INSTRUCTION BOOK

FOR

GASOLINE ENGINE GENERATOR SET PU-107A/U

PREPARED FOR
THE SIGNAL CORPS
ON ORDER No. 29E-7955-29
25 FEBRUARY 1955

FORWARD COMMENTS ON THIS PUBLICATION DIRECTLY TO:

Commanding Officer
The Signal Corps Publications Agency
Fort Monmouth, New Jersey
ATTN: Standards Division

WARNING

Dangerous voltages are generated by this equipment. Do not attempt to change output connections or the setting of the Wye-Delta change board while the equipment is in operation.

Provide proper and adequate ventilation if the equipment is operated in a confined space. Exhaust gases, produced by a gasoline engine, are poisonous. Excessive inhalation may cause serious sickness or death.

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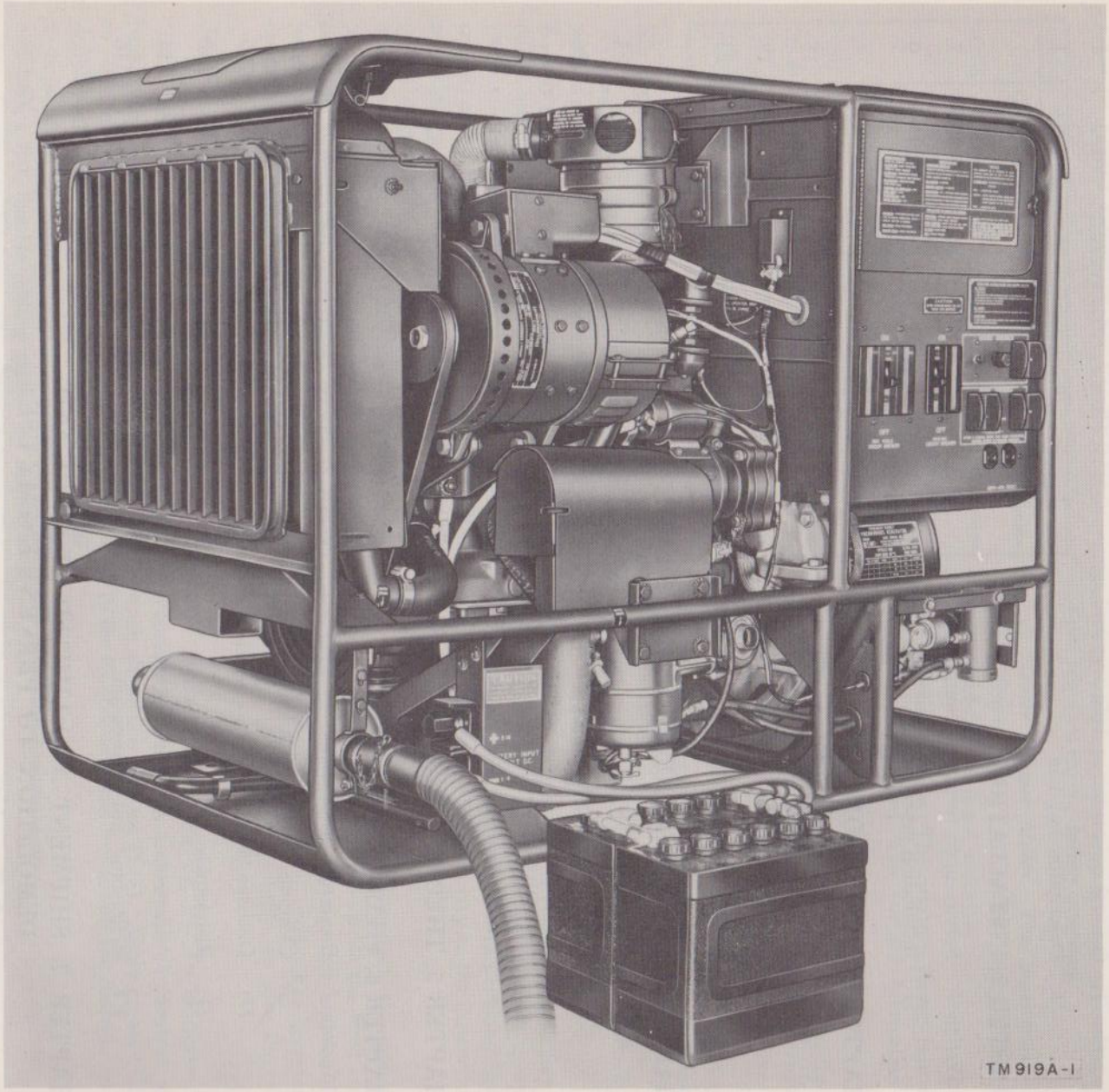

Figure 1. Gasoline Engine Generator Set PU-107A/U.

Note. This instruction book will be replaced by TM11-919A which when published, will be listed Department of the Army Pamphlet No. 310-4.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

These instructions are published for the information of all concerned. They include complete information for operating, servicing, maintaining, and overhauling Gasoline Engine Generator Set PU-107A/U. Also included are a detailed description of all major parts and a discussion of the theory of operation.

2. Forms and Records

a. The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment and in performing preventive maintenance.

(1) DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

(2) DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

(3) DD Form 535 Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AF TO 00-35D-54.

(4) DA Form 11-260, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Power Units, Reel Units (Engine-Driven)), will be used in accordance with instructions appearing on the form.

(5) DA Form 11-261, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Power Units, Reel Units (Engine-Driven)), will be used in accordance with instructions appearing on the form.

(6) WD Form 460 (Preventive Maintenance Roster) will be used in accordance with current practices.

b. Use other forms and records as authorized.

3. Purpose and Use

a. Gasoline Engine Generator Set PU-107A/U is intended as a source of power for Electronic Search Central AN/GSS-1. It also may be used as a source of power for transportable or mobile radar and similar Signal Corps equipment.

b. The 28-volt direct-current (dc) generator can be used to charge groups of wet cell storage batteries in either series or parallel circuits. Using a 20-ampere charging rate with a series circuit, it is possible to charge four 6-volt batteries, or one 24-volt battery. Using a 20-ampere charging rate with a parallel circuit, it is possible to charge five groups of four 6-volt batteries, five groups of two 12-volt batteries, or five 24-volt batteries.

Section II. DESCRIPTION AND DATA

Note. All left and right designations are assumed as viewed from the rear, or generator end, facing the set.

4. Description

Gasoline Engine Generator Set PU-107A/U is a portable electric generating set that consists of the

following major assemblies: a single bearing, permanent magnet, 400-cycle alternator; a 28-volt dc generator; a four-cylinder, four-stroke cycle, liquid cooled, gasoline engine; a winterization system to aid starting in low temperatures; and necessary controls and instruments for the operation and regulation of the equipment. The 400-cycle alternator is directly coupled to the engine flywheel and the 28-volt dc generator is belt driven from the engine crankshaft. All necessary controls and instruments are mounted on panels on the left-hand side at the generator end of the unit. Power output and remote control connections are provided on the right-hand side of the unit. The entire equipment is mounted within a tubular steel frame and a canvas cover is provided to protect the equipment when it is not in operation.

5. Major Systems and Assemblies

a. Engine. The generator is driven by a conventional, L-head, four-stroke cycle, four-cylinder, liquid cooled, gasoline engine. Ignition is provided by a high-tension magneto (11, fig. 3) and self shielded spark plugs (3, fig. 3). A 15-quart, tubular-cell radiator (27, fig. 2), belt driven fan and water pump comprise the major elements of the cooling system. The engine is lubricated by a gear-type oil pump that delivers oil under pressure to the main bearings and connecting rod bearings. The fuel system consists of an up-draft carburetor (14, fig. 3), a diaphragm-type fuel pump (16, fig. 3), and a remote fuel line and fuel drum adapter. There is no fuel tank on the unit. The engine may be started by means of a hand crank or by a 24-volt electric starting system. Two 12-volt storage batteries, connected in series, are provided to supply power for the electric starting motor. A belt-driven, 24-volt dc generator (5, fig. 3) maintains the batteries in a charged condition.

b. Winterization system. A winterization system is provided to aid in starting the engine in low temperatures. The winterization unit consists of a fuel pump (15, fig. 2), fuel control valve (16, fig. 2), blower (17, fig. 2), heat exchanger pan (18, fig. 2), and shield (21, fig. 2). A switch, circuit breaker, and indicator lamp for control of the winterization system are mounted on the unit control panel.

c. Alternator. (9, fig. 4). The alternator is of the permanent magnet-type with 28 poles. It is directly coupled to the engine and, when operated at 1,714 revolutions per minute (rpm), develops 12.5 kilowatts (kw), 120 or 208 volt, three-phase, four-wire output at .8 power factor. A compensator assembly, consisting of a transformer (1, fig. 4) and a capacitor assembly (4, fig. 4), is provided to maintain voltage stability.

d. Dc power generator. A separate, 28-volt dc generator (1, fig. 2) is mounted to one side of the engine and driven by a V-belt from the engine crankshaft. This generator, when operated at 4,500 rpm, will deliver 2.5 kw, 28 volts dc.

e. Radio-frequency Suppression Equipment. Radio frequencies produced by the operation of the set are suppressed by shielding, ground straps, grounded capacitors, resistor-suppressors, and bonds formed by external-internal-toothed lock washers. A complete description of suppression equipment is contained in paragraph 67.

f. Frame. The frame structure (12, fig. 3) supports the entire generator set assembly and is comprised of two parts. The lower frame acts as a skid and also shock-mounts the engine and alternator. The upper frame mounts the instrument and control panels, the wye-delta change board, and terminal panel.

6. Performance Characteristics

a. Output combinations. The generator set is rated at the following output combinations:

(1) Ten kilowatts (kw) at .8 power factor, 120 volts alternating-current (ac), single-phase, 400 cycles, 2.5 kw at 28 volts dc.

(2) Ten kw at .8 power factor, 120/208 volts ac, three-phase, four-wire, 400 cycles, 2.5 kw at 28 volts dc.

(3) Twelve and one-half kw at .8 power factor, 120/208 volts ac, three-phase, four-wire, 400 cycles.

b. Alternating Current.

(1) *Single-phase, 120-volt, .8 power factor.*

Approx. load	Amperes	Volts	Kilowatts	Cycles
0	0	124	0	400-415
¼	25.5	122-124	2.5	400-415
½	52.0	120-122	5.0	400-415
¾	78.0	120-122	7.5	400-415
Full	104.0	118-120	10.0	400-415

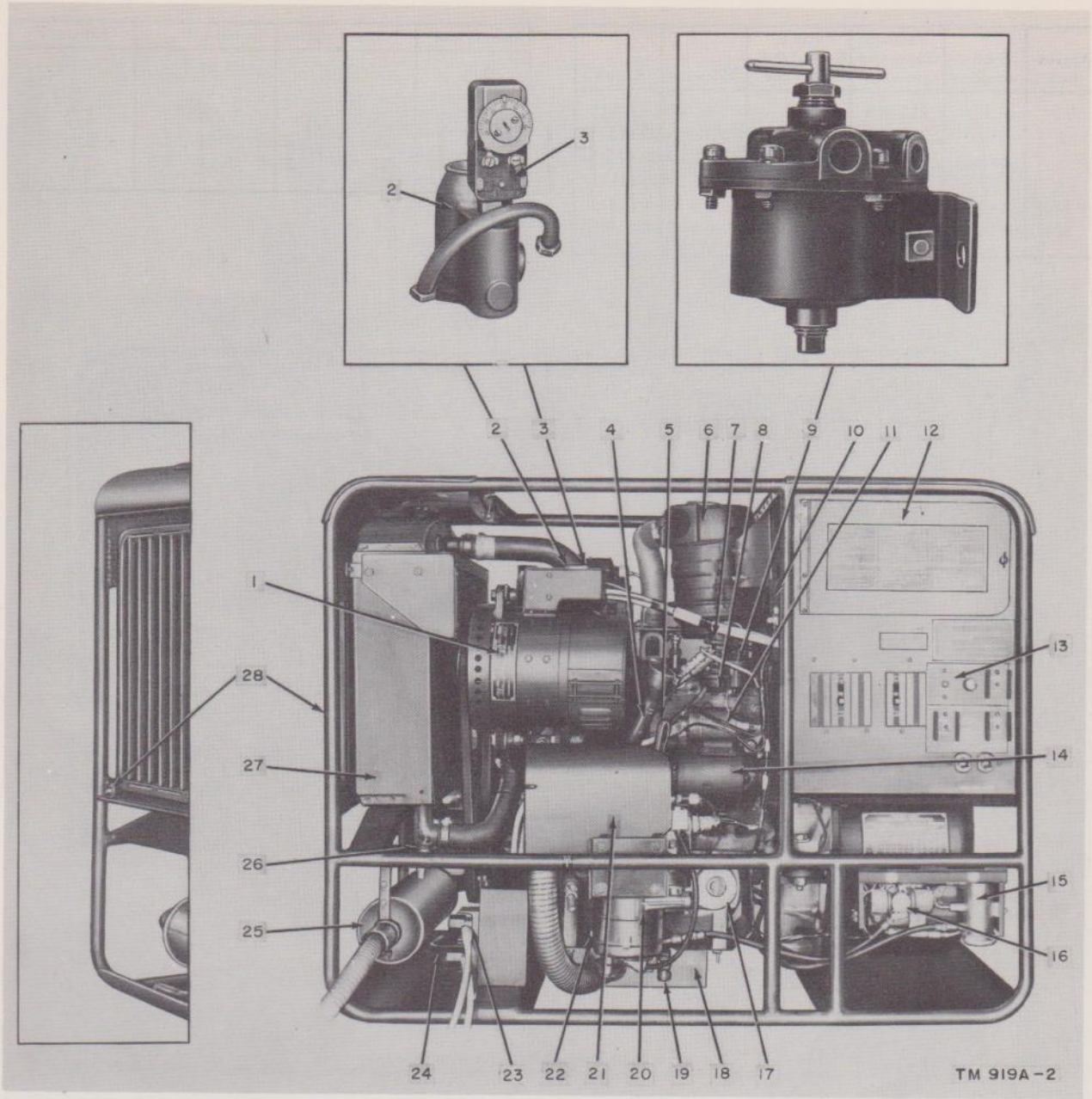

Figure 2. Gasoline Engine Generator Set PU-107A/U, left side.

