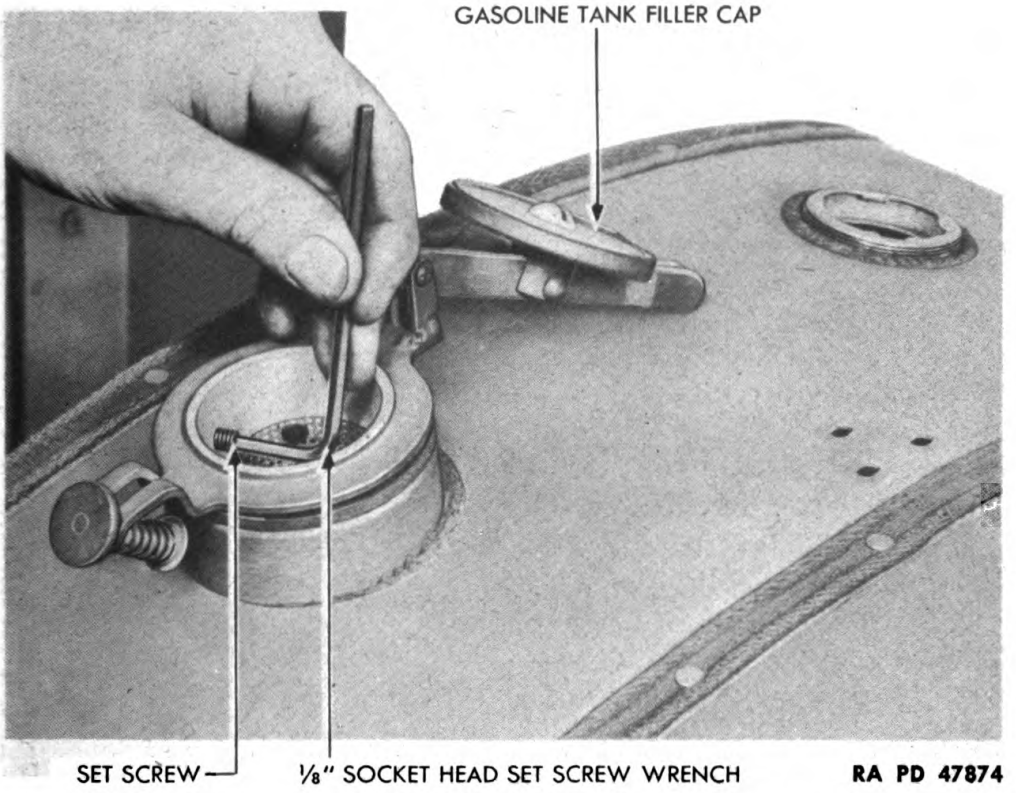

Figure 19 — Gasoline Tank Filler Cap Assembly Removal

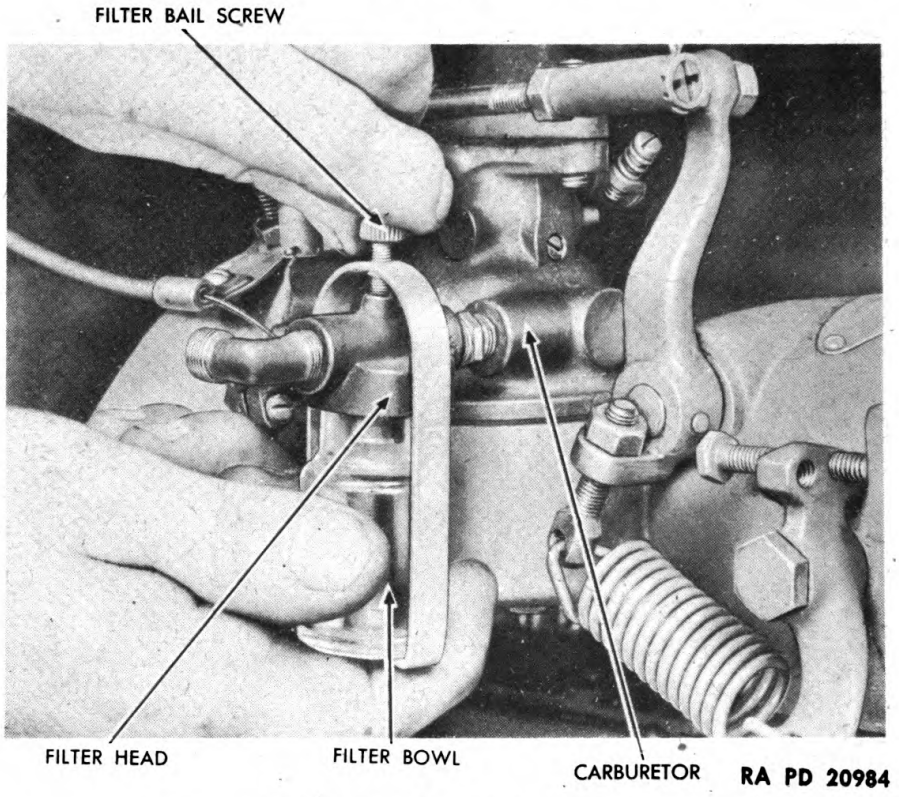

Figure 20 — Gasoline Strainer Removal

the cap and turn the entire assembly a quarter of a turn to the left. This will loosen the assembly. Next, loosen the two socket-head set screws as shown in figure 19, and remove the filler cap assembly. To install filler cap assembly, reverse the removal procedure.

d. Gasoline Tank Replacement. Removing the generating unit housing, take off filler cap assembly (subpar. **c**, above) and gasoline gage cap (subpar. **b**, above). Remove the four bolts securing gasoline tank to the housing and lift off tank. When replacing tank, be sure to install the felt pads over the filler cap assembly and fuel gage openings.

47. GASOLINE STRAINER (fig. 20).

a. General. The gasoline strainer assembly is attached directly to the carburetor. The fuel entering the strainer is forced through the filter element (fig. 21) where it deposits all of the dirt before entering the carburetor. Water and other foreign elements collect at the bottom of the filter bowl.

b. Servicing. Daily, inspect filter bowl for water or other foreign particles. If water or dirt is trapped, it can be seen through the transparent glass bowl. To remove bowl, shut off gasoline flow at shut-off cock below gasoline tank. Loosen filter bail screw and lift filter bowl

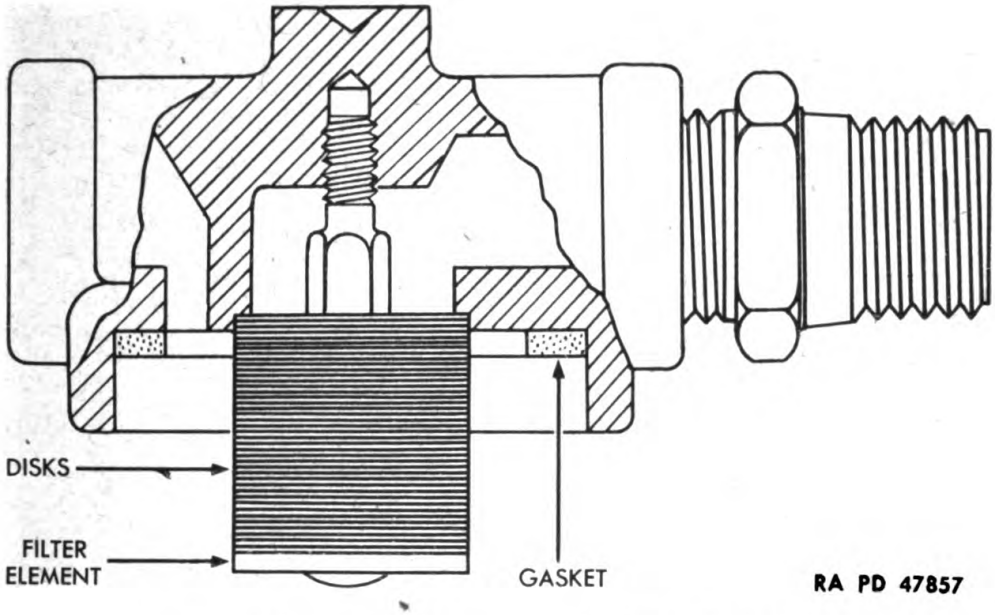

Figure 21 — Filter Element — Sectionalized View

out. Unscrew filter element from strainer head. Wash filter bowl and element in SOLVENT, dry-cleaning, and allow to dry. If accumulated dirt on element is gummy, brushing in dry-cleaning solvent will loosen it. If compressed air or a tire pump is available, every particle of dirt can be blown from the element without danger of any entering the system; none of the dirt will be forced through the disks. When replacing both the filter element and bowl, screw up fingertight to prevent damage to the filter element or breaking the glass bowl. Open shut-off cock below gasoline tank and check for gasoline leaks at the bowl. A leak may denote a faulty bowl gasket or the bowl has been improperly replaced.

48. CARBURETOR (fig. 22).

a. Description. The carburetor is of the conventional automotive up-draft type, and is bolted to the intake manifold companion flange. It is provided with a throttle valve and a choke valve. A float-controlled needle valve mounted on the carburetor body in the float bowl regulates the flow of gasoline from the gasoline tank to the carburetor.

b. Functioning. The function of the carburetor is to convert liquid gasoline to a vapor, and mix this vapor with the proper proportion of air to form a highly explosive mixture. The throttle valve regulates the quantity of mixture entering the intake manifold to the engine cylinders, thus controlling the engine speed. The choke control valve regulates only the flow of air through the carburetor, con-

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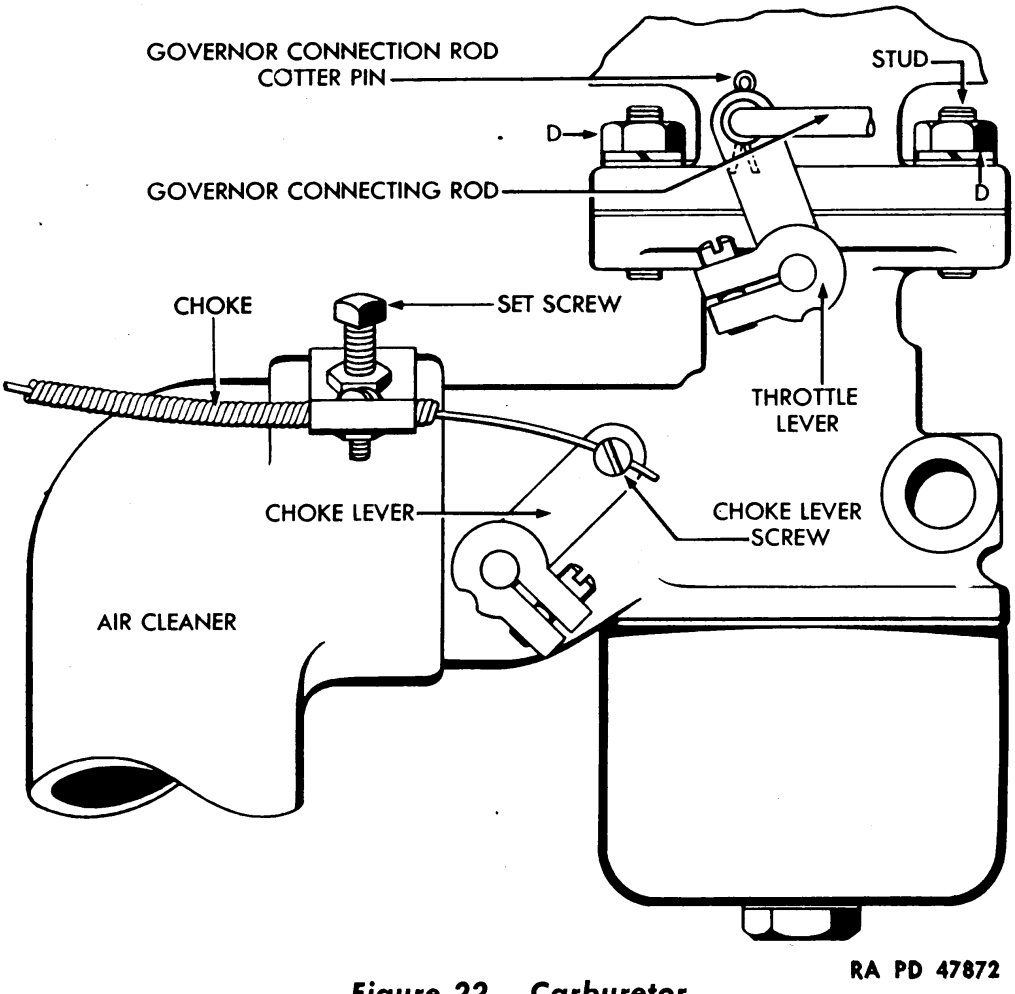

Figure 22 — Carburetor

sequently increasing the gasoline vapor content of the mixture. This is required when starting the unit in cold climates, or when the unit has been out of operation for some time. The choke should be used as sparingly as possible, since a continuous rich mixture will cause the engine to operate poorly and inefficiently.

c. Removal.

(1) Remove air cleaner assembly.

(2) Remove gasoline strainer assembly.

(3) Loosen screw securing choke wire to choke lever and pull wire from lever.

(4) Remove governor connecting rod cotter pin, and pull connecting rod from throttle lever.

(5) On the Generating Unit M6, unscrew auxiliary governor connecting rod ball joint from throttle lever.

(6) Unscrew the two throttle flange stud nuts securing carburetor to the intake manifold flange and remove carburetor.

