TM 11-941C

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

POWER UNITS PE-215-C AND PE-215-E

DEPARTMENT OF THE ARMY • SEPTEMBER 1950

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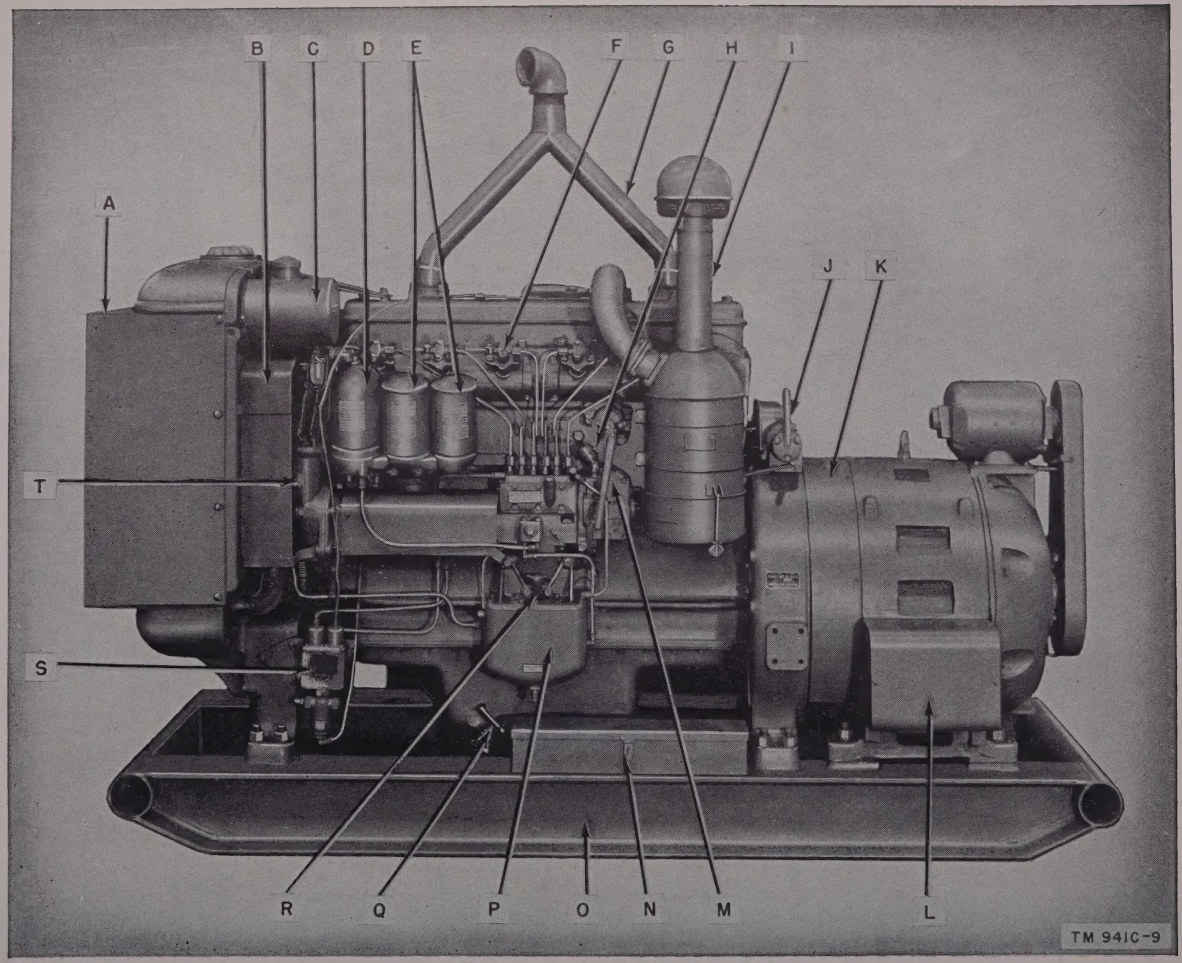
CONTENTS

		Paragraphs	Page
CHAPTER 1.	INTRODUCTION.		
Section I.	General	1–2	1
II.	Description and data	3–7	1
CHAPTER 2.	OPERATING INSTRUCTIONS.		
Section I.	Service upon receipt of equipment	8–9	21
II.	Controls and instruments	10–11	30
III.	Operation under usual conditions	12–17	34
IV.	Operation under unusual conditions	18–21	38
CHAPTER 3.	MAINTENANCE INSTRUCTIONS.		
Section I.	Organizational tools	22–25	40
II.	Lubrication and preservation	26–31	43
III.	Preventive maintenance	32–36	46
IV.	Trouble shooting	37–39	54
CHAPTER 4.	FIELD MAINTENANCE INSTRUCTIONS.		
Section I.	General	40–41	69
II.	Differences in models	42–43	69
III.	Prerepair procedure	44–46	69
IV.	Cleaning, inspecting, and stripping	47–51	70
V.	Disassembly, repair, and reassembly	52–80	78
VI.	Adjustments	81–83	92
VII.	Final testing	84–86	95
VIII.	Preservation	87–88	96
IX.	Suppression	89–90	97
CHAPTER 5.	SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE.		
Section I.	Shipment and limited storage	91–92	104
II.	Demolition to prevent enemy use	93–94	104
APPENDIX I.	REFERENCES		105
II.	IDENTIFICATION TABLE OF PARTS FOR POWER UNITS PE–215–C and –E		107
INDEX			132

SAFETY NOTICE

This equipment generates high voltage which is dangerous to life. At all times, be careful and observe every safety regulation. Keep clear of all live parts. Never make or change electrical connections while the unit is in operation.

Do not remove any guards, shields, or screens while the unit is in operation. Keep tools, oilcans, bolts, etc., away from the unit. Such items might fall into the generator or be drawn into the rotating parts by magnetic attraction. Keep moisture away from the unit and keep surrounding area dry.


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T
TM 941C-9

A. Radiator air duct adapter.

B. Fan guard.

C. Gasoline tank.

D. Fuel oil filter.

E. Lubricating-oil filters.

F. Injector nozzle.

G. Exhaust connection.

H. Injection pump breather.

I. Air cleaner.

J. Governor control lever.

K. Coupling guard.

L. Alternator terminal box.

M. Compression release lever.

N. Toolbox.

O. Skid base.

P. Day tank.

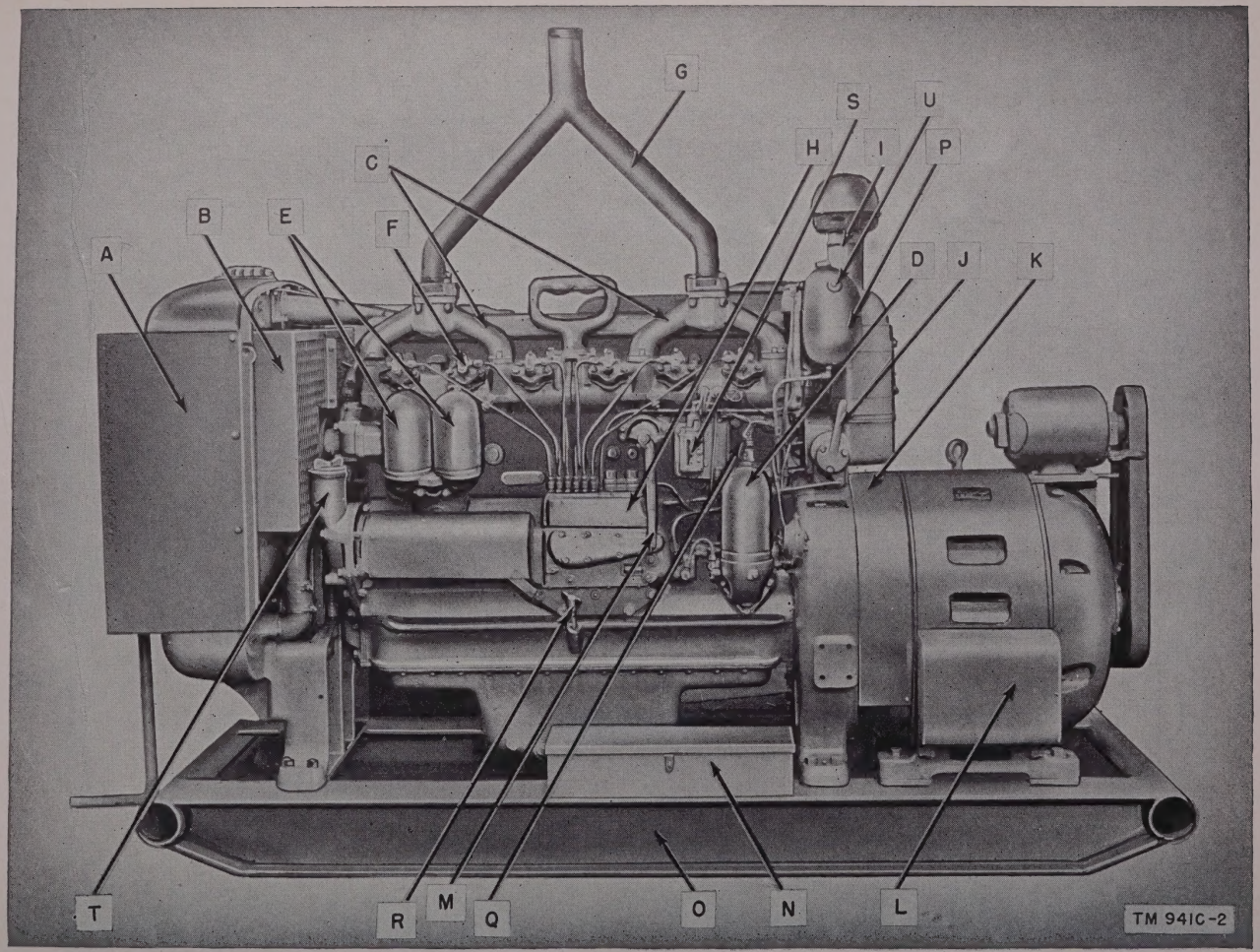
Q. Thermometer

R. Bayonet oil gage.

S. Safety cut-off valve.

T. Crankcase filler pipe.

Figure 2.—Power Unit PE–215–C—right side.


A
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L
TM 941C-2

A. Radiator air duct adapter.

B. Fan guard.

C. Exhaust manifolds.

D. Fuel oil filter.

E. Lubricating-oil filters.

F. Spray nozzle.

G. Exhaust connection.

H. Fuel injection pump.

I. Air cleaner.

J. Governor control lever.

K. Coupling guard.

L. Alternator terminal box.

M. Compression release lever.

N. Toolbox.

O. Skid base.

P. Day tank.

Q. Solenoid valve.

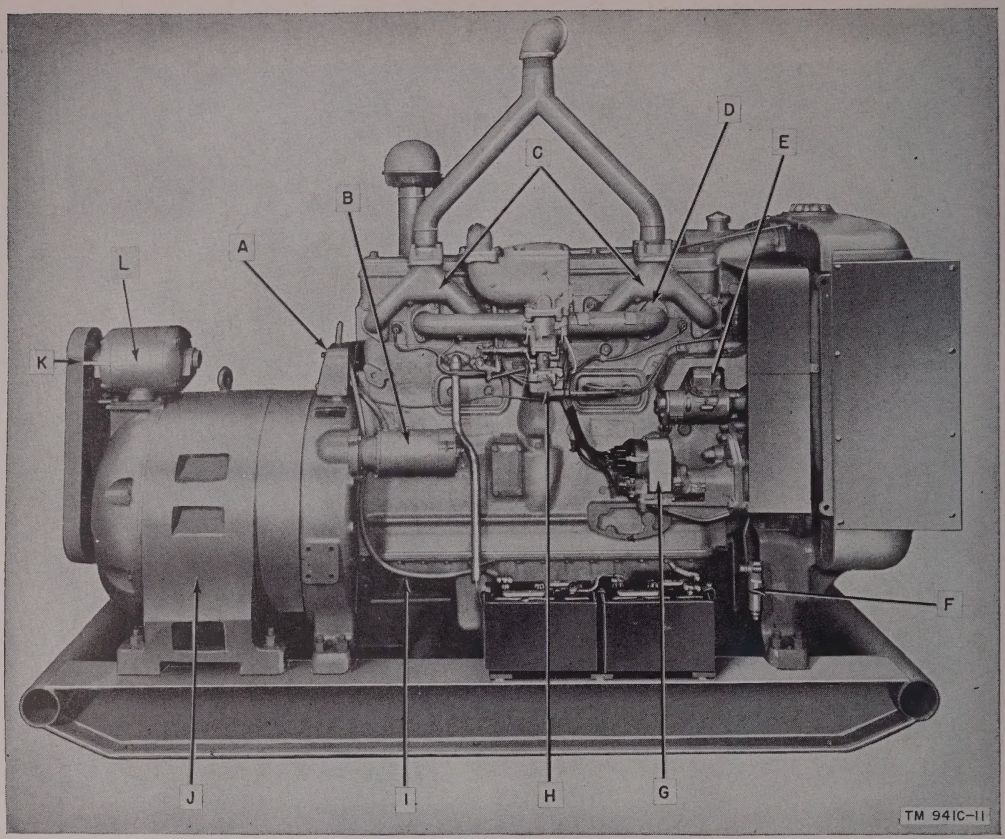
R. Bayonet oil gage.

S. Safety cut-off.

T. Crankcase filler pipe.

U. Fuel overflow connection.

Figure 3.—Power Unit PE–215–E—right side.



A. Engine instrument panel.
B. Starting motor.
C. Exhaust manifolds.
D. Intake manifold.
E. Battery-charging generator.
F. Fuel supply pump strainer.
G. Magneto.
H. Carburetor.
I. Battery cable.
J. Alternator.
K. Exciter belt guard.
L. Exciter.

Figure 4.—Power Unit PE–215–C—left side.

4. Purpose and Use

Power Units PE–215–C and PE–215–E are intended as sources of power for Signal Corps Radio Set AN/CPS–1 and Signal Corps Fixed Plant Communication Equipment. These units may also be used to furnish power for other equipment requiring power within their rated capacity.

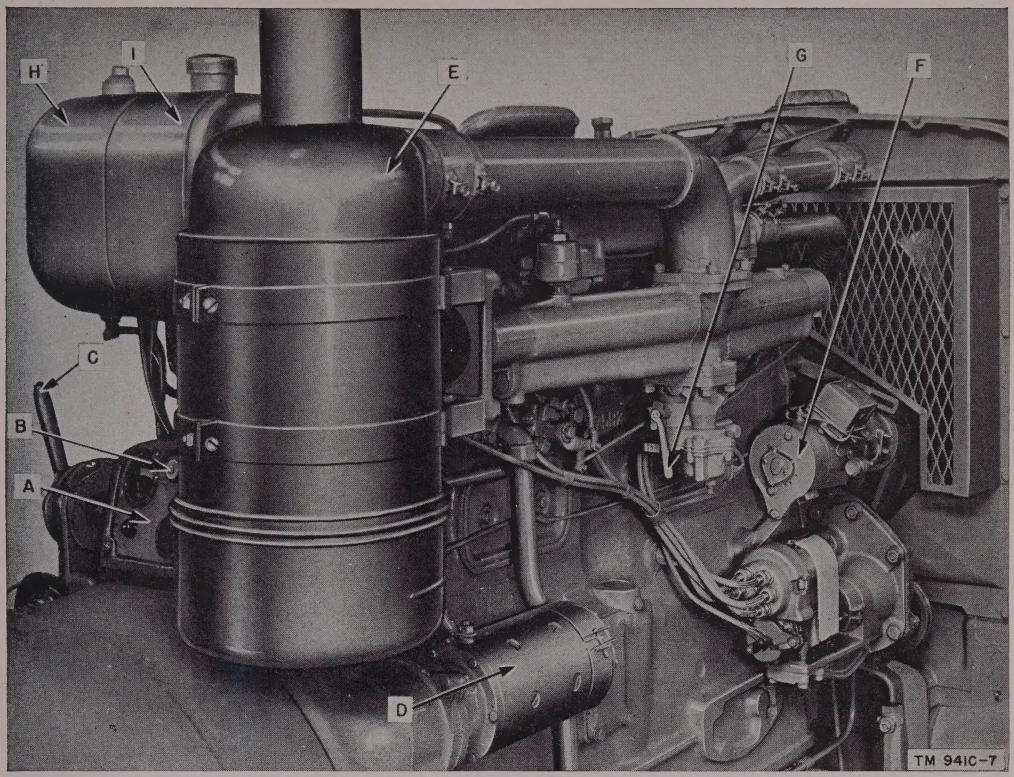
5. Differences in Models

Power Units PE–215–C and PE–215–E are identical units except for differences in certain components. These differences are explained in detail in paragraph 6.

6. Major Parts and Assemblies

Note.—The lists appearing in this paragraph are for general information only. See appropriate publication for information pertaining to requisitioning of spare parts.

a. ENGINE. The engine used in Power Unit PE–215–C is an International Harvester Company Model UD–18. The engine used in Power Unit PE–215–E is an International Harvester Co. model UD–18A. The model UD–18 engine

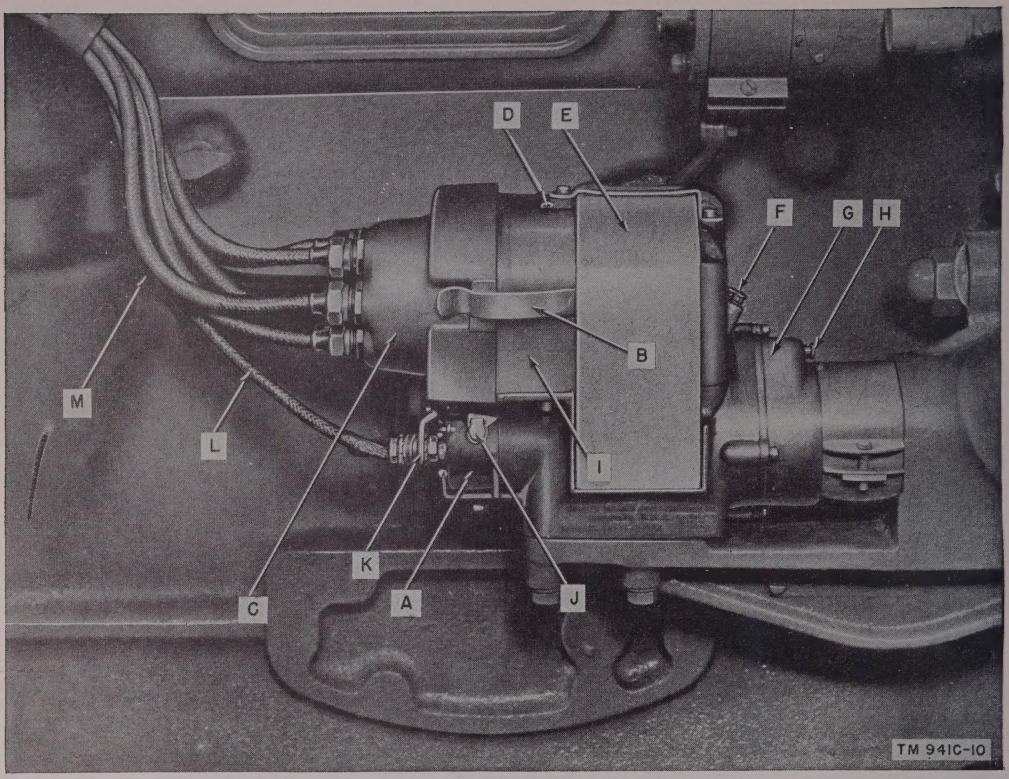


A. Engine instrument panel.
B. Starter button.
C. Governor control lever.
D. Starting motor.
E. Air cleaner.
F. Battery-charging generator.
G. Carburetor choke.
H. Day tank.
I. Gasoline tank.