1. 28-v, 2.5-kw generator (G3).
2. Coolant outlet neck (A 1).
3. Coolant temperature cutoff switch (S3)
4. Oil filler tube (MP3).
5. Bayonet gage (M21).
6. Air cleaner.
7. Low-oil-pressure cutoff switch (S2).
8. Oil-pressure transmitter (E8).
9. Oil filter (FL1).
10. Ten-conductor socket (P1 and J2).
11. Starting motor solenoid (L2).
12. Instrument panel door (A 136).
13. Control panel (MP530).
14. Starting motor (B1).
15. Heater fuel pump (L5).
16. Heater fuel control valve (L4).
17. Heater blower (B2).
18. Heater heat exchanger pan (HR1).
19. Crankcase drain (H535).
20. Heater (HR2).
21. Heater shield (MP550).
22. Crankcase.
23. Battery input terminals (H1953 and H1954).
24. Hand crank (MP557).
25. Muffler (MP201).
26. Radiator drain (MP207).
27. Radiator (A 41).
28. Manual choke (MP534).

(2) *Three-phase, 208-volt, .8 power factor.*

Approx. load	Output Amperes	Phase-to-Phase Output Volts	Phase-to-Neutral Output Volts	Kilowatts	Cycles
0	0	215-218	124	0	400-415
¼	10.0	213-215	123	3.0	400-415
½	21.5	210-212	121	6.25	400-415
¾	32.5	210-212	121	9.5	400-415
Full	43.5	208-211	120	12.5	400-415
5/4	54.0	206-208	119	15.5	400-415

c. Direct current.

Approx. load	Output Amperes	Output Volts	Kilowatts
0	0	27-30	0
¼	22	27-30	.625
½	45	27-30	1.25
¾	71	27-30	2.0
Full	90	27-30	2.5

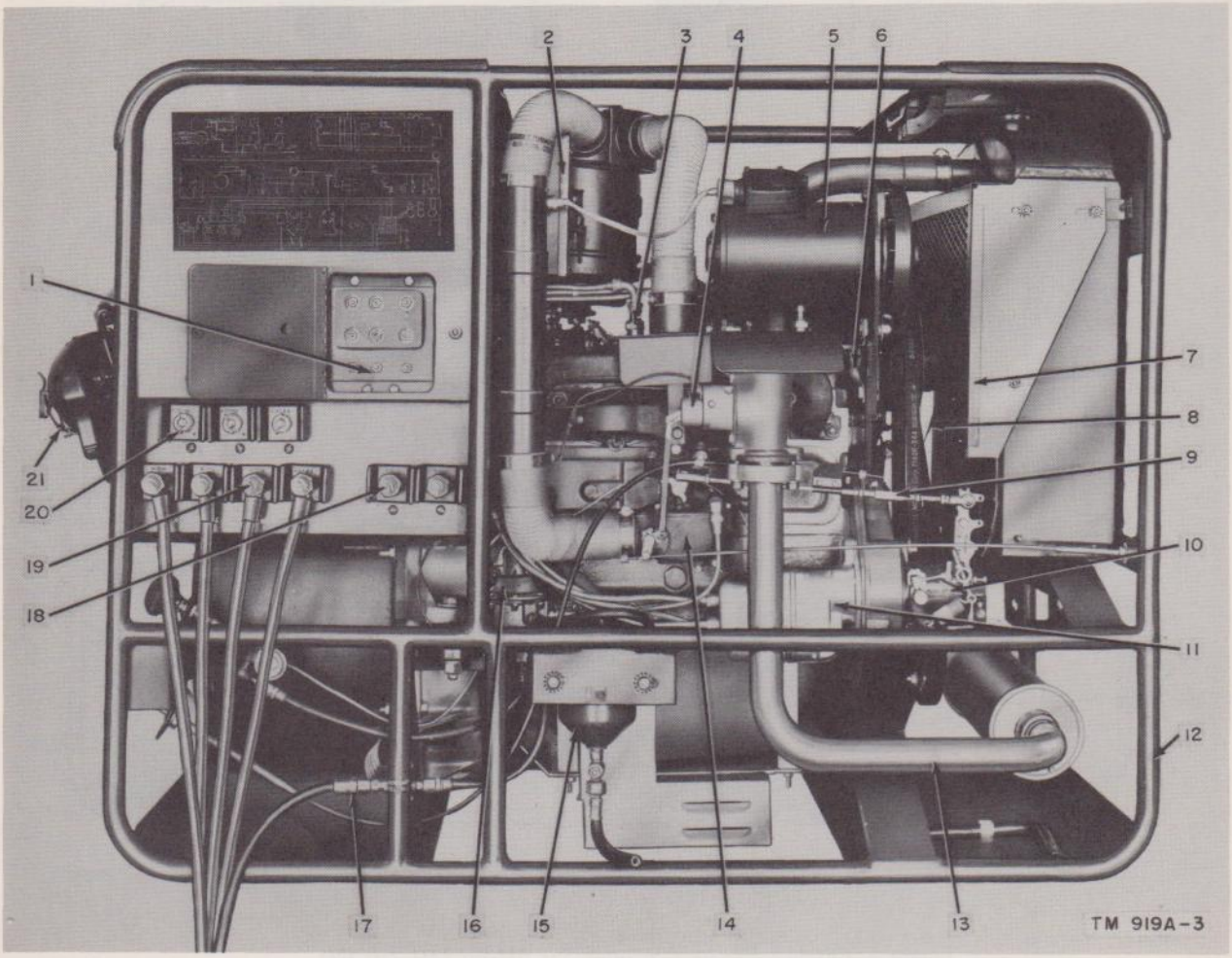

Figure 3. Gasoline Engine Generator Set, PU-107A/U, right view.

1. Wye-delta change board.
2. Suppression box (VR5).
3. Spark plugs (E195 and E198).
4. Electric choke (L3).
5. 24-volt battery-charging generator (G3).
6. Water pump.
7. Fan guards (A 44 and A 45).
8. Fan (B26).
9. Carburetor-to-governor linkage.
10. Governor (MP535).
11. Magneto (E13).
12. Frames (A 178 and A 179).
13. Exhaust system.
14. Carburetor (MP292).
15. Fuel filter (FL12).
16. Fuel pump (MP272).
17. Auxiliary fuel line adapter (MP558).
18. Dc voltage output terminals (E18 and E19).
19. Ac voltage output terminal.
20. Remote control terminal.
21. Fire extinguisher (MP556).

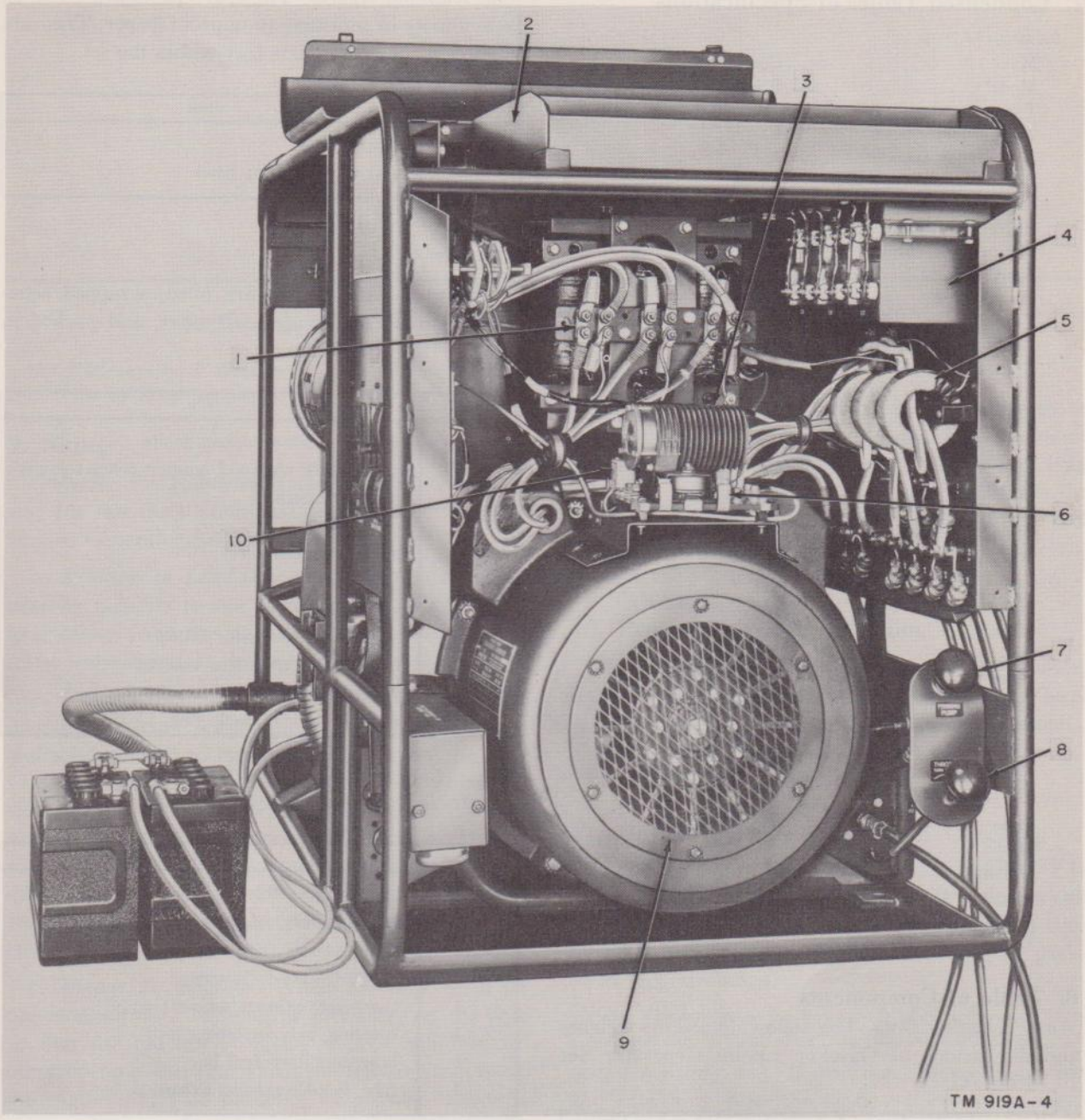

Figure 4. Gasoline Engine Generator Set PU-107A/U, rear view.

1. Compensator transformer (T2).
2. Tool tray (MP546)
3. Dc voltage regulator (E14)
4. Compensator capacitor assembly (C26)
5. Ammeter current transformers (T4 and T6).
6. Stop relay (K3).
7. Primer pump (MP431).
8. Manual throttle (MP531).
9. Alternator (G2).
10. Start relay (K1).

7. Condensed Tables of Specifications

a. Engine.

Make ..... Continental.
Model ..... FS-162-6011.
Type ..... 4-stroke cycle.
Type cylinder head ..... L.
Number of cylinders..... 4.
Bore ..... $3\text{-}^{7}/_{16}$.
Stroke ..... $4\text{-}^{3}/_{8}$.
Piston displacement ..... 162 cu in.
Compression ratio ..... 6.3 to 1.
Speed ..... 1,714 rpm.
Horsepower ..... 41.
Type cooling ..... Liquid.
Cooling system capacity .... 15 qt.
Type lubrication ..... Pressure and splash system
Lube oil capacity ..... 4½ qt.
Fuel consumption (gal per hr). ..... 2.5.
Air cleaner ..... Oil bath.
Spark plugs ..... XE-8 Coml (Champion).
Ignition system ..... Magneto.
Batteries (2) ..... 12-v each.

b. Alternator.