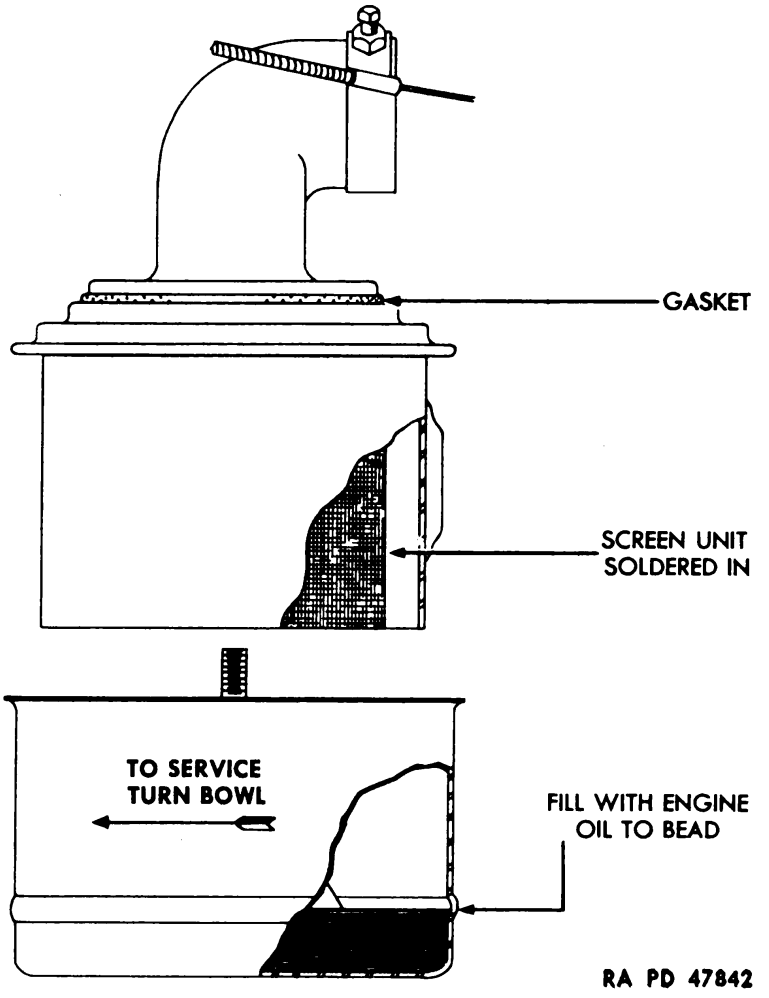

Figure 23 — Air Cleaner

d. Installation.

(1) Using a new gasket between the carburetor and intake manifold flange, secure carburetor to manifold with the two throttle flange stud nuts.

(2) On the Generating Unit M6, connect the auxiliary governor rod ball joint to the throttle lever.

(3) Place governor connecting rod in position through throttle lever hole and lock in position with cotter pin. NOTE: When installing new carburetor, it may be necessary to make adjustments to the throttle lever arm as shown in figures 24 and 25.

(4) Install air cleaner assembly and choke wire clamp.

(5) Install gasoline strainer assembly.

(6) Secure choke wire to choke lever in such a position that when the choke button on the instrument panel is all the way in, the choke valve in the carburetor is wide open.

GENERATING UNITS M5 AND M6

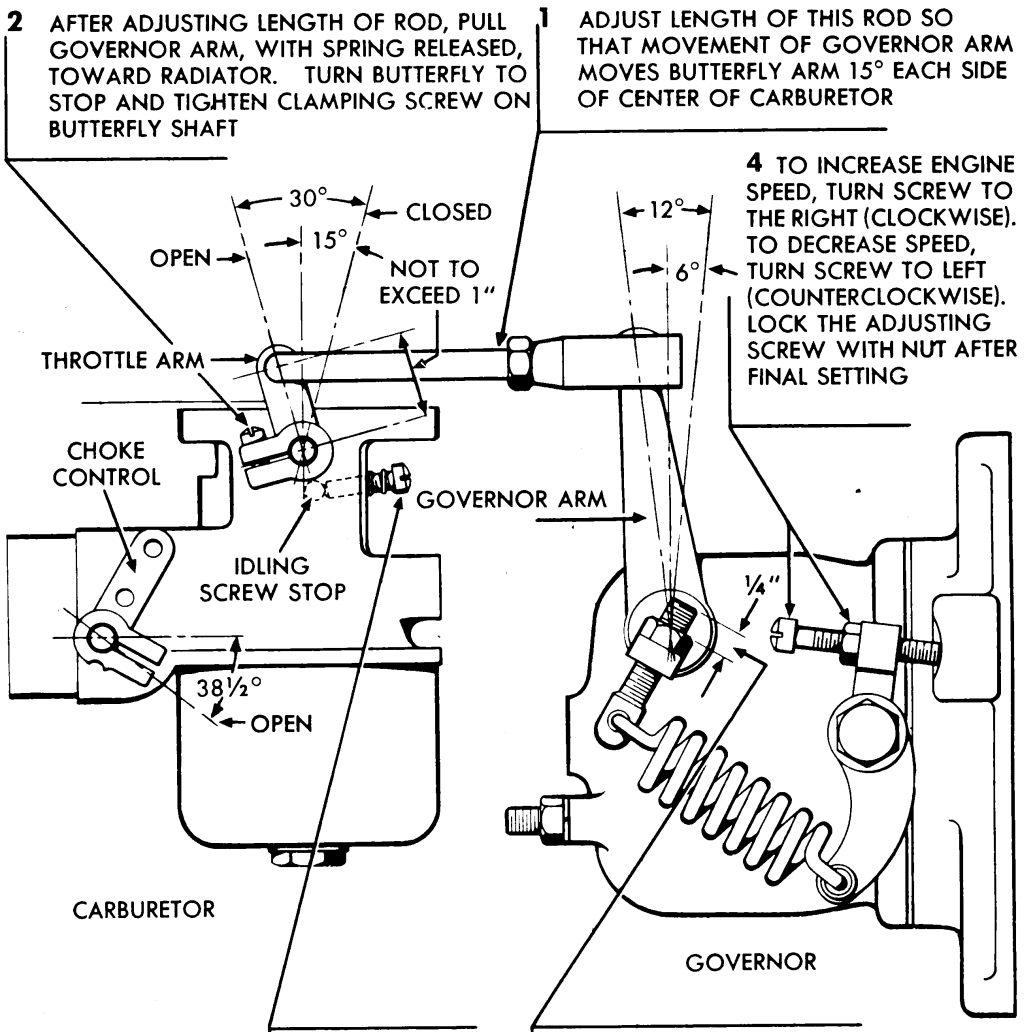

Figure 24 — Governor and Carburetor — Generating Unit M5

49. AIR CLEANER (fig. 23).

a. Description. The air cleaner is the oil-bath type and is attached to the carburetor body with two set screws. The assembly is composed of a mounting bracket, filter element, baffle plate, and a bowl assembly. The bowl assembly is readily removed to facilitate changing its oil.

b. Functioning. The function of the air cleaner is to remove all dust and dirt from the air before the air enters the carburetor. Air drawn into the carburetor enters the cleaner through the aperture

FUEL SYSTEM

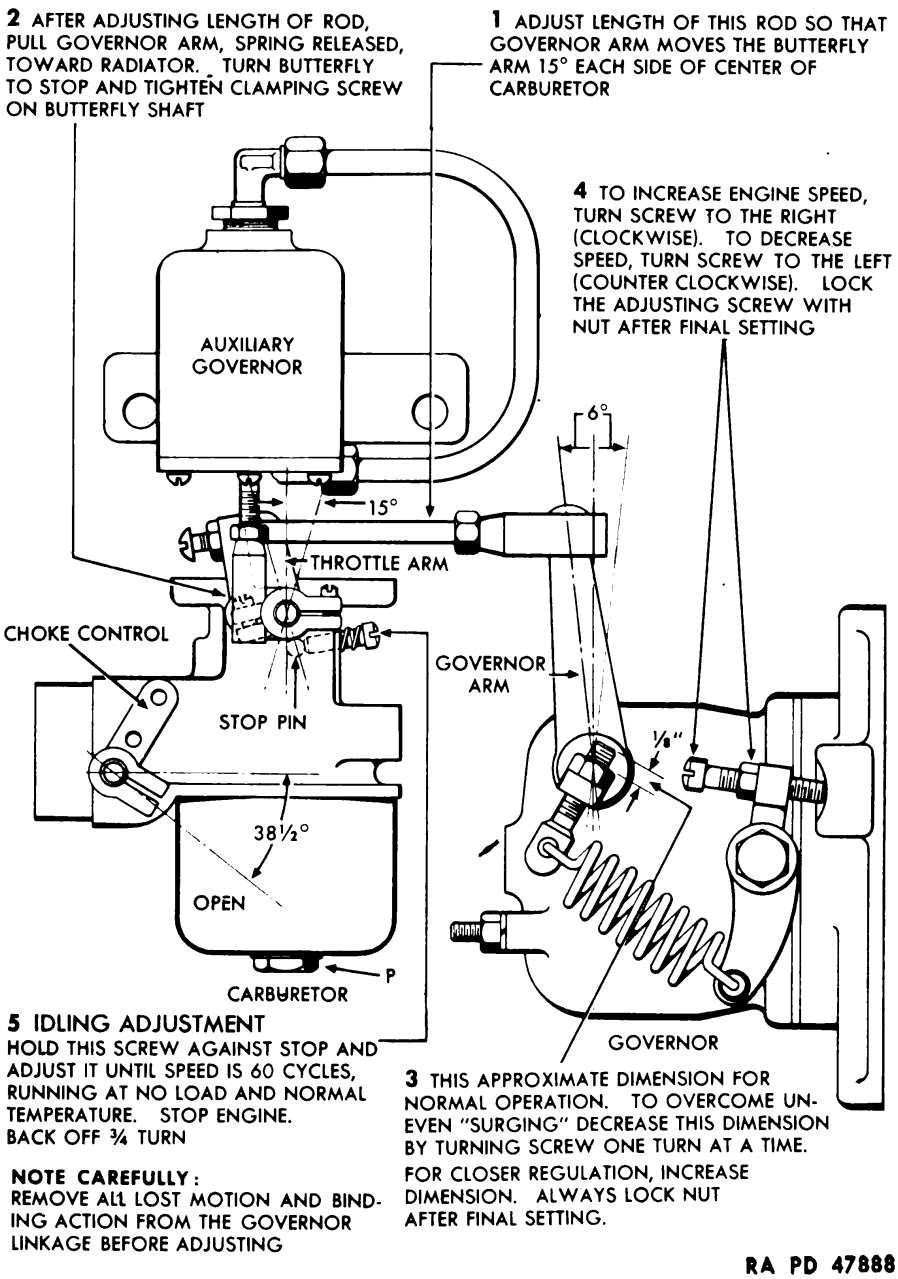

Figure 25 — Governor, Auxiliary Governor, and Carburetor Linkage — Generating Unit M6

between the bowl and the filter element. The sudden impact caused by the air striking the baffle of the cleaner causes most of its dust to be thrown into the oil in the cleaner bowl. The partially cleaned air then continues through a dense oil-welted wire mesh where the remaining dust is trapped.

c. Maintenance. The air cleaner must be cleaned and serviced as specified in the lubrication section of this manual (sec. IV). To remove bowl and filter element, turn the outer bowl to the left until

it drops down, then move it forward toward the radiator and then lift upward to get it out. Have some waste on hand to soak up oil that may have spilled while removing bowl.

50. GOVERNOR (figs. 24 and 25).

a. Construction. The governor is a gear-driven, spring-loaded, flyball-type unit mounted on the right front side of the engine cylinder block. A governor rod connects the governor arm with the carburetor throttle lever.

b. Functioning. The governor, driven from the camshaft gear, controls the amount of opening of the throttle valve in the carburetor. Its operation is controlled by the tension of the external governor spring. Varying this spring tension varies the engine speed.

c. Adjustments. NOTE: The using arms are not permitted to make any adjustments to the governor without permission from higher authority. When permission is obtained, proceed with adjustments as specified in figures 24 and 25. If it is only necessary to increase or decrease the engine speed, refer to "4" in figures 24 and 25. Before attempting any adjustments, check to see if any other fault may be the cause of faulty engine performance. Make sure engine has reached its operating temperature (160 to 180° F), as a cold engine may cause operation that would make it appear that the governor is at fault.

51. AUXILIARY GOVERNOR (fig. 25).

a. The auxiliary governor is used on the Generating Units M6 only, and is mounted on the two center manifold studs directly over the carburetor. A vacuum line from the intake manifold is connected to the top of the governor.

b. The auxiliary governor prevents surging of the engine as the load varies. Vacuum of the intake manifold operates the auxiliary governor. Decreased vacuum, caused by increased engine load, allows the bellows to contract. Contraction of the bellows lowers the plunger which opens the carburetor throttle valve. This allows more fuel to flow from the carburetor into the manifold. The added fuel compensates for the increased engine load and allows the engine to maintain its speed.

c. No adjustments are to be made to the auxiliary governor without permission of higher authority. For adjustments, refer to figure 25.

Section XII

ENGINE LUBRICATION SYSTEM

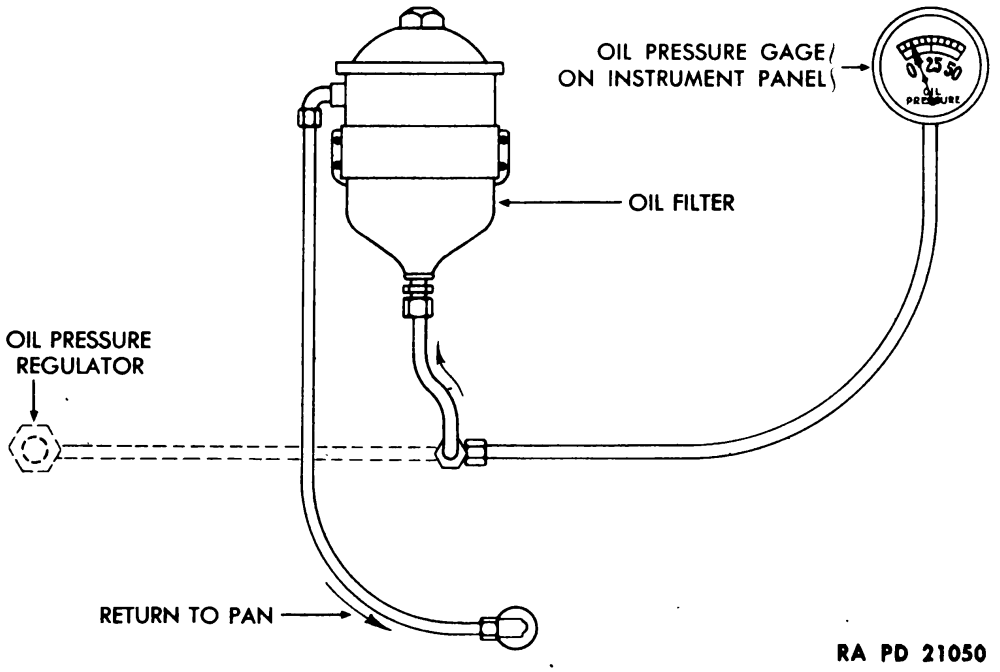

Figure 26 — Engine Lubrication System — External Oil Lines

52. DESCRIPTION.

a. The engine lubrication system consists of the oil pan, oil pump, oil pressure gage, oil pressure regulator, oil filter, and necessary connecting parts.

b. A constant flow of oil to the various internal moving parts of the engine is maintained by the action of the oil pump.