Figure 5.—Power Unit PE–215–E—engine close-up, left side.

develops 72 horsepower while the model UD–18A engine develops 82 horsepower. Both engines operate at a speed of 1,200 revolutions per minute. The difference in horsepower is due to the fact that the model UD–18 engine has a compression ratio of 13.67 to 1 while the model UD–18A engine has a compression ratio of 15.5 to 1. Both engines are six-cylinder, gasoline starting, full Diesel operating, and are provided with conventional electric starting equipment and battery-charging generators. Provision is made to permit starting the units by hand in the event of failure of the electric starting equipment. Both engines have a bore of 4.75 inches, a stroke of 6.5 inches, and a piston displacement of 691 cubic inches. These engines are liquid-cooled, of the overhead valve type, and magneto ignition is provided for gasoline operation when starting. They will operate in ambient temperatures between 32° F. and 115° F., relative humidity between 0 and 90 percent, and at any altitude between sea level and 3,300 feet. They may be operated on any Diesel fuel conforming to U. S. Army Specification 2–102B.

b. CRANKING SYSTEM. In addition to a hand crank, Power Units PE–215–C and PE–215–E are provided with an electric starting system. This consists of an electric starting motor with Bendix drive to which power is supplied by two 6-volt storage batteries connected in series to deliver 12 volts. These batteries are charged,



A. Breaker housing.
B. Distributor cap clamp.
C. Distributor cap.
D. Oil cup for distributor bearing.
E. Magneto magnet.
F. Rotor bearing oil cup.
G. Impulse coupling housing.
H. Impulse coupling oil cup.
I. Magneto frame.
J. Rotor bearing oil cup.
K. Breaker point and spark plug gage.
L. Ground cable.
M. Distributor to spark plug cables.

Figure 6.—Magneto.

when the units are operating, by a battery-charging generator which is located on the left side of the engine. A metal-shielded voltage regulator, mounted on the battery-charging generator, controls the battery-charging current.

c. GASOLINE STARTING SYSTEM. Power Units PE–215–C and PE–215–E are each provided with a carburetor, gasoline tank, and magneto ignition system for starting purposes only. The gasoline system consists of a small gasoline tank, a gasoline shut-off cock, a sediment-bowl type fuel strainer, and the carburetor.

Note.—Power Unit PE–215–C is provided with a manually operated primer which is not supplied on Power Unit PE–215–E.

d. INTAKE MANIFOLD (fig. 4). A dual-type or two passage intake manifold is provided to enable operation on either gasoline or fuel oil. An air valve of the mushroom type, within the manifold, opens the gasoline passage and closes the fuel oil passage when the compression release lever is in gasoline operating position. When the compression release lever is in fuel oil operating position, the gasoline passage is closed and the fuel oil passage is opened. A

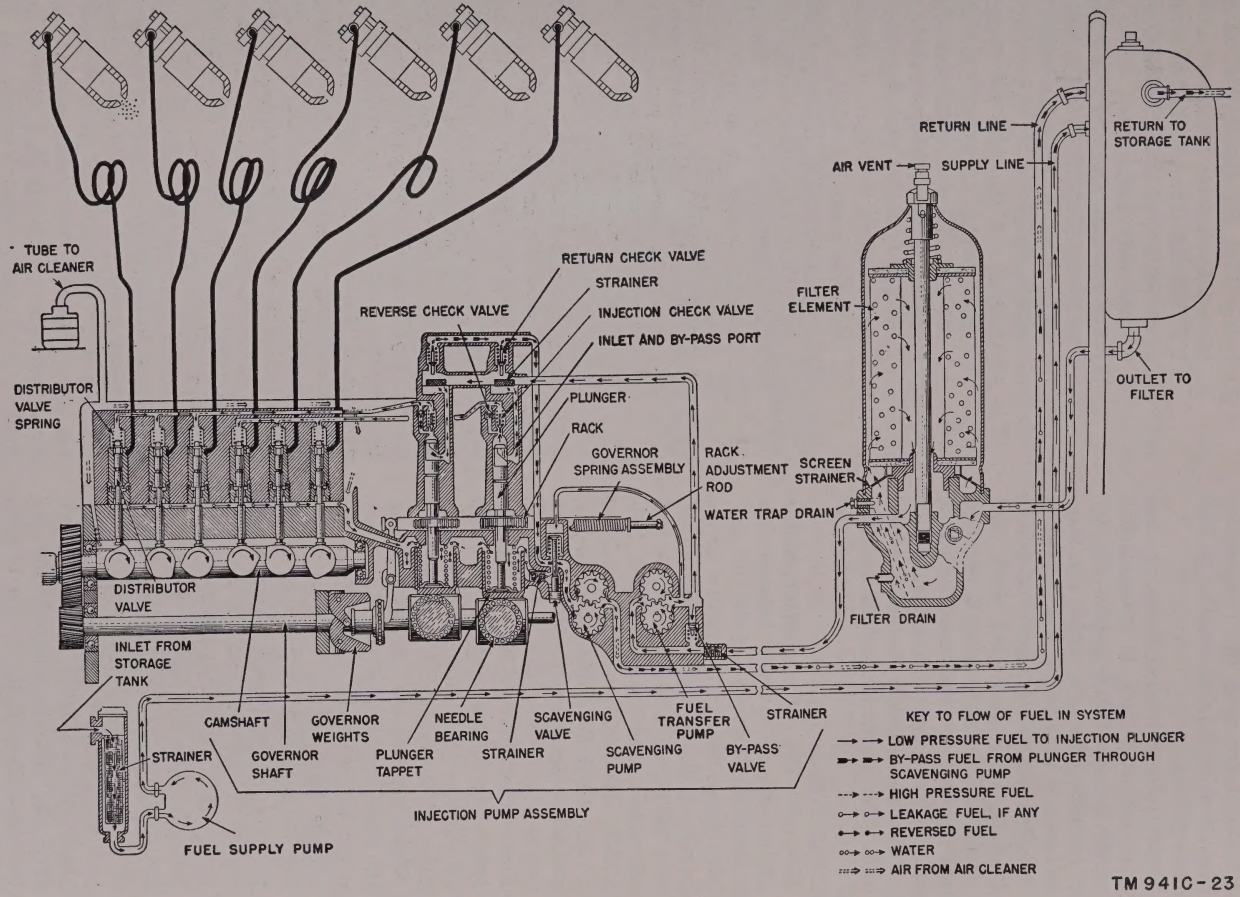


Figure 7.—Power Unit PE-215-E—fuel oil flow chart.

magneto cut-out switch is housed within the manifold, attached to the air valve shaft, and grounds the magneto when the compression release lever is shifted from gasoline to fuel oil operating position.

e. MAGNETO. A high-tension magneto, used only for starting on gasoline, is mounted on a bracket on the left side of the engine (fig. 6). The drive assembly, through which the magneto is driven, is a part of the mounting bracket. This drive assembly consists of a drive gear and shaft, idler gear and shaft, and coupling parts. An impulse coupling is provided to facilitate starting at hand-cranking speed. The direction of rotation of the magneto is clockwise when viewed from the radiator end of the unit. The magneto system is fully shielded.

f. FUEL OIL SYSTEM (fig. 7).

(1) *General.*—The fuel oil system consists of an intake strainer between the fuel oil storage tank and the fuel supply pump, the fuel injection pump, governor, day tank, necessary filters, and the injection nozzles. As the fuel oil system used on Power Unit PE–215–E differs from that used on Power Unit PE–215–C, each is described separately in (2) and (3) below.

(2) *Power Unit PE–215–C, fuel oil system.*—This system consists of a fuel oil storage tank (not supplied as a part of the unit), a fuel strainer located between the storage tank and the fuel supply pump, a fuel supply pump which draws fuel oil from the storage tank, a day tank to which fuel oil is pumped by the fuel supply pump, a fuel oil transfer pump which pumps the fuel oil from the day tank to the fuel oil filter, a solenoid valve through which the fuel oil passes before reaching the fuel injection pump, the fuel injection nozzles, and necessary connecting tubing. A scavenging pump which returns excess fuel oil from the injection pump to the day tank is also a part of this system. The governor which automatically proportions the fuel to the load is a part of the fuel injection pump assembly.

(3) *Power Unit PE–215–E, fuel oil system.*—The fuel oil system of Power Unit PE–215–E is essentially the same as that of Power Unit PE–215–C with the following exceptions:

(*a*) The day tank (air and water trap) on Power Unit PE–215–E is located on the rear of the engine beside the gasoline tank.

(*b*) Instead of the fuel oil transfer pump, which in Power Unit PE–215–C is mounted on the side of the fuel injection pump, Power Unit PE–215–E has a primary fuel oil pump which is a part of the fuel injection pump assembly.

(*c*) A twin-barreled injection pump feeds fuel oil, under pressure, to the metering pumps of the fuel injection pump assembly.

Note.—The fuel injection metering pumps, fuel injection pumps, primary fuel pump, scavenging pump, and governor are all contained within the injection pump assembly.

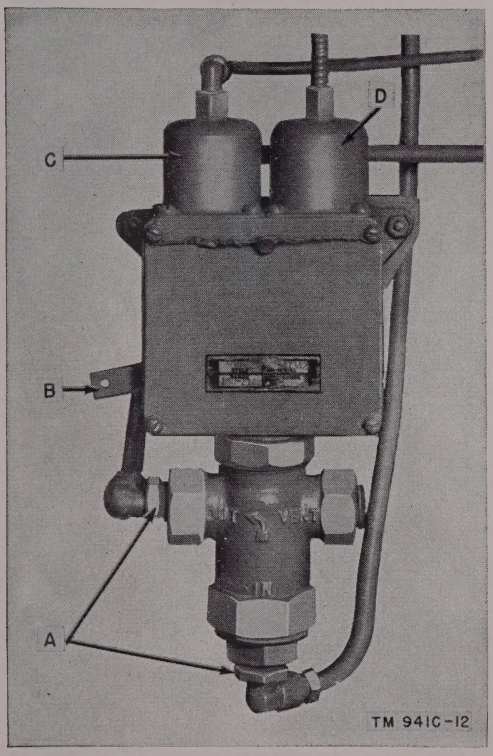
g. GOVERNOR. The governors used on Power Units PE–215–C and PE–215–E are of the flyweight type. They are an integral part of the fuel injection pump assembly. In both units, any change in the position of the governor weights, caused by fluctuation of engine speed, is transmitted to the injection pump plungers through a yoke which acts upon a toothed rack that engages toothed sections on the plungers and causes them to rotate. This rotation increases or decreases the stroke of the plungers and thus controls the amount of fuel reaching the injection nozzles. This controls the engine speed. The governors of both units are adjusted to maintain an engine speed of approximately 1,200 revolutions per minute.

h. SAFETY CONTROL (figs. 8 and 9). A solenoid valve, in the fuel line, shuts off the engine fuel whenever the engine temperature becomes too high or the lubricating-oil pressure becomes too low. Whenever the safety control shuts down the engine on PE–215–E, a warning light lights and an audible signal sounds. On PE–215–E, a manually operated switch is provided on the engine instrument panel to enable cut-

ting off the safety control until satisfactory lubricating-oil pressure has been built up when the unit is being started.

Note.—No audible alarm, cut-out switch, nor warning light is provided on Power Unit PE–215–C.

i. COOLING SYSTEM. The cooling system used on Power Units PE–215–C and PE–215–E is of the forced-circulation, liquid-cooled type. A centrifugal, belt-driven pump forces the coolant through the engine water jackets and a flat-tube, fin-type radiator. Air is driven outward between the tubes of the radiator by a fan which is driven by the same belt that drives the circulation pump. This current of air passing between the radiator tubes carries off excess heat and thus reduces the temperature of the coolant passing through the radiator. Thermostats, located between the engine coolant outlet and the radiator, control the coolant flow and thus regulate engine temperature.



A. Fuel oil connections.
B. Tripping lever.
C. Low lubricating-oil section.
D. High water temperature section.

Figure 8.—Power Unit PE–215–C—automatic safety cut-off.

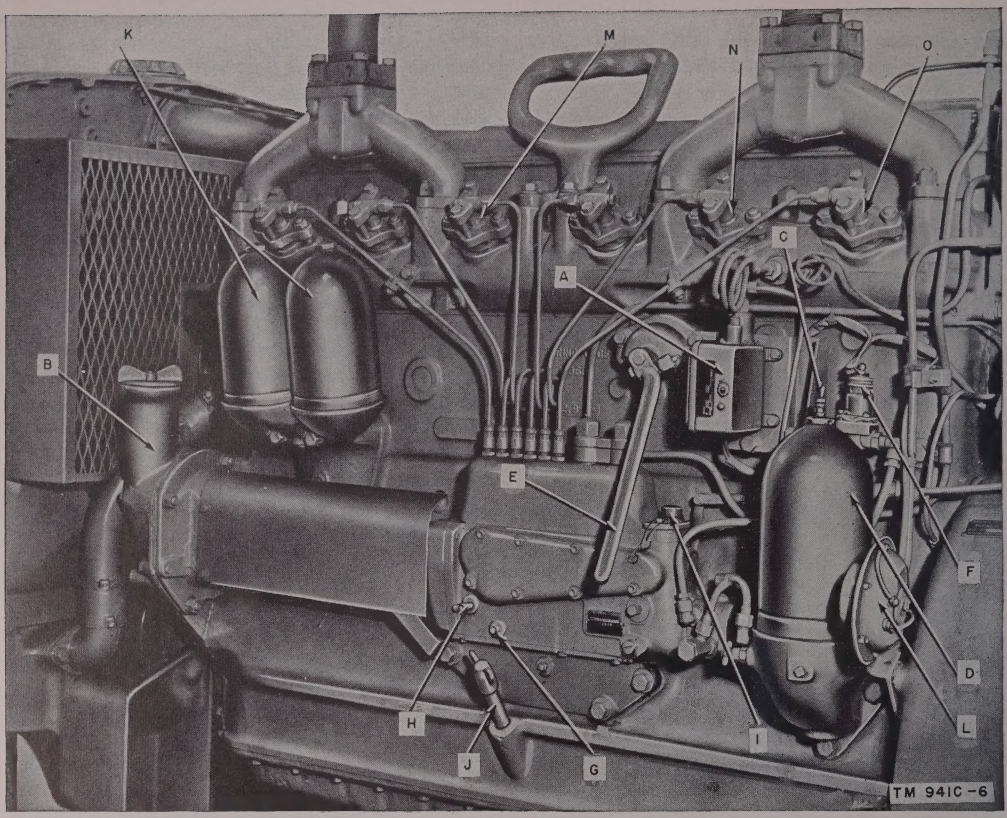
j. LUBRICATING SYSTEM. The lubricating systems of Power Units PE–215–C and PE–215–E are of the full force-feed type. A gear-type pump circulates the lubricating oil, under pressure, to the valve mechanism, timing gears, governor, and drilled bearings of the crankshaft, camshaft, connecting rods, and piston pins. Two lubricating-oil filters are provided to prevent foreign matter from being circulated to vital parts of the engine. A pressure regulator of the plunger type permits adjustment of the lubricating-oil pressure. The lubricating-oil system also includes an oil pressure gage, a bayonet-type oil level gage, and a low-oil-pressure cut-off switch.

k. GENERATOR.

(1) *Alternator.*—The alternators used on Power Units PE–215–C and PE–215–E are six-pole, four-wire, two-phase units which operate at a driven speed of 1,200 revolutions per minute. They are directly connected to the engine and are rated at 50 kilowatts, 62.5 kilovolt-amperes, 60 cycles, 80 percent power factor. The frame is of dripproof construction to protect current-carrying parts from dripping moisture and falling particles and objects. The rotor rides in a ball bearing at the outboard end while the engine end is supported by the pilot bearing at the flywheel end of the engine. The alternators are cooled by a current of air which is circulated by fans at each end of the rotor. The maximum temperature rise at 100 percent continuous load is 40° C.

Note.—The voltage rating of Power Unit PE–215–C is 120/208 volts while that of Power Unit PE–215–E is 120/240 volts.

(2) *Exciter.*—The exciters of Power Units PE–215–C and PE–215–E are mounted on the tops of the alternators and driven from the alternator shafts by means of dual V belts. The exciters are shunt wound, operate at 2,000 revolutions per minute, and are rated at 1.5 kilowatts, 64 volts, and 23.4



A. Safety switch.
B. Crankcase oil filler.
C. Bleeder valve (fuel oil).
D. Fuel oil filter.
E. Compression release lever.
F. Fuel solenoid valve.
G. Lubricating-oil drain plug (injection pump).
H. Lubricating-oil level cock (injection pump).
I. Lubricating-oil filler (injection pump).
J. Bayonet gage.
K. Lubricating-oil filter.

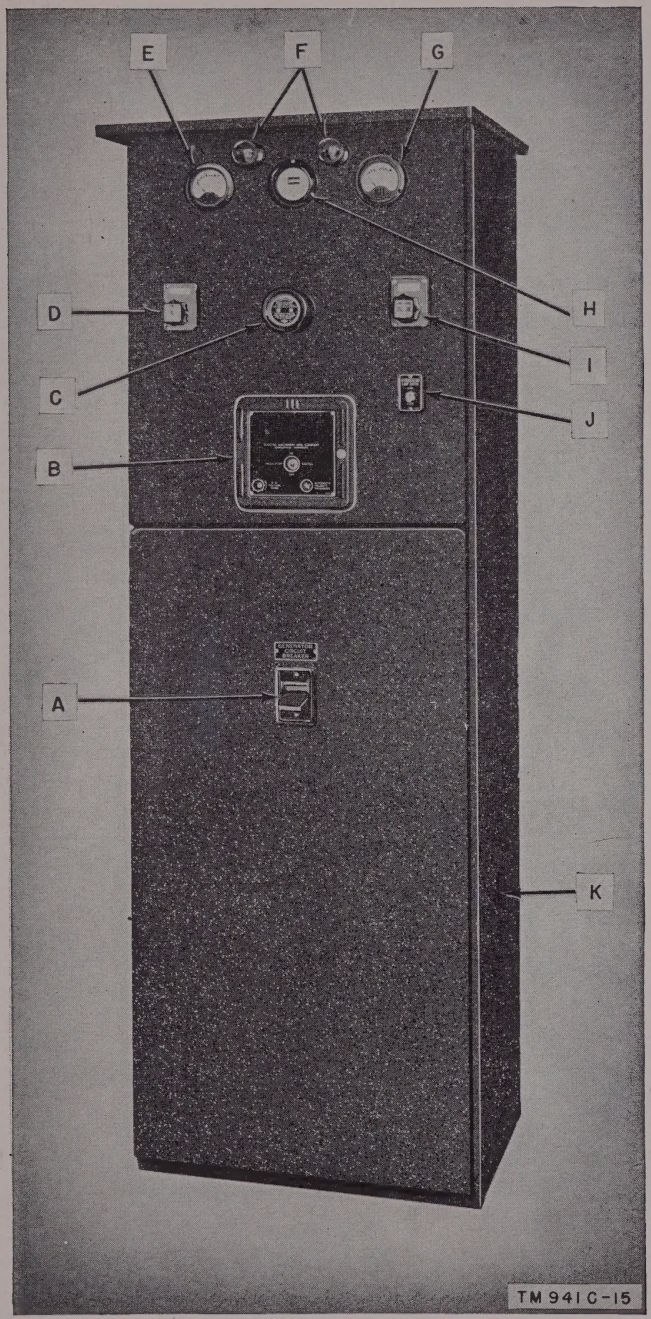
Figure 9.—Power Unit PE–215–E—right side of engine showing safety switch.

amperes. The exciters are of drip-proof construction.

l. SWITCHBOARD (figs. 10, 11, 12, and 13).