Make ..... Hollingsworth.
Model ..... APG-H-11636.
Voltage ..... 120/208.
Phase ..... Single or three.
Cycle ..... 400.
Power factor 0.8
Speed ..... 1,714 rpm.
Drive ..... Direct.

c. Dc Generator.

Make ..... Hollingsworth.
Model ..... DG.
Voltage ..... 28.
Ampere rating ..... 90.
Speed ..... 4,500 rpm.
Drive ..... Pulley and belt.

8. Table of Components

a. Packaging Data. The following are the weights and dimensions of Gasoline Engine Generator Set PU-107A/U.

Quantity	Item	Width (in.)	Length (in.)	Height (in.)	Volume (cu ft)	Weight (lb)
1	Gasoline Engine Generator Set PU-107A/U	28	48	37	28.8	1,150
	1 Engine	22	24	22	7.77	335
	1 Alternator	18.5	11.06	18.88	1.79	245
	2 Battery (crated)	9	14	12	0.087	35

b. Running Spares. The spare parts are wrapped individually in moisture-fungiproof paper. They are packed in the spare parts tray within the set.

Quantity	Item
4	spark plugs
4	gaskets, fuel pump bowl

c. Tools.

The tools listed below are oiled, wrapped separately in moisture-fungiproof paper, and packed in the tool tray within the set.

Quantity	Item
1	dresser, ignition contact points
1	gage, spark plug and ignition contact points
1	handle, wrench
1	oiler, hand
1	pliers, combination
2	sandpaper, flint
1	screw driver
1	screw, eye, alternator lifting
1	bolt, puller, alternator bearing
1	wrench, adjustable
1	wrench, socket, spark plug, 13/16 in.

d. Installation Equipment.

Quantity	Item
1	adapter, fuel drum
1	cable, battery, negative
1	cable, battery, positive
1	cable, battery-to-battery
1	connector, exhaust tubing pipe
1	coupling, exhaust tubing lock
1	hose, auxiliary fuel line
1	tube, flexible exhaust extension

e. Miscellaneous Equipment.

Quantity	Item
2	battery, 12-volt storage (separately packaged)
1	cover, canvas
1	crank, hand
1	fire extinguisher

CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

Note. Paragraphs 9 through 17 cover service for new, old, or reconditioned equipment.

9. Siting

Consider the following factors when selecting a site for the installation and operation of Gasoline Engine Generator Set PU-107A/U.

a. Relation to Load. Locate the generator set as near as possible to the electrical load. Excessively long cables from the unit to the load increase line resistance and cause a definite voltage drop.

b. Outdoor Installation. When the unit is to be operated outdoors, select a site that is reasonably dry and solid enough to support the weight of the unit (1,250 pounds). No special foundation is necessary; however, the unit should be operated in as near a level position as possible. If the terrain is soft or muddy, make a foundation out of planks or other similar material. If possible, provide some form of shelter to protect the equipment from the elements.

c. Indoor Installation. When the unit is to be operated within a building or inclosure, set the unit so that the radiator is facing a door, window, or other opening through which the hot-air blast from the engine may pass outdoors. If possible, attach a canvas duct to the radiator grill and attach the other end of the duct to the building opening. Connect the flexible exhaust tubing to the muffler outlet and extend the free end of the exhaust tubing to the outside of the building or shelter. Be sure that all exhaust connections are gastight. *Carbon monoxide fumes from a gasoline engine are extremely dangerous and, when inhaled, may cause serious illness or death.* Provide not less than 2 feet of space on all sides of the unit to facilitate working on and operating the equipment.

d. Location of Fuel Supply. If the unit is to be operated indoors, locate the fuel supply tank outside the inclosure within easy range of the 20-foot long fuel line furnished with the equipment. Locate the fuel supply drum so that the bottom of the fuel drum adapter is not more than 6 feet below the level of the engine fuel pump.

10. Preparation of Foundation

No special foundation is necessary; however, the generator set should be placed on a firm, level surface capable of supporting at least 1,250 pounds. The base of the packing crate will serve as a temporary foundation in mud or snow.

11. Uncrating, Unpacking, and Checking

Gasoline Engine Generator Set PU-107A/U is shipped in three packages. The set, including all spare parts, tools, and installation equipment, is contained in one large crate. The two batteries are packed in separate boxes.

Note. The bottom of the large crate is constructed to form a skid and can be used for sliding the set short distances.

a. Uncrating and Unpacking. Before uncrating and unpacking, place the set near the location where it will be operated. Uncrate the set carefully to avoid damage. Use a nail puller and other appropriate tools. Be sure to remove all packages and parts within the crate or they may be accidentally discarded with the packing material. The set is inclosed in waterproof paper and a vaporproof barrier only when prepared for overseas shipment. When prepared for domestic shipment, the vaporproof barrier is not used. Refer to figure 5 and uncrate and unpack the equipment as follows:

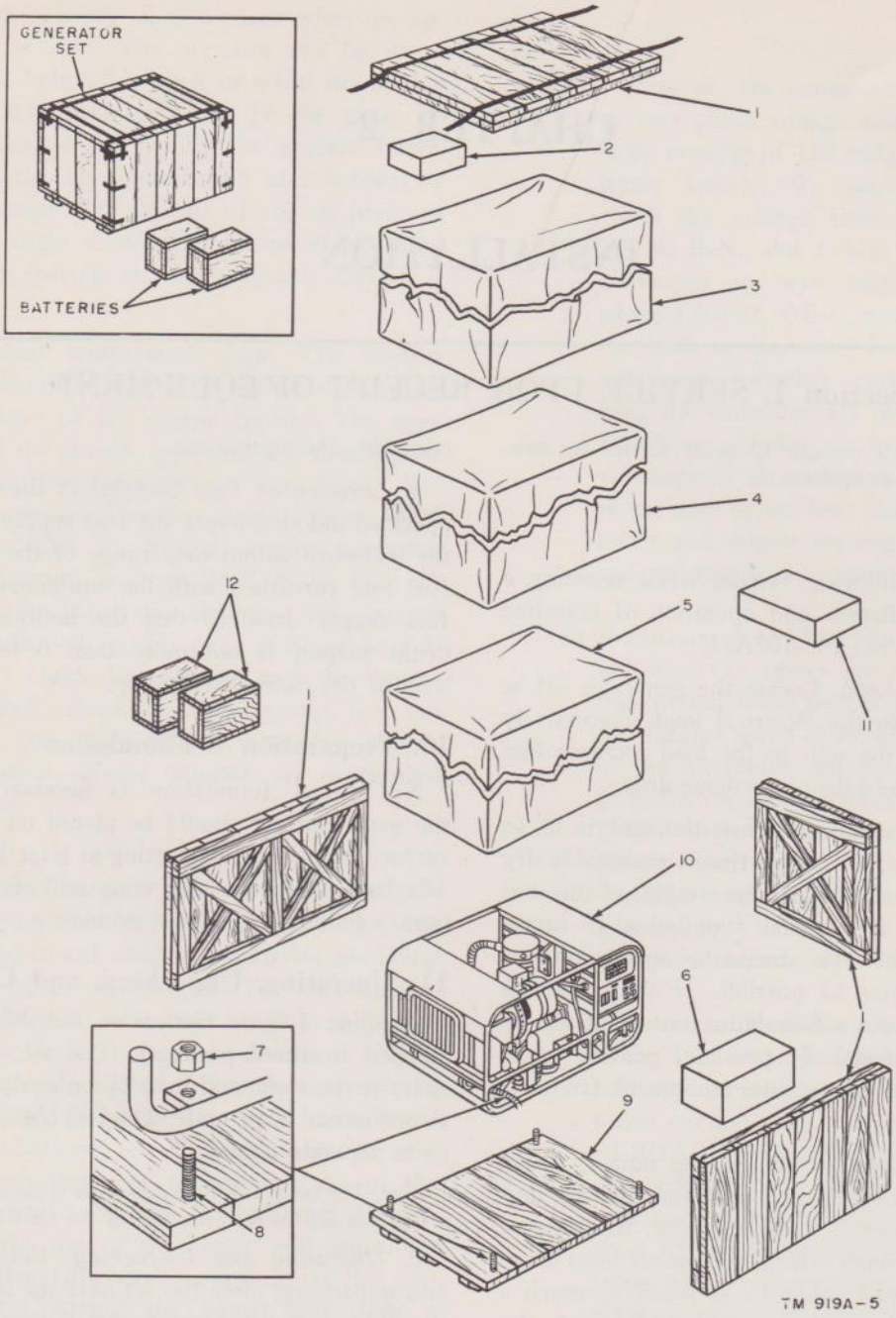

Figure 5. Generator set, packaging.

1. Top and sides.
2. Manuals.
3. Waterproof paper.
4. Vaporproof barrier.
5. Canvas cover (H2368).
6. Installation equipment.
7. Nuts.
8. Bolts.
9. Base.
10. Generator set.
11. Spare parts.
12. Batteries (BT1 and BT2).

(1) Remove the top and sides (1) of the large crate.
(2) Remove the manuals (2), located on top of the set.
(3) Remove the waterproof paper (3) and the vaporproof barrier (4).
(4) Remove the canvas cover (5), inclosing the entire set.
(5) Remove all the packaged installation equipment (6) located in the bottom of the lower frame.
(6) Remove the nuts (7) from the four bolts (8) fastening the set to the crate base (9). The generator set (10) can now be removed.
(7) Unpack the spare parts (11). The tools are wrapped individually in the tool tray in the top rear of the unit. Unwrap these only as required.
(8) Do not uncrate the batteries (12) until the equipment has been set up for operation.

b. Checking. A list of all spare parts and tools packed with the equipment is mounted on the underside of the tool tray cover. Check to be sure the equipment is complete and has not been damaged in shipment and handling.

(1) Check the tools, spare parts, installation equipment, and all major components with the packing lists.
(2) Inspect the over-all unit carefully for damage. Give particular attention to the following: Examine the carburetor, magneto, air cleaner, and fuel pump for dents and breakage. Check the fuel line from the fuel pump to the carburetor for loose connections and kinks. Examine the instruments and controls or damage. Check all wiring for torn insulation and broken wires. If any damage is noted or if the equipment does not check with the packing lists, fill out and forward DD Form 6 in accordance with the instructions in paragraph 2.

Section II. INSTALLATION PROCEDURE

12. Setting Up Equipment

After a suitable location has been chosen (par. 9) and the equipment has been checked (par. 11*b*), set up the equipment as follows:

a. Mounting on Foundation. Determine whether the equipment is to be installed indoors or outdoors, and follow the instructions in subparagraphs (1) or (2) below, as applicable.

(1) For permanent indoor installation, fasten the set to the floor or foundation. Four holes are located in the mounting pads on the bottom four corners of the lower frame. Fasten the set to the floor with ½-inch bolts or lag screws of proper length.
(2) For outdoor installation, locate the set on level ground. If this is impossible, the alternator end of the set must be the lower end.

Warning: Never operate the generator set in a position more than 10° off level, longitudinally or laterally.

b. Connecting Exhaust Tube. For indoor operation, connect the exhaust extension tube to the muffler (fig. 6). Extend the tube to an exterior wall by the most direct route with as few turns as possible. Pitch the tube downward so all condensate will drain out. If the tubing passes through an inflammable wall, install appropriate fireproof insulation.

Warning: Be sure that all connections are gastight. Carbon monoxide is deadly poisonous. Inhaling exhaust gases may be fatal.

c. Installing Fuel Hose. Connect the 20-foot

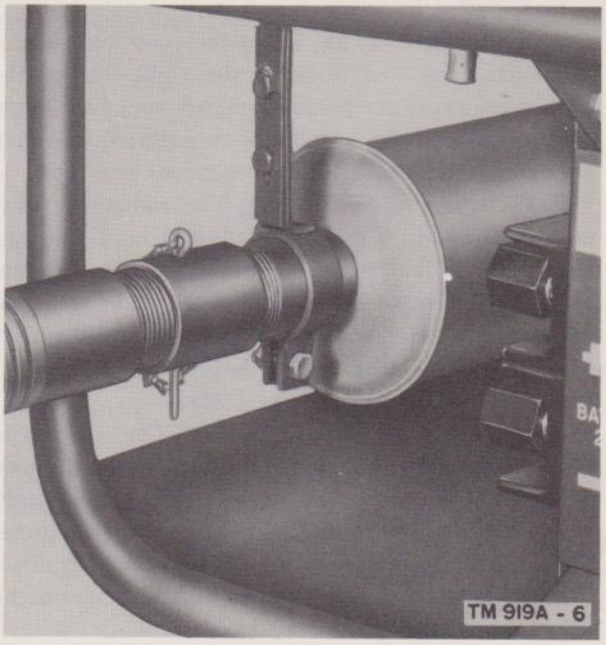

Figure 6. Exhaust tube connection to muffler.