53. OIL FILTER (fig. 26).

a. Description. The oil filter is of the removal element type and is mounted on a bracket at the top of the engine cylinder head.

b. Functioning. Oil is forced through the filter element of the filter assembly where it deposits its dirt and other impurities before returning to the oil pan.

c. Maintenance. Service oil filter as directed in section IV of this manual. Oil filter element can be replaced by unscrewing the hexagonal nut at the top of the filter and removing the filter cover. Fil-

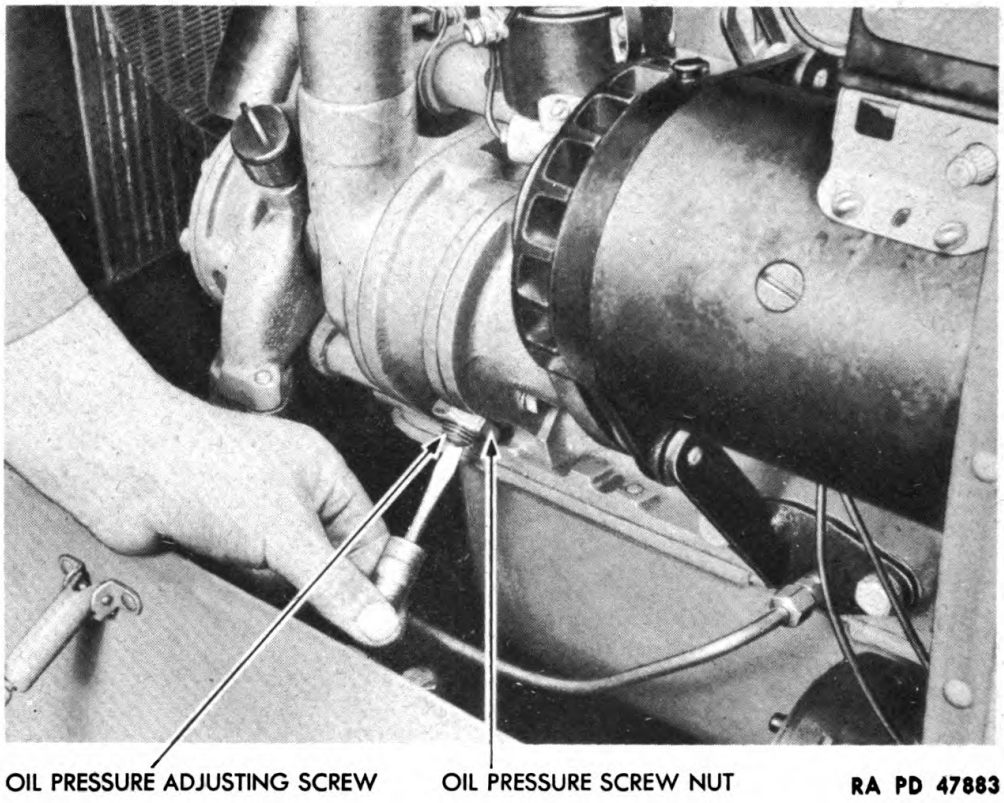

Figure 27 — Adjusting Engine Oil Pressure

ter element can now be lifted out. Before installing new filter element, thoroughly clean out any sludge that may have accumulated at the bottom of the filter case.

d. Replacement. Should it be necessary to replace the entire filter assembly proceed as follows:

(1) Disconnect the oil lines at the filter assembly.

(2) Remove oil filter assembly bracket bolts, nuts, and lock washers, and lift filter from bracket.

(3) Secure new oil filter assembly to bracket and attach the connecting oil lines.

(4) Start engine and check for oil leaks about the filter assembly.

54. OIL PRESSURE ADJUSTMENT.

NOTE: Low oil pressure is usually caused by faulty engine operation, leaks in oil lines or improper grade oil. Report to higher authority before proceeding to adjust oil pressure.

a. Remove acorn nut and gasket from oil pressure adjusting screw.

b. Loosen adjusting screw lock nut.

c. With engine running and operating at normal temperature, turn adjusting screw (fig. 27) to right or left until oil pressure on instrument panel shows 15 pounds pressure. To increase pressure, turn screw in. Tighten adjusting screw lock nut.

d. Replace acorn nut and gasket.

Section XIII

ENGINE ELECTRICAL SYSTEM

55. DESCRIPTION.

a. The engine electrical system can be broken up in three groups, namely; the ignition system, the starting system, and the generating system.

(1) The function of the ignition system is to provide high voltage current, at the proper instant to the engine spark plugs. This spark ignites the highly-explosive mixture compressed in the engine cylinders (par. 59).

(2) The starting system provides means of cranking the engine without the use of a hand crank. This consists of the battery, the starter switch and the starting motor.

(3) The generating system keeps the battery in a charged condition by replacing the electrical energy taken from it in starting the unit. The generating system also replaces the electrical energy used by the ignition system, the instrument panel light, and trouble light. This system consists of the battery-charging generator, the generator regulator, the ammeter and connecting wires.

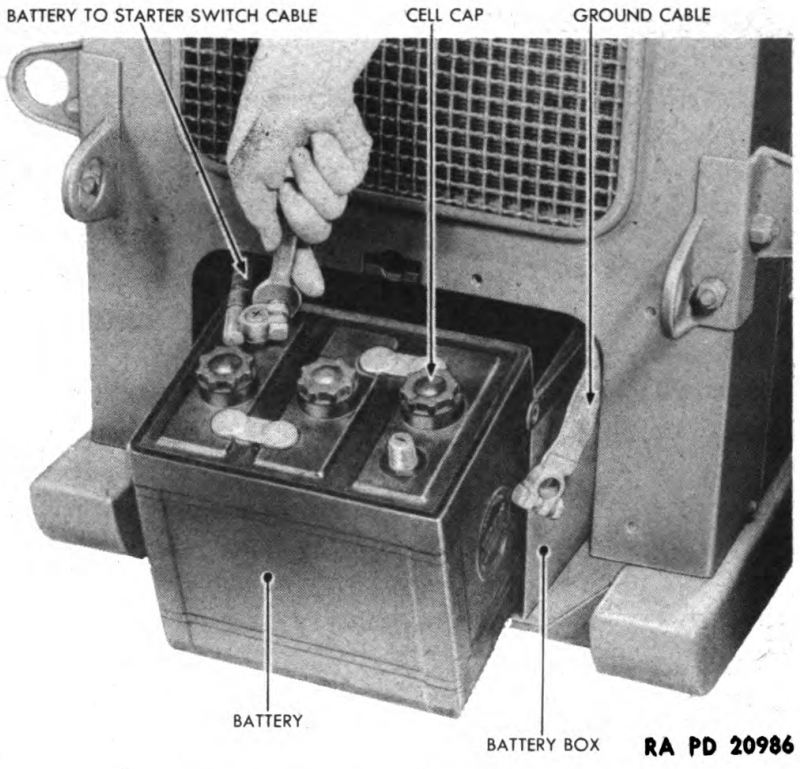

Figure 28 — Battery Removal

56. BATTERY (fig. 28).

a. General. A 6-volt, 3-cell, 100-ampere-hour storage battery supplies the electrical current for the starting motor, ignition system, and the instrument panel light. The battery is mounted in a box under the radiator, and can be inspected from the engine compartment. The battery cable from the starter switch is connected to the positive "+" post of the battery while the ground cable is connected to the negative "–" post.

b. Maintenance.

(1) The battery should always be kept filled with distilled water or rain water collected in a nonmetallic container, to a point approximately ⅜ inch above the separators. If the unit is used regularly, the battery should stay in proper charged condition. If battery has been discharged, it should be charged by a standard auxiliary battery charger. If this is impossible, the engine can be started by hand cranking and the battery charged by the battery-charging generator.

(2) The battery and battery box must be kept clean and dry. The battery cell caps must be on tight and their vent holes kept open.

(3) Battery cables and terminals must be kept clean and tight or the proper connections cannot be maintained. Scrape terminals clean

ENGINE ELECTRICAL SYSTEM

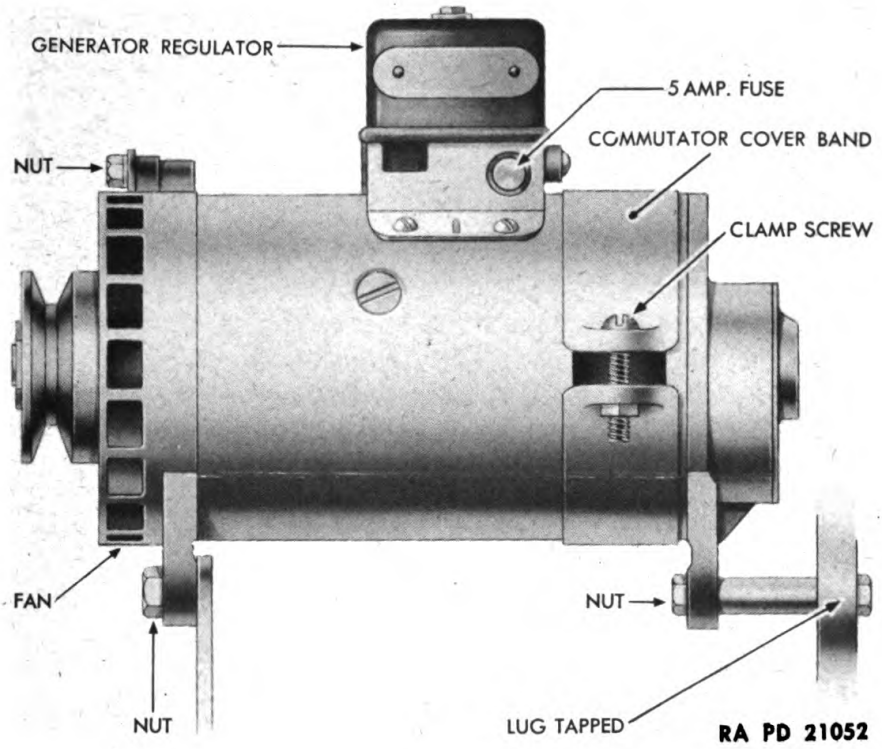

Figure 29 — Battery-charging Generator

and wash surface with soap and hot water. After connecting cables to battery posts, coat terminals with **GREASE**, general purpose (seasonal grade).

c. Servicing New Battery. **NOTE**: Prior to servicing new battery, obtain permission from higher authority.

(1) ADDING ELECTROLYTE. A tag attached to each replacement battery gives instructions for putting the battery into service. All this work is usually attended to before the battery reaches a field installation, but the following instructions are given here, to cover any contingency:

(a) Take off the cell caps and remove the vent plugs.

(b) Pour in electrolyte sufficient to cover the plates to a depth of about ⅜ inch. The electrolyte should be dilute sulphuric acid having a specific gravity of 1.335 (36.4° Baume) for temperate climates, or 1.240 (28.1° Baume) for tropical climates.

(c) Replace the caps, install the battery in the unit, and start the engine with the use of the hand crank. The engine generator will quickly bring the battery up to full charge. After the initial installation, only distilled water should be added to the cells. Never add acid except to replace loss occasioned by upsets and other accidents.

d. Battery Replacement (fig. 28).

(1) Remove battery cover and the tie bolt securing battery in battery box and slide battery out as far as cables permit.

(2) Loosen starter switch cable terminal and ground cable terminal on battery posts and lift off terminals. If the terminals are corroded and will not come off readily, spread them with a wedge.

(3) When replacing a battery, note that the cable from the starter switch is connected to the positive "+" or larger post and the ground cable is connected to the negative "–" post. Be careful not to damage the top of the battery as it is thin and somewhat brittle.

57. BATTERY-CHARGING GENERATOR AND GENERATOR REGULATOR (fig. 29).

a. General. The battery-charging generator is a 2-pole, shunt-wound, third-brush regulated, ventilated unit with a capacity of 6 volts. A generator regulator is mounted on the generator frame, and combines the cut-out with the regulator. A 5-ampere fuse is mounted in the regulator.

b. Functioning. The generator produces current for charging the battery. The regulator allows the generator to charge at its high rate until the battery is nearly charged, and has reached a predetermined voltage, at which time a resistance is cut into the field circuit of the generator, reducing the charging rate approximately one-half. The cut-out acts as an automatic switch between the generator and the battery, closing the circuit when the generator is producing sufficient output to charge the battery, and opening the circuit when the generator is not charging, so as to prevent the battery from discharging back through the generator.

c. Trouble Shooting.

(1) BURNT-OUT FUSE.

Possible Cause	Possible Remedy
Faulty generator regulator.	Replace regulator.

(2) GENERATOR FAILS TO CHARGE.

Brushes worn out.	Replace brushes.
Loose generator belt.	Adjust belt.

(3) LOW CURRENT OR NO CURRENT.

Open circuit in brush connections.	Replace brushes.
Brush is stuck in holder.	Clean brushes and brush holders.
Open circuit due to dirty commutator.	Clean commutator.

(4) NOISE AT ENGINE IDLING SPEED.

Possible Cause	Possible Remedy
Noisy bearing.	Notify ordnance personnel.
Loose pulley.	Tighten pulley.
Loose pole piece.	Tighten pole piece.

d. Maintenance.

(1) To inspect the battery-charging generator, remove the cover at the commutator end. If the commutator is discolored or dirty, it can be cleaned by holding a piece of PAPER, flint, class B, grade No. 00, against it while the generator is running slowly.

(2) BRUSHES.