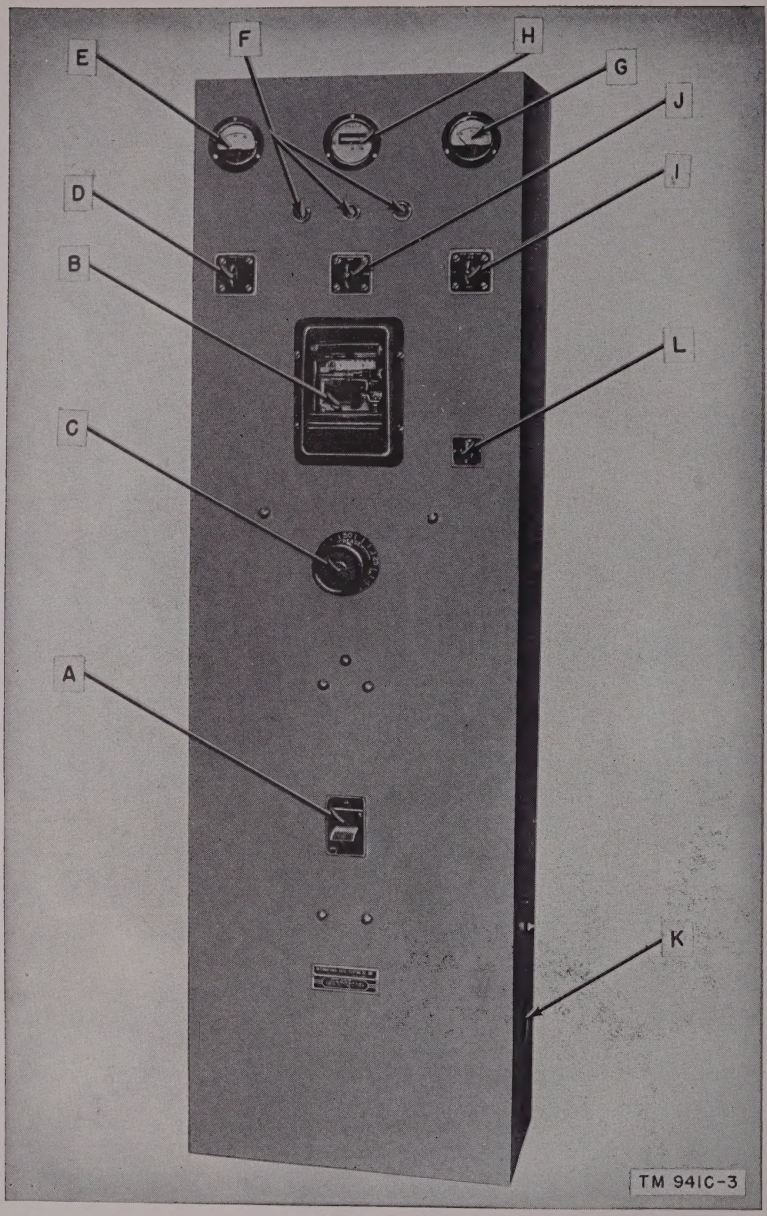
(1) *General.*—The switchboards used with Power Units PE–215–C and PE–215–E consist of cabinets which are mounted on bases separate from the engine and generator. The fronts of these cabinets consist of panels on which the operating controls and meters are mounted. The two sides of the cabinets are inclosed by steel panels while the rear is open. The switchboards are of the free-standing, dead-front type and they are electrically connected to the generator by flexible cables. The front and rear of the switchboard used with Power Unit PE–215–C are shown in figures 10 and 12. The front and rear of the switchboard used with Power Unit PE–215–E are shown in figures 11 and 13. The various components of the switchboards are listed in the table in (2) below.

(2) *Switchboard components.*—In the following table, components which are common to both units will be indicated



A. Circuit breaker.
B. Voltage regulator.
C. Exciter-field rheostat.
D. Ammeter switch.
E. A-c ammeter.
F. Synchronizing lamps.
G. A-c voltmeter.
H. Frequency meter.
I. Voltmeter switch.
J. Synchronizing lamp switch.
K. Power take-off lead mounting hole.

Figure 10.—Power Unit PE-215-C—switchboard, front view.



A. Circuit breaker.
B. Voltage regulator.
C. Exciter-field rheostat.
D. Ammeter switch.
E. A-c ammeter.
F. Synchronizing lamps.
G. A-c voltmeter.
H. Frequency meter.
I. Voltmeter switch.
J. Synchronizing lamp switch.
K. Power take-off conduit hole.
L. Voltage adjusting rheostat.

Figure 11.—Power Unit PE-215-E—switchboard, front view.

by the letters C–E after the listing of the component. Components which are used only on the switchboard for Power Unit PE–215–C will be indicated by the letter C after the listing of the component. Components which are used only on the switchboard for Power Unit PE–215–E will be indicated by the letter E after the listing of the component.

Quantity	Description	Used with—
1	A-c ammeter, rated at 5 amp	C–E
1	A-c voltmeter, 0- to 300-v scale	C–E
1	Frequency meter, 58 to 62 cyc (reed type with external resistor).	C–E
1	Three-phase ammeter switch, three positions.	E
1	Three-phase ammeter switch, four positions.	C
1	Three-phase voltmeter switch, four positions.	E
1	Three-phase voltmeter switch, seven positions.	C
1	Exciter-field rheostat, 80 ohms	C–E
1	Air circuit breaker	C–E
1	Automatic voltage regulator	C–E
1	Potential transformer for voltage regulator, ratio 200: 115.	C
1	Potential transformer for voltage regulator, ratio 230: 115.	E
1	Current transformer for cross-current compensation, ring-type, ratio 400: 5.	E
1	Current transformer for cross-current compensation, ring-type, ratio 500: 5.	C
3	Metering current transformers, ring-type, ratio 200: 5.	E
4	Metering current transformers, ring-type, ratio 200: 5.	C
3	Synchronizing lamps, 6 w, 120 v	E
2	Synchronizing lamps, 6 w, 120 v	C
1	Synchronizing lamp switch, triple-pole, single-throw.	E
1	Synchronizing lamp switch, double-pole, single-throw.	C
3	Resistors, 2,250 ohms, 10 w, in synchronizing lamp circuit.	E
1	Resistor, 2,250 ohms, 10 w, in synchronizing lamp circuit.	C
4	2 capacitors, 0.01 uf; and 2 capacitors, 0.1 uf (suppression).	E
4	Capacitors, 0.01 uf (suppression)	C

Note.—The circuit breakers are three-pole, single-throw, three thermal element, manually operated units. The circuit breaker on Power Unit PE–215–C is rated 225 amperes. The circuit breaker on Power Unit PE–215–E is rated 175 amperes.

7. Tabular Data

Note.—The lists appearing in this paragraph are for general information only. See appropriate publication for information pertaining to requisitioning of spare parts.

a. WEIGHTS AND DIMENSIONS.

(1) *Power Unit PE–215–C.*

Quantity	Item	Dimensions			Weight (lb)
		Width (in.)	Length (in.)	Height (in.)	
1	Power Unit PE–215–C with accessories.	38 1/16	106	59 7/16	6,500
1	Alternator and exciter.	30	30 3/4	37 3/16	1,730
1	Switchboard.	26	22 1/8	76	436
1	Steel base	33	104	8	475
1	Coupling	5 1/2	19 7/8 (diam)		132
2	Battery	7	12 1/2	8 1/4	91

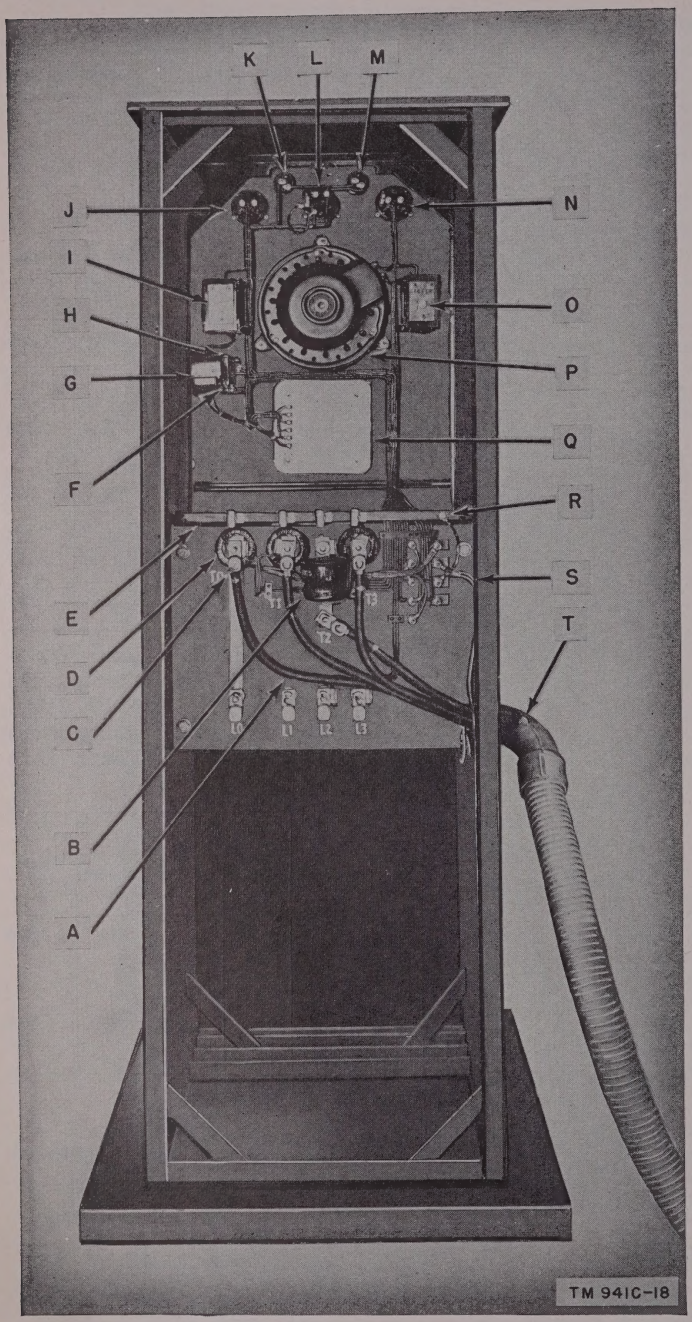
(2) *Power Unit PE–215–E.* Unless otherwise indicated below, the components used with Power Unit PE–215–E have the same weight and dimensions as those used with Power Unit PE–215–C.

Quantity	Item	Dimensions			Weight (lb)
		Width (in.)	Length (in.)	Height (in.)	
1	Power Unit PE–215–E with accessories.	38 11/16	106 1/4	61 5/8	5,800
1	Switchboard.	20	12 1/4	67	240

b. TABLE OF SPECIFICATIONS.

(1) *Engine.*

Make	International Harvester Co.
Model	UD–18 (PE–215–C), UD–18A (PE–215–E).
Type	4-cyc, gasoline starting, Diesel.
Type cylinder head	overhead valve.
Number of cylinders	6.
Bore	4.75 in.
Stroke	6.5 in.
Piston displacement	691 cu in.



A. Power cable.
B. Cross-current compensating transformer.
C. Generator cable terminal.
D. Current transformer.
E. Capacitor support strap.
F. Synchronizing lamp switch.
G. Potential transformer.
H. Synchronizing light resistor.
I. Voltmeter switch.
J. Voltmeter.
K. Synchronizing lamp socket.
L. Frequency meter.
M. Synchronizing lamp socket.
N. Ammeter.
O. Ammeter switch.
P. Exciter-field rheostat.
Q. Voltage regulator.
R. Grounding screw.
S. Exciter wires.
T. Flexible conduit elbow.

Figure 12.—Power Unit PE-215-C—switchboard, rear view.

Compression ratio ..... 13.67 to 1 (PE–215–C); 15.5 to 1 (PE–215–E).
Speed ..... 1,200 rpm.
Horsepower ..... 76 (PE–215–C); 82 (PE–215–E).
Type cooling ..... liquid.
Cooling system capacity .. 26 gal.
Type lubrication ..... force feed.
Lubricating-oil capacity .. 22 qt (PE–215–C); 26 qt (PE–215–E).
Type air cleaners ..... oil bath.
Type ignition:
Gasoline ..... magneto.
Diesel ..... compression.
Spark plugs ..... SAE ⅞"–18, hot type.
Starting system ..... electric, Bendix drive.
Batteries ..... two, 6-v, series connected.

(2) *Generator.*

Make and model ..... General Electric #12G857 (PE–215–C); General Electric #12G308 (PE–215–E).
Voltage ..... 120/208 v ac (PE–215–C); 120/240 v ac (PE–215–E).
Frequency ..... 60 cyc.
Phase ..... 3.
Power factor ..... 80%.
Rating ..... 50 kw, 62.5 kva.
Ampere output ..... 174 (PE–215–C); 150 (PE–215–E).
Speed ..... 1,200 rpm.
Drive ..... direct.

(3) *Exciter.*

Make and model ..... General Electric #78K (PE–215–C); General Electric #5BC78DB8A (PE–215–E).
Rating ..... 1.5 kw, 64 v dc.
Speed ..... 2,000 rpm.
Drive ..... dual V belts.

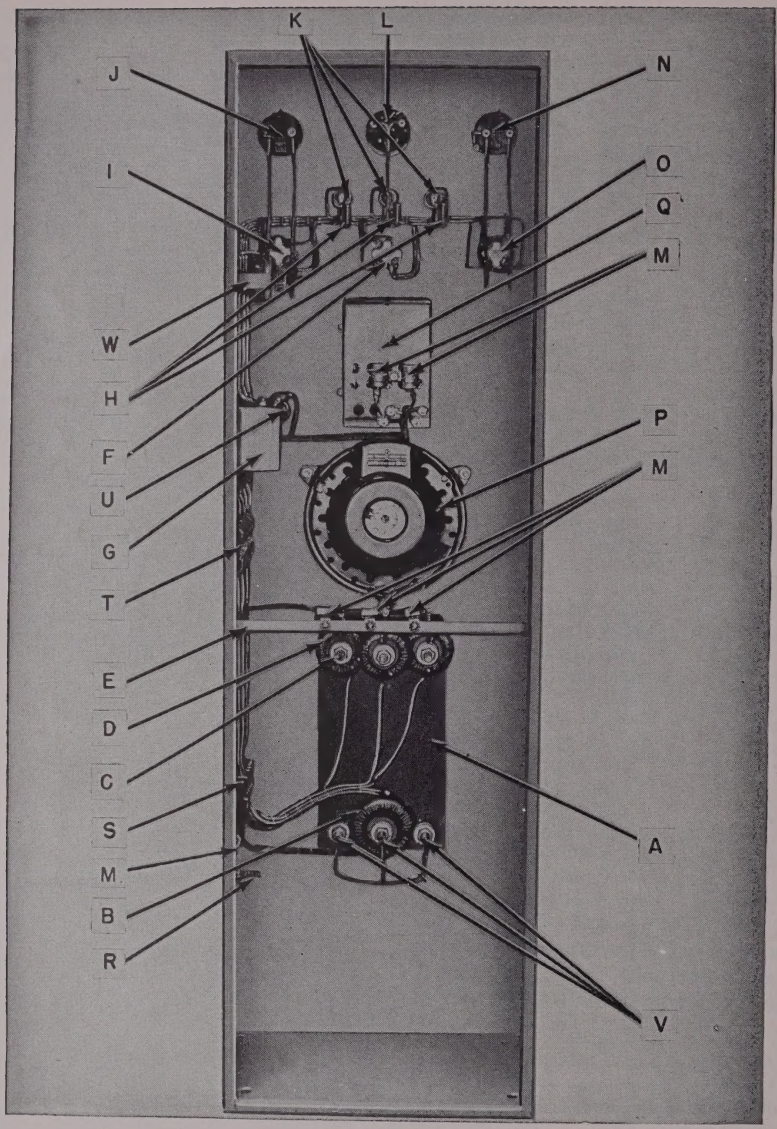
c. SPARE PARTS. The spare parts listed in (1) below are packed in the crate that contains the engine-generator unit.

(1) *Spare parts for Power Unit PE–215–E.*

Quantity	Item
2	Belt, fuel supply pump drive.
4	Belt, cooling fan drive.
1	Bearing, main, front.
4	Bearing, main, intermediate.
1	Bearing, main, center.
1	Bearing, main, rear.
6	Bearing, connecting rod (upper and lower)
3	Brush, battery-charging generator.
6	Brush, starting motor.
8	Brush, alternator.
4	Brush, exciter.
1	Brush holder, alternator.
1	Brush holder assembly, with 4 brushes.
1	Brush holder, stud and insulation.
2	Belt, V, exciter drive.
1	Brush plate, insulated, Delco-Remy.
6	Gasket, nozzle spacer.
6	Gasket, nozzle body.
1 set	Gaskets, engine.
1	Felt, valve mechanism, lubricating.
1	Felt, injection pump drive housing.
2	Hose, radiator outlet.
1	Hose, radiator inlet.
1	Retainer, oil seal, crankshaft, front.
1	Retainer, oil seal, crankshaft, rear.
1	Seal, oil, water pump, inner.
1	Seal, oil, water pump, outer.
1	Seal, oil, starting valve.
1	Seal, oil, cross shaft, starting valve.
1	Seal, oil, injection pump drive.
1	Seal, magneto drive shaft.
2	Shim, exciter.
6	Seal, dust, nozzle body.
6	Seal, dust, nozzle body retainer.
1	Washer, felt, water pump.
2	Washer, felt, oil seal, crankshaft, front.
1	Element, metal, fuel filter.
3	Element, cloth, fuel filter.
80	Element, lubricating-oil filter.
3	Nozzle, fuel injection, complete.
12	Packing, water pump.
6	Valve, exhaust.
2	Valve, intake
6	Plug, spark.
12	Spring, valve.
6	Guide, valve.

(2) *Spare parts for Power Unit PE–215–C.*

Quantity	Item
2	Lamp, synchronizing.
4	Belt, fan drive.
2	Belt, fuel supply pump drive.
2 pair	Belts, matched, exciter drive.
6	Brush, starting motor.
3	Brush, battery-charging generator.
8	Brush, generator.
4	Brush, exciter.
1	Capacitor, magneto.
1 set	Contacts, voltage regulator.
2	Contact, magneto.
4	Element, metal, fuel filter.
10	Element, Puro, fuel filter.
20	Element, lubricating-oil filter.
1	Felt, lubricating, rocker arm.
1 set	Gasket, engine.
6	Gasket, valve cover.
2	Gasket, cylinder-head.
6	Gasket, ring, cylinder-head.



A. Circuit breaker.
B. Cross-current compensating transformer.
C. Generator cable terminals.
D. Current transformers.
E. Capacitor support strap.
F. Synchronizing lamp switch.
G. Potential transformer.
H. Synchronizing lamp resistors.
I. Voltmeter switch.
J. A-c voltmeter.
K. Synchronizing lamp sockets.
L. Frequency meter.
M. Suppression capacitors.
N. A-c ammeter.
O. Ammeter switch.
P. Exciter-field rheostat.
Q. Voltage regulator.
R. Neutral terminal.
S. Exciter connection terminal block.
T. Fuse blocks.
U. Voltage adjusting rheostat.
V. Load cable terminals.
W. Cross-current compensating rheostat.

Figure 13.—Power Unit PE-215-E—switchboard, rear view.

Quantity	Item
2	Gasket, cylinder-head housing.
6	Gasket, nozzle body.
6	Gasket, nozzle fitting.
4	Gasket, exhaust pipe flange.
8	Gasket, exhaust manifold.
2	Gasket, intake manifold, center.
4	Gasket, intake manifold, outer.
3	Gasket, gasoline strainer bowl.
3	Gasket, fuel filter.
20	Gasket, Puro filter.
20	Gasket, Puro filter cover.
2	Hose, radiator outlet.
1	Hose, thermostat.
2	Hose, radiator inlet.
3	Nozzle, fuel injector.
2	Packing, water pump.
3	Plug, spark.
2	Rod, push.
1	Seal, oil retainer, gear cover.
1 set	Seal, felt, crankshaft.
6	Seal, dust, nozzle body retainer.
6	Seal, dust, injector nozzle body.
2	Seal, oil, water pump.
12	Spring, valve.
1	Valve, intake.
2	Valve, exhaust.
2	Washer, felt, gear cover.
1	Washer, felt, fan idler.
1	Washer, felt, water pump.

d. TOOLS.