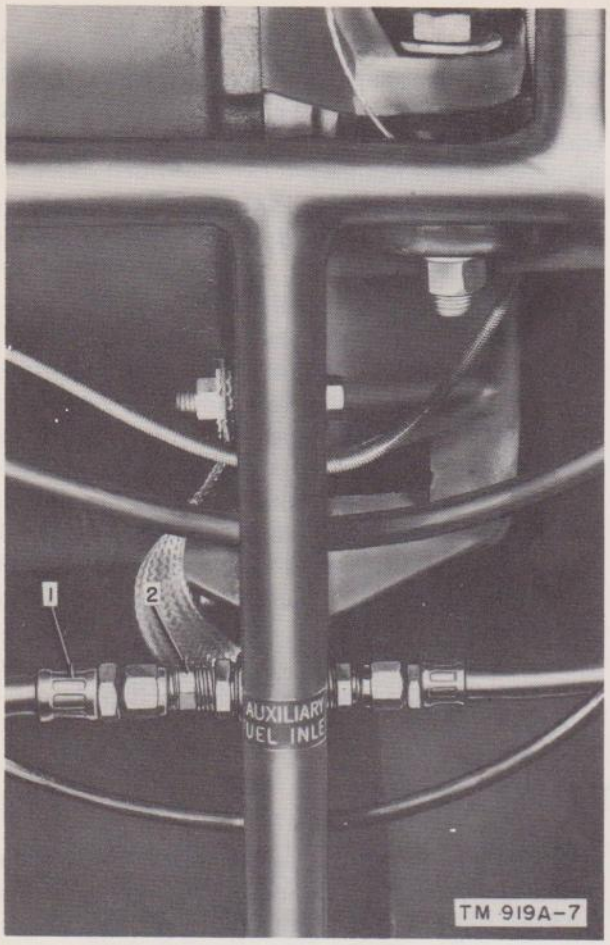

Figure 7. Fuel supply hose connection.
1. Remote fuel line. 2. Remote fuel line adapter.

remote fuel line (1, fig. 7) to the coupling (2) located near the fuel filter on the right side of the unit. Connect the opposite end to the fuel drum adapter. Mount the adapter in an externally located fuel container. Be sure all connections are tight.

d. Installing Radiator Duct. The radiator grill is constructed with a channel flange around the outside edge. For indoor operation, attach a canvas duct to the flange. Use a window or make an opening in an exterior wall and attach the outlet end of the duct. This opening must be at least as large as the radiator grill flange.

e. Installing Fire Extinguisher. The fire extinguisher, mounting bracket, and hardware are shipped with the equipment but detached from the unit. Mounting holes have been drilled in the rear upper frame panel for mounting the fire-extinguisher bracket. Bolt the bracket to the unit and mount the fire extinguisher in the bracket.

13. Removal of Corrosion Preventives

Corrosion preventives are for permanent protection and must not be removed. There are no protective seals installed on the unit.

14. Connections and Interconnections

All internal connections for the operation of the generator set are made at the factory and no additional connections within the unit are needed. Make ac output connections, dc output connections, remote start connections, and battery connections as follows:

a. Ac Output Connections. The wye-delta change board and the output terminals are located on the right side of the unit. Open the change board door to check the ac output rating in which the generator set is connected. The symbol of the rated load will be either Y (wye) or Δ (delta). To change the voltage connections, remove the six nuts and washers that secure the jumper board to the terminal board. For 120-volt, single-phase, 10-kw operation, connect the jumper board in the delta position (fig. 8). Connect cables from the load to output terminals marked PHASE A (1, fig. 8) and PHASE C (2). Use #O AWG (American Wire Gauge) cable. For 120/208-volt, three-phase, 12.5-kw operation, connect the jumper board in the wye position (fig. 9). Connect cables from the load to output terminals marked PHASE A (1, fig. 9), PHASE B (2), PHASE C (3), and NEUTRAL (if required). Use #4 AWG cable. Figures 8 and 9 show the proper delta and wye connections.

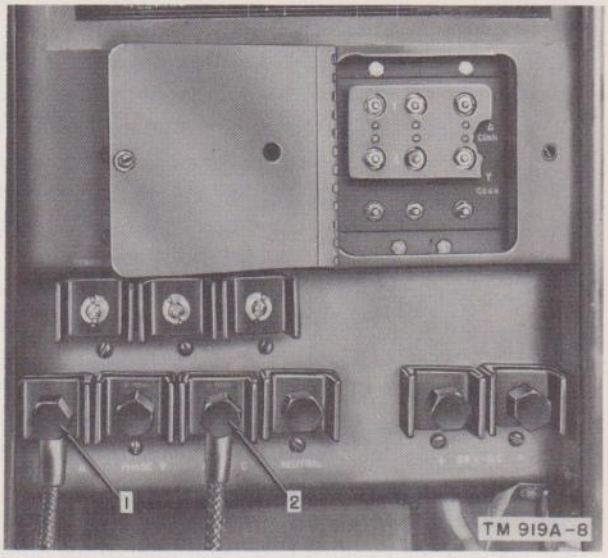

Figure 8. Single phase, 120 volt connections (Delta).
1. PHASE A terminal. 2. PHASE B terminal.

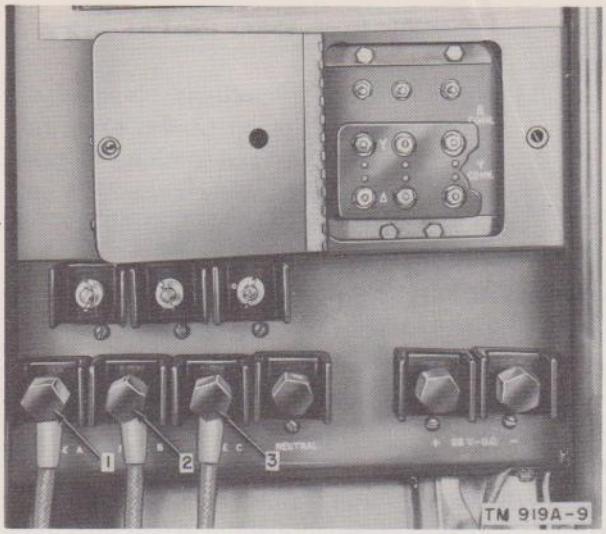

Figure 9. Three-phase, 120/208-volt connections (Wye).

1. PHASE A terminal. 2. PHASE B terminal. 3. PHASE C terminal.

Warning: Never change the output voltage with the unit in operation.

b. Dc Output Connections. A dc load of 2.5 kw at 28 volts may be connected to the unit at any time that the total ac load is not in excess of 10 kw, three-phase, or single-phase. Connect the dc load to the positive (+) and negative (—) output terminals located adjacent to the ac output terminals on the left side of the unit. Use #O AWG cable.

c. Remote Control Connections (fig. 10). Three remote control terminals are located on the right side of the unit, above the ac output terminals. The terminals are marked STOP, COMMON, and START. By using a three-conductor cable, #14 AWG or larger, the remote location may be extended up to 150 feet. To operate the unit from a remote location, it will be necessary to install a start-stop switch at the remote point. With a single-pole, double-throw, center-off toggle switch, make the following connections:

(1) Connect one wire of the cable from the stop terminal on the switch to the remote stop terminal on the unit.

(2) Connect one wire of the cable from the start terminal on the switch to the remote start terminal on the unit.

(3) Connect the remaining wire from the common terminal on the unit to the center (common) terminal of the switch.

d. Battery Connections. Two terminals for connecting the battery cables are located on the left side of the unit. After preparing the batteries for use as instructed in paragraph 17, position the batteries near the unit and connect them as follows: Attach the battery jumper cable from the negative post of one battery to the positive post of the other battery. Connect a cable from the positive (+) terminal (1, fig. 11) on the unit to the battery with the *open* positive post. Connect a cable from the negative (—) terminal (2) on the unit to the battery with the *open* negative post. Figure 11 shows the proper battery connections.

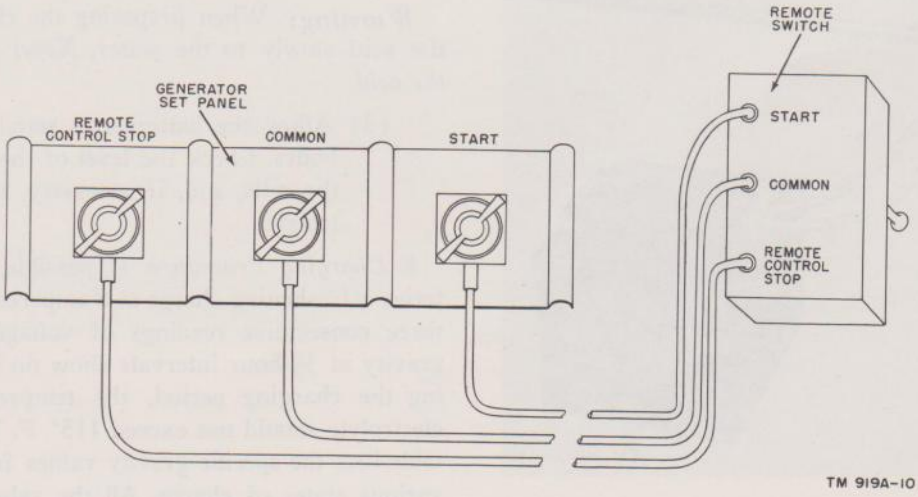

Figure 10. Remote control connections.

15. Initial Lubrication

Inspect the crankcase oil drain valve to be sure it is closed. Remove the cap from the oil filler tube and fill the crankcase with oil as specified in the lubrication chart (fig. 17). The capacity of the lubrication system is 4½ quarts. Replace the oil-filler tube cap. Unfasten the two clamps on the air cleaner and remove the bowl. Clean the bowl with Solvent, Dry Cleaning (SD) and fill to the normal oil level mark with oil as specified in the lubrication chart. The remainder of the set is factory-lubricated and does not require initial preparation.

16. Preparation of Fuel System and Cooling System

a. Install the flexible fuel line and the fuel drum adapter as instructed in paragraph 12*c*. If possible, the container from which fuel is drawn should be located so that the bottom of the fuel drum adapter is about on the same level as the carburetor on the engine. Avoid placing the fuel container too much above or below this level. Prime the fuel system as follows:

(1) With all the fuel connections completed, operate the priming pump (7, fig. 4) by pulling the handle up and pushing it down again, until considerable resistance is built up within the pump. This will fill the fuel filter and fuel lines.

(2) Be sure that the priming pump handle is pushed all the way in before attempting to start the engine.

b. Be sure the coolant drain cocks on the radiator and the winterization heater are closed. Fill the cooling system with clear water for temperatures above 32° F. In temperatures 32° F or lower, add antifreeze solution in accordance with current directives. The liquid capacity of the cooling system is 15 quarts.

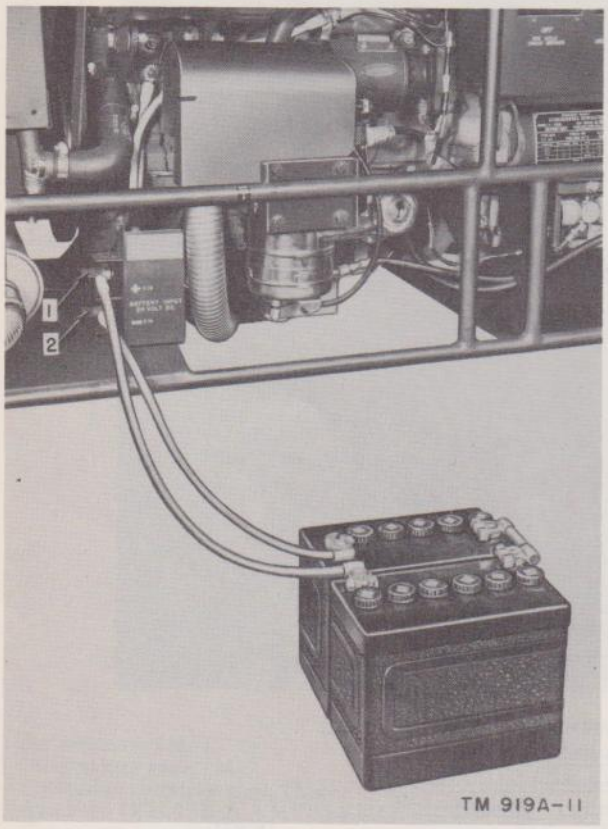

Figure 11. Battery connections.
1. Positive (+) terminal. 2. Negative (—) terminal.

17. Preparation of Storage Batteries

a. Initial Preparation. The two 12-volt lead-acid storage batteries are shipped in a dry-charged condition. The manufacturer's instructions for preparing the batteries are lettered on each battery. Additional instructions follow:

(1) Remove or destroy any sealing device that may have been used to close or restrict the vent openings.

(2) Fill the cells to ½ inch above the separators with electrolyte (sulphuric acid diluted with distilled water). The electrolyte should have a specific gravity of 1.280 at a temperature of 80° F.