(a) If brushes are badly worn, new brushes should be installed. The brushes should be fitted to have at least 80 percent brush surface contact with the commutator. To seat the brushes, clean the commutator (step (1), above), then wrap around the commutator a piece of PAPER, flint, class B, grade No. 00, of the same width as the commutator, and move it back and forth along the commutator with sanded face against the brushes until the brush is properly seated. Blow the generator out with compressed air to remove all particles of abrasive. Use only PAPER, flint, class B, grade No. 00, to seat brushes.

(b) Brush spring tension can be tested by hooking a scale in the hole at the end of the brush arm, and taking a reading as the arm leaves the brush. The tension for all three brushes, when new, should not be more than 53 ounces maximum.

(c) The charging rate of the generator is controlled by an adjustable third brush. Advance or retard the third brush as required. Moving the brush in direction of armature rotation increases the charging rate, while moving it against armature rotation decreases the charging rate.

(3) GENERATOR BELT. Check condition and tension of generator belt. Replace damaged or worn belt.

e. Generator Replacement.

(1) Disconnect wire from ignition coil and wire from ammeter at the generator regulator.

(2) Remove the generator drive belt adjusting screw and loosen the two lower generator mounting screws.

(3) Push generator toward engine and lift drive belt from generator pulley.

(4) Remove the two lower generator mounting screws and the spacer between the generator and bell housing, and lift out generator.

(5) To install generator reverse the steps (1), (2), (3), and (4), above, placing the spacer between the generator and the bell housing.

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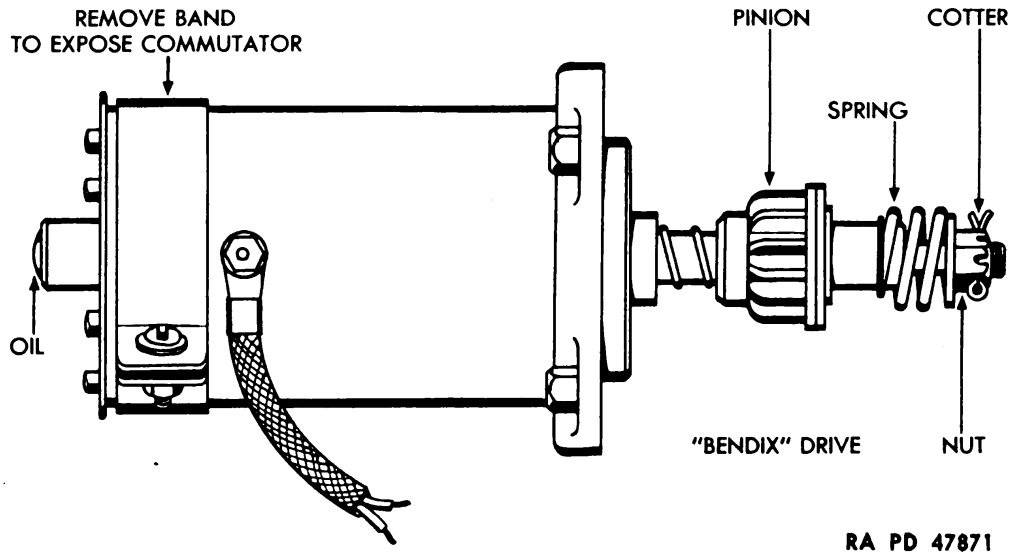

Figure 30 — Starting Motor with Bendix Drive

(6) Attach wire from the ammeter to the "B" terminal of the generator regulator and the wire from the ignition coil to the "T" terminal.

(7) Adjust generator drive belt so that it can be deflected ½ inch to ¾ inch, midway between its pulleys.

f. Generator Regulator Replacement.

(1) Disconnect ignition coil wire and wire from the ammeter at the generator regulator terminals.

(2) Remove the four screws securing the generator regulator to the generator and lift regulator from the generator.

(3) Disconnect the generator field and armature wires attached to the bottom of the regulator.

(4) Place new regulator over generator and attach the generator armature wire (red) to the "A" terminal and field wire (black) to "F" terminal on the lower part of the regulator.

(5) Place regulator in position on generator and secure with the four screws and lock washers.

(6) Attach wire from the ignition coil to the regulator "T" terminal and the wire from the ammeter to the "B" terminal.

58. STARTING MOTOR (fig. 30).

a. General. The starting motor is of the 6-volt, 4-brush Bendix drive type. It is mounted on the left side of the engine bell housing. It has a removable cover band to facilitate inspection of the brushes and commutator.

b. Functioning. When the starter switch button on the instrument panel is pushed in, the current from the battery flows through the starting motor causing its armature to rotate. A pinion attached

to the extended armature shaft meshes with the engine flywheel gear causing the starting motor to turn the engine crankshaft. The sudden shock caused by this action is taken up by a spring on the armature shaft. When the engine starts, the pinion is forced back away from the flywheel gear.

c. Maintenance.

(1) Lubricate starting motor as specified in section IV of this manual.

(2) Periodically, remove cover band and inspect brushes and commutator. A dirty commutator can be cleaned by applying PAPER, flint, class B, grade No. 00, to it while the armature shaft is rotating. After cleaning commutator, blow out dirt and flint particles with compressed air.

(3) If Bendix drive fails to function properly, remove starting motor and wash the drive parts in SOLVENT, dry-cleaning. Apply a few drops of OIL, engine, SAE 10, to pinion and armature shaft before installing starting motor. Bendix drive can be disassembled by removing the cotter pin and nut and the drive end of the armature shaft.

d. Replacement.

(1) Disconnect cable from starting motor terminal post, remove three cap screws and lock washers securing starting motor to bell housing and lift out the assembly.

(2) Before installing new starting motor, check position of cover band screw. The screw must be in a position where it can be loosened after the starting motor has been installed.

(3) Place starting motor on bell housing so that the Bendix drive enters bell housing and secure in position with three cap screws and lock washers. Connect the cable to the starting motor terminal post.

59. IGNITION SYSTEM (fig. 31).

a. The ignition system contains the battery, distributor, ignition coil, spark plugs, and necessary high and low tension wires, to complete the circuit for these units of the ignition system. The complete ignition circuit consists of two separate circuits, the primary circuit, and the secondary circuit. Briefly, these circuits function as follows:

(1) With the ignition switch turned on and the distributor breaker points closed, current flows through the primary winding of the ignition coil and builds up a strong magnetic field in the coil. When the breaker points open, the primary circuit is broken, collapsing the magnetic field and inducing a high voltage in the secondary winding of the coil. This induced high voltage is distributed to the spark plugs by the distributor cap and rotor and the high tension wiring between the distributor cap and spark plugs.

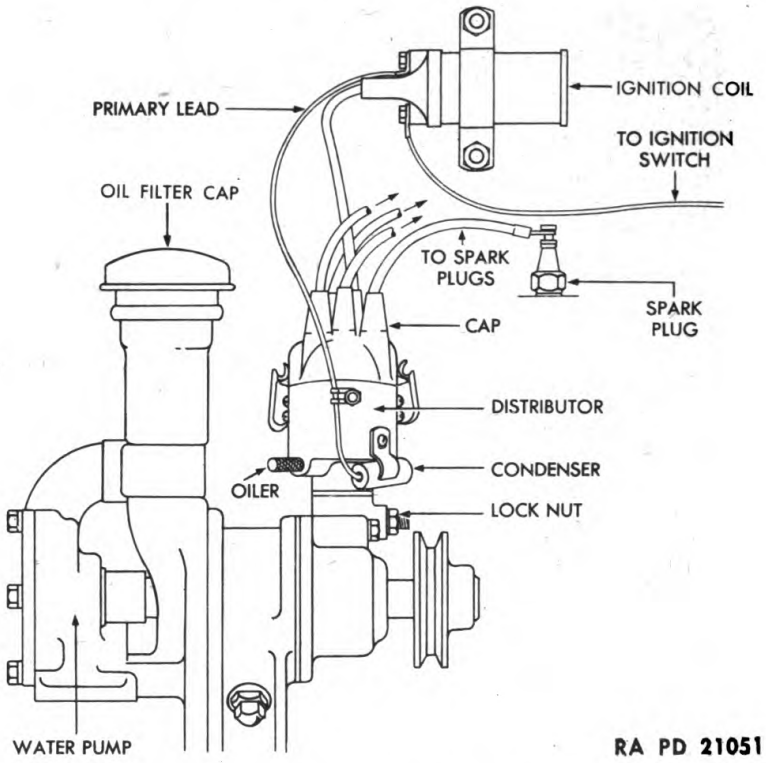

Figure 31 — Ignition System

(2) To prevent arcing across the distributor breaker points as they open, a condenser is connected in parallel with the points. The purpose of the condenser is to provide a place for the primary current to flow until the points have separated far enough to prevent an arc across the points. The condenser brings the flow of current through the primary circuit to a quick stop. The quick stop of the current flow collapses the magnetic field and induces the high voltage necessary to provide a spark at the spark plug.

60. DISTRIBUTOR (fig. 32).

a. General. The distributor is a 4-cylinder automotive type and is driven by a gear on the accessory drive shaft. It consists of a body assembly, cap, breaker points, rotor, and a condenser.

b. Maintenance.

(1) DISTRIBUTOR BODY. Lubricate distributor as specified in section IV of this manual. Keep distributor clean and securely mounted to the accessory drive housing.

(2) DISTRIBUTOR CAP. The distributor cap must be kept clean and should be constantly inspected for cracks, carbon runners, evidence of arcing, or corroded high-tension terminals. If any of these conditions are present, the cap should be replaced. After a distrib-

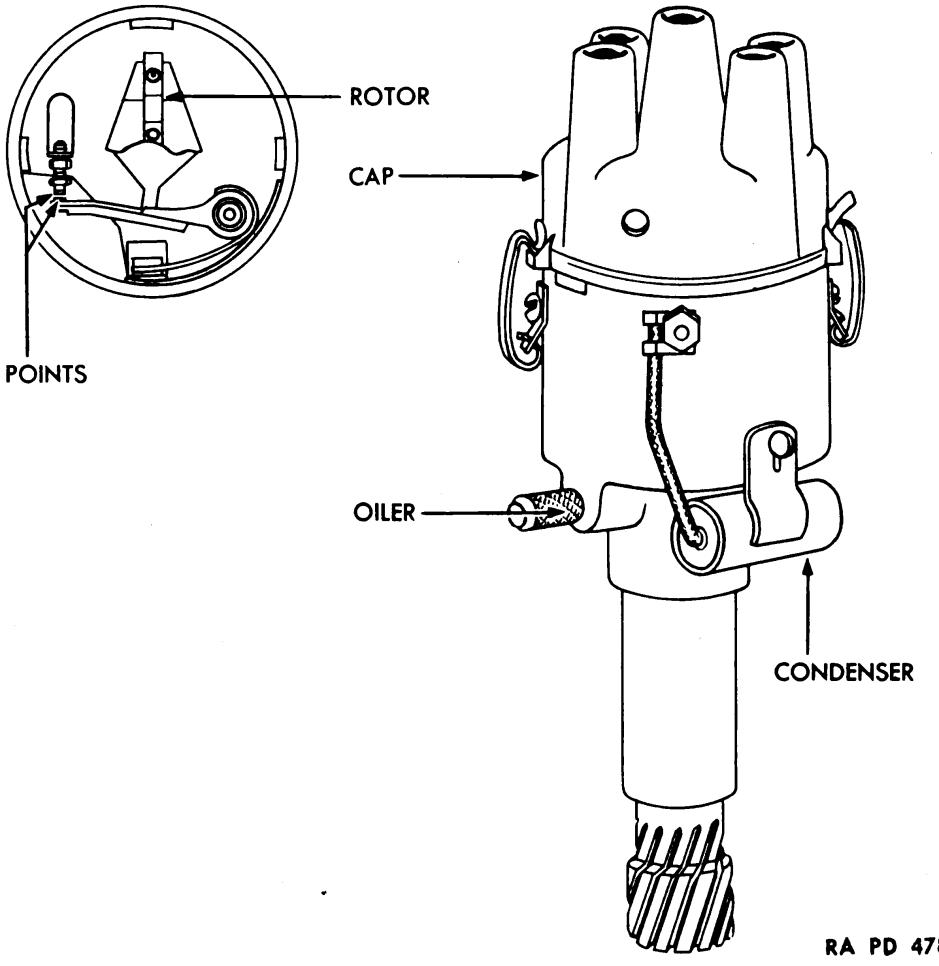

Figure 32 — Distributor

utor cap has had normal use, the inside of the cap inserts will become slightly burned. If these inserts are badly burned at any other point, the cap should be replaced.

(3) ROTOR. The rotor should be inspected for cracks. If cracks are found, it should be replaced. After a rotor has had normal use, the end of the contact will become burned. If this burning is not excessive, and is found only on the end of the metal strip, the rotor need not be replaced. If burning is found on the top of the strip, it indicates the rotor is too short, and needs replacing. Usually when this condition is found, the distributor cap inserts will be burned on their horizontal face, and the cap also will need replacing.

(4) BREAKER POINTS. If breaker points are in good condition, they will show a grayish color with no evidence of burning or pitting. Breaker points should be so alined as to make contact over the whole area of the contact surfaces. Breaker point gap should be set at 0.018 inch $\pm$0.002 inch. If alinement is not correct, bend the station-

ary point bracket to secure proper alinement, and then adjust the gap (fig. 33) and tighten the lock nut.

(5) Condenser should be checked for broken wires, frayed insulation, and firm mounting. See that connections are clean and tight.

61. SPARK PLUGS.

a. Description. The spark plugs are of the commercial automotive type with electrode gap adjustments made by bending the side electrode. Each plug consists of a metal shell within which is fixed an insulator with a central electrode stem. The metal shell is threaded to screw into the engine cylinder head. The central electrode stem is threaded at the upper part of the insulator to provide means of attaching the high tension lead from the distributor. 14-mm Titan model 6 or equivalent spark plugs are used.

b. Functioning. When the circuit from the ignition coil to the spark plug is closed, a spark jumps across the spark plug electrode gap and ignites the gas mixture in the combustion chamber.

c. Trouble Shooting. Cracked, dirty, or improperly adjusted spark plugs cause poor engine performance. To determine if faulty engine performance is caused by one or more faulty spark plugs, start engine and set speed slightly above idling. Short out each spark plug with a wood-handle screwdriver, by holding the screwdriver bit against the spark plug terminal and engine cylinder head. **NOTE:** Do not touch metal part of screwdriver as an unpleasant shock will be felt. If there is noticeable difference in the engine performance, the shorted spark plug can be assumed to be in good condition. If, however, there is no noticeable difference in engine performance, the shorted spark plug should be renewed. If the installation of new spark plugs does not improve engine performance, fault must be found elsewhere in the ignition system, in the fuel system, or a mechanical defect exists in the engine.

d. Maintenance. Remove spark plugs after each 100 hours of operation, and make the following check.