(1) *Power Unit PE–215–E.*—The following tools, supplied with Power Unit PE–215–E, are packed in the toolbox attached to the skid base of the unit:

Quantity	Item
1	Wrench, socket and handle (for coupling).
1 set	Wrench, socket, ½-in. drive, consisting of:
	1 Extension, 5½ in.
	1 Extension, 10½ in.
	1 Handle, flexible, 17¼ in.
	1 Ratchet, reversible, 10½ in.
	1 Handle, speeder, 12 in.
	1 Handle, sliding T, 11 in.
	1 Universal.
	1 Socket, 7/16 in.
	1 Socket, ½ in.
	1 Socket, 9/16 in.
	1 Socket, 19/32 in.
	1 Socket, 5/8 in.
	1 Socket, 11/16 in.
	1 Socket, ¾ in.
	1 Socket, 25/32 in.
	1 Socket, 13/16 in.
	1 Socket, 7/8 in.
	1 Socket, 31/32 in.
	1 Socket, 1 in.
	1 Socket, extra deep, 11/16 in.
	1 Socket, extra deep, 13/16 in.
	1 Socket, extra deep, 7/8 in. (spark plug).
	1 Socket, extra deep, 15/16 in.
	1 Socket, deep, 1⅛ in.
1	Gage, thickness, 9 leaf.
1	Gun, grease, 5 oz.
1	Hammer, ball-peen, 9 oz.
1	Can, oil, ½ pt.
1	Pliers, slip joint, 6 in.
1	Screw driver, 4 in. blade.
1	Screw driver, 5½ in. blade.
1	Screw driver, 7½ in. blade.
1	Screw driver, 12 in. blade.
1	Wrench, adjustable angle, 8 in.
1	Wrench, Allen setscrew.
1	Wrench, water pump.
1 set	Wrenches, open end, consisting of:
	1 Roll, tool, 10 pocket.
	1 Wrench, 5/16–⅜ in.
	1 Wrench, 13/32–½ in.
	1 Wrench, 7/16–9/16 in.
	1 Wrench, 19/32–11/16 in.
	1 Wrench, ⅝–¾ in.
	1 Wrench, 13/16–7/8 in.
	1 Wrench, 25/32–31/32 in.
	1 Wrench, 15/16–1 in.
	1 Wrench, 1⅛–1 5/16 in.
	1 Wrench, 1¼–1⅝ in.

(2) *Power Unit PE–215–C.*—The following tools are supplied with Power Unit PE–215–C:

Quantity	Item
1	Bottle, shellac, small.
1	Can, oil.
1	Can, valve-grinding compound, 2 oz.
1 box	Cotter pins, small, assorted.
1	File, contact, voltage regulator.
1	Gage, feeler.
1	Grinder, valve.
1	Hammer, ball-peen.
1	Handle, socket wrench, ½-in. drive, 9¼ in. lg.
1	Handle, socket wrench, ⅜-in. drive, 4¾ in. lg.
1	Lifter, valve.
1	Lubricator, 9 oz.
2 sheets	Paper, sand, #00.
1 tube	Permatex, 8 oz.
1	Pliers, gas, 6½ in.

Quantity	Item
1	Screw driver, 4-in. blade.
1	Screw driver, 6-in. blade.
1	Screw driver, 10-in. blade.
1	Wrench, adjustable, 12 in.
1	Wrench, water pump.
1	Wrench, spark plug, with handle.
1	Wrench, stem handle, socket.
1	Wrench, 5/16 in. hexagonal (for switchboard lugs).
1	Wrench, socket, 5/16 in. hexagonal.
1	Wrench, socket, 5/16 in. hexagonal (voltage regulator).
1 set	Wrenches, box, double-end, consisting of:
	1 Wrench, 3/8–7/16 in.
	1 Wrench, 1/2–9/16 in.
	1 Wrench, 5/8–11/16 in.
	1 Wrench, 3/4–25/32 in.
	1 Wrench, 13/16–7/8 in.
	1 Wrench, 15/16–1 in.
1 set	Wrenches, double-end, open-end, consisting of:
	1 Wrench, 3/8–7/16 in.
	1 Wrench, 1/2–18/32 in.
	1 Wrench, 9/16–5/8 in.
	1 Wrench, 11/16–25/32 in.
	1 Wrench, 3/4–7/8 in.
	1 Wrench, 15/16–1 in.

e. INSTALLATION MATERIAL. The following installation material for Power Unit PE–215–E is packed with the unit:

Quantity	Item
6	Bolts, machine, 3/4 in. x 10 in., threaded 3 in., square head, steel.
12	Nuts, 3/4 in. NC thread, steel.
12	Washers, 3/4 in., SAE, steel.
6	Sleeves, pipe, 1 1/2 in. IPS x 6 11/16 in., steel.
6	Washers, 3/4 in. std, 3 in. OD, cast-iron.
6	Screws, lag, 3/4 in. x 4 in., steel.
6	Sleeves, lag screw expansion, for 3/4 in. screw.
24	Screws, #10–24 x 7/8 in. lg, RHMS, steel.
24	Nuts, #10–24, hexagonal steel.
24	Washers, 3/16 in., SAE, steel.
24	Screws, #8 x 1 1/2 in. FH wood, steel.
1 lb	Nails, 10d, 3 in. lg, steel.
1/4 lb	Tacks, #8 x 9/16 in. lg, steel.
30 ft	Tubing copper, 3/8 in., with couplings.
30 ft	Tubing, copper, 1/2 in., with couplings.
10 ft	Pipe, 3 in., black iron, both ends threaded.
1	Elbow, 3 in., 90°.
1	Union, 3 in. flange.
5 yd	Canvas, 36 in. wd, for air duct.
2	Nipples, 3 in. pipe.
	Bolts and gaskets for flange.

CHAPTER 2

OPERATING PROCEDURES

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

8. Service Necessary for New Equipment

a. SITING. Choose a location that will be consistent with the assignment to be performed and the length of attaching cables. Locate the power unit as near the center of the load as practicable. Allow sufficient room for servicing the unit and for installation of the control cabinet. As these power units have no protection against the weather, some form of housing or shelter must be provided. Make provision for ample ventilation to carry off heat generated by the unit and to provide air to support combustion.

b. PREPARATION OF FOUNDATION. Place the power unit on a substantial foundation, preferably concrete. Install the remote fuel tank (not supplied with the equipment) in accordance with the installation diagram (fig. 14). The bottom of the fuel tank must not be more

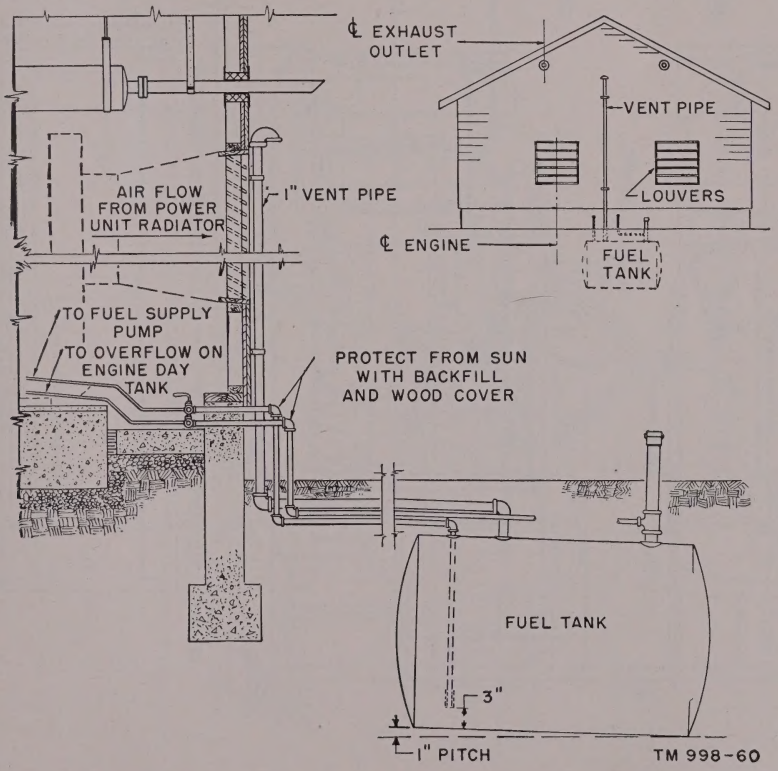
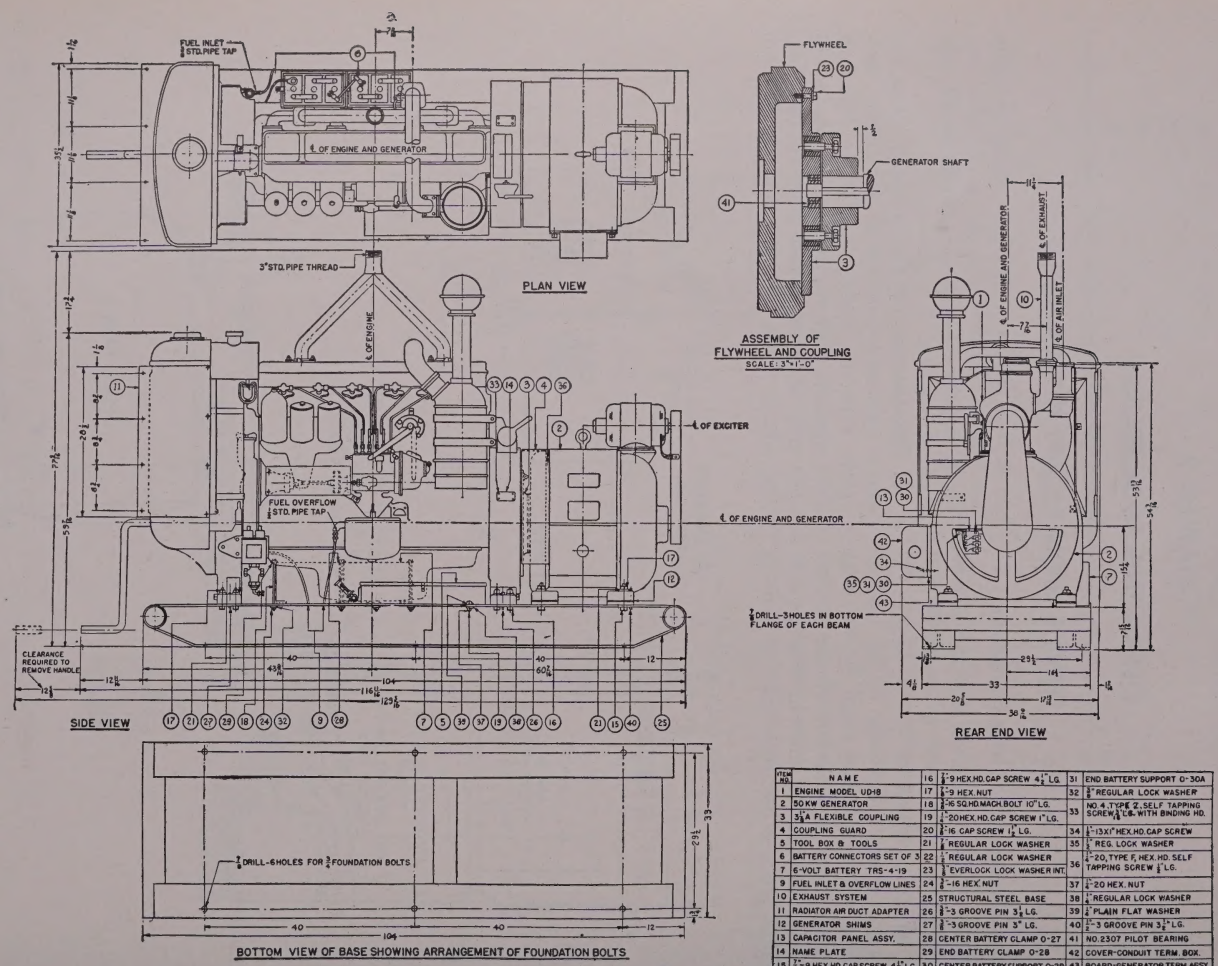


Figure 14.—Typical power unit installation—diagram.



ITEM NO.	NAME	ITEM NO.	NAME	ITEM NO.	NAME
1	ENGINE MODEL UD18	16	½-9 HEX.HD.CAP SCREW 4½" LG.	31	END BATTERY SUPPORT D-30A
2	50 KW GENERATOR	17	½-9 HEX.NUT	32	⅜ REGULAR LOCK WASHER
3	3⅛ A FLEXIBLE COUPLING	18	⅜-16 SQ.HD.MACH.BOLT 10" LG.	33	NO.4 TYPE 2 SELF TAPPING SCREW ¼ LG. WITH BINDING HD.
4	COUPLING GUARD	19	¼-20 HEX.HD.CAP SCREW 1" LG.		
5	TOOL BOX & TOOLS	20	⅜-16 CAP SCREW 1½ LG.	34	½-13 X 1" HEX.HD.CAP SCREW
6	BATTERY CONNECTORS SET OF 3	21	¼ REGULAR LOCK WASHER	35	½ REG. LOCK WASHER
7	6-VOLT BATTERY TRS-4-19	22	¼ REGULAR LOCK WASHER	36	¼-20, TYPE F, HEX.HD. SELF TAPPING SCREW ½ LG.
9	FUEL INLET & OVERFLOW LINES	23	⅜ EVERLOCK LOCK WASHER INT.		
10	EXHAUST SYSTEM	24	⅜-16 HEX.NUT	37	¼-20 HEX.NUT
11	RADIATOR AIR DUCT ADAPTER	25	STRUCTURAL STEEL BASE	38	¼ REGULAR LOCK WASHER
12	GENERATOR SHIMS	26	⅜-3 GROOVE PIN 3½ LG.	39	½ PLAIN FLAT WASHER
13	CAPACITOR PANEL ASSY.	27	⅜-3 GROOVE PIN 3" LG.	40	½-3 GROOVE PIN 3½ LG.
14	NAME PLATE	28	CENTER BATTERY CLAMP D-27	41	NO.2307 PILOT BEARING
15	⅜-9 HEX.HD.CAP SCREW 4½ LG.	29	END BATTERY CLAMP D-28	42	COVER-CONDUIT TERM. BOX.
		30	CENTER BATTERY SUPPORT D-29	43	BOARD-GENERATOR TERM. ASSY.

TM 941C-19

Figure 15.—Power Unit PE-215-C—assembly diagram.

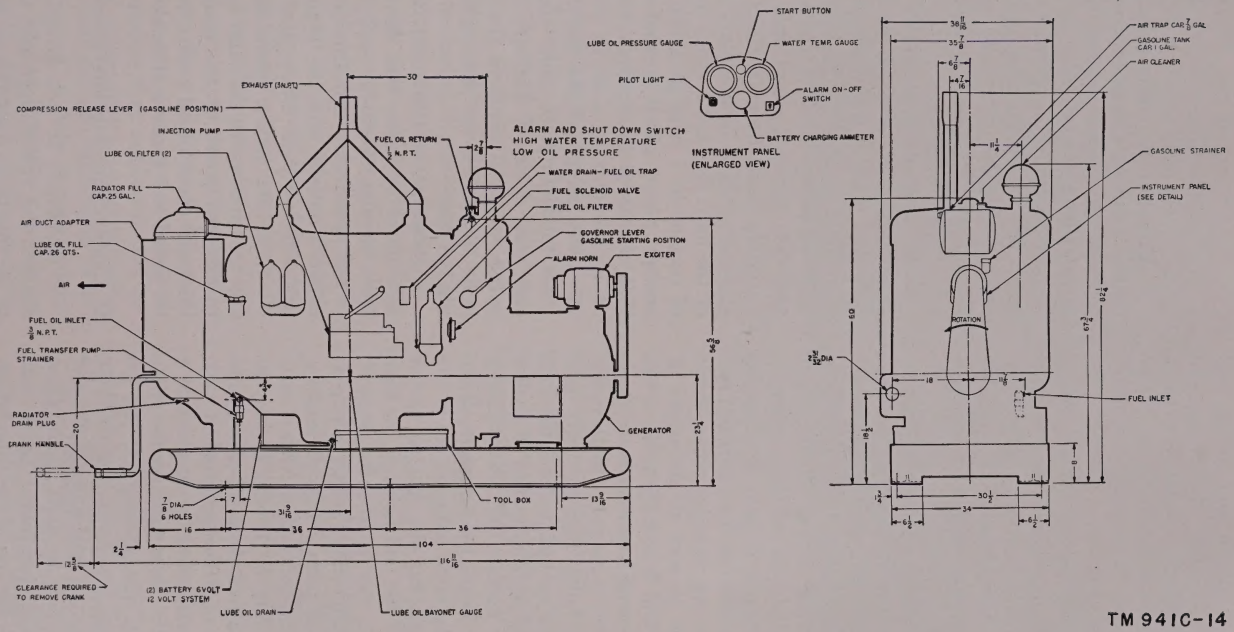


Figure 16.—Power Unit PE–215–E—dimensions.

than 8 feet below the level of the engine crankshaft. Install the tank as far away from the unit as the length of piping and tubing will permit and make sure that all tubing and piping pitches downward toward the tank. Install a check valve between the engine fuel oil intake and the tank to prevent back drain when the engine is shut down.

(1) *Using old foundation.*—If a suitable concrete slab or concrete floor is available, mark the location of the hold-down bolt holes and drill the concrete to take expansion sleeves for the hold-down bolts.

(2) *New foundations.*—If a new foundation is necessary, excavate an area approximately 40 inches by 140 inches to a depth of at least 12 inches. If the soil is not firm, increase the depth of the excavation accordingly. Make a wooden template to hold the foundation bolts in their correct position and support the template by cross pieces long enough to rest on the edges of the excavation. Insert the bolts in the holes in the template with their heads down and run nuts onto the threaded ends of the bolts. Run the nuts onto the bolts far enough to hold the tops of the bolts approximately 3 inches above the surface of the finished foundation. Level the template. Make sure that the bolts hang plumb in the template and that the spacing agrees with that of the bolt holes in the base of the unit. Secure the template to prevent displacement while the concrete is being poured into the excavation. Fill the excavation with a mixture consisting of 1 part of cement (by weight) to 2 parts of coarse sand and 3 parts of gravel or crushed rock. Add only enough water to produce a workable mix. Do not use forms unless the walls of the excavation are too soft to stand up. Tamp the concrete well around the hold-down bolts and make sure not to shift them from their correct positions. Level and rough finish the top of the foundation. Be sure that the concrete is thoroughly set before removing the template. Keep the top of the foundation damp for at least 10 days to insure proper curing. This may be accomplished by covering the concrete with wet straw, burlap, or canvas.