Warning: When preparing the electrolyte, add the acid slowly to the water. *Never add water to the acid.*

(3) Allow the batteries to stand from 1 to 4 hours. Check the level of the electrolyte in the cells, and, if necessary, add more electrolyte.

b. Charging Procedure. If possible, give the batteries a freshening charge at 8 amperes. Charge until three consecutive readings of voltage and specific gravity at ½-hour intervals show no increase. During the charging period, the temperature of the electrolyte should not exceed 115° F. The following table lists the specific gravity values for batteries in various states of charge. All the values shown are for electrolyte at the correct filling height and at 80° F.

State of Charge	Standard specific gravity in temperate climates
Fully charged	1.280
75% charged.	1.230
50% charged.	1.180
25% charged.	1.130
Discharged.	1.080

c. Temperature Changes of Specific Gravity.

(1) The hydrometer readings will be correct only when the electrolyte in the battery is at a temperature of 80° F. If the temperature is higher or lower than 80° F, an allowance must be made to correct the reading obtained.

(2) Draw electrolyte in and out of the hydrometer barrel several times to bring the temperature of the hydrometer float to that of the acid in the cell and then measure the electrloyte temperature in the cell. Some hydrometers have a small thermometer and a correction scale built into them so that the temperature corrections can be made readily. The temperature correction is approximately .004 specific gravity, sometimes referred to as four points of gravity for each 10° F change in temperature.

(3) The following table lists the correction for hydrometer readings with the amount to be added or subtracted when the electrolyte temperature (not the air temperature) is above or below 80° F.

Temperature of electrolyte (° F)	Specific gravity correction factor
160	Add .032
155	Add .030
150	Add .028
145	Add .026
140	Add .024
135	Add .022
130	Add .020
125	Add .018
120	Add .016
115	Add .014
110	Add .012
105	Add .010
100	Add .008
95	Add .006
90	Add .004
85	Add .002
80	.000
75	Subtract .002
70	Subtract .004
65	Subtract .006
60	Subtract .008
55	Subtract .010
50	Subtract .012
45	Subtract .014
40	Subtract .016
35	Subtract .018
30	Subtract .020
25	Subtract .022
20	Subtract .024
15	Subtract .026
10	Subtract .028

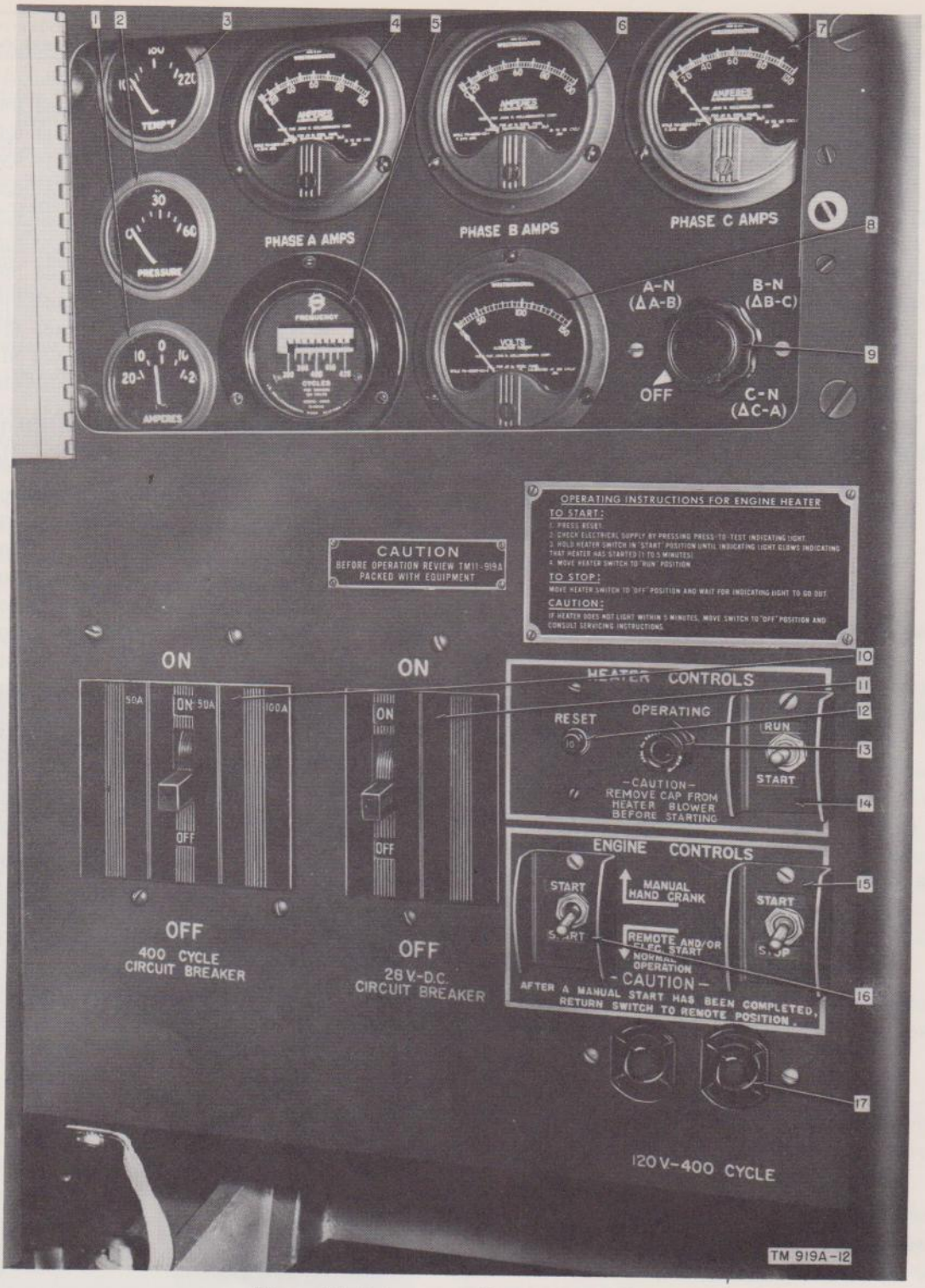

Figure 12. Instrument and control panel.

1. Dc ammeter (M3).
2. Oil pressure gage (M1).
3. Coolant temperature gage (M2).
4. Ammeter (PHASE A AMPS) (M6).
5. Frequency meter (M4).
6. Ammeter (PHASE B AMPS) (M7).
7. Ammeter (PHASE C AMPS) (M8).
8. Voltmeter (M4).
9. Voltmeter selector switch (S8).
10. 400 CYCLE CIRCUIT BREAKER (CD3).
11. 28-V.-D.C. CIRCUIT BREAKER (CD1).
12. Heater circuit breaker (RESET) (CD2).
13. Heater OPERATING indicator lamp (XDS1).
14. Heater RUN-START switch (S7).
15. START-STOP switch (S4).
16. Ignition switch (S1).
17. 120 V.-400 CYCLE duplex receptacle (J1).

CHAPTER 3

OPERATION

Section I. CONTROLS AND INSTRUMENTS

Note. This section describes, locates, illustrates, and furnishes the operating personnel with information pertaining to the various controls and instruments provided for the proper operation of the equipment.

18. Manual Controls

a. Engine.

(1) *Ignition switch* (16, fig. 12). A toggle-type switch, located on the control panel, selects the ignition circuit for MANUAL HAND CRANK or REMOTE AND/OR ELEC. START NORMAL OPERATION. If the unit is to be started by hand cranking, place the switch in the MANUAL HAND CRANK position; if the set is to be started remotely or by the START-STOP switch (subpar. (2) below), place the switch in the REMOTE AND/OR ELEC. START NORMAL OPERATION position.

(2) *START-STOP switch* (15, fig. 12). The three-position, START-STOP toggle switch is located on the control panel. To start the set, hold the switch in the START position; to stop the set, place the switch in the STOP position. The switch is designed so that the actuating handle returns to the center position when released from the START position.

(3) *CHOKE* (28, fig. 2). To assist in starting the set while hand cranking, a flexible wire-and-sleeve type manual choke is mounted on the right side of the radiator. Pull the CHOKE out when cranking a cold engine. After the set has started, push the CHOKE in all the way.

Note. Function of the automatic choke (par. 19*a*(4)) is sufficient after the engine has started, and manual choking is no longer necessary.

(4) *THROTTLE* (8, fig. 4). The manual THROTTLE is a wire-and-sleeve-type control mounted on the rear of the set on the lower frame. Use the manual THROTTLE to run the engine for prolonged periods of no load operation or when the unit is to be started in a cold temperature and it is necessary to warm the engine at idling speed. Lock the THROTTLE in the desired position by turning the knob clockwise.

Caution: Do not apply load to the set while the manual THROTTLE is in control.

(5) PRIMING PUMP (fig. 4). The set is provided with a PRIMING PUMP (7) located just above the manual THROTTLE. Use the pump when starting the set in low temperatures. To operate the pump, pull the knob out all the way and push it back to its original position. Operate the pump only while the engine is being cranked. One or two strokes are usually enough to start the engine. Be careful not to overprime.

b. Dc Generator. Two manual controls are used with the dc generator (1, fig. 2); a circuit breaker

and a variable voltage resistor. The 28-V. D. C. CIRCUIT BREAKER (11, fig. 12), mounted on the control panel, serves as the main load switch and the overload trip in the dc circuit. To connect the load, push the trip lever to ON; to disconnect the load, push the trip lever to OFF. The circuit breaker trips off automatically (par. 19*b*(1)) whenever the circuit becomes overloaded. To reset the circuit breaker after it has tripped, push the lever all the way down to the OFF position and then up to the ON position. The variable resistor on the dc voltage regulator (3, fig. 4) has a range of from 25 to 30 volts. Turn the slotted shaft of the variable resistor until the desired voltage is reached.

c. Winterization System (fig. 12). All the winterization controls are located on the control panel.

(1) *Circuit breaker* (RESET). The circuit breaker (RESET) (12) is used as the main switch to connect and disconnect the winterization system circuit. Push in the RESET button all the way to connect the system; pull out the button to disconnect the system. The circuit breaker trips off automatically (par. 19*c*(1)) whenever the circuit becomes heavily overloaded. To reset the circuit breaker after it has tripped, push in the RESET button.

(2) *Heater RUN-START switch.* The heater RUN-START switch (14) is used to start and run the winterization heater. To start the heater, after the RESET button has been pushed in (subpar. (1) above), hold the switch in the START position 2 to 4 minutes. After the heater OPERATing indicator lamp (subpar. (3) below) flashes on, place the switch in the RUN position. To shut off the heater, place the switch in the off (center) position.

(3) *Heater OPERATING indicator lamp.* The heater OPERATING indicator lamp (13) shows when the heater is in operation (par. 19*c*(2)). The lamp also may be used as a check on the power supply to the heater. To check the power supply, be sure the circuit breaker (RESET) button (subpar. (1) above) is in all the way. Then press the lamp. If power is available, the lamp will glow.

d. Alternator.

(1) *Circuit breaker* (fig. 12). The 400 CYCLE CIRCUIT BREAKER (10) mounted on the control panel, serves as the main load ON-OFF switch and the overload trip in the ac circuit. To connect the load, push the trip lever to ON; to disconnect the load, push the trip lever to OFF. The circuit breaker trips off automatically (par. 19*d*(1)) whenever the circuit becomes heavily overloaded. To reset the circuit breaker after it has tripped, push the lever all the way down to the OFF position and then up to the ON position.

(2) *Wye-delta change board* (fig. 3). The wye-delta change board (1), mounted on the right side of the set, is used to select the output voltage of the alternator, depending on the load requirements. Refer to paragraph 14*a* for instructions on changing the voltage connections by means of the wye-delta change board. The connection can be checked and/or changed after opening the change board door.

e. Miscellaneous. The 120V-400 CYCLE duplex receptacle (17, fig. 12) mounted on the control panel, is a means of connecting external power for trouble-shooting lamps, fans, or similar equipment requiring 120-volt, 400-cycle power. The receptacle is the Twistlock type and contains two connectors.

19. Automatic Controls

a. Engine.

(1) *Engine speed governor* (10, fig. 3). An engine speed governor, mounted on the right side of the engine, regulates the speed of the engine that governs the output frequency of the set. The governor is gear-driven from the camshaft timing gear and is connected to the carburetor throttle through adjustable linkage. The governor is set at the factory and should not require adjustment. However, if adjustment is necessary, follow the instructions in paragraph 25*b*.

(2) *High coolant temperature cutoff switch* (3, fig. 2). The engine is equipped with a thermostatically operated high coolant

temperature cutoff switch, mounted on the cylinder-head coolant outlet neck. If the coolant temperature exceeds a predetermined value, the switch grounds the magneto primary and thereby stops the engine. The switch is adjustable to permit selection of any desired temperature between 160° F and 220° F. It is set at 200° F at the factory.

(3) *Low-oil-pressure cutoff switch* (7, fig. 2). A low-oil-pressure cutoff switch, mounted on the left side of the engine, grounds the magneto circuit if the engine oil pressure drops below a safe minimum of approximately 5 psi for engine operation.