(1) Check for cracked or blistered insulations, and replace plugs, if any is evident.

(2) Check for dirty electrodes and insulations. Thoroughly clean each dirty spark plug in sand blast spark plug cleaner.

(3) Check for worn electrodes. Replace spark plugs with worn electrodes.

(4) Check and adjust spark plug electrode gap using 0.025 feeler on gage. Bend outside electrode with pliers to obtain correct gap. Never bend inside electrode.

(5) Test each spark plug on a spark plug tester to assure proper performance.

ENGINE ELECTRICAL SYSTEM

62. IGNITION COIL.

a. General. The ignition coil is a self-contained unit consisting of an iron core around which are wound a few turns of wire to form the primary circuit, and several turns of wire to form the secondary circuit. The core and wires are enclosed in a sealed case to form the complete coil. Its function is to step up the low-tension current of the primary circuit to the high-tension current of the secondary circuit, which is needed to produce a spark across the points of the spark plugs by which the gasoline and air mixture in the cylinder is ignited.

b. Maintenance.

(1) The ignition coil is a totally inclosed unit that needs no special attention. Connections and terminals should be kept clean and tight.

(2) If the ignition coil is thought to be faulty, substitute another coil known to be in good condition, and check engine performance.

c. Removal.

(1) Pull distributor high tension cable from ignition coil and disconnect wires attached to the coil terminal posts.

(2) Remove the two nuts and bolts securing coil to the bracket and lift off coil.

d. Installation.

(1) Attach ignition coil to bracket with two nuts and bolts.

(2) Push distributor high tension wire into tower on end of coil.

(3) Attach distributor wire to positive "+" terminal post and generator regulator and ignition switch wire to negative "–" terminal post.

63. TROUBLE SHOOTING.

a. Engine Fails To Start, Starting Motor Operative.

Possible Cause	Possible Remedy
No spark.	Replace coil-distributor wire.
Weak spark.	Check wiring, distributor points, and if necessary, replace condenser.
Weak spark after replacing condenser.	Replace coil.
Cracked distributor cap.	Replace distributor cap.
Grounded distributor rotor.	Replace rotor.
Defective spark plug cable.	Replace cable.
Defective spark plugs.	Service or replace spark plugs.

b. Ammeter Shows Constant Normal Discharge while Engine Is Being Cranked.

Possible Cause	Possible Remedy
Faulty distributor.	Notify ordnance personnel.
Defective or grounded coil-distributor wire.	Eliminate ground or replace wire.
Defective coil.	Replace coil.

c. Ammeter Shows No Discharge.

Distributor at fault.	Notify ordnance personnel.
Broken wires or loose connections.	Replace faulty wiring or tighten all connections.

d. Engine Fails To Crank.

Fully discharged battery.	Charge battery.
Starting motor burned out.	Replace starting motor.
Starter switch faulty.	Replace starter switch.
Loose connections.	Tighten connections.
Corroded battery terminals.	Clean terminals.

Section XIV

GENERATING SYSTEM

64. MAIN GENERATOR AND EXCITER (fig. 33).

a. General.

(1) The main generator consists of two generators mounted on the same shaft in the same housing between one set of bearings. The smaller of the two generators, the exciter, is a d-c stationary-field type. Its function is to furnish excitation (direct current) for field windings of the other generator. The other generator is an a-c revolving-field type whose function is to deliver the electrical output of the unit.

GENERATING SYSTEM

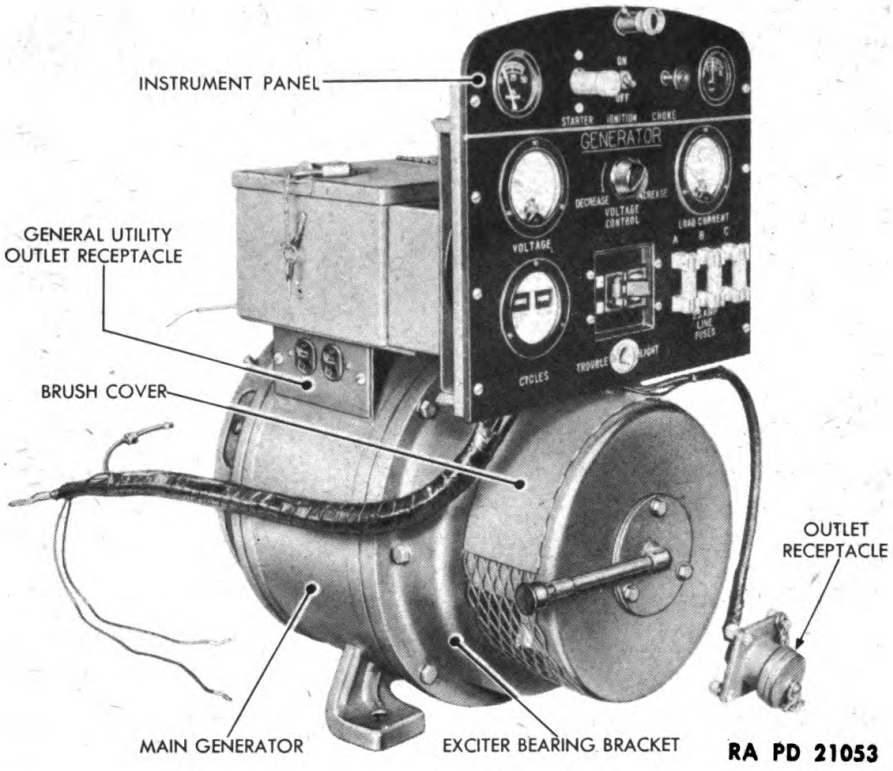

Figure 33 — Main Generator and Instrument Panel — Left Rear View

(2) On the Generating Unit M5, the generator is a 3-phase, 3KVA, a-c generator. It produces 60 cycles, 125 volts at 1,200 rpm or 50 cycles, 130 volts at 1,000 rpm.

(3) On the Generating Unit M6, serial numbers 377 to 726, the generator can be adjusted to deliver either a single- or 3-phase output. As a single-phase generator, it delivers 2.5 KVA, 20 amperes, 60 cycles, 125 volts 3 KVA, 13.9 amperes, 60 cycles, 125 volts at 1,200 rpm. M6 units bearing serial numbers 1 to 266 inclusive, and 367 to 376, inclusive, deliver only single-phase current.

b. Tabulated Data, M5 Unit.

Phase of generator	3
Rating	3 KVA
Type of field	Revolving
Frequency	60 cycle (or 50 cycle)
Normal speed (60 cycles)	1,200 rpm
Normal speed (50 cycles)	1,000 rpm
Rated voltage at 50 cycles	130
Rated voltage at 60 cycles	125

GENERATING UNITS M5 AND M6

In the M5 Unit the frequency can be changed from 60 cycles to 50 cycles, and vice versa. This is accomplished by a repositioning of the links on the subpanel and a change of engine speed.

c. Tabulated Data, M6 Unit.

Phase of generator	3
Rating, 3-phase load	3 KVA
Rating single-phase load	2.5 KVA
Type of field	Revolving
Frequency	60 cycles
Normal speed	1,200 rpm
Voltage	125

NOTE: The generator is the same for M6 Unit as for M5 Unit, but connections are such in the M6 Unit that single-phase power may be used to advantage. The M6 Unit can be changed to deliver 3-phase power by a rearrangement of links on the subpanel.

d. Maintenance.

(1) GENERAL. Lubricate the main generator as specified in section IV of this manual. Keep the entire assembly clean and dry. Frequently apply a wrench to its mounting screws to assure it being securely mounted on the frame.

(2) BRUSHES AND BRUSH HOLDERS.

(a) Periodically, depending on operating conditions, inspect brushes and brush holders. This can be done by removing the brush cover at the rear of the main generator. The brushes should be clean and free to move in their holders. If gummy and stuck in their holders, they should be removed and cleaned. At this time, the brush holders should also be cleaned.

(b) As brushes wear down, it may be necessary to increase their spring tensions. This can be done by moving the end of the spring up the spring adjusting washer a notch or two. Correct brush spring tension is 8 ounces for the slip ring brushes and 12 ounces for the exciter commutator brushes.

(c) Replace brushes when they are worn flush or below the top of their holders. When installing new brushes, they must be fitted to the slip rings or commutator. This can be done with a strip of PAPER, flint, class B, grade No. 00, wrapped about the commutator or slip ring with the abrasive side facing the brush. With the brush under tension in its holder, the flint paper is moved causing it to seat the brush to the slip ring or commutator. After fitting new brushes, clean out the inside of the main generator with dry compressed air.

(3) SLIP RINGS AND COMMUTATOR. Whenever checking the brushes and brush holders, visually inspect the slip rings and the commutator. Dirty or rough slip rings or commutators should be lightly polished with PAPER, flint, class B, grade No. 00, applied to their

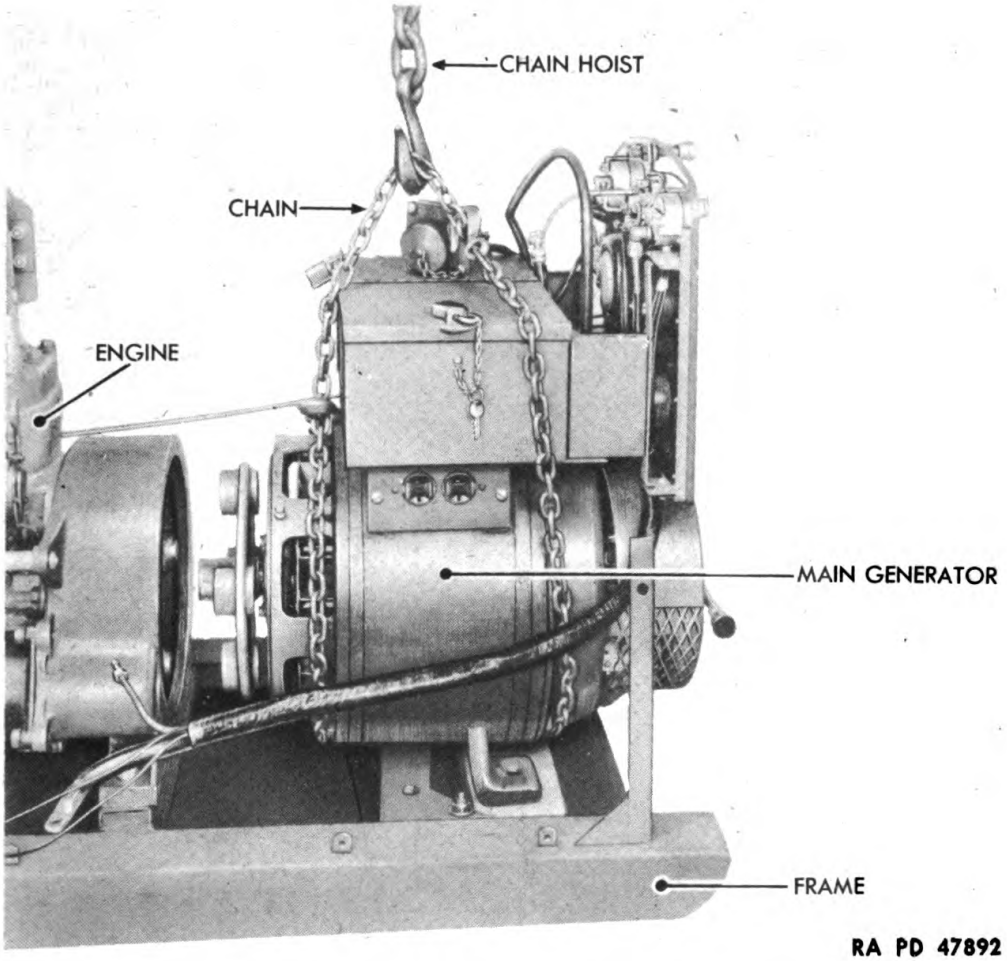

Figure 34 — Main Generator Removal

surfaces while the generating unit is operating at a slow speed. After cleaning slip rings or armature, blow out dirt from inside the main generator with dry compressed air.

e. Replacement.

(1) Remove canopy.

(2) Detach the combination cable. This consists of the oil pipe to the tee connection, the cable to the starting motor and two wires to the ignition coil and the generator regulator. Detach also the cable that runs from the battery to the starter switch on the instrument panel, the choke wire from the carburetor and the outlet receptacle.

(3) Take out the two large bolts which secure the generator to the frame cross member. Watch for shims under the legs of the generator; if the same generator is put back in, the shims will need to go back in the same position; if a new generator is installed, the shimming may be a little different.

(4) Take off generator fan cover and remove the bolts that secure the generator to the engine bell housing.

(5) Arrange a sling around the generator (fig. 34), pull generator back away from the engine and lift up the entire assembly of generator, tool box, and instrument panel.

(6) When installing a new generator reverse the above steps, but before securing generator to frame cross member and engine bell housing, be sure the generator bracket is perfectly lined up with the engine bell housing. Correct alinement can be obtained by varying the thickness or the amount of shims used under the legs of the generator.

65. CONTROLS.

a. Circuit Breaker.

(1) The circuit breaker serves a dual function; as a main switch for the generating system, and to protect the generator from excessive overloads.

(2) Three coils (two on some Generating Units M6) within the circuit breaker create sufficient magnetism when an excessive current flows through them, to attract an iron lever. The lever serves as a trigger which, when drawn to the coil, allows springs to snap the circuit breaker to "OFF" position. An overload in any one of the lines will trip the circuit breaker to "OFF" position.

(3) Should the circuit breaker fail to function properly, the unit should be replaced.

(a) Remove rheostat (subpar. b (2), below).

(b) Remove the screws that secure the circuit breaker to the instrument panel and pull the unit away from the panel toward the generator. Turn the circuit breaker so that the wire binding screws are on top, and detach the wires.