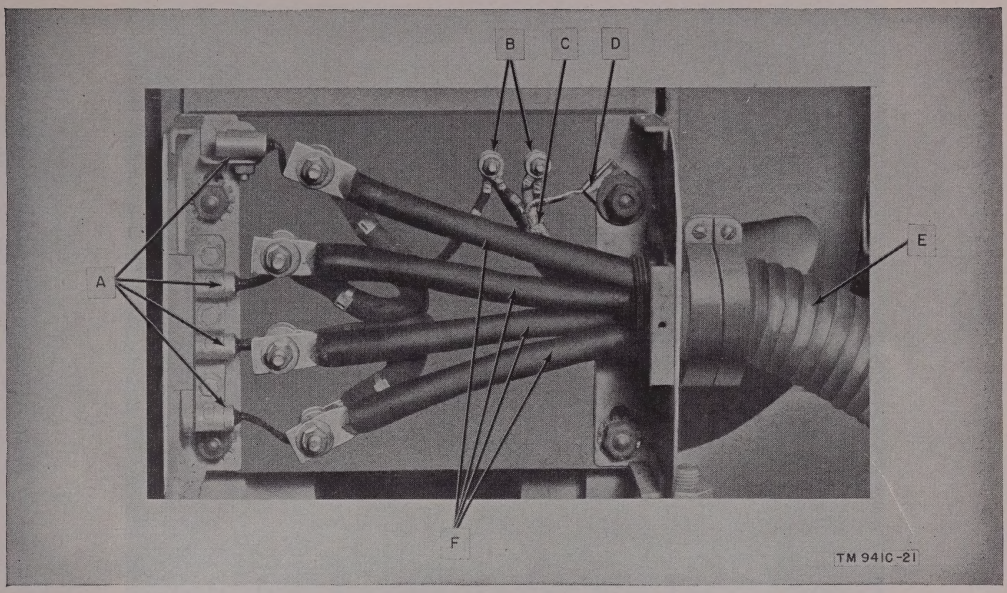
c. UNPACKING. Carefully remove the packing crates from the equipment and check the contents of the crates against the packing lists to see that the equipment is complete. Check for any possible damage that may have occurred in transit. If any damage is noted or if the equipment does not check with the packing lists, fill out DD form 6 and forward in accordance with AR 700–30.

d. SETTING UP EQUIPMENT. Raise the unit sufficiently to clear the tops of the hold-down bolts and move it into position on the foundation. Make sure that the hold-down bolts are centered in the holes in the base of the unit, and then lower the unit onto the foundation. Carefully level the unit. Build a wooden dam, approximately 3 inches high, around the base of the unit. Prepare a grout mixture of 1 part of cement to 1 part of sharp sand with just enough water added to make a thick liquid that can be easily worked. Pour this mixture under the unit to a depth sufficient to cover the lower flange of the skid base. Tamp the grout mix into place under the unit and make sure that it is of uniform thickness at all points where it contacts the base. Allow the grout mixture to set thoroughly before removing the dam.

e. REMOVAL OF CORROSION PREVENTIVES. On new units or units that have been removed from storage, check for seals or blind gaskets in the carburetor and Diesel air intakes, the exhaust outlets, and the crankcase breather; and remove them. Drain the rust preventive oil from the engine cranckcase and remove any rust preventive that may have been applied to external parts of the equipment. Make a thorough check of all points that may possibly be sealed and remove all seals that are found.

9. Connections and Interconnections

a. GENERAL. If not already accomplished, connect the fuel supply and fuel return lines to the fuel tank. Assemble all necessary exhaust line and electrical connection materials and check their condition.



A. Suppression capacitors.
B. Exciter lead terminals.
C. Exciter leads.
D. Shielding ground.
E. Flexible conduit.
F. Power cables to switchboard.

Figure 17.—Power Unit PE–215–C—alternator terminal box connections.

b. EXHAUST CONNECTIONS. Install the two branches of the Y section of the exhaust line to the exhaust manifolds of the engine. Be sure to install any gaskets that are provided. Connect the flexible metal exhaust hose to the outlet of the Y section. Install the exhaust muffler in the most convenient position and extend the exhaust line from the outlet side of the muffler to the outside of the building or shelter. Insulate the exhaust line thoroughly wherever it passes through a wall or partition and protect the outlet end of the exhaust line from the entrance of rain or other forms of moisture.

c. ELECTRICAL CONNECTIONS (figs. 17–21). Set the control cabinet in position and complete connections between the switchboard and generator. Four power leads are brought out to the alternator terminal box and connected to terminal studs on a terminal board within the box. The exciter leads are also brought to studs on this terminal board. A hole is provided in the terminal box for the connecting cables to the switchboard. (On PE–215–C, the connecting cables pass through a flexible conduit which is not provided on PE–215–E.) The attaching cables are provided with metal markers which are marked T0, T1, T2, and T3 for the alternator leads, and 2 and 3 for the exciter leads. Connect the cables as follows:

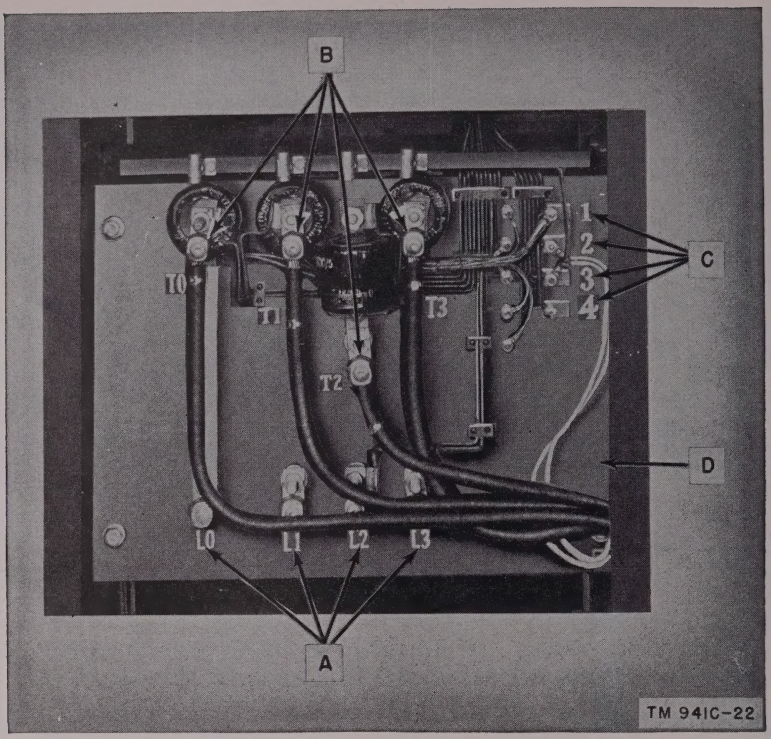
(1) Connect the cable lugs marked 0, 1, 2, and 3 to the terminals in the terminal box marked T0, T1, T2, and T3.

(2) Connect the shielded wires marked 2 and 3 to the terminals marked 2 and 3 on the terminal board. (Wires are unshielded on PE–215–E.)

(3) On Power Unit PE–215–C, ground the shielding of the exciter leads to the upper right-hand terminal board mounting stud.

(4) Connect the alternator leads to the upper circuit breaker terminals on the back of the switchboard that bear the same markings as on the alternator ends of the cables.

(5) On PE–215–C, connect the exciter leads marked 2 and 3 to the corre-



A. Load connection terminals.
B. Alternator connection terminals.
C. Exciter connection terminals.
D. Ebony-asbestos panel.

Figure 18.—Power Unit PE–215–C—circuit breaker connections.

spondingly marked terminals on the ebony-asbestos panel on the switchboard. Ground the exciter lead shielding to the screw in the capacitor support strap directly above terminals 2 and 3.

(6) On PE–215–E, connect the exciter leads marked 2 and 3 to terminals 2 and 3 of the seven-point terminal block on the side of the switchboard interior. These leads are unshielded.

d. GROUNDING. Connect the base of the power unit and the switchboard frame to a good low-resistance ground. A pipe or rod driven well down into moist earth is recommended for this purpose. Use a ground conductor at least equal in size to the largest connector between the alternator and switchboard. Connect the ground lead to either terminal 1 or 4 on the back of the circuit breaker on PE–215–C or to terminal 1 of the seven-point terminal block on PE–215–E.

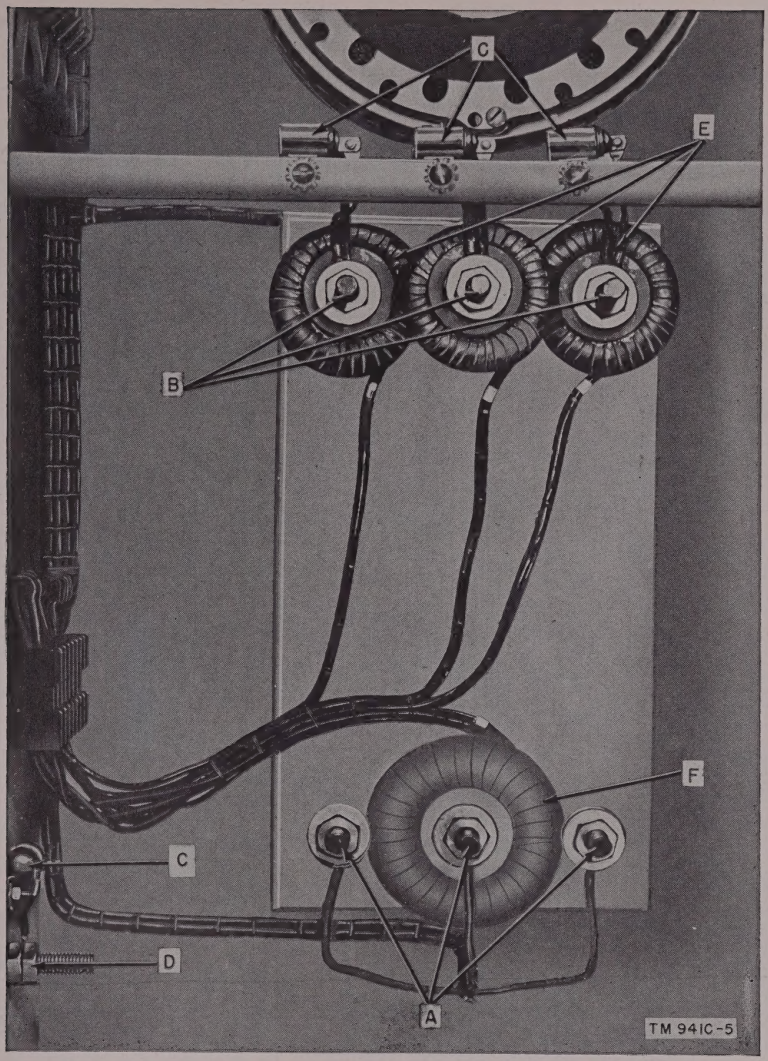
e. LOAD CONNECTIONS.

(1) *Power Unit PE–215–C.*—On Power Unit PE–215–C, connect the load to the four lower terminals of the circuit breaker marked L0, L1, L2, and L3.

(2) *Power Unit PE–215–E.*—On Power Unit PE–215–E, connect the load to the three lower terminals of the circuit breaker marked L1, L2, and L3. Connect the neutral wire, if used, to the terminal stud marked T0.

f. PARALLEL CONNECTIONS. To operate these units in parallel, connect terminals L0, L1, L2, and L3 of the circuit breaker to the correspondingly marked terminals of the other units.

g. BATTERY CONNECTIONS. The two dry-charged storage batteries are installed on the bases of the units when shipped. These bat-

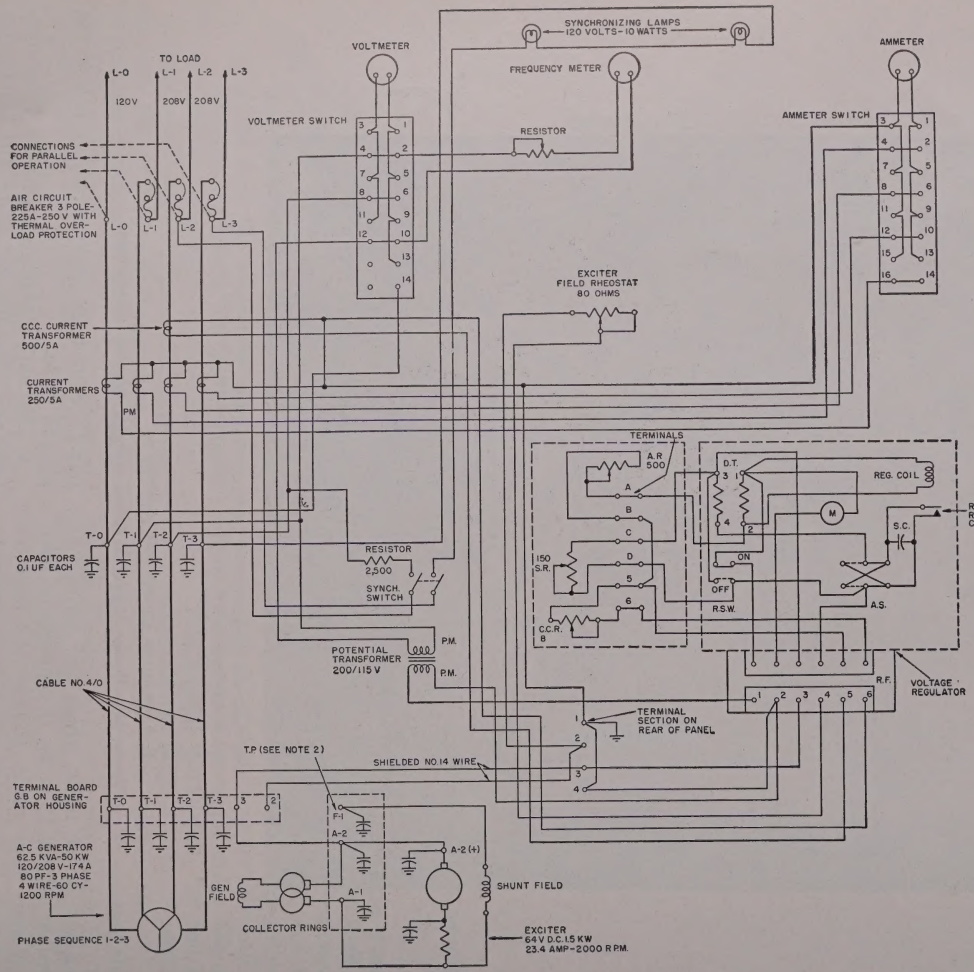


A. Load connection terminals (lower circuit breaker terminals).
B. Alternator terminal connection (upper circuit breaker terminals).
C. Suppression capacitors.
D. Neutral stud.
E. Current transformer.
F. Cross-current compensating transformer.

Figure 19.—Power Unit PE-215-E—circuit breaker connections.

teries are 6-volt units which are series-connected to deliver 12 volts. If connections have not already been made, connect the negative battery pole to the cable which is connected to the starter switch on the engine instrument panel. Connect the positive battery pole to the ground cable.

h. OLD OR RECONDITIONED UNITS. Previously used and reconditioned units will require the same general handling as new equipment.



DRUM DEVELOPMENT FOR AMMETER SWITCH

CONTACTS	POSITION 1 (T-1)	2 (T-2)	3 (T-3)	4 (N)
1 o—o 2	X			
3 o—o 4		X	X	X
5 o—o 6		X		
7 o—o 8	X		X	X
9 o—o 10			X	
11 o—o 12	X	X		X
13 o—o 14				X
15 o—o 16	X	X	X	

DRUM DEVELOPMENT FOR VOLTMETER SWITCH

CONTACTS	POSITION LINE TO NEUTRAL OFF	1	2	3	LINE TO LINE OFF	1	2	3
1 o—o 2								X
3 o—o 4		X				X		
5 o—o 6						X		
7 o—o 8			X				X	
9 o—o 10							X	
11 o—o 12				X				X
13 o—o 14		X	X	X				

"X" INDICATES CLOSED CONTACTS

ABBREVIATIONS:

A.R.—ANTI-HUNT & CALIBRATING RESISTOR
A.S.—AUTOMATIC POLARITY REVERSING SWITCH
C.C.C.—CROSS CURRENT COMPENSATION
C.C.R.—CROSS CURRENT RESISTOR
D.T.—DAMPING TRANSFORMER
M — A.S. MOTOR
P.M.—POLARITY MARK
R.F.—RADIO INTERFERENCE SUPPRESSION FILTER
R.S.W.—VOLTAGE REGULATOR SWITCH
S.C.—SPARK SUPPRESSOR CAPACITOR
S.R.—SHUNT FIELD RESISTOR
T.P.—TERMINAL PANEL ON GENERTOR END SHIELD

NOTES:

1. ALL CAPACITORS SHOWN ARE 0.1 UF
2. LOCATIONS OF TERMINALS AS SHOWN ON GEN. & EXCITER TERMINAL BOARDS G.T. & T.P. ARE NOT PHYSICAL, ONLY DIAGRAMMATICAL.

TM941C-24

Figure 20.—Power Unit PE-215-C—wiring diagram.

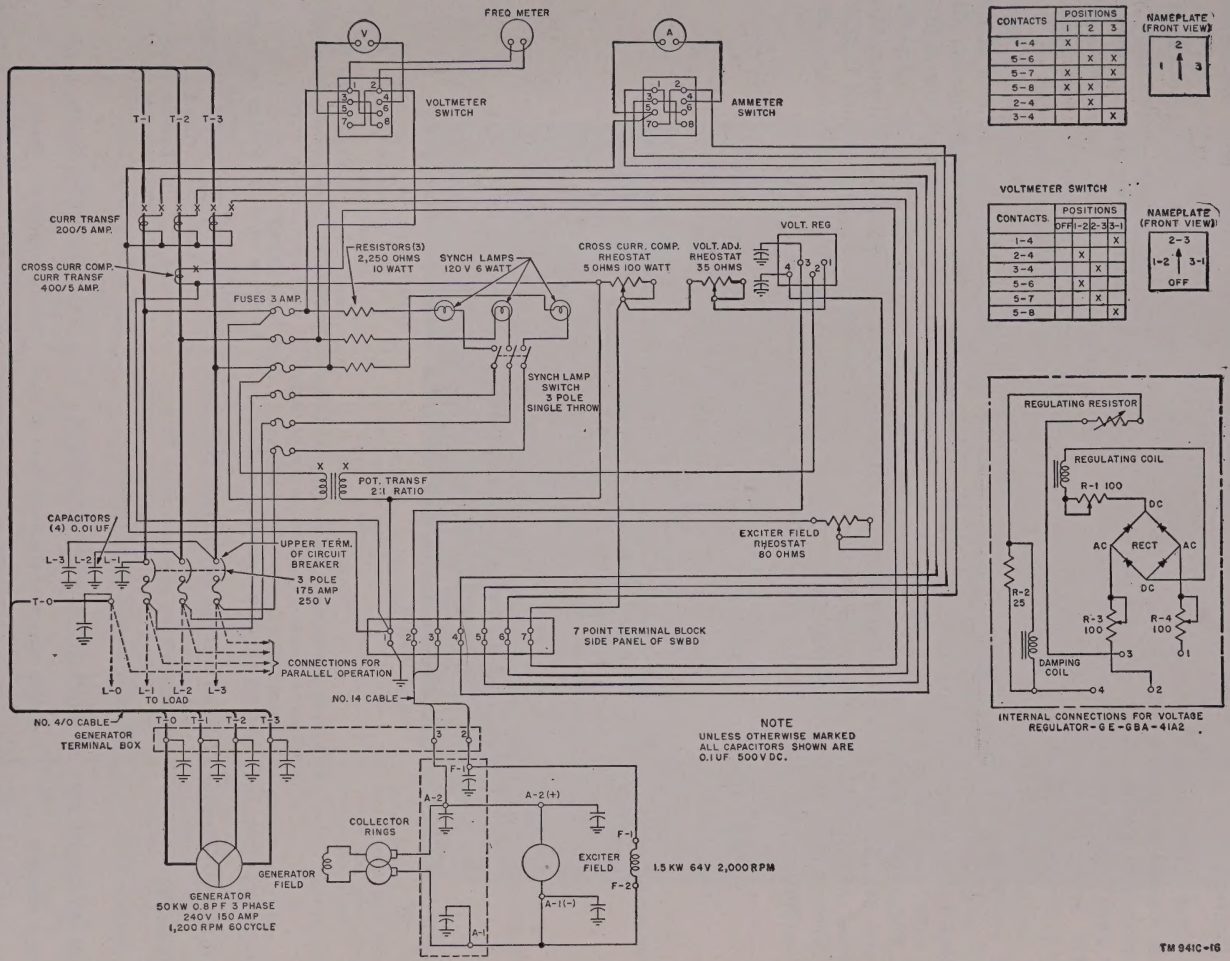


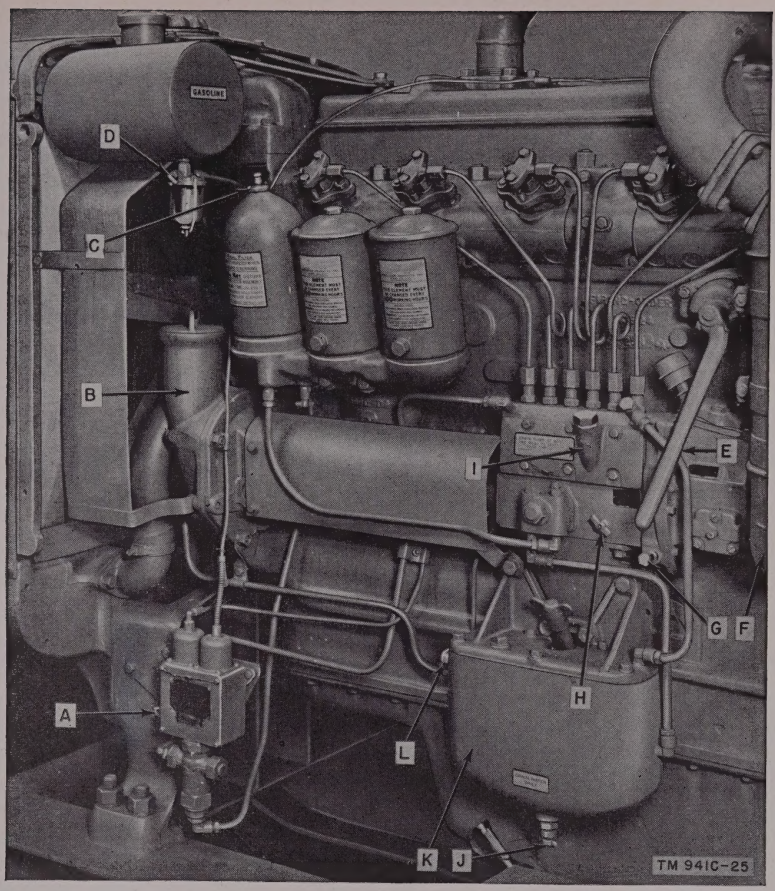
Figure 21.—Power Unit PE-215-E—wiring diagram.