(4) *Automatic choke* (4, fig. 3). An automatic thermal-type choke is installed on the exhaust manifold adapter elbow. When the engine is cranked electrically, the carburetor is choked automatically to the extent required by the temperature of the engine.

b. Dc Generator.

(1) *Circuit breaker* (11, fig. 12). The 28-V. D.C. CIRCUIT BREAKER, mounted on the control panel, trips automatically if the circuit becomes heavily overloaded. The thermal trip release is factory-set for time-delay operation and the circuit breaker is sealed. To reset or manually operate the circuit breaker as a load switch, refer to paragraph 18*b*.

(2) *Dc voltage regulator* (3, fig. 4). A dc voltage regulator is mounted on a base secured to the top of the alternator stator housing. The carbon pile voltage regulator controls the 28-volt dc generator voltage output by automatically controlling the generator field current.

c. Winterization System.

(1) *Heater circuit breaker* (12, fig. 12). The heater circuit breaker (RESET) trips automatically when the heater circuit becomes heavily overloaded. For use as a master switch and for the method of resetting, refer to paragraph 18*c*(1).

(2) *Heater OPERATING indicator lamp.* The heater OPERATING indicator lamp (13), mounted on the control panel indicates when the heater is operating. The lamp will glow when the heater is burning on either high or low fire, or after the heater has been turned off and is purging itself of fuel. To operate the lamp as a check on the winterization system power supply, refer to paragraph 18*c*(3).

d. Alternator.

(1) 400 CYCLE CIRCUIT BREAKER. The 400 CYCLE CIRCUIT BREAKER (10), mounted on the control panel, trips automatically if the circuit becomes heavily overloaded. The thermal trip release is factory-set for time-delay operation and the circuit breaker is sealed. To reset or manually operate the circuit breaker as a load switch, refer to paragraph 18*d*(1).

(2) *Compensator assembly* (1, fig. 4). A compensator assembly, consisting of a three-phase transformer and a network of six capacitors (4), serves as a static voltage regulator by correcting the alternator internal power factor. The compensating transformer is mounted on the firewall above the alternator stator housing. The capacitors are mounted above and to the right of the transformer.

e. Battery Charging (5, fig. 3). The 24-volt dc automotive-type battery-charging generator is mounted on the right side of the engine, and is used to keep the engine starting batteries charged for regular use. The charging rate to the batteries is controlled by the automotive-type battery-charging voltage regulator mounted on the forward side of the firewall, inside of the suppression box (2).

20. Instruments

a. Engine Instruments (fig. 12). All the engine instruments are located on the instrument panel.

(1) *Oil-pressure gage.* The oil-pressure gage (2) indicates the pounds per square inch of oil pressure being delivered to the engine bearings. The gage is of the electric type and will not operate unless the batteries are connected. The gage has a 0 to 60-pound

scale, and normal operating oil pressure is 20 to 30 psi. The pressure will be higher when heavy oil is used or when the engine is cold. The pressure will be lower when light oil is used or when the engine bearings become worn. If the gage indication is not within the correct range, stop the set immediately and investigate the cause. Adjustment of the oil pressure to a slight extent can be made according to the instructions in paragraph 25*b*(6).

(2) *Coolant temperature gage.* The coolant temperature gage (3) indicates the temperature of the engine coolant. The gage is of the electric type and will not operate unless the batteries are connected. The scale reading on the gage is from 100° F to 220° F. Normal engine operating temperature is from 165° F to 185° F. If, after warm-up, abnormal temperature is indicated on the gage, proceed as follows: check the coolant and the engine oil level; check the water pump, fan, fan belt, and thermostatic valve for proper operation. Never operate an overheated engine.

(3) *Battery-charging ammeter.* The battery-charging ammeter (1) indicates the rate in amperes at which the batteries are being charged or discharged. The ammeter is calibrated to read from —20 to +20 amperes. Under normal conditions, a charging rate of +½ to +5 amperes should be indicated. A higher rate may be indicated if the batteries are discharged. During cold temperatures that require the use of the winterization system for cold engine starting, the use of the heater will indicate a negative (discharge) reading on the ammeter. Starting the heater will show a —12-ampere reading from 1 to 5 minutes; and running the heater will show approximately —¾ ampere. Negative readings, while the unit is operating, may also indicate that the battery leads are reversed or that there is a short circuit in the charging system. No reading indicates a faulty charging system or a loose or broken connection.

b. Alternator Instruments (fig. 12). All the alternator instruments are located on the instrument panel.

(1) *Voltmeter.* The voltmeter (8) is connected to read phase voltage and has a maximum scale reading of 150 volts. A voltmeter selector switch (9), provides facilities to check the voltage from phase to neutral (A-N, B-N, and C-N) when the unit is connected in wye and from phase to phase (△A-B, △B-C, and △C-A) when the unit is connected in delta. With the alternator operating under full balanced load, the voltmeter will indicate 120 volts in all phases. Under no load, the voltmeter will register about 124 volts. If the voltage is too high or too low, check the frequency meter and adjust the engine speed governor as instructed in paragraph 25*b*.

(2) *Frequency meter.* The frequency meter (5) indicates the cycles per second (cps) of the current being produced by the alternator. Engine speed determines the frequency of the alternator output. The meter scale provides for indications of 380 to 420 cps. Under stable operation at full load, the frequency meter must indicate 400 cps. Any deviation from the desired reading can be adjusted by changing the engine speed as described in paragraph 25*b*.

(3) *Ammeters.* The three ammeters (4, 6, and 7, fig. 12), connected to the alternator circuit by current transformers, register phase current. The ammeters are designated PHASE A AMPS, PHASE B AMPS, and PHASE C AMPS and provide a maximum scale reading of slightly more than 100 amperes. When the alternator is connected for single-phase, 120-volt output (delta), the PHASE A AMPS and PHASE C AMPS ammeters will register 104 amperes under full load. The PHASE B AMPS ammeter will indicate zero. When the alternator is connected for three-phase, 208-volt output (wye), all the ammeters will register 43.5 amperes under full load, Abnormal ammeter readings indicate an unbalanced load, defective ammeters, or defective lines to the load.

Section II. OPERATION UNDER USUAL CONDITIONS

Note. Personnel charged with the operation of the equipment covered in this manual will secure DA Form 11-260, and make appropriate entries thereon.

21. Preliminary Procedures

Before starting, check the set as follows:

a. Fuel System. Check the available supply for the correct grade of fuel. In temperatures above 0° F, use Gasoline, Automotive Combat (86A). Check the auxiliary fuel hose for proper connections (par. 12*c*). Examine all fuel fittings for loose connections.

b. Cooling System. Be sure the cooling system is filled to capacity (15 quarts) with clean water. Inspect all hose fittings and drains for evidence of looseness or leakage. Check the high coolant temperature cutoff switch for proper setting (par. 19*a*(2)).

c. Exhaust System. Check all exhaust connections for proper installation. Be sure the exhaust extension tube is assembled properly (par. 12*b*). All connections must be gastight.

d. Lubrication. The lubrication system must be prepared as instructed in paragraph 15. Recheck to be sure the crankcase oil level is correct.

e. Batteries. Check to be sure that the batteries have been prepared adequately for use (par. 17) and that all cable connections are correct and secure (par. 14*d*).

f. Instrument and Control Panel. Check all the instruments and controls located on the panel and within the unit for damage and insecure mounting. See that all electrical connections are tight and correct. The circuit breakers must be in the OFF position unless the unit is to be started remotely.

g. Remote Starting. If the unit is to be operated from a remote location, be sure the connections are correct as instructed in paragraph 14*c*. They must be clean and secure. The circuit breakers must be in the ON positions for remote operation.

h. Output Connections. Check the wye-delta change board for proper setting for desired output. If incorrect, change as instructed in paragraph 14*a*. The output terminals must be connected to the load correctly, and the connections must be secure and clean.

i. General Inspection. Inspect the fan belt, dc generator belt, and battery-charging generator belt for proper tension (par. 48). Check the entire unit for loose nuts, bolts, electrical connections, and fittings. Remove all tools and waste material from around the unit. Be sure the operating location is ventilated properly.

22. Starting

Caution: Do not attempt to start the set with the circuit breakers in the ON position, except when starting from a remote location.

a. Electrically. To start the set electrically, proceed as follows:

(1) Be sure both circuit breakers (10 and 11) are in the OFF position.

(2) Move the ignition switch (16) into the REMOTE AND/OR ELEC. START NORMAL OPERATION position.

(3) Move the START-STOP switch (15) to the START position and hold it there until the engine starts. As soon as the engine starts, release the switch. If the engine fails to start, release the switch for at least 10 seconds and then repeat the starting procedure. If the engine still fails to start, refer to the trouble-shooting chart (par. 50) for the possible cause and the remedy.

Caution: Do not operate the hand CHOKE when starting electrically.

(4) To start the set at idling speed, operate the manual THROTTLE as instructed in paragraph 18*a*(4).

b. Manually. The engine may be started by hand cranking in the event that the batteries do not supply sufficient power. To start the engine manually, proceed as follows:

(1) Be sure both circuit breakers (10 and 11) are in the OFF positions.

(2) Be sure the START-STOP switch (15) is in the run (center) position.

(3) Place the ignition switch (16) in the MANUAL HAND CRANK position.

(4) Insert the hand crank (24, fig. 2) and rotate it until it engages with the crankshaft.

(5) Pull out the manual CHOKE (28, fig. 2) in the front of the set if starting in cold temperatures.

(6) Crank the engine by using a strong, quick, upward pull. Repeat as necessary; be careful not to overchoke.

(7) After the engine starts, return the ignition switch to the REMOTE AND/OR ELEC. START NORMAL OPERATION position, and push in the manual CHOKE all the way.

c. Remotely. To start the engine from a remote location, connect the remote cables as instructed in paragraph 14*c* and proceed as follows:

(1) Place the ignition switch (16) into the REMOTE AND/OR ELEC. START NORMAL OPERATION position.

(2) Place the circuit breakers (10 and 11) into the ON positions.

(3) Continue remote starting procedure in accordance with subparagraph *a*(3) above. The ignition switch in the REMOTE AND/OR ELEC. START NORMAL OPERATION position serves the same function as the electric START-STOP switch on the control panel.

23. Precaution after Starting

Warning: Do not touch the wye-delta change board or the output terminals while the set is in operation. Perform the following immediately after starting the equipment.

a. Check the coolant, fuel, and oil lines for leakage. If leaks have developed, correct them immediately. Stop the set if necessary.

b. Check the reading of the engine oil-pressure gage. It may read high during the first minutes of operation. After the warm-up period, the gage should read between 20 and 30 psi. If a high- or low-oil pressure reading is observed, shut off the unit and refer to the trouble-shooting chart (par. 50) for the possible cause.

c. The battery-charging ammeter should indicate a charging rate of +½ to +5 amperes with the batteries fully charged. If no charge or a discharge is indicated, refer to the trouble-shooting chart (par. 50) for the possible cause.

d. Observe the readings of the voltmeter and the frequency meter. The voltmeter should register between 120 and 126 volts; the frequency meter should indicate between 400 and 407 cps. The frequency is factory-set and should be correct. However, if necessary to correct the frequency, refer to paragraph 25*b* and adjust the engine speed governor as instructed.

e. The coolant temperature indicated should be between 165° F and 185° F after the warm-up period. If the temperature is above normal, remove the radiator cap and check the coolant level. Add coolant if necessary. Be careful when removing the radiator cap to avoid scalding.

f. Observe the manual CHOKE to be sure it is all the way in.

24. Applying Load

Warning: Do not apply load to the set until the engine has warmed. Be sure the load is within the range of the unit.

To apply the ac or dc load to the set, place the appropriate circuit breaker in the ON position. If the ac load has been applied, check the ammeter, voltmeter, and frequency meter readings. Compare them with the correct readings listed in paragraph 20*b*. Any deviation must be investigated and corrected immediately. If the circuit breaker automatically trips off after applying the load, recheck for overload conditions and incorrect connections. To reset, switch the circuit breaker lever to the OFF position and then to ON. *Never manually hold the circuit breaker in the ON position.*

25. Operating Procedure

a. Instrument Readings. At frequent intervals during load operation, check the reading of the instruments located on the instrument panel. Refer to paragraph 23 for normal instrument indications and the corrections necessary to adjust abnormal readings.

b. Adjustments. Adjustments necessary to correct abnormal operation of the set are explained below:

(1) *Governor adjustment to correct frequency*

(fig. 13). If the indicated frequency is abnormal and thereby causes improper voltage output, correct the frequency by making the governor adjustments as instructed in subparagraph (1)(*a*) through (*d*) below.

(*a*) To adjust the governor to correct abnormal frequency, the engine must be stopped. Loosen the lock nuts (4) and rotate the adjusting sleeve (5) until the dimension A is approximately 11¼ inches. Check the eyebolt dimension B to see that it is ⅞ inch. To increase this dimension, loosen the upper adjusting nut (9) and tighten the lower adjusting nut (10). To decrease this dimension, loosen the lower adjusting nut (10) and tighten the upper adjusting nut (9).