(c) Reverse the above steps when installing circuit breaker. Connect wires to the unit as shown in the wiring diagrams (figs. 39, 40, and 41).

b. Field Rheostat.

(1) The field rheostat labeled "VOLTAGE CONTROL" on the instrument panel is a variable resistance unit. Its function is to allow manual control of the voltage output of the main generator. To increase the voltage of the current delivered, the knob is turned clockwise or to the right. The minimum voltage position, which is the position the knob should be in before starting or stopping the unit, is when the knob is turned counterclockwise or to the left as far as possible.

(2) If the field rheostat fails to operate properly it should be replaced.

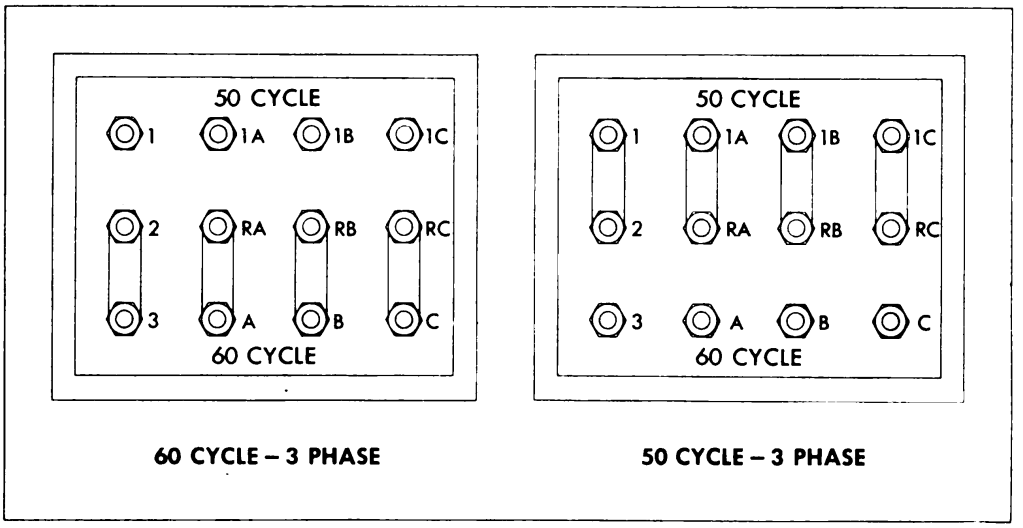

Figure 35 — Chart for Changing Frequencies

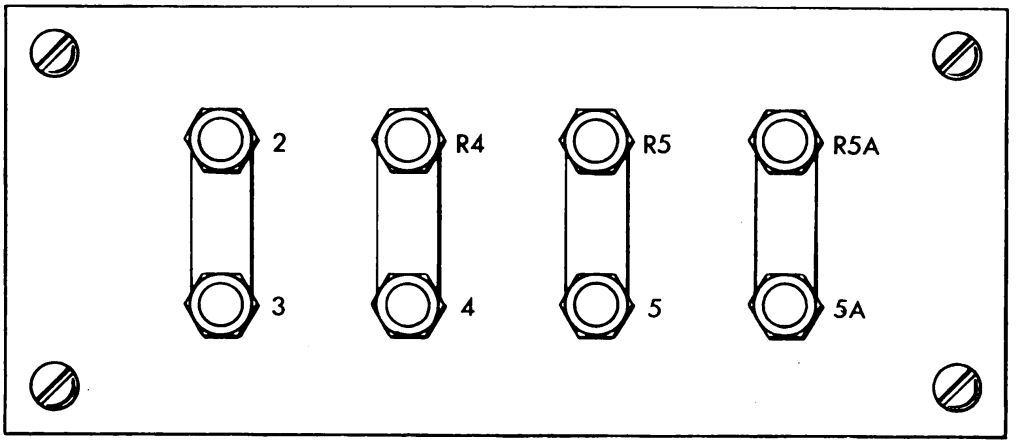

Figure 36 — Terminal Panel on Early Model Generating Units M6

(a) Disconnect the wires connected to the back of the rheostat.

(b) Loosen the small set screw on rheostat knob and take off knob.

(c) Unscrew the thin hexagonal nut on the front and pull the unit out at the back.

(d) When replacing rheostat connect wires as in the wiring diagrams (figs. 39, 40, and 41).

66. WIRING.

a. General. Differences exist in the wiring of the M5, M6 single-phase, and the M6 single- and 3-phase generating units. Figure 39 applies to all M5 Units, figure 40 applies to M6 single-phase Units (serial numbers 1 to 266, and 367 to 376 inclusive). Figure 41 applies to M6 single- and 3-phase Units (serial numbers 267 to 366, and 377 to 726 inclusive).

GENERATING UNITS M5 AND M6

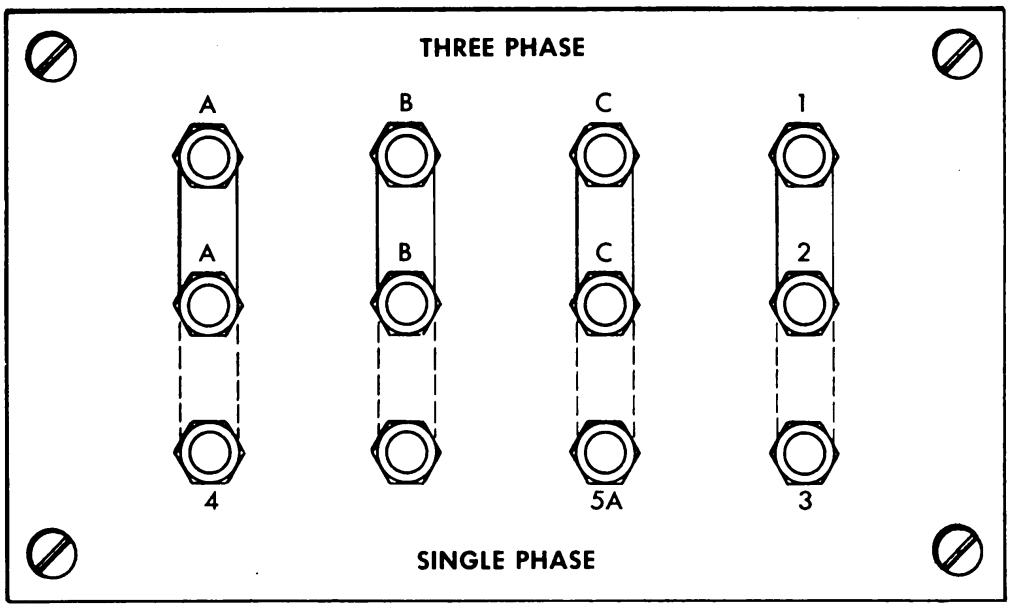

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Figure 37 — Link Arrangement on Subpanel for Changing from 3-phase to Single-phase Operation — Generating Units M6 (Later Models)

b. Subpanel or Change-over Panel.

(1) GENERATING UNIT M5. A separate panel is provided with this unit to facilitate connecting the unit for 50-cycle or 60-cycle operation. Before operating the unit, check for proper frequency connections on the subpanel. Figure 35 shows how links should be connected for either frequency operation.

(2) GENERATING UNIT M6. (Serial numbers 1 to 266, and 367 to 376 inclusive.) These units are provided with a separate panel with eight binding posts connected by links (fig. 36). No adjustments or changes can be made on these units.

(3) GENERATING UNIT M6. (Serial numbers 267 to 366, and 377 to 726 inclusive.) These units have an 8-inch by 5-inch separate panel to facilitate connecting the unit for either 3-phase or single-phase operations. Before operating the unit, check to see if links are properly connected for the type of operation for which the unit is to be used (fig. 37).

67. OUTLET RECEPTACLES.

a. General. All Generating Units M5 have 3-pole outlet power receptacles. All Generating Units M6 have 19-pole receptacles. M6 Units with serial numbers from 267 to 366, and 377 to 726 inclusive, also have 3-pole receptacles mounted on the rear of the unit. The 3-pole receptacles are used for 3-phase current, while the 19-pole receptacles (fig. 38) are used for single-phase current.

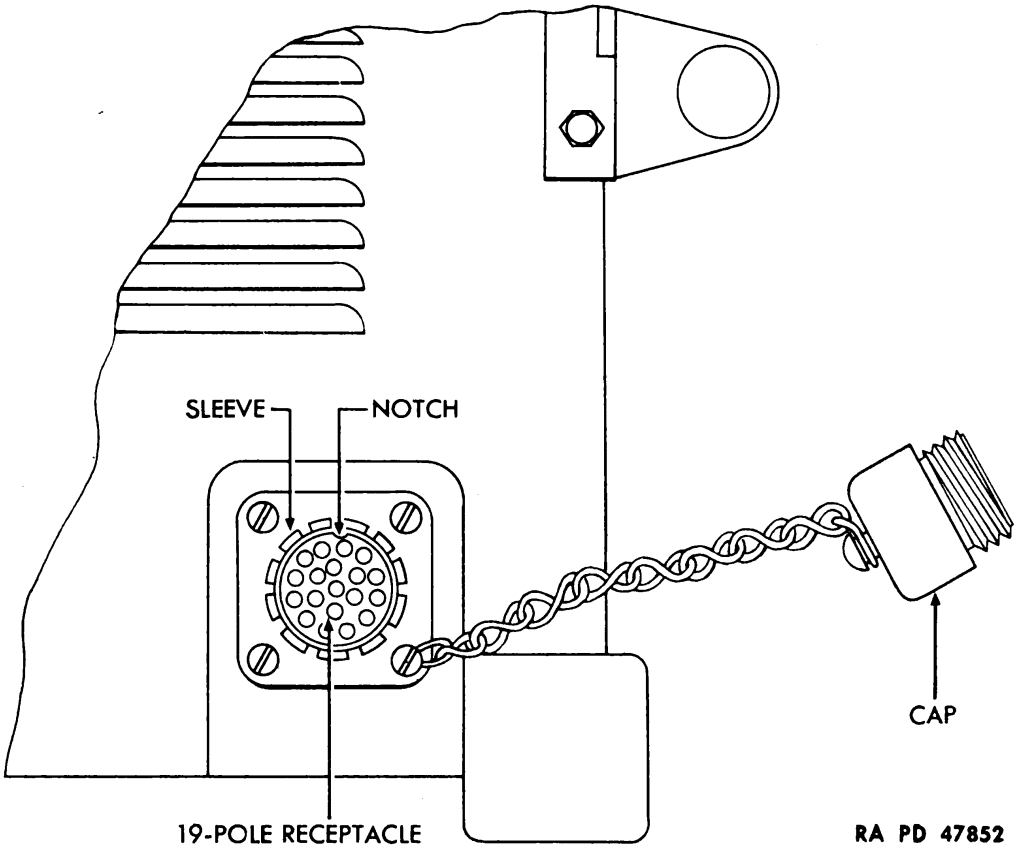

Figure 38 — 19-pole Outlet Receptacle — Generating Unit M6

b. Maintenance. Periodically, tighten receptacle mounting screws. Keep receptacles clean and dry. When not in use, keep receptacles covered with cover furnished.

68. DUPLEX RECEPTACLES.

a. Each generating unit is equipped with duplex receptacles which serves as means of obtaining current from the main generator to operate 110-volt lights and appliances. On the M5 Unit, the receptacles are located under the tool box on the left side, while on the M6 Unit, they are located on the right side under the change-over panel.

69. RESISTORS, CAPACITORS, AND TIME DELAY-RELAY.

a. General. Five resistors, four of fixed capacity and one variable capacity, three capacitors, and a time delay-relay is furnished with the Generating Unit M6 only. The resistors and the capacitors are mounted on brackets above the main generator while the time delay-relay is mounted to the right of the main generator. None of these assemblies are provided on the M5 Unit because they are only needed to provide for single-phase conversion on the M6 Unit.