10. Controls

a. ENGINE CONTROLS. The engine controls on Power Units PE–215–C and PE–215–E consist of a manually operated carburetor choke (used only when starting on gasoline), a compression release lever for changing the units from gasoline to fuel oil operation, and a governor control (used on Diesel operation only). A manually operated priming pump also is provided on PE–215–C. The units also are provided with automatic low-oil-pressure and high-temperature cut-offs and an automatic governor.

b. LOCATION OF ENGINE CONTROLS (figs. 22, 23, and 24). The compression release lever is mounted on the injector side of the engine; the carburetor choke is located directly above the carburetor; and the governor control is attached to the side of the engine instrument panel which is mounted above the flywheel. On this panel are mounted a lubricating-oil pressure gage, a coolant temperature gage, a battery charge-discharge ammeter, and the electric starter switch button. On Power Unit PE–215–E, an ALARM ON-OFF switch and an indicating light are also mounted on the engine control panel. A bayonet-type oil level gage is provided for checking the level of the lubricating oil in the engine crankcase. On Power Unit PE–215–C, a thermometer is provided on the side of the crankcase, below the fuel oil day tank, to indicate the temperature of the crankcase oil. The purpose and location of the various controls and instruments are indicated in the table that follows:

Item	Purpose	Location	
		PE–215–C	PE–215–E
Compression release	When moved forward (toward the radiator), this lever places the unit in gasoline operating condition. When moved toward the rear of the unit, it places the unit in Diesel operating condition.	On right-hand side of unit.	Same.
Carburetor choke	Reduces the amount of air drawn through the carburetor when starting the unit and thus provides a rich gasoline-air mixture.	On upper part of carburetor. Left-hand side of unit.	Same.
Governor control	Controls governor action and thus acts as engine throttle.	Above flywheel housing on the side of the engine instrument panel.	Same.
Safety switch	Automatically stops the unit when lubricating-oil pressure becomes too low or engine temperature becomes too high.	Attached to front right-hand engine support.	Beside compression release.
Safety switch reset	Restores switch to operating condition	Lever on side of switch.	Button on face of switch unit.
ALARM ON-OFF switch	Permits removing safety switch from operation when starting.	Not used	Engine instrument panel.
Warning light	Indicates normal operation when lit.	Not used	Engine instrument panel.
Oil pressure gage	Indicates lubricating-oil pressure	Engine instrument panel.	Same.
Water temperature gage	Indicates engine coolant temperature	Engine instrument panel.	Same.
Battery ammeter	Indicates charge or discharge rate of storage battery.	Engine instrument panel.	Same.
Electric starter button	Closes circuit to starting motor when pressed.	Engine instrument panel.	Same.



A. Safety device trip lever.
B. Crankcase oil filler.
C. Fuel filter bleeder valve.
D. Gasoline shut off.
E. Compression release lever.
F. Air cleaner base.
G. Lubricating-oil drain.
H. Lubricating-oil level cock.
I. Lubricating-oil filler.
J. Fuel oil (day tank) drain.
K. Fuel oil (day tank) tank.
L. Fuel oil connection.

Figure 22.—Power Unit PE-215-C—engine close-up, right side.

c. SWITCHBOARD CONTROLS AND METERS (figs. 10 and 11).

(1) *Controls.*—The purpose and location of the various controls on the switchboards are indicated in the following table:

Item	Purpose	Location	
		PE-215-C	PE-215-E
Circuit breaker	Acts as load switch and also automatically disconnects load in the event of overload or short circuit.	Lower center of face of switchboard.	Same.
Exciter-field rheostat	Permits manual adjustment of generator output.	Center of upper half of switchboard.	Center of switchboard.
Ammeter switch	Permits shifting ammeter from one phase to another.	To left of exciter-field rheostat.	Left center of upper half of switchboard.

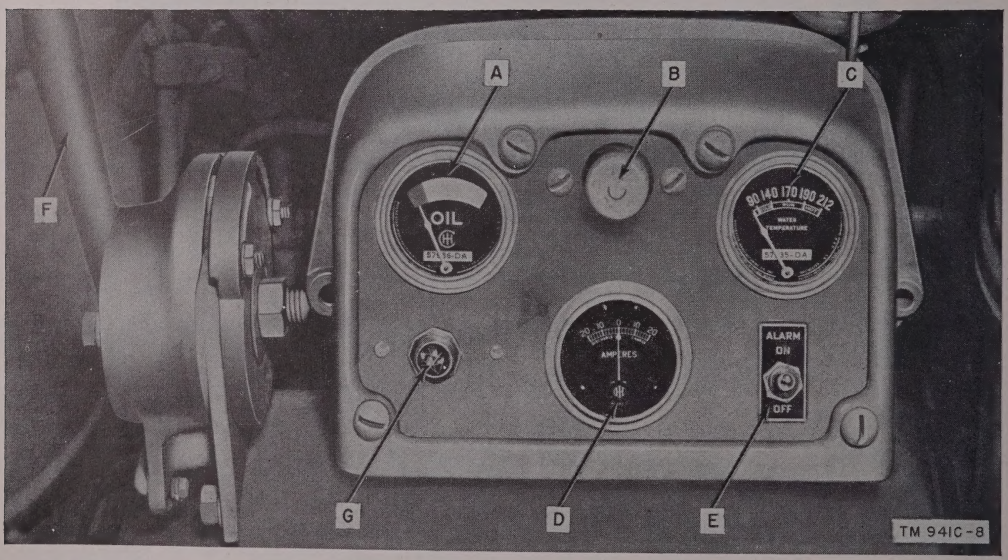
Item	Purpose	Location	
		PE–215–C	PE–215–E
Voltmeter switch	Permits shifting voltmeter from one phase circuit to another.	To right of exciter-field rheostat.	Top right center of switchboard.
Synchronizing lamps	Indicate when units are in proper synchronization.	Extreme top center of switchboard.	Center of panel below frequency meter.
Synchronizing lamp switch.	Permits cutting synchronizing lamps in or out of circuit.	Below voltmeter switch.	Below center synchronizing lamp.
Voltage adjusting rheostat.	Permits manual adjustment of voltage regulator.	See note 1 below.	Left-hand side of switchboard below voltmeter switch.
Voltage regulator switch See note 2 below.	Permits cutting automatic voltage regulator in or out of service.	Center of face of regulator.	Pull-out tray at bottom of regulator.

Note 1.—The automatic voltage regulator on Power Unit PE–215–C has a slotted shaft in the lower left corner of the face of the regulator to permit adjustment.

Note 2.—The voltage regulator switch on Power Unit PE–215–C is a conventional on-off toggle switch. On Power Unit PE–215–E, it is a pull-out tray. When the tray is pulled out, the regulator is out of service. When pushed in, the regulator is in service.

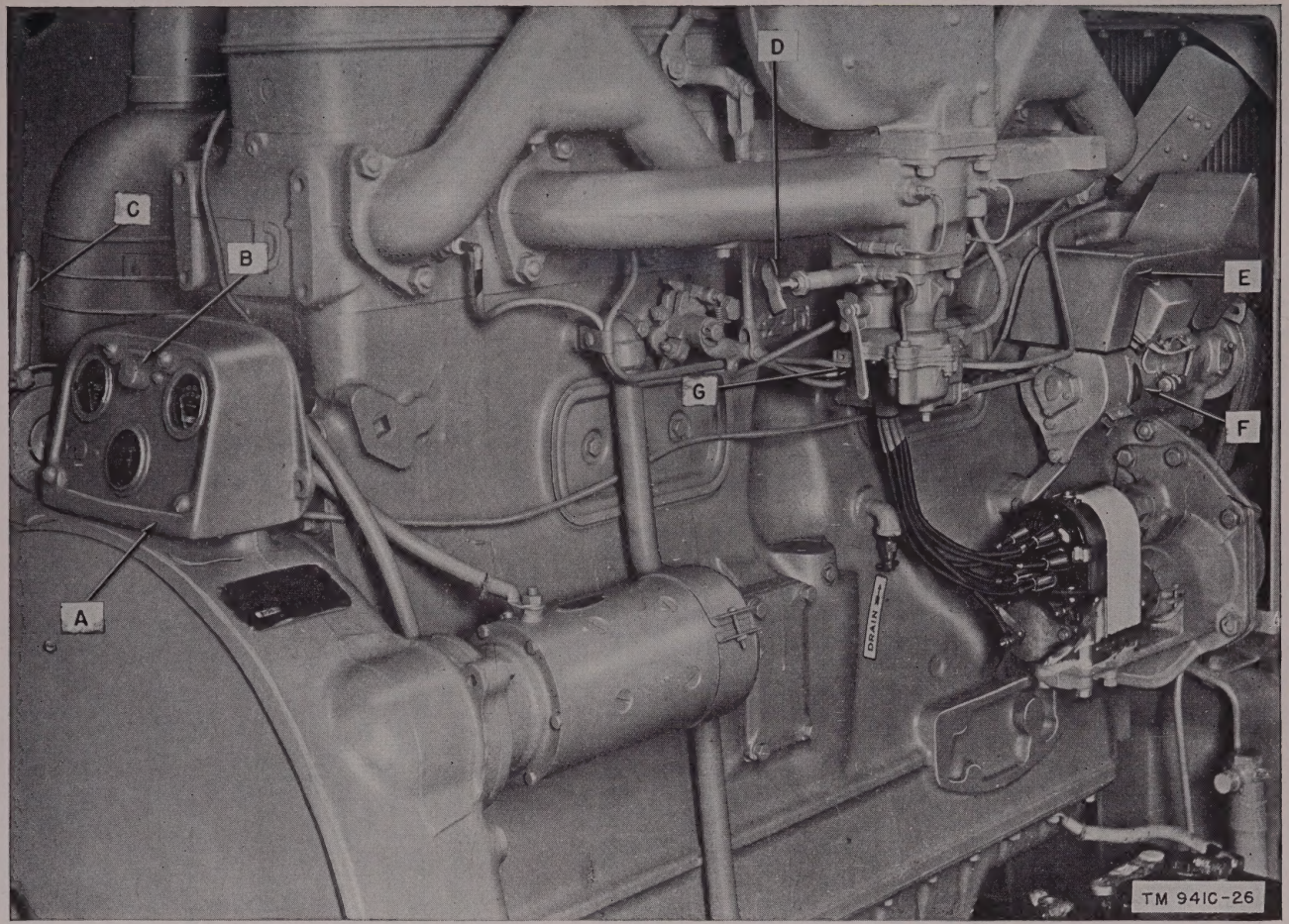
(2) *Meters.*—The purpose and location of the various meters used on the switchboards are shown in the following table:

Item	Purpose	Location	
		PE–215–C	PE–215–E
A-c ammeter	Permits reading load on any phase by operating ammeter switch.	Upper left of switchboard.	Same.
A-c voltmeter	Permits reading voltage output	Upper right of switchboard.	Same.
Frequency meter	Permits reading frequency	Top center of switchboard.	Same.



A. Lubricating-oil pressure gage.
B. Electric starting button.
C. Water temperature gage.
D. Battery charging ammeter.
E. Safety alarm switch.
F. Governor control lever.
G. Pilot light.

Figure 23.—Power Unit PE–215–E—engine control panel.



A. Engine instrument panel.
B. Electric starting button.
C. Governor control lever.
D. Priming pump.
E. Charging generator shield.
F. Charging generator.
G. Carburetor choke.

Figure 24.—Power Unit PE-215-C—engine close-up, left side.

11. Automatic Controls

a. ENGINE SAFETY SWITCH. See paragraph 10*b* for the location of this switch. This switch is an automatic valve device which automatically cuts off the fuel supply when the lubricating-oil pressure drops below a safe value or the engine-coolant temperature becomes too high. Within the valve are two precisely guided, floating poppets. These poppets are spring loaded and are held open by a trigger arrangement. Failure of oil pressure or excessive engine-coolant temperature causes the trigger of one or the other of these valves to trip and thus permits the valve to close and cut off the engine fuel supply. Before the engine can again be started, the safety device must be reset. On Power Unit PE–215–C, this is accomplished by lifting a lever projecting from the side of the device. On Power Unit PE–215–E, it is accomplished by pushing the reset button on the face of the safety switch.

b. ENGINE TEMPERATURE CONTROL. The temperature of the coolant in the engine cooling system is controlled by thermostats within a housing through which the engine coolant flows when returning to the radiator. These thermostats restrict the flow of coolant whenever the temperature of the coolant is below a predetermined level.

c. BATTERY-CHARGING REGULATOR. The battery-charging regulator unit, mounted on top of the battery-charging generator, consists of an automatic voltage regulating device and an automatic cut-out switch. The entire assembly is housed in a metal case. The automatic cut-out (relay) disconnects the battery when the unit is stopped or when the generator output drops too low to charge the battery. The purpose of this cut-out is to prevent battery discharge through the generator. The voltage regulator regulates the charging rate and thus prevents excessive voltage from causing damage to the battery.

d. ALTERNATOR VOLTAGE REGULATOR. The purpose of this automatic voltage regulator is to maintain automatically constant voltage output of the alternator. This device is cut in or out of the circuit by operation of the voltage regulator toggle switch on Power Unit PE–215–C or by manipulation of the pull-out tray of the voltage regulator on Power Unit PE–215–E. This regulator functions by cutting resistance in or out of the exciter-field circuit, thus increasing or lowering the exciter-field current.

Section III. OPERATION UNDER USUAL CONDITIONS

12. Preliminary Procedures

a. PRELIMINARY INSPECTION. Inspect the unit thoroughly to see that it is in proper working order and that all moving parts move freely. Check all fuel, oil, coolant, and wire connections to make sure that they are secure. Tighten any loose screws, nuts, or bolts. See that all protective guards are securely in place.

b. LUBRICATION. Refer to the lubricating instructions in sections II and III, chapter 3. Clean all lubricating fittings before lubricating, and lubricate the equipment in accordance with the instructions.

c. FUEL AND COOLANT. Fill the gasoline tank with Motor fuel U. S. Army Specification 2–103C. See that the fuel oil storage tank is filled with Oil, fuel, Diesel (DA for moderate temperatures, DX for freezing temperatures) U. S. Army Specification 2–102C (Amend. 3). Fill the radiator and cooling system with clean water. See that all drains are closed and check all cooling system connections for leaks after filling the system. If the unit is operated in freezing temperatures, protect the cooling system with antifreeze in accordance with the following table:

Lowest expected temperature	10° F.	0° F.	−10° F.	−20° F.	−30° F.	−40° F.	−50° F.
Compound, antifreeze (in pints) per gallon of cooling system capacity.	2	2½	3	3½	4	4½	5

d. AIR CLEANER. Remove the base of the air cleaner and make sure that it is free from all foreign matter. Fill the bowl of the air cleaner, up to the indicated level, with the same grade of Oil, engine (OE) U. S. Army Specification 2–104B (Amend. 5) as used in the engine crankcase. See that all hose connections and fastenings are secure.

e. FUEL INJECTION PUMP.

(1) *Power Unit PE–215–C* (fig. 22).—Remove the drain plug G and drain the fuel injection pump. Replace the drain plug and remove the filler plug. Pour 6 ounces of the same grade of oil (OE) as that used in the engine crankcase into the oil filler (I) opening. Open the level cock H and continue to pour in oil until it appears at the level cock. Replace the filler plug and close the level cock.

(2) *Power Unit PE–215–E* (fig. 9).—Remove the drain plug G and drain the base of the fuel injection pump. Replace the drain plug. Remove the oil filler plug I and pour 14 ounces of oil (OE) into the oil filler hole and replace the filler plug. Check the oil level by opening the oil level cock H. Oil should drip from this cock if the level is satisfactory.

f. BATTERIES. On new units, unscrew the filler plugs from the cells of the storage batteries and remove the sealing disks from the filler holes. If electrolyte was received with the equipment, fill each cell to approximately one-half inch above the tops of the separators. The temperature of the batteries and electrolyte should not be less than 60° F. nor more than 90° F.

Caution: If electrolyte is spilled on the hands or clothing, rinse immediately and thoroughly with water. Do not place hands near eyes or mouth while handling batteries or electrolyte and always wash hands thoroughly after working around batteries.

If the batteries received with the equipment are dry charged, they may be put into service immediately after filling. All batteries, however, should receive a full charge as soon as possible after being put into service. Batteries received dry and uncharged must be fully charged before being used. Refer to TM 9–2857 and TM 11–430 for more complete information on storage batteries.

13. Starting

a. NEW OR RECONDITIONED UNITS. Before attempting to start the unit for the first time, proceed as follows:

(1) Remove the plug from the top of the fuel oil day tank and fill the tank with clean fuel oil. Replace the plug securely.

(2) Fill the gasoline tank and open the shut-off valve at the top of the gasoline strainer. Gasoline should flow into the glass sediment bowl. If gasoline does not flow into the sediment bowl freely, check the vent hole in the tank filler cap and see that it is unobstructed.

(3) Raise the choke lever on the side of the carburetor to a horizontal position. (On PE–215–C, operate the priming pump, above the choke lever, one or two strokes.)

(4) Throw the compression release lever as far forward (counterclockwise) as it will go. A click should be heard when it has reached the correct position.

(5) On PE–215–E, throw the ALARM ON-OFF switch OFF. On PE–215–C, raise the trip lever on the safety control and fasten it in a raised position.

(6) Throw the governor control handle as far to the rear (clockwise) as it will go.

(7) Press the starter button and hold it in for about 30 seconds. Release the starter button as soon as the engine starts. If the engine does not start in 30 seconds, release the starter button and allow the starting motor to cool for about 1 minute before again pressing the button.

(8) When the engine starts, gradually open the choke. The choke should be fully open when the engine is at operating temperature.

(9) As soon as the engine is running, look at the lubricating-oil pressure gage to

see that the engine lubricating system is functioning properly.