(*b*) Start the engine and bring the unit up to operating speed and temperature. With the generator operating at approximately 400 cycles at no load, loosen the lock nuts (4) and rotate the adjusting sleeve (5) until an increase in engine speed is effected. Turn the sleeve back until the governor just begins to take control and the generator frequency is restored to 400 cycles. Tighten the lock nuts (4) when the adjustment has been completed.

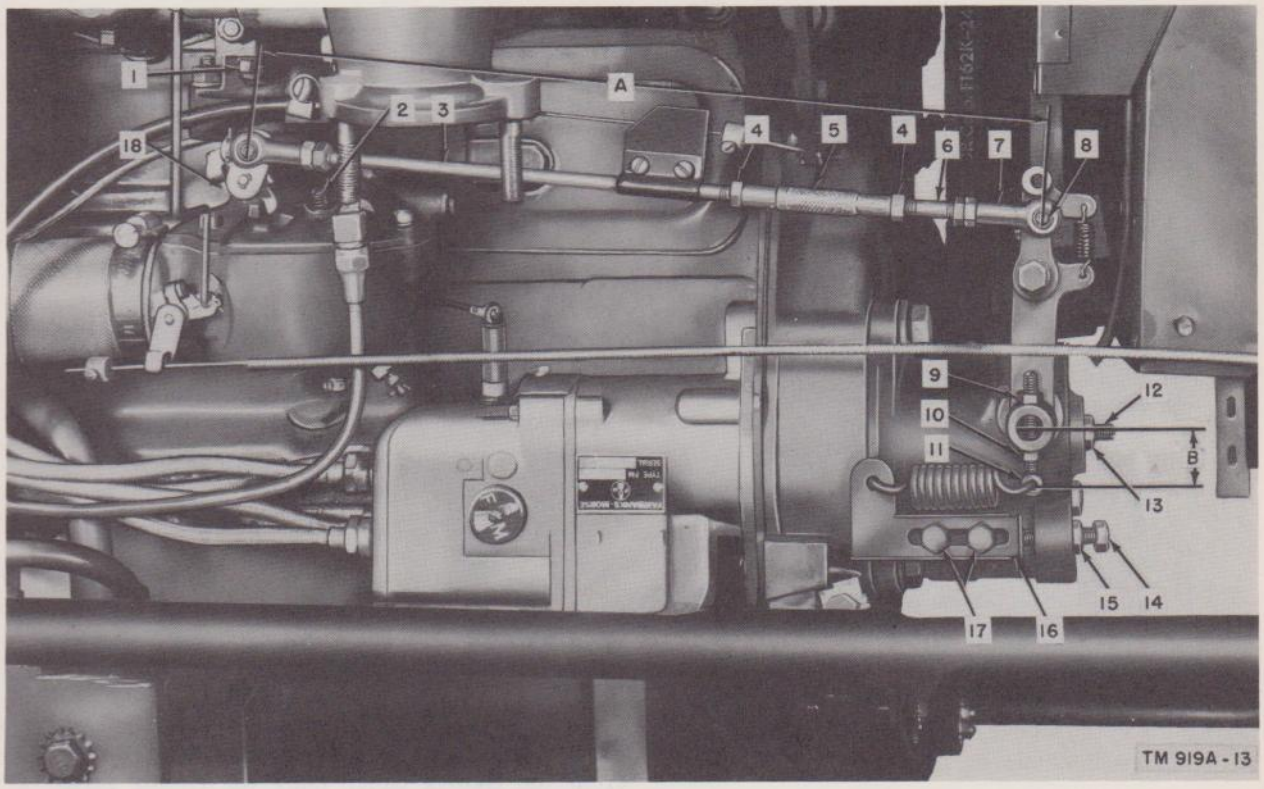

Figure 13. Engine speed governor adjustments.

1. Pipe plug.
2. Idle-adjusting needle.
3. Governor-to-throttle rod, long.
4. Lock nut.
5. Adjusting sleeve.
6. Governor-to-throttle rod, short.
7. Rod end.
8. Hexagonal nut.
9. Upper adjusting nut.
10. Lower adjusting nut.
11. Control arm eyebolt.
12. Bumper screw.
13. Lock nut.
14. Adjusting screw.
15. Lock nut.
16. Adjustment slide.
17. Shoulder bolt.
18. Throttle stop screw.

(*c*) Loosen the two shoulder bolts (17) that hold the adjustment slide (16). Loosen the lock nut (15) and change the engine speed by turning the adjustment screw (14). Turn the screw clockwise to increase the engine speed and counterclockwise to decrease the engine speed.

(*d*) When the frequency meter indicates 400 cps under load or about 405 cps under no load, secure the adjustment by tightening the lock nut (15) and shoulder bolts (17). If necessary, readjust the linkage between the governor and carburetor (subpar. (*a*) and (*b*) above).

(2) *Governor adjustment to correct engine surge under no load.* If the engine is hunting or surging under no load, correct the condition by adjusting the engine speed governor as follows:

(*a*) Loosen the lock nut (13) and turn the bumper screw (12) in, until the engine stops surging. Do not turn the bumper screw in too far or the engine speed will increase and the governor will not function properly.

(*b*) When the bumper screw has been adjusted properly, secure the setting by tightening the lock nut (13).

(*c*) If the frequency drop from no load to rated load is greater than the specified 407 to 400 cycles, decrease dimension B (fig. 13) by loosening the lower adjusting nut (10) and tightening the upper adjusting nut (9). Then readjust the no-load speed of the engine (subpar. (1)(*c*) above) until a frequency of 405 cps is obtained.

(3) *Governor adjustment to correct engine surge under load.* If the engine is hunting or surging under load, correct the condition by increasing dimension B. To do this, loosen the upper nut (9) and tighten the lower nut (10). Readjust the engine no-load speed in accordance with the instructions in subparagraph (1)(*c*) above.

(4) *Dc voltage regulator adjustment.* If necessary, refer to paragraph 18*b* and adjust the regulator to the desired output as instructed.

(5) *Carburetor adjustments.* The carburetor is provided with two external adjustments, the throttle stop screw (18, fig. 13) and the idle-adjusting needle (2). If the carburetor idling adjustment is required after the engine has warmed to operating temperature, proceed as follows: Set the hand throttle to an idling speed of approximately 500 to 700 rpm with the engine under *no load*, or to a point where the carburetor throttle stop screw (18) will touch or nearly touch the throttle stop pin (21, fig. 24). Turn the idle-adjusting needle (2, fig. 13) in (clockwise) until the engine begins to run roughly or falters, then slowly turn the screw out (counterclockwise) until the engine runs smoothly. Recheck the adjustment after the engine has been operating under load for about ½ hour.

(6) *Oil-pressure adjustment.* The engine oil-pressure adjustment should never need altering under normal conditions. However, the pressure can be slightly raised or lowered by adding or removing shims in the relief valve assembly (fig. 45) located on the right side of the cylinder block. Adding .030-inch shims between the plug (23) and the spring (26) will increase the oil pressure. Removing shims will decrease the pressure. This adjustment will change the pressure at load speed but not at idle speed.

26. Stopping

a. If the engine generator set is being controlled from the control panel, place the circuit breakers in OFF position. If the engine generator is being controlled from a remote point, leave the circuit breakers in ON position but, if possible, remove or disconnect the load at the using equipment.

b. Allow the unit to operate for a few minutes at no load and then place the START-STOP switch in STOP position.

c. Service the unit with fuel, coolant, and lubricants and, if it is not to be restarted immediately, cover it with the canvas cover provided.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

27. Operation in Arctic Climates

To operate the set in subzero temperature, special precautions must be taken to prevent poor performance or total operational failure. The equipment can operate effectively under extreme cold conditions (to —65° F) only if the procedures listed below are followed carefully. If possible, install the unit in a properly ventilated, heated shelter.

a. Service and Maintenance.

(1) *Fuel system.* When freezing temperatures are expected, drain the fuel filters and fuel lines to remove any water that may have accumulated in the fuel system. Moisture, resulting from condensation, will accumulate in tanks, drums, and containers. At low temperatures, this condensation will form into ice crystals that will clog fuel lines and carburetor jets, unless the following precautions are taken:

(*a*) Be sure that all containers are thoroughly clean and free from rust before storing fuel in them.

(*b*) Keep all containers tightly closed to prevent snow, ice, dirt, and other foreign matter from entering.

(*c*) Add 2 to 3 ounces of denatured alcohol to each gallon of fuel.

(*d*) Inspect the fuel system for leaks and correct any that are found.

(*e*) Drain any water-alcohol precipitate from the fuel filter weekly or more frequently if necessary.

(2) *Lubrication.* For protracted low temperature operation (below —10° F), drain the oil filter, engine crankcase, and air cleaner and refill with Oil, Engine, Subzero (OES). Check the crankcase oil level every 4 hours. Drain the lubricating oil filter after every shut-down to prevent accumulated sludge from freezing. Drain the engine crankcase every third day of operation.

(3) *Cooling system.* If temperatures below freezing are anticipated, protect the cooling system with antifreeze. Drain the system and refill with a mixture of 50 per cent ethylene glycol noncorrosive antifreeze and 50 per cent clean water. If the temperature is expected to reach —30° F or lower, drain the system and refill with Compound Antifreeze, Arctic, (MIL-C-11755). Do not dilute the arctic-type antifreeze.

(4) *Batteries.* In arctic climates it is essential to keep the battery electrolyte at the proper level and the batteries fully charged. The danger of the electrolyte freezing depends on the full-charge specific gravity. The electrolyte will become mushy with ice crystals at —63° F with the specific gravity at 1.250 and at —18° with the specific gravity at 1.200. When the batteries are not in use, store them in a warm place.

b. Starting. To facilitate starting in subzero temperatures, the set is equipped with a winterization system which heats the coolant, engine oil, and intake manifold. To start the unit with the aid of the winterization system, remove the cap from the blower intake, and proceed as follows:

(1) Check the fuel supply and prime the fuel system as instructed in paragraph 16*a*.

(2) Disconnect the automatic choke rod. The automatic choke must be inoperative when starting in subzero temperature.

(3) Press in the heater circuit breaker (RESET) button.

(4) Check the electrical supply by pushing the heater OPERATING indicator lamp. If power is available, the lamp will glow.

(5) Hold the heater RUN-START switch in START position until the indicator lamp flashes on (approximately 2 to 4 minutes). This indicates that the heater has started.

(6) Move the RUN-START switch to RUN position.

Note. The sound of combustion may be heard before the indicator lamp flashes on; however, do not move the switch to the RUN position until the indicator lamp lights. If the lamp does not light within 5 minutes, move the RUN-START switch to off (center) position and consult the trouble-shooting chart (par. 50).

(7) Keep the heater on for approximately 20

to 30 minutes until the engine is sufficiently warm to start and operate smoothly.

(8) Start the set in accordance with instructions in paragraph 22. Pull out the manual CHOKE about ½ to ¾ of the way from its closed position. Prime the engine slowly with one stroke of the primer pump while the engine is being cranked. If the engine does not start within 15 to 20 seconds, stop cranking and wait for at least 5 minutes before repeating the starting procedure.

Caution: Fuel does not vaporize readily in subzero temperatures. Be careful not to overprime.

(9) To stop the heater, move the heater RUN-START switch to off (center) position. The indicator lamp will remain lighted until the heater has purged itself of fuel and will then go out automatically. Pull out the heater circuit breaker (RESET) button.

(10) Replace the cap on the blower intake.

c. Stopping. Refer to paragraph 26 and stop the set as instructed. Recheck the arctic service and maintenance instructions; use adequate precautions to protect the unit when not in use.

28. Operation in Desert Areas

Locate the equipment in an area protected from sand and dust. Inspect and clean the equipment more frequently than under normal operating conditions. Keep the unit covered when not in operation.

a. Fuel System. Be sure all fuel line connections are tight. Keep the fuel supply tank tightly closed to prevent the entrance of dirt and sand.

b. Lubrication. Keep all moving parts well cleaned and lubricated when the unit is being operated in desert areas. Always remove sand, dirt, and old lubricant from parts before relubrication. Check and change the engine oil often, depending on the severity of the climate, presence of excessive dust conditions, and frequency of operation.

c. Cooling System. Proper ventilation of the cooling system is of prime importance. Keep the system full of clean water, and keep the radiator cap tight.

d. Batteries. Check the level of the electrolyte in the batteries more frequently than under normal operating conditions. Keep the vent caps tightly in place.

e. Air Cleaner. Keep clean oil in the air cleaner to prevent dust from entering the engine. Clean the air cleaner and change the oil at frequent intervals, depending on the severity of the climate. Under these conditions, never operate the unit with the air cleaner dry.