GENERATING UNITS M5 AND M6

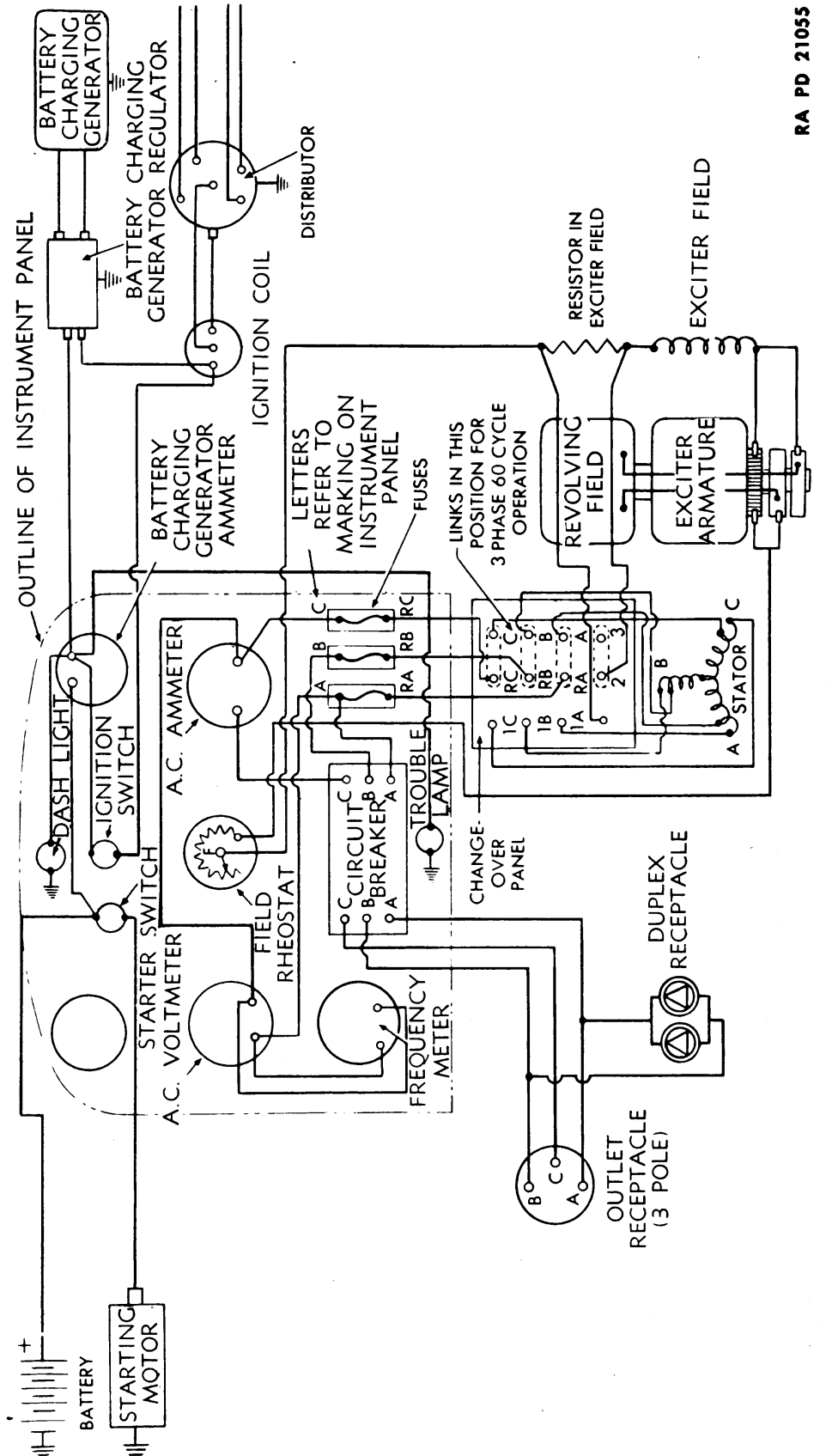

Figure 39 — Wiring Diagram — Generating Unit M5

GENERATING SYSTEM

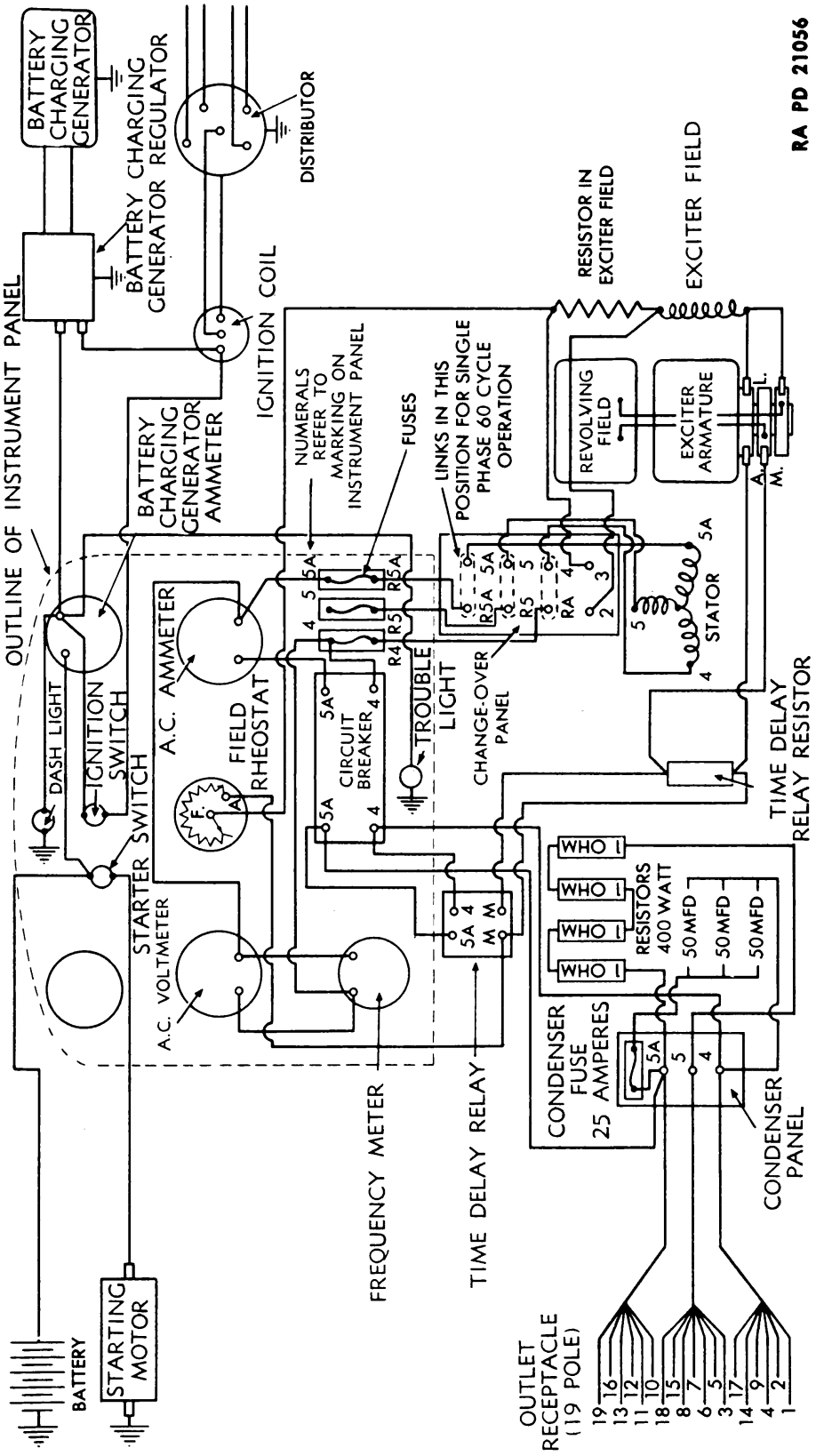

Figure 40 — Wiring Diagram — Single-phase Generating Unit M6

GENERATING UNITS M5 AND M6

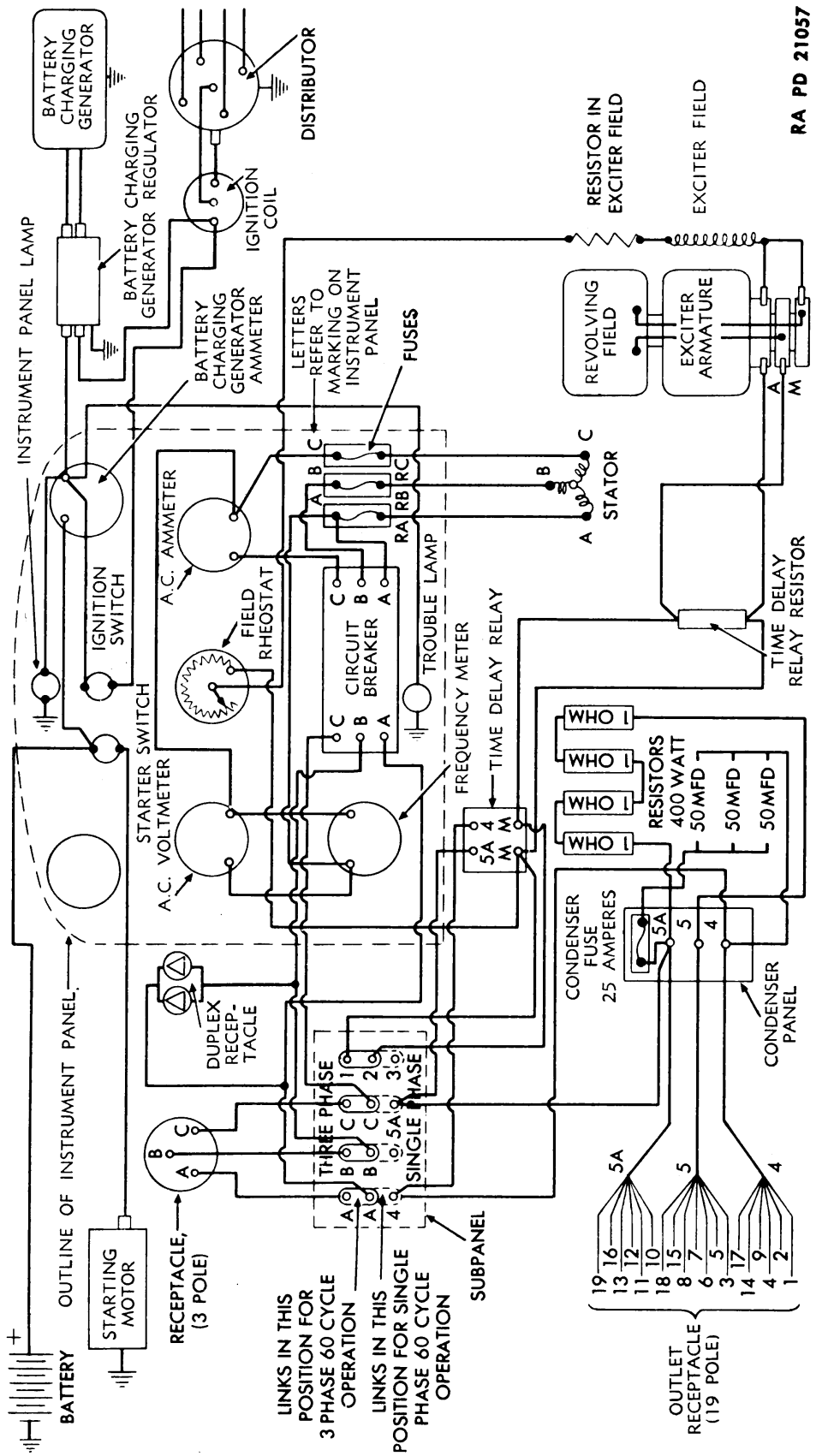

Figure 41 — Wiring Diagram — Single-phase and 3-phase Generating Unit M6

b. Maintenance. Periodically, check the wire connections to the above assemblies to assure good clean tight connections. Keep the time delay unit clean and dry. Blow out dust collected in the resistors with dry compressed air. Make sure the assemblies are securely mounted on their brackets.

70. TROUBLE SHOOTING.

a. Generator Fails To Deliver Rated Current.

Possible Cause	Possible Remedy
Unbalanced load on line.	Reconnect load so that it is more evenly balanced between phases.
Links on subpanel incorrectly connected.	Connect links correctly. (See metal plate on lid of subpanel box.)
Rheostat incorrectly adjusted.	Adjust "VOLTAGE CONTROL" on panel.
Worn brushes or dirty commutator in commutator exciter.	Replace brushes and/or clean commutator.

b. Frequency Incorrect (M5 Unit).

Links on subpanel incorrectly connected.	Connect links correctly. (See metal plate on lid of subpanel box.)
Incorrect engine speed.	Correct engine speed to 1,200 rpm for 60 cycles, 1,000 rpm for 50 cycles.

c. Arcing at Brushes.

Worn brushes or dirty commutator.	Replace brushes and/or clean commutator.

Section XV

INSTRUMENT PANEL AND INSTRUMENTS

GENERATING UNITS M5 AND M6

71. INSTRUMENT PANEL.

a. General. The instrument panel is located at the rear of the generating unit and is furnished with a door. It furnishes a consolidated location for the switches, fuses, and instruments of the unit. Grouped at the top are the engine instruments and controls. Included in this group are the oil pressure gage, starter switch, ignition switch, choke control, and battery-charging generator ammeter. Grouped beneath the engine controls are the main generator instruments and controls which include the a-c voltmeter and ammeter, field rheostat (VOLTAGE CONTROL), circuit breaker, frequency meter, and three fuses. At the extreme top of the panel is a dash lamp, while at the extreme bottom is a trouble light socket. Directive lettering to explain and identify the instruments and controls is cut on the face of the panel.

b. Maintenance. Keep front and back of instrument panel clean and dry. Check all wire connections on the various instruments and switches to assure their being clean and tight. Tighten all loose instrument panel, switch, and instrument mounting screws.

72. A-C AMMETER, VOLTMETER, AND FREQUENCY METER.

a. The a-c ammeter is mounted on the right side of the instrument panel, the a-c voltmeter on the left side, and the frequency meter just below the a-c voltmeter. The function of these instruments is to show the operator the voltage, current, and the frequency output of the main generator. If either instrument is damaged or not functioning properly, it should be replaced. Procedure for replacing either instrument is practically the same.

(1) Disconnect the wires attached to the terminals at the back of the instrument (fig. 42).

(2) Remove the three screws and nuts securing the instrument to the instrument panel and lift out instrument from the front of the panel.

(3) When replacing instrument, connect the wires to its terminals as shown in the wiring diagrams (figs. 39, 40, and 41).

73. BATTERY AMMETER.

a. The battery ammeter, located at the upper right corner of the instrument panel, indicates the rate of charge or discharge of the battery. It is connected in series with the battery and the engine electrical system (not including the starting system). Battery discharge is indicated when the ammeter needle points toward the minus "–" side of the "0" of the instrument and battery charging as indicated when the needle points to the plus "+" side. With the ignition switch in "OFF" position, and the instrument panel light or trouble light not

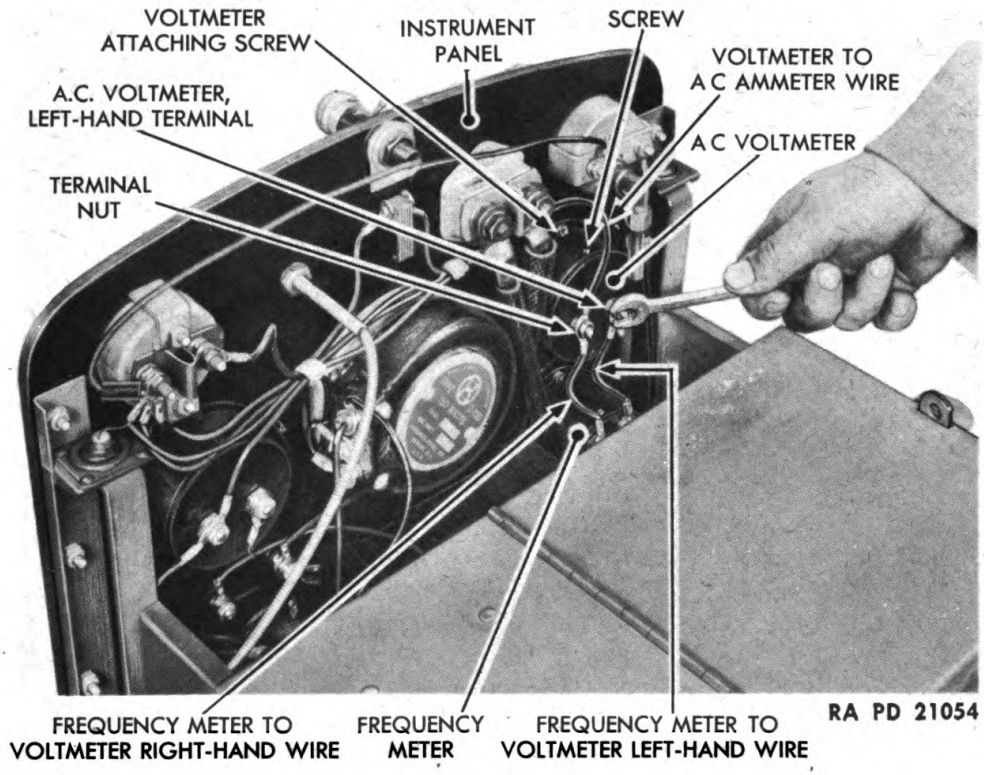

Figure 42 — A-C Voltmeter Removal

in use, the ammeter needle should be in line with the "0" indication on its face. A faulty or damaged ammeter should be replaced as follows:

(1) Disconnect either of the two battery terminals from the battery terminal post.