(10) Open the vent on the top of the fuel oil filter and leave it open until fuel oil, free from air bubbles, appears and then close the vent.

(11) Loosen the bleeder screw on the fuel injector nozzle for No. 1 cylinder and leave it loose until fuel appears. Retighten the screw and perform the same operation on the remaining cylinders.

(12) On PE–215–E, throw the ALARM ON-OFF switch ON. On PE–215–C, release the trip lever on the safety control.

(13) Allow the engine to run on gasoline until the exhaust is clear and the unit has reached operating temperature.

(14) When the engine has reached operating temperature and is running smoothly, throw the compression release lever to Diesel operating position.

(15) Close the gasoline shut-off valve on the gasoline strainer.

(16) Adjust the governor control to the point where the engine is operating at the desired speed.

b. PREVIOUSLY OPERATED UNITS. To start units which have been previously operated and have not been in storage, follow the instructions in *a* above. Omit operations (1), (10), and (11).

14. Precautions After Starting

a. As soon as the engine starts, be alert to detect unusual sounds or operating conditions. Check for leaks in the fuel and cooling systems and at all gasketed joints. Correct any leaks that are found.

b. Look at the lubricating-oil pressure gage to see that correct oil pressure is being maintained. On PE–215–C, the normal lubricating-oil pressure is approximately 60 pounds. On PE–215–E, the indicator needle must be within the white sector of the dial. Lubricating-oil pressures will be slightly above normal when the units are first started.

c. Look at the battery-charging ammeter to see that it indicates charge.

d. Look at the engine temperature gage (WATER TEMPERATURE) to see that it registers within the RUN sector of the dial.

e. See that the indicator light on the engine instrument panel of PE–215–E is lit. Make sure that the ALARM ON-OFF switch is ON.

15. Applying Load

Caution: Do not apply load while the unit is operating on gasoline. Always allow the unit to operate for about 10 minutes on fuel oil before applying load.

a. ADJUSTING VOLTAGE. Before adjusting voltage make the following checks:

(1) See that the frequency meter registers approximately 60 cycles.

(2) On PE–215–C, see that the REGULATOR ON-OFF SWITCH is OFF. On PE–215–E, see that the pull-out tray at the bottom of the voltage regulator is pulled out.

(3) Adjust the exciter-field rheostat until the voltmeter indicates the desired voltage. On PE–215–C, the voltage reading should be 215 volts. On PE–215–E, the voltage reading should be 250 volts. With no load on the unit, the voltage reading on all phases will be the same.

(4) Turn the exciter-field rheostat to resistance-all-out position (extreme counterclockwise rotation). On PE–215–C, throw the REGULATOR ON-OFF SWITCH to ON position. Insert a screw driver in the slotted shaft in the lower left-hand corner of the voltage regulator and adjust the voltage to approximately 215 volts. Look into the AUTOMATIC POLARITY REVERSING peephole to see that the disk is rotating. On PE–215–E, push the tray at the bottom of the regulator in and adjust the voltage to approximately 250 volts by means of the voltage adjusting rheostat (L, fig. 11).

b. CIRCUIT BREAKER. Close circut breaker by pulling the handle up to ON position. If the circuit breaker trips, an overload is indicated. Check the load and remove the cause before again closing the circuit breaker. After closing

the circuit breaker, make the following checks and adjustments:

(1) *Frequency.*—Check the reading of the frequency meter. The frequency should not drop more than 1.8 cycles under full load. The governor control lever has been adjusted to maintain a frequency of 60 cycles under full load when the control lever is in full counterclockwise position. Correct the frequency, if necessary, by changing the setting of the governor control lever.

(2) *Voltage.*—Check the reading of the voltmeter. Normally, the voltage should drop upon application of load. The maximum drop is approximately 10 volts when a 50-kilowatt, 80-percent power factor load is applied. This drop will vary depending upon the amount and power factor of the load. If a rise in voltage is indicated when load is applied, an incorrect phase sequence or incorrect connections in the voltage regulator circuit are indicated. Check the voltage readings on all phases by rotating the voltmeter switch on the switchboard. An incorrect phase sequency (1-3-2 instead of 1-2-3) is caused by an improper connection between the generator and switchboard. Check all connections against the wiring diagrams (figs. 20 and 21).

16. Operation

While the unit is operating, be constantly alert for any of the following indications of faulty operation:

a. See that the battery-charging ammeter continues to show charge while the unit is running. If this meter should indicate zero reading or discharge while the unit is running, investigate the cause immediately.

b. Look at the lubricating-oil pressure gage frequently. Investigate any sudden drop in pressure. Normally, the safety control will stop the unit if the lubrication system fails. If the oil pressure drops to the danger zone and the safety control fails to operate, immediately pull the governor control handle all the way clockwise. This will stop the unit. Do not restart the unit until the trouble has been located and corrected.

c. Check the engine temperature (WATER TEMPERATURE) gage frequently. The most efficient operating temperature is approximately 190° F. If the unit fails to maintain an operating temperature between 180° F. and 190° F., it may be necessary to restrict the air flow through the radiator by covering a portion of the radiator. Normally, the unit should not be operated at a temperature above 200° F. If the temperature should rise to 205° F. and the safety control fails to function, stop the unit as instructed in *b* above.

d. Read the switchboard instruments frequently and investigate any sudden changes.

e. Be alert for signs of smoke that might indicate an overheated part. Listen for unusual sounds that might indicate possible trouble. Investigate any and all abnormal conditions and take necessary steps to correct them. Shut down the unit, if necessary; otherwise, make note of the difficulty and attend to it at the first opportuniy.

17. Stopping the Unit

In an emergency, stop the unit as instructed in paragraph 16*b*. Under normal conditions, stop the unit as follows:

a. Remove the load by throwing the circuit breaker handle down to OFF position.

b. Open the gasoline shut-off valve at the top of the gasoline strainer.

c. Throw the compression release lever to gasoline operating position (toward the radiator end of the unit). A click will be heard when it is in correct position. At the same time, rotate the governor control clockwise as far as it will go.

d. Allow the engine to operate on gasoline for approximately 1 minute to purge the combustion chambers of any accumulation of fuel oil.

e. Shut off the gasoline supply by closing the valve on the gasoline strainer.

f. On PE–215–E, throw the ALARM ON-OFF switch to OFF position.

g. As soon as the engine stops, throw the compression release lever to Diesel operating position. This permits the starting valves to cool in their seats and reduces the possibility of valve warpage.

h. Do not take the automatic voltage regulator out of service as it will resume operation whenever the unit is restarted. Leave the exciter-field rheostat in its operating position.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

18. Parallel Operation

a. REQUIREMENTS. For satisfactory operation of engine-driven a-c generators in parallel, the engines and their governors must have similar speed-regulation characteristics. Generators must have approximately identical voltage-regulation characteristics, waveform, frequency, phase sequence, phase voltage relationship, and equal terminal voltage. The first, second, and third conditions are determined by design, construction, number of poles, and revolutions per minute. The fourth condition is obtained by connecting leads properly as described in *b* below. The fifth and sixth conditions are obtained by synchronizing the units. Use the voltage regulators to maintain constant voltage under varying loads.

b. PHASING OUT. Generators are factory adjusted to develop proper phase sequence if generator and control panel terminals are connected in accordance with terminal markings. However, a preliminary test, called phasing out, must be made to assure identical phase sequence. If no phase rotation tester is available, use either of the following methods:

(1) Start the second unit, bring it up to speed and voltage, and turn the synchronizing switch ON. If the phase sequence of the generators is alike, the phase lamps will operate simultaneously. If the second unit has a wrong phase sequence, at no time will the phase lamps be dark simultaneously. Instead, lamps in different legs of the circuit will darken successively.

(2) An alternate method of checking the phase sequence is to run a three-phase motor from generator 1 and then shift the motor connections to generator 2. Make certain that the leads from the motor are connected to identical phases. The size of the motor is unimportant. If the motor runs in the same direction when connected to the second generator as when connected to the first, the phase sequence is correct. If the motor reverses, the phase sequence is reversed. Interchanging any two connections of a three-phase generator will change phase rotation. Once established, correct phase rotation (1-2-3) will remain correct as long as connections remain unchanged.

c. CONNECTING GENERATORS IN PARALLEL. Before connecting two generators in parallel, establish identical frequency and voltage. Stop the units and connect terminals L1, L2, and L3 of the circuit breaker to the correspondingly marked terminals of the unit to be placed in parallel. Connect the neutral terminal L0, if used, to the neutral wires of the parallel generators. Start both units and bring them up to speed. Turn the voltmeter switch on the second unit to ON, and adjust the voltage to correspond with that of the first unit. Turn the synchronizing switch of the second unit on. The synchronizing lamps will flash on and off at a frequency depending on the difference in the speeds of the two units. The speed of the incoming unit (carrying no load) will be higher than that of the loaded unit, and must be reduced by adjusting the governor control of the unit. After adjusting the speed of the unit, wait briefly for the lamp fluctuations to slow down. The phase lamps should now flash about once every 3 or 4 seconds. Now adjust the voltage of the incoming unit to the exact value of the loaded unit. Watch for a dark interval of the synchronizing lamps and close the circuit breaker of the incoming unit while the lamps are dark. Do not close the circuit breaker while the lamps are lighted as this will cause severe voltage disturbance.

d. BALANCING. After the units are in parallel, divide the load equally by adjusting the engine speed of the incoming unit (supplying more energy to the shaft of the incoming engine), not by changing the adjustment of the exciter-field rheostat or voltage adjusting rheostat. Such change might result in generation of cross-currents between generators. Turn

both ammeter switches to the same position and adjust the speeds of the units by adjustment of the governor control until approximately the same current reading is indicated on the ammeters of both units. This will indicate that load distribution is equal. When adjusting the governor controls, it is necessary to adjust both units simultaneously.

e. ELIMINATING WATTLESS CURRENT. Check and eliminate cross-currents after the load has been divided equally. These currents are not part of the true generator output, but are registered on the ammeters. Circulating cross-current is indicated when the sum of both ammeter readings is higher than the total current taken by the load. It is caused by a difference between terminal voltage of the generators. To eliminate this cross-current, turn the voltage adjustment on the voltage regulator of one unit clockwise. If no action occurs, turn it counterclockwise to decrease the ammeter readings and continue until the lowest reading is obtained. Repeat on the second unit.

f. ADJUSTMENTS. Once proper load distribution between units has been established, little or no adjustment should be required when the load is increased or decreased. However, if speed (frequency) or voltage adjustments are desired, make them simultaneously on both units to avoid circulating cross-currents. Equal division of the kilowatt load is assured by the speed-regulation characteristics of the units. Equal division of the wattless load will be maintained by the cross-current compensation feature of the voltage regulator.

g. REMOVING PARALLEL GENERATORS FROM LINE. To remove a generator from parallel operation, reduce the load of the outgoing unit by adjusting the governor control until the ammeter drops approximately three-quarters and then open the circuit breaker.

19. Operation in Arctic Climates

When operating in zero or subzero temperatures, it is mandatory that units be kept in peak condition at all times. Keep the starting batteries fully charged, as extremely low temperatures will cause a fully charged battery to lose as much as 50 percent of its power. Electrolyte in a discharged battery will freeze at a temperature only slightly below zero. Observe the following precautions:

a. Pay special attention to cold weather lubrication instructions.

b. Always crank the unit a few times with the hand crank before using the electric starter.

c. Keep the fuel tanks as full as possible at all times to prevent condensation and make sure that no water is present in the fuel used.

d. Cover the unit with blankets and tarpaulines when it is not operating. If possible, remove the batteries and store them in a moderately warm place.

e. Follow pertinent instructions in TB SIG 66.

20. Operation in Desert Areas

When operating the unit in extremely dusty or sandy areas, service the oil-bath air cleaner and breathers more frequently than under normal operating conditions. Protect the equipment as much as possible from sand and dust. Keep all moving control parts clean and well lubricated, and frequently check and clean the interior of the generator and exciter. It is good practice to spread waste oil over the area immediately surrounding the building or shelter in which the unit is housed and to sweep out the area surrounding the unit at frequent intervals. Follow pertinent instructions in TB SIG 75.

21. Operation in Tropical Climates

When the unit is being operated under conditions of extreme heat and humidity, check the coolant at frequent intervals. Keep all air passages free from obstructions and protect the unit as much as possible from the direct rays of the sun. Inspect the fan belt and other parts of the cooling system frequently and keep them in top condition. Check the level of the electrolyte in the storage batteries more frequently than when operating in more temperate climates. Follow pertinent instructions in TB SIG 72.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS

22. Use of Tools

a. GENERAL. The proper use of tools is very important as improper use will damage the tools, damage the equipment, and may result in personal injury.

b. WRENCHES. When tightening a nut, bolt, or cap screw, be sure to use the proper wrench for the job. Do not use a wrench that is slightly oversize or one that is badly worn, as this will result in rounding the nut, bolt head, or screw head, and may cause damage to the equipment or personal injury if the wrench should slip. Never use pliers for tightening or loosening nuts, bolts, or cap screws. If possible, always use the correct size open-end wrench, box wrench, or socket wrench. If these are not available, use an adjustable wrench. When tightening cylinder-head bolts or cap screws, use a torsion wrench, if one is available. Never use a pipe or other means to increase the leverage as this will bend or break the wrench and may possibly strip the threads.

c. SCREW DRIVERS. When loosening or tightening a fastening having a slotted head, use a screw driver with a blade that fits the slot in the head of the fastening. Do not use a wrench or pliers on the shank 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.

d. OTHER TOOLS. Keep in mind that specific tools are made for specific purposes. Make sure to use the right tool for the job and that it is of the correct size for the work to be done.

23. Care of Tools

The condition in which a mechanic keeps his tool equipment is a good indication of his ability. Do not abuse tools by using them for work for which they were never intended. Keep tool equipment properly stowed and protected from dirt and dampness at all times. When finished using a tool, clean it thoroughly and replace it in its proper place in the toolbox. Keep all tools free from rust and keep adjustable tools, such as pliers and adjustable wrenches, lubricated. Keep the toolbox clean and free from all foreign matter and debris. After cleaning tools and before putting them away, wipe them with a clean cloth moistened with oil to protect them against rust. For more

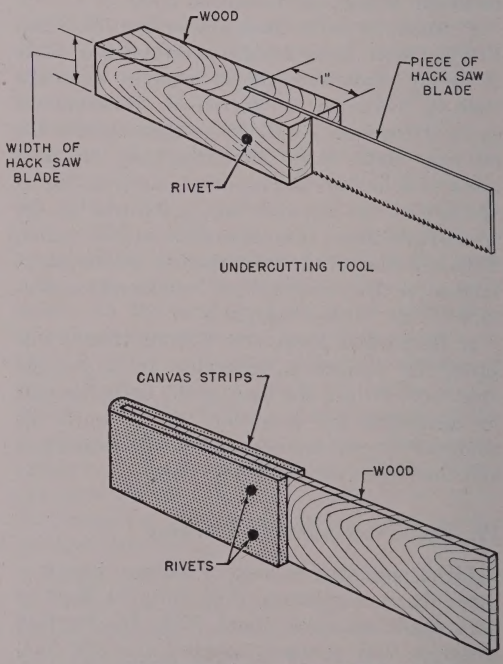


Figure 25.—Commutator undercutting and commutator burnishing tools.

complete details on the care and use of tools, refer to TB 11–453–1. This technical bulletin deals with the use of various wrenches and other mechanic's tool equipment.

24. Improvised Tools

(fig. 25)

a. COMMUTATOR BURNISHER. A simple tool for cleaning or burnishing the commutator and slip rings may be easily made. Obtain a strip of hardwood about 10 inches long and approximately the width of the commutator. Cut several strips of heavy canvas the same width as the wooden strip and long enough to permit wrapping them around the end of the strip and extending several inches up on each side. Fasten the canvas securely with two or more rivets.

b. COMMUTATOR UNDERCUTTER. A suitable tool for undercutting the mica between the commutator bars can be made from a hack-saw blade. Snap the blade in two. Fashion a handle from a block of wood and cut a slot in it in which to insert the half of the hack-saw blade. Insert the blade in the block with the teeth of the blade faced so that they will cut when pulled toward the user. Locate the position of the hole in the end of the blade when it is inserted in the handle. Drill a hole in the handle and rivet the blade in the handle. Wrap friction tape around the end of the handle in which the blade is inserted to hold it more securely. Grind the blade to the exact width of the spaces between the commutator bars.

25. Test Equipment

a. The following test equipment is necessary for testing and/or repairing the subject equipment:

Item	Description	Use	Stock No.
Motor tune-up set	Consists of: compression gage, timing light, and vacuum and fuel pump pressure gage.	For making necessary tests in connection with motor tune-up.	6R46155 (Sig C).
Electric tachometer.	Consists of electrically actuated indicator.	For checking rpm of rotating machinery.	18–T–230 (Ord).
Ignition circuit tester.	Consists of necessary meters for making electrical tests of ignition system.	For testing components of high-tension electric system.	17–T–5520 (Ord).
Spark plug tool	Consists of several feeler gages attached to a flat piece of metal which is notched on one end.	For checking gap between spark plug electrodes and adjusting electrodes.	6Q37003 (Sig C).
Feeler gage set	Consists of a number of strips of shim stock of various thicknesses.	For checking various gaps and clearances.	6Q45713 (Sig C).
Battery hydrometer	Consists of glass tube in which a glass, graduated float is incased.	Used for testing specific gravity of battery electrolyte.	3B2250–386 (Sig C).
Antifreeze hydrometer.	Similar to battery hydrometer but has a number of scales on float for different types of antifreeze.	For testing antifreeze protection of coolant.	
Low-voltage circuit tester.	Consists of necessary meters, switches, etc., for testing low-voltage circuits.	For testing low-voltage engine components.	17–T5575 (Ord).
Growler	Consists of windings on laminated iron core.	For checking the windings of armatures for short circuits.	6Q48530 (Sig C).

b. The use of the various test equipment listed above is explained below.

(1) *Motor tune-up set.*

(*a*) *Compression gage.*—This gage is a calibrated meter with a hexagonal stem equipped with a pressure-relief valve and a ball check valve, a flexible hose connection with screw-type adapters to fit 10-, 14-, 18-millimeter and ⅞-inch spark plug ports, an extension equipped with a rubber adapter for rigid compression tests, and an air-check adapter for compressed air tests. To use the equipment, set the compression release lever in gasoline

operating position and remove the spark plugs from the cylinders. Block the carburetor throttle in wide open position. Press the rigid assembly firmly into the spark plug port of No. 1 cylinder. Crank the engine with the cranking motor and count the number of piston strokes required to reach a maximum reading (4 or 5 strokes). Release the pressure in the gage by unscrewing the valve cap on the hexagon of the adapter one-half turn. The pointer should return to zero. Close the release valve by tightening the valve cap and repeat the above operations until all cylinders have been tested. The pressure of all cylinders should be approximately the same.

(*b*) *Timing light.*—This equipment is designed for checking and timing the ignition on all types of gasoline engines. It consists of a body which holds the neon light tube and lens and has two wire leads with insulated contact clips for connection to the equipment. Before using the timing light, inspect, clean, and adjust all spark plugs. Observe the flywheel markings through the peephole in the flywheel housing while cranking the engine by hand. Continue turning the crank until the marking 1&6 DC appears in the center of the peephole. The distributor rotor will now be opposite the terminal of the spark plug to be used for timing. Attach one lead of the timing light to this spark plug and ground the other lead on the engine. Start the engine on gasoline and block the engine throttle in about one-quarter open position. Hold the timing light in position so that its beam is centered in the peephole. The timing mark on the flywheel should coincide with the indicator on the flywheel housing.

(2) *Electrical testing equipment.*—The electric tachometer, ignition circuit tester, and low-voltage circuit tester are contained in individual cases. Complete operating instructions are contained on the inside of the cover of each instrument.

(3) *Growler.*—This piece of equipment consists essentially of a primary coil and the primary portion of the iron core of a transformer. The iron of the armature or stator under test completes the magnetic circuit. When ac is passed through the growler, an alternating magnetic flux is produced in the iron core of the growler and in the iron of the armature or stator resting between the jaws of the growler. To test an armature, place it between the jaws of the growler and, with the current turned on, hold a hack-saw blade above the armature as it is rotated. If the hack-saw blade vibrates, the armature is short-circuited.

(4) *Battery hydrometer.*—This consists of a glass, graduated float within a glass tube. One end of the glass tube is provided with a rubber stopper and short rubber tube while the other end is provided with a rubber bulb. To use the hydrometer, insert the short rubber tube into the electrolyte in a battery cell, squeeze the rubber bulb, and release it slowly until the graduated float, within the tube, floats freely. Read the specific gravity of the electrolyte at the point where the float projects above the level of the electrolyte. Do not attempt to take specific gravity readings of a battery cell to the electrolyte of which water has just been added and before a charging current has been passed through the battery. All specific gravity readings have to be corrected to temperature in accordance with instructions in paragraph 12, TM 9–2857, or paragraph 13 TM 11–430.

26. Lubricating Periods

Lubrication instructions are frequently given in periods of days, weeks, months, half years, and years. A daily period of operation consists of any consecutive 8-hour period or any number of periods of operation that total 8 hours. A weekly period of operation is any number of operating periods that total 64 hours. A monthly period of operation is any number of operating periods that total 256 hours. A half-yearly period of operation is any number of operating periods that total 1,024 hours. A yearly period of operation is any number of operating periods that total 2,048 hours.

27. Lubrication Requiring Disassembly

a. MAGNETO. Maintenance personnel should disassemble the magneto every 512 operating hours and clean and lubricate it. Follow the instructions contained in the lubricating order for the equipment. Disassembly and reassembly instructions will be found in paragraphs 49*f* and 50*d*.

b. STARTING MOTOR (fig. 36). Semiannually or at the end of every 1,024 hours of operation, remove the starting motor. Thoroughly clean the Bendix assembly and lubricate the worm shaft with Oil, lubricating, preservative, special (PL-Special) JAN–L–644. Apply oil (OE 10) to the outboard shaft bearing. Do not apply oil or grease to the drive gear.

28. Routine Lubrication

a. GENERAL. Each power unit is provided with a lubrication order which contains instructions for all routine lubrication of the equipment. Follow instructions in the lubrication order. If the lubrication order becomes defaced, follow instructions covering lubrication in the preventive maintenance section of this manual.

b. TABLE OF APPROVED LUBRICANTS.

Lubricant symbol	Standard nomenclature	Specification No.	Application
OE	Oil, engine*	U. S. Army 2–104B (Amend. 5).	Engine crankcase, air cleaner, fuel injection pump, crankcase breather, starting motor bearings, and charging generator bearings.
CG–1	Grease, lubricant, automotive and industrial.	FS VV–G–632	Above 32° F. Fan bearing and charging generator drive housing.
CG–0	Grease, general purpose No. 0...	U. S. Army 2–106 (Amend. 2).	Below 32° F. Use as above.
WB	Grease, general purpose No. 2...	U. S. Army 2–108B	Power generator rear bearing. Exciter bearings.
WP	Grease, lubricant, automotive and industrial.	FS VV–G–632	Water pump.
PL-Special ..	Oil, lubricating, preservative, special.	JAN–L–644	Magneto impulse coupling, magneto rotor bearings, magneto distributor bearing, and Bendix drive.

*At temperatures above 32° F., use OE 30; from +32° F. to 0° F., use OE 10; below 0° F., dilute crankcase oil with approximately 6 quarts of oil, fuel, Diesel.

29. 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 moistureproofing 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.

c. LUBRICATION. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. 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.

LUBRICATION ORDER

LO 11-941

(Supersedes WDLO No. 3233, 2 Aug 44)

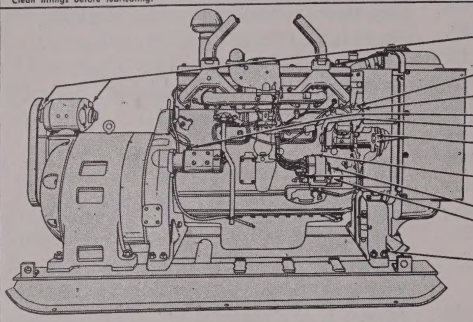
POWER UNITS PE-215-A, -B, -C, & -E

(International Harvester Co. Engine Models UD-18 & UD-18A)

References: TM 11-941 and TM 11-941C.

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be adjusted to compensate. Clean fittings before lubricating.

Clean parts with Solvent, dry-cleaning, or with Oil, fuel, Diesel. Dry before lubricating. Drain crankcase and gear cases only when hot after operation; check level and replenish when cool.

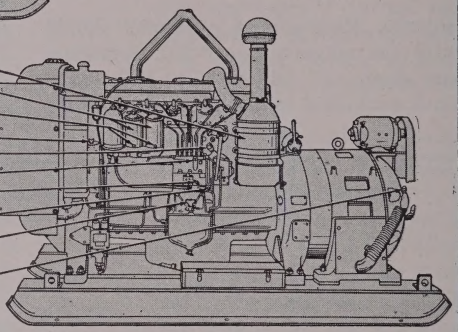


Interval — Lubricant

- Q — **GL Exciter Bearings** — Remove plug, insert fitting, and lubricate sparingly.
- W — **GL Fan Bearing** — Lubricate sparingly. See Note 3.
- D — **WP Water Pump (Model UD-18 Only)** — Lubricate sparingly through lower fitting.
- 2W — **OE Starting Motor Bearings**
- 2W — **OE Charging Motor Bearings**
- M — **GL Charging Generator Drive Housing** — Remove level plug, fill housing to plug level through fitting, and reinstall plug.
- Q — **PL Magneto Distributor Bearing** — Fill oil cup. Quarterly, pack recess in breaker arm and back of breaker arm rubbing block, sparingly with GL.
- S — **PL Magneto Rotor Bearings**
- W — **PL Magneto Impulse Coupling** — Oil liberally.
- 2W — **Crankcase Drain** — Drain and refill. For capacity see Note 2.

Lubricant — Interval

- **Air Cleaner OE** — Clean and refill oil cup. Monthly remove and wash filter section. — W
- **Oil Filters** — Drain, clean inside of filter body, and renew element. — M
- **Oil Filter Drains** — Drain sludge. — W
- **Crankcase Fill OE**
- **Fuel Injection Pump and Governor Breather OE** — (Bosch type only). Remove cap, wash, and saturate element. — Q
- **Fuel Injection Pump and Governor Fill OE**
- **Fuel Injection Pump and Governor Level Cock** — Check level. — D
- **Fuel Injection Pump and Governor Drain** — Drain and refill. — M
- **Crankcase Level Gage** — Check level. To check level, rest gage wing nut on top of sleeve threads. — D
- **Power Generator Rear Bearing GL** — Remove drain plug. Refill and turn down grease cup until lubricant appears at drain plug opening. To expel excess lubricant, run power generator until operating temperature is reached. Then reinstall drain plug. — Q



KEY

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	above +32° F	+32° F to 0° F	below 0° F	
OE—Oil, engine	OE 30 or Navy Symbol 9250	OE 10 or Navy Symbol 9110	OE—10 (See Note 2.)	D—Daily W—Weekly 2W—2 Weeks Q—Quarterly S—Semiannually
WP—GREASE, water pump	All temperatures			
PL—OIL, lubricating, preservative ,special	All temperatures			
GL—Grease, instrument	All temperatures			

NOTES

1. **OILCAN POINTS.** Weekly, lubricate Compression Release Shaft Bearings and the Control Linkage with OE.
2. **CRANKCASE CAPACITY.** Model UD-18, 22 quarts; Model UD-18A, 26 quarts.
3. **FAN BEARING HOUSING,** (MODEL UD-18A ONLY). Monthly, remove level and fill plugs. Insert fittings into top plug hole and fill with GL to lower plug level. Remove fittings and reinstall plugs.
4. **COLD WEATHER** (WHEN WINTERIZATION KIT IS NOT AVAILABLE). Refill crankcase to FULL mark with OE 10. Add 4 qts of gasoline to Model UD-18 and 5 qts to Model UD-18A. Operate engine 5 minutes to mix. For reference, mark the new level on the gage. Every ½ day check level and fill to FULL mark with OE 10. When engine is to be shut down for ½ day or more, check level, fill to FULL mark with OE 10 and add gasoline until new level mark is reached. Operate engine 5 minutes to mix. Weekly, drain crankcase. Diesel fuel may be used as a temporary diluent, but only when gasoline is not available.

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

BY ORDER OF THE SECRETARY OF THE ARMY:

J. LAWTON COLLINS
Chief of Staff, United States Army

OFFICIAL:

EDWARD F. WITSELL
Major General
The Adjutant General

TM 941C-27

Figure 26.—Lubrication order (LO 11-941).

30. 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 rust and the formation of gum in the gasoline system. Process the equipment as follows:

a. MATERIALS REQUIRED. Requisition the materials below through regular channels and proceed with the rustproofing and gumproofing treatment immediately after shutting down the unit. Rustproofing must be applied while the engine is still warm.

(1) Oil, fuel, Diesel, U. S. Army Specification 2–102.
(2) Oil, engine, U. S. Army Specification 2–104B (Amend. 5).
(3) Oil, engine, preservative, U. S. Army Specification 2–126.
(4) Oil, flushing, Ordnance Specification AXS–979.
(5) Compound, insulation, ignition, Ordnance Specification AXS–858.
(6) Compound, gum preventive, Federal stock No. 51–C1586–225.
(7) Tape, nonhygroscopic, adhesive, Ordnance Specification AXS–871.

b. PROCEDURE.

(1) Drain the fuel oil from the fuel oil filter. Disconnect the pipe from the fuel oil tank to the fuel oil pump at the pump intake. Disconnect the fuel oil return line at the injection pump. Connect a suitable tube to the fuel oil pump intake and place its free end in a container filled with flushing oil.
(2) Drain the lubricating-oil system and fill the crankcase with Oil, engine, preservative.
(3) Start the unit on gasoline and operate it on that fuel until the fuel oil filter is filled. Check this by opening the vent on the top of the filter. Close the vent as soon as fuel oil appears. Do not drain the flushing oil from the system.
(4) Disconnect the fuel pipe from the gasoline strainer. Open the gasoline shut-off valve and drain the gasoline tank. Reconnect the gasoline line and fill the tank with clean gasoline to which gum preventive compound, in the proportion of one-quarter container of compound to 5 gallons of gasoline, has been added. Operate the unit for a minimum of 5 minutes on this mixture.
(5) Stop the unit by shutting off the gasoline supply and completely drain the gasoline system. Remove the sediment bowl from the gasoline strainer, clean it thoroughly, and replace it. See that all gasoline is removed from the carburetor.
(6) Remove the spark plugs and crank the engine, by means of the starting motor, for about 1 minute. This will blow any residual fuel oil from the cylinders. Now have the engine cranked by hand and spray Oil, engine, preservative into the cylinders through the spark plug holes, while the engine is being cranked. The compression release lever must be in gasoline operating position while this is being done. Use about 2 ounces of oil per cylinder.
(7) Remove the valve cover from the valve housing and spray the entire valve mechanism with preservative oil. Be sure to spray between the cylinder block and the side plate through which the push rods pass. Spray the same oil into the oil filler tube and breathers.
(8) Drain the preservative oil from the crankcase. Attach a red tag to the oil filler cap which reads as follows:
Caution: This engine has been rustproofed. Date.....Use engine oil (OE) conforming to U. S. Army Specification 2–104B (Amend. 5), seasonal grade when placing the unit back in service.
(9) If the engine is to be moisture-vaporproof packed, including a dehydrating agent, remove the spark plugs and replace them with dehydrating plugs.
(10) After the engine has cooled, remove all grease, oil, and dirt from its exterior. Use Solvent, dry-cleaning (SD), Federal Specification P–S–661a (Amend. 7) for this purpose.

(11) Seal all breathers and breather holes, air intakes, and the exhaust outlet with nonhygroscopic tape.

(12) Make sure that all surfaces are dry and spray all unpainted exterior surfaces with insulation compound. Include all wiring and electrical equipment. Do not get this compound on the interior of the alternator, exciter, or switchboard components.

31. Refinishing

When the painted surfaces of the equipment become scratched or otherwise damaged, rust and corrosion may be prevented by thoroughly cleaning and then touching up the damaged surface. Proceed as follows:

a. Remove all traces of oil or grease with solvent (SD) and thoroughly sandpaper the portions to be refinished. Apply paint in light, even coats with a small brush. Two light coats are better than one heavy coat.

b. If the painted surfaces have become blistered from heat, remove all old pain with paint remover. Thoroughly sandpaper the surfaces or rub them down with steel wool. Apply a smooth, even priming coat, sand it down lightly with No. 000 sandpaper, and then apply the finish coat.

c. All units should be carefully refinished after overhaul. If the finish is in fair condition, touch up only the damaged surfaces.

Caution: Avoid getting paint on moving parts in such a manner as to hinder their movement. Do not paint electrical contacts and avoid getting paint into oil and breather holes.

Section III. PREVENTIVE MAINTENANCE

32. Operator's Maintenance

a. To insure mechanical efficiency, it is necessary for each power unit operator to inspect the equipment systematically and perform certain designated maintenance services at specified intervals each day that the equipment is operated. These inspections and services enable the detection and correction of minor difficulties before they result in serious damage or equipment failure. The services set forth in this section are those to be performed before operation, during operation, during shut-down periods, after operation, and at other specified intervals.

b. Every power unit operator should have available DD Form 110 (Vehicle and Equipment Operational Record). The use of this form is explained in TM 37-2810. The services to be performed on Power Units PE-215-C and PE-215-E follows:

(1) *Fuel, oil, and water.*—See that the fuel supply, lubricating oil, and coolant are ample for the anticipated period of operation. In freezing temperatures, check the antifreeze protection of the coolant. Check these items before operation, during at-halt or shut-down periods, and after operation.

(2) *Clean equipment.*—Wipe off all dust and dirt and remove all traces of oil and grease from the exterior of the equipment before starting an operating period.

(3) *Battery.*—Check the level of the electrolyte in each battery cell. If it is necessary, correct the level of the electrolyte. Add only pure water. See that all battery connections are clean and tight.

Note.—In freezing temperatures, do not add water to the battery cells unless the unit is going to be run immediately or the battery is placed on charge.

(4) *Assemblies and belts.*—Inspect the equipment to see that all assemblies are secure and in good condition. See that all belts are in good condition and properly adjusted.

(5) *Electrical wiring.*—See that all electrical wiring is in good condition, free from oil and grease, and that all terminals and connections are clean and secure.

(6) *Tools and equipment.*—See that all tool equipment is present, in good condition, and properly stowed.

(7) *Fuel filters.*—See that all fuel filters

are in good condition and properly serviced.

(8) *Lights.*—Check the safety panel light on PE–215–E to see that it is in good condition.

(9) *Publications.*—See that Form NME 110, DA AGO 464, DA AGO 468, and WD AGO 460 are present and in legible condition. See that all pertinent technical bulletins and technical manuals are present and in legible condition. See that all modification work orders pertaining to the equipment have been completed. Make sure that the lubrication order for the equipment is legible, and perform all lubrication operations specified on the lubrication order for the number of hours that the unit has been operated.

(10) *During-operation.*—While the power unit is operating, the operator must be alert for any indications of unsatisfactory operation or trouble. He must watch for any deficiencies in engine performance, such as lack of usual power, misfiring, unusual noise, indications of overheating, unusual exhaust smoke, and improper response to controls. All meters and gages must be checked at frequent intervals and improper readings corrected immediately, if possible.

(11) *After-operation.*—Whenever the power unit is shut down, the operator should check for possible leaks in the fuel, lubricating, and cooling systems. Any deficiencies noted during operation that were not corrected immediately should be corrected, if possible, at this time. Fuel, oil, and coolant should be replenished and the unit left in a ready-to-operate condition.

33. Maintenance Schedule

Perform the following maintenance services at approximately the periods indicated. Lubrication instructions are in accordance with the lubrication order for the equipment. If differences between this schedule and the lubrication order are found, follow the instructions contained in the lubrication order. If the lubrication order becomes defaced, use this schedule until the lubrication order has been replaced.

a. DAILY. Before starting the daily operating period, check over the entire equipment to see that all fastenings, wires, fuel, oil, and cooling system lines and connections are secure and do not leak. Inspect all subassemblies and accessories to see that they are in good condition and secure. See that all lubrication for the number of hours that the unit has been operated has been performed.

b. EVERY 8 HOURS. After every 8 hours of operation, perform the following services:

(1) *Water pump.*—On PE–215–C, lubricate the water pump sparingly through the lower fitting.

(2) *Crankcase level.*—Remove the bayonet gage and check the level of the lubricating oil in the crankcase. If the level is low, add oil (OE) of the correct grade for the temperature in which the unit is being operated.

(3) *Fuel injection pump.*—Check the level of the lubricating oil in the fuel injection pump. If the level is low, add oil (OE) of the same grade as used in the engine crankcase.

(4) *Fuel oil filter.*—Open the drain on the bottom of the fuel oil filter and drain any water or other foreign matter. Close the drain and, when the unit is running, open the air vent in the top of the filter and bleed any air that may be present. Close the vent as soon as fuel oil appears.

(5) *Air cleaner.*—Remove the base of the air cleaner and inspect the level and condition of the oil in the oil cup. If the level is low, add oil (OE) of the same grade as used in the engine crankcase. If the oil in the cup is dirty, clean the cup and refill it with fresh oil.

c. EVERY 64 HOURS. After every 64 hours of operation, make all checks called for in subparagraph *b* above and proceed as follows:

(1) *Magneto impulse coupling.*—Oil liberally with oil (PL-Special).

(2) *Fuel supply pump filter.*—Remove screen; clean and reinstall.

(3) *Fan bearing.*—Lubricate sparingly with grease (CG) (PE–215–C only).

(4) *Gasoline strainer.*—Inspect the sediment bowl. If water or other foreign matter is present, remove, clean, and reinstall.

(5) *Fuel oil filter.*—Remove the plug from the bottom of the fuel oil filter and drain all water and other foreign matter. Replace the drain plug securely.

(6) *Lubricating-oil filters.*—Remove the drain plugs from the lubricating-oil filters and drain off sludge. Replace the plugs securely.

(7) *Fuel injection pump.*—Remove the breather cap on the governor housing, wash it thoroughly in clean fuel oil, saturate the element with clean engine oil (OE), and reinstall (PE–215–C only).

(8) *Battery.*—Check the level of the electrolyte in all cells of the battery. See that the electrolyte level is above the tops of the separators. If the level is low, add only pure water. See that all battery connections are clean and secure.

Note.—Test the specific gravity of the electrolyte before adding water. In freezing temperature, do not add water unless the unit is to be operated immediately or the battery is placed on charge.

(9) *Radiator.*—Inspect the radiator and clean all foreign matter from between the tubes with an air hose or a stream of water. If water is used, flush from the inside toward the outside of the unit so as to keep the water away from electrical parts.

d. EVERY 128 HOURS. After every 128 hours of operation, make all checks called for in *c* above and proceed as follows:

(1) *Starting motor.*—Lubricate with 2 to 4 drops of oil (OE).

(2) *Charging generator.*—Lubricate with 6 to 8 drops of oil (OE).

(3) *Crankcase.*—Operate the engine until it has reached normal operating temperature. Stop the engine and remove the crankcase drain plug. Remove the lubricating-oil filter and thoroughly clean the filter element. Replace the oil filter; then replace the crankcase drain plug. Fill the crankcase with oil (OE) of the correct grade for the temperature in which the unit is being operated.

(4) *Fuel oil filter.*—Drain and disassemble the fuel oil filter. Wash all parts thoroughly in solvent (SD). Reassemble