29. Operation in Tropical Climates

When operating in hot, humid climates, the equipment must be provided with unobstructed ventilation. Locate the set so that it is protected from direct rays of the sun. Shorten the time between normal lubrication periods. Keep the cooling system full of clean water. If the set is to remain idle for long periods in humid areas, run it every few days for at least 1 hour to prevent the accumulation of moisture in the stator housing. In tropical climates, prepare the batteries as instructed in paragraph 17, with the following modifications: Batteries operating in tropical climates should use electrolyte of about 1.225 specific gravity when fully charged. This milder strength of acid is less deteriorating to separators and plates which results in longer battery life. The following chart lists the specific gravity values to be used in tropical climates for batteries in various states of charge. The values shown in the table are for electrolyte at the correct filling height and at 80° F.

State of charge	Specific gravity used in tropical climates
Fully charged.	1.225
75% charged.	1.180
50% charged.	1.135
25% charged.	1.090
Discharged.	1.045

30. Operation in High Altitudes

The set will operate at rated performance at elevations from sea level to 5,000 feet above with no major adjustments. At high altitudes, however, the engine is more apt to overheat than at sea level. It is important to keep the cooling system full and to provide adequate ventilation.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. ORGANIZATIONAL TOOLS

31. Tools

All tools required for organizational maintenance are supplied with Gasoline Engine Generator Set PU-107A/U. The tools are listed in paragraph 8*c* and are normally stored in the tool tray within the set.

32. Use of Tools

a. General. The proper use of tools is very important. Tools used improperly will result in damage to the tools or the equipment and may cause personal injury.

b. Wrenches. When tightening a nut, bolt, or cap screw, be sure to use the proper size wrench. A wrench that is worn or slightly oversize will round the nut, bolt, or cap screw, and may cause damage to the equipment or personal injury if it should slip. Never use pliers for tightening or loosening nuts or bolts. Use the correct size open-end, box, or socket wrench. When tightening cylinder-head nuts or bolts, use a tension wrench if one is available. Never use a piece of pipe or other means to increase the leverage of a wrench, as this will probably result in bending the wrench or stripping the threads of the fastening.

c. Screw Drivers. When tightening or loosening a fastening with a slotted head, use a screw driver with a blade that fits the head of the fastening. Do not use a wrench or pliers on the shaft of the screw driver to increase leverage. Be sure to keep the blade of the screw driver square in the slot of the fastening. Never use a screw driver as a pry bar or chisel.

33. Care of Tools

The condition in which a mechanic keeps his tools and equipment is a good indication of his ability. Do not abuse tools by using them for work for which they were not designed. Keep tools and equipment properly stored and protected at all times when not in use. After using a tool, clean it and replace it in its proper place in the tool box. Keep all tools free from rust and protected from moisture. Keep the tool box clean and free from rust and dampness.

Section II. LUBRICATION AND PRESERVATION

34. Lubricants

The following table lists the lubricants, solvents, and preservative materials approved for use with Gasoline Engine Generator Set PU-107A/U.

Symbol	Nomenclature	Specification	Application
OE	Oil, Engine, Heavy Duty	MIL-O-2104 (ORD)	Engine crankcase, air cleaner.
OES	Oil, Engine, Subzero	MIL-O-10295 (ORD)	Engine crankcase.
GL	Grease, Aircraft and Instruments (for low and high temperatures.)	MIL-G-3278	Carburetor-to-governor linkage bearings, primer pump, throttle, manual choke.
SD	Solvent, Dry Cleaning	Federal P-S-661a	Cleaning
D-40 or D-35	Fuel Oil, Diesel	MIL-F-896	Cleaning.
GAA	Grease, Automotive and Artillery	MIL-G-10924 (ORD)	Battery cables and terminals.

35. Lubrication Periods

Lubrication instructions frequently are given in periods of days, weeks, months, half-years, and years. A daily period of operation consists of any continuous 8-hour period or any number of consecutive periods of operation that total 8 hours. A weekly period of operation is any number of consecutive operating periods that total 50 hours. A monthly period of operation is any number of consecutive operating periods that total 250 hours. A half-yearly period of operation is any number of consecutive operating periods that total 1,000 hours. A yearly period of operation is any number of consecutive operating periods that total 2,000 hours.

36. Factory-lubricated Parts

a. Alternator Bearing. The alternator bearing is packed, at the factory, with grease conforming to specification MIL-G-3278. The bearing is a double-seal Fafnir Plya-Seal type. The Plya-Seal is a diaphragm-type contact seal, composed of two members, a flat, flexible sealing washer of synthetic rubber-impregnated fabric and a split retaining ring of thin spring steel. The two members of the seal can readily be removed for inspection, cleaning, and lubrication. At the time of disassembly and overhaul of the alternator, remove the bearing seals and, if necessary, add new grease (GL). If there is evidence of dirt or grit in the bearing, remove both seals and thoroughly flush the old grease from the bearing with hot oil.

b. Water Pump Bearing. The water pump has a factory-sealed, prelubricated bearing, and lubrication is not required except during overhaul.

c. Heater Blower Motor. The bearings of the heater blower motor are factory-lubricated and additional lubrication is not necessary.

d. Starting Motor. The starting motor bearings are factory-lubricated. No further lubrication is necessary.

e. Dc 28-volt Generator. All bearings in the dc generator are of the same type used in the alternator. Follow the instructions in subparagraph *a* above.

f. 24-volt Battery-charging Generator. The 24-volt battery-charging generator bearings are factory lubricated. No further lubrication is necessary.

37. Lubrication Requiring Disassembly

Lubrication operations that require disassembly of parts or assemblies are explained in subparagraphs *a* and *b* below and the detailed lubrication and cleaning information is supplementary to the instructions in the lubrication chart (fig. 17).

a. Air cleaner (fig. 14). To check the quantity of oil in the air cleaner, disassemble the bowl from the body by loosening the spring clips, and see that oil is up to the caution level. Add oil as necessary. Reassemble the bowl to the body; be sure the clips are secure.

b. Manuel Choke (28, fig. 2). To lubricate the manual choke control, disassemble the control, and wash all parts in solvent (SD). Apply grease (GL) to the control wire and reassemble the control.

38. Routine Lubrication

a. Lubrication Orders. Each power unit is provided with an official lubrication order or a lubrication chart. Official lubrication orders are illustrated, numbered or dated cards, or decalcomania labels that prescribe approved lubrication instructions for mechanical equipment which requires lubrication by using organizations. Current lubrication orders

should be requisitioned in conformance with instructions and lists in Dept. of the Army Pamphlet No. 310-4 Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders. Instructions contained in lubrication orders are mandatory and supersede all conflicting lubrication instructions of an earlier date.

b. Lubrication Instructions. Subparagraphs (1) through (10) below contain detailed lubrication and cleaning information and are supplementary to the instructions in the lubrication chart (fig. 17).

(1) *Engine crankcase.* Check the crankcase oil level daily (after 8 operating hours) and add oil (OE) if necessary. Change the engine oil weekly (after 50 operating hours). Drain the oil by opening the drain cock located on the left side of the engine oil pan. (Drain oil while engine is warm.) Refill the crankcase with 4½ quarts of oil (OE), in accordance with the lubrication chart (fig. 17).

(2) *Air Cleaner* (fig. 14). Check the quantity of oil in the air cleaner bowl weekly (after 50 operating hours). If the oil is below the caution level, add oil (OE) up to the normal level of the bowl. At monthly intervals (after 250 operating hours), remove the air cleaner element and wash it in solvent (SD). At the same time, clean the air cleaner bowl and refill with engine oil (OE). To remove the element, remove the bowl and unscrew the wing screw located on the bottom of the element housing. Then pull the element out of the housing. (The wing screw does not come out of the element.)

(3) *Oil filter* (fig. 15). Clean the oil filter element at least once every day (after 8 operating hours) by rotating the external handle 1 complete turn in either direction. Remove the plug in the filter bowl and drain the sludge from the filter with each crankcase oil change (after 50 operating hours). If the handle becomes difficult to rotate, remove the element from the housing and wash it in solvent (SD). Clean the bowl and replace the bowl gasket. If the element disks or blades are damaged, replace the body and element assembly.

(4) *Fuel filter* (fig. 16). After each day of operation (8 operating hours), open the fuel filter drain to remove any accumulated dirt and water. This is particularly important when operating in damp or cold climates. At least once each month, after 250 operating hours, remove the filter element and wash it in fuel oil (D-40 or D-35) or solvent (SD). Be careful not to damage the element disks. Worn gaskets must be replaced.

(5) *Fuel pump* (fig. 25). To avoid difficulties created by water and other foreign matter, refer to paragraph 56*d*(1)(*a*) and remove the cover cap plate (6), gasket (5), and screen (4). Clean parts thoroughly with solvent (SD) at least twice a year (after

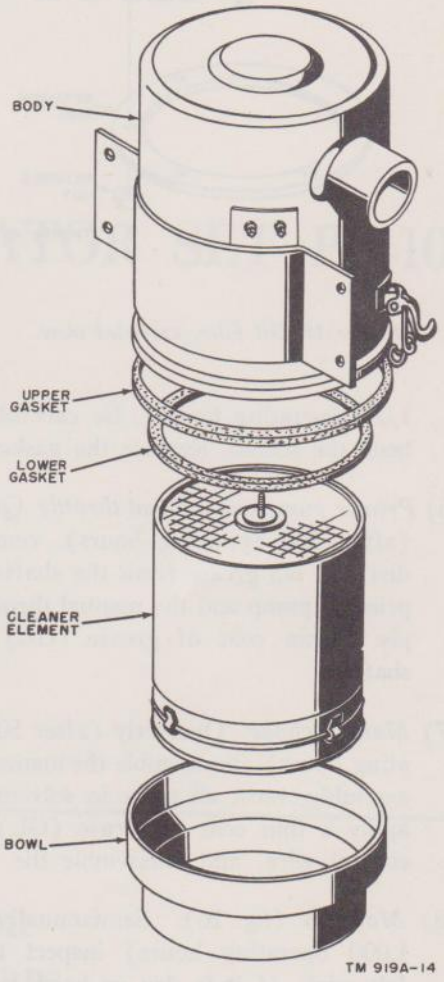

Figure 14. Air cleaner, exploded view.

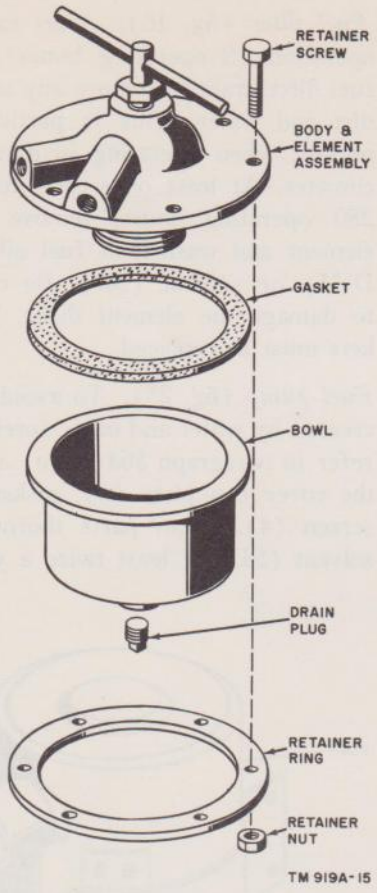

Figure 15. Oil filter, exploded view.

1,000 operating hours). Be careful not to bend the screen. Replace the gasket (5).

(6) *Primer pump and manual throttle.* Quarterly (after 500 operating hours), remove all dirt and old grease from the shafts of the priming pump and the manual throttle. Apply a thin coat of grease (GL) to the shafts.

(7) *Manual choke.* Quarterly (after 500 operating hours), disassemble the manual choke assembly, wash all parts in solvent (SD), apply a thin coat of grease (GL) to the control wire, and reassemble the control.

(8) *Magneto* (fig. 26). Semiannually (after 1,000 operating hours) inspect the cam felt wick. If it is dry or hard, replace it with a new factory-impregnated wick. The magneto is factory-lubricated and will require no further lubrication except during overhaul.

(9) *Heater fuel pump* (fig. 35). When operating the heater every day, remove and clean the heater fuel pump strainer and cover daily (after 8 equipment operating hours) with solvent (SD) or fuel oil (D-40 or D-35). Apply air pressure to remove any foreign particles that may have accumulated in the small magnetic separator chamber in the center of the fuel pump cover. If the heater is in frequent operation, clean the fuel pump subassembly twice a year (after 1,000 equipment operating hours) with solvent (SD) or fuel oil (D-40 or D-35). To remove the strainer and subassembly follow the instructions in paragraph 56*l*.

(10) *Engine speed governor.* The engine speed governor is factory-lubricated and the drive gear is lubricated by engine oil during operation. No lubrication is necessary at overhaul.

39. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised, which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13 and TB SIG 72, Moisture-proofing and Fungiproofing Signal Corps Equipment, and Tropical Maintenance of Ground Signal Equipment, respectively.

c. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69, Lubrication of Ground Signal Equipment. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat.

40. Rustproofing

Whenever the equipment is to be placed in storage or is to be out of service for a period of 30 days or more, precautions must be taken to guard against