(2) Disconnect the wires connected to the terminals at the back of the ammeter.

(3) Remove the ammeter clamp nuts and lock washers, remove clamp and lift out ammeter from the front of the instrument panel.

(4) When replacing ammeter, connect wires as shown in the wiring diagrams (figs 39, 40, and 41).

74. STARTER SWITCH.

a. The starter switch is of the automotive push-button type. A faulty starter switch must be replaced. A quick check for testing a starter switch is to momentarily short circuit the two wires attached to the switch terminals. If the starting motor functions when doing this and does not function when the button is depressed, the switch is faulty. Replace as follows:

(1) Disconnect either of the two battery terminals from the battery terminal post.

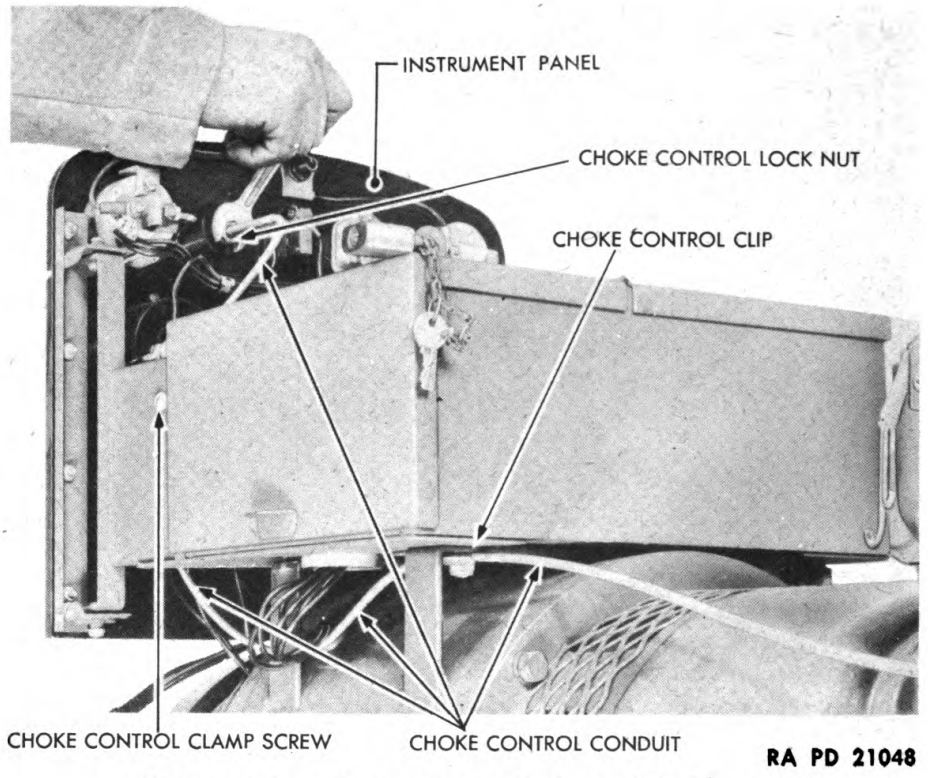

Figure 43 — Choke Control Assembly Removal

(2) Disconnect cables from the starter switch terminals.

(3) Take out the two screws securing switch to instrument panel and lift switch out from the back of the panel.

(4) When replacing starter switch, replace cables in the same positions from which they were removed.

75. OIL PRESSURE GAGE.

a. The oil pressure gage indicates the oil pressure built up by the oil pump inside the engine. Normal pressure reading should be approximately 15 pounds with the engine running at normal operating temperature (160 to 180 degrees F). Faulty oil pressure gage can be replaced as follows:

(1) Disconnect the oil line attached to the elbow in back of the gage.

(2) Remove the oil gage clamp screws and lock washers, lift off wire from instrument panel light socket, and lift off clamp. The gage can now be removed from the front of the instrument panel.

(3) After replacing oil gage, start engine and check for an oil leak at the oil line connection. NOTE: Ground wire of the instrument light socket is attached to the oil pressure gage mounting screw during installation of gage.

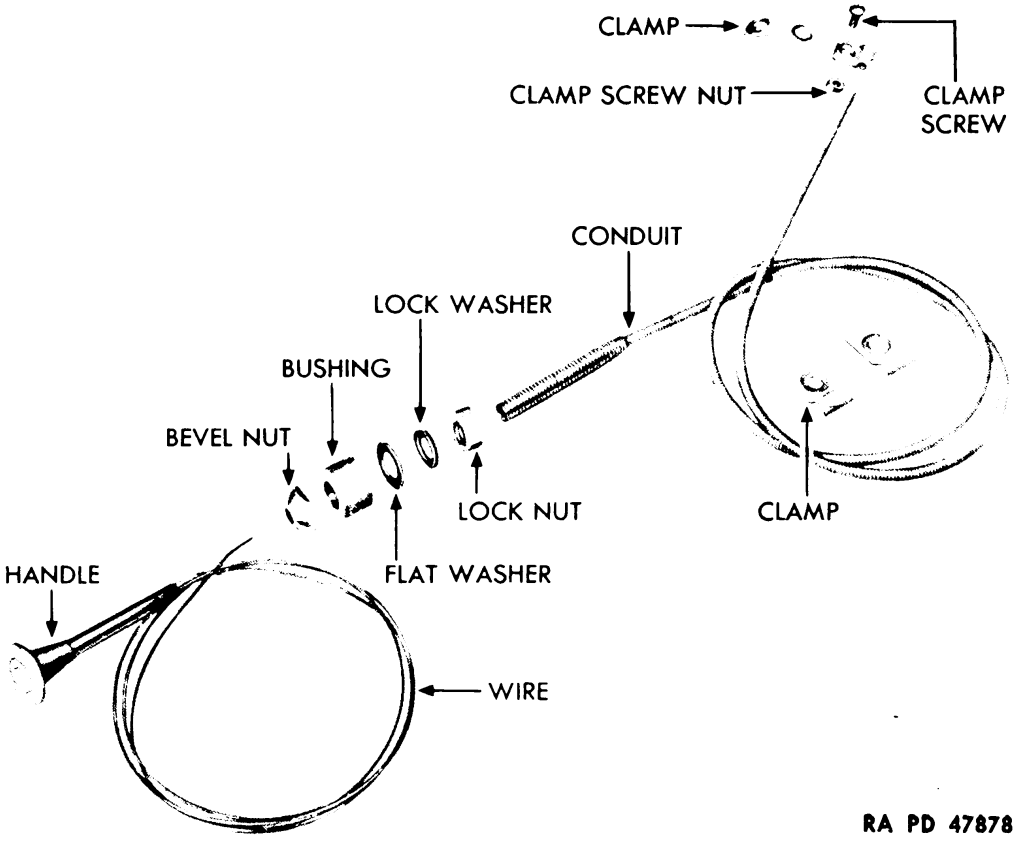

Figure 44 — Parts for Choke Control

76. CHOKE CONTROL.

a. The choke control or choke button regulates the fuel mixture of the gasoline engine. By pulling the choke button out, the gasoline vapor content of the fuel is greatly increased. The choke button must be pushed all the way in after the engine has started and is beginning to warm up.

b. If the choke wire breaks, replace the entire handle assembly. Pull out the choke handle with the remainder of the wire attached to it, and push in a new wire and handle assembly. Let the new wire pass through the hole in the choke lever. Push the choke handle all the way in, pull the choke lever to the "WIDE OPEN" position, and tighten the choke lever screw. Clip off surplus wire extending beyond the choke lever.

c. If the choke control fails to function properly due to the conduit being damaged, it will be necessary to replace the entire assembly. Remove the choke control assembly as follows:

(1) Loosen the screws through the two clamps securing the choke control conduit in position and remove conduit from the clamp.

(2) Loosen conduit clamp screw at carburetor and loosen the screw attaching the choke wire to the choke valve lever.

(3) Screw the choke control lock nut completely off the threads (fig. 43) and pull choke control assembly out through the front of the instrument panel. The complete parts for the choke control assembly are shown in figure 44.

77. IGNITION SWITCH.

a. The ignition switch controls the flow of battery current to the ignition system. When the switch is snapped to "ON" position, the circuit is closed, permitting current to flow from the battery to the ignition system. If engine fails to start due to a faulty ignition switch, the unit must be replaced. A quick method of checking for a faulty switch is to connect the wires in back of the switch together. If the engine now starts, but failed to start when the wires were properly connected to the switch and the switch was in "ON" position, the switch is faulty. Replace switch as follows:

(1) Disconnect the wires attached to the switch in back of the instrument panel.

(2) Unscrew round nut securing ignition switch to the instrument panel and lift switch out from the rear of the panel.

Section XVI

STORAGE AND SHIPMENT

78. GENERAL.

a. Gasoline Generating Units M5 and M6 will ordinarily be shipped crated whether shipment is domestic or overseas. It is also preferable to store these items crated. Units may be shipped and stored uncrated if the period of transit or storage is not in excess of 30 days. In such instances, these units will be prepared in accordance with paragraph 79.

b. If it can be ascertained in advance that the materiel will not be in process of shipment or storage for a period exceeding 7 days, the corrosion preventive treatment for engine given in paragraph 79*f* need not be applied.

STORAGE AND SHIPMENT

79. PREPARATION FOR DOMESTIC SHIPMENT AND LIMITED STORAGE.

a. Cooling System. Drain the water from the cooling system. Attach tag to unit indicating that system has been drained of coolant. If system was originally filled with antifreeze, solution shall be retained for further use at the point of departure of shipment.

b. Fuel. Drain the fuel from the fuel tank.

c. Battery.

(1) Battery lead terminals shall be disconnected, cleaned, and taped with TAPE, adhesive, non-hygroscopic, or friction tape.

(2) Secure battery lead terminals away from battery posts.

(3) Apply a coating of COMPOUND, rust-preventive, light, to battery posts.

(4) Hydrometer readings shall be taken of the electrolyte in the battery cells, and if readings fall below 1.275, battery shall be recharged before shipment.

d. Cleaning. The materiel shall be thoroughly cleaned and made free of all foreign matter by using SOLVENT, dry-cleaning, or a soap solution where necessary.

e. Painting. Exterior painted surfaces that have become checked, pitted, or rusted must have the rust spots removed and the surfaces repainted.

f. Engine.

(1) Drain oil from the crankcase.

(2) Add to fuel tanks several gallons of gasoline, unleaded and undyed.

(3) Refill lubrication system with OIL, engine, SAE 10. Attach tag to unit indicating that crankcase has been filled with OIL, engine.

(4) Start engine and gradually bring speed up to 1,200 rpm and allow to run at that speed for approximately 10 minutes in addition to the time required to use up all leaded gasoline in the lines and fuel system.

(5) Stop engine, remove spark plugs, and spray into tops of cylinders with OIL, engine, SAE 30, while slowly rotating engine. Replace spark plugs.

(6) After engine has cooled, remove grease and dirt from exterior portions of the engine.

80. LIMITED STORAGE INSPECTION.

a. Periodical inspections shall be made while the materiel is stored, to note among other things, general condition, missing parts, and the need for repairs. If found to be corroding at any part, the entire procedure as given herein under "PREPARATION FOR DOMESTIC SHIPMENT AND LIMITED STORAGE" will be repeated.

b. Repeat the battery service as described in paragraph 79 **c**.

GENERATING UNITS M5 AND M6

Section XVII

REFERENCES

81. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of references given in this section and for new publications relating to materiel covered in this manual:

a. Ordnance Publications for Supply Index (index to SNL's) ..... ASF Cat. ORD 2 OPSI

b. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, FSMWO's, BSD, S of SR's, OSSC's, and OFSB's; and includes Alphabetical List of Major Items with Publications Pertaining Thereto ..... OFSB 1-1

c. List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's concerning training) ..... FM 21-6

d. List of Training Films, Film Strips and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject) ..... FM 21-7

e. Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays) ..... FM 21-8

82. STANDARD NOMENCLATURE LISTS.

a. Unit, generating, M5 and M6 ..... SNL F-227

83. EXPLANATORY PUBLICATIONS.

a. Maintenance and Inspection.

37-mm A.A. gun materiel ..... TM 9-235

40-mm automatic gun M1 and 40-mm antiaircraft gun carriage M2 ..... TM 9-252

REFERENCES

Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Fire prevention, safety precautions, accidents	TM 10-360
Hand, measuring, and power tools	TM 10-590
Instruction guide: The instrument repairman	TM 9-2602
Ordnance maintenance — Generating units M5 and M6	TM 9-1616
Ordnance maintenance: Remote control systems M1 and M5 and cable system M8	TM 9-1643

b. Miscellaneous.

Camouflage	FM 5-20
Chemical decontamination materials and equipment	TM 3-220
Cold weather lubrication and service of artillery materiel	OFSB 6-5
Cold weather lubrication and service of combat vehicles and automotive materiel	OFSB 6-11
Defense against chemical attack	FM 21-40
Fuels and carburetion	TM 10-550
Instruction guide: Welding — theory and application	TM 9-2852
Internal combustion engine, the	TM 10-570
Ordnance storage and shipment chart — group F	OSSC F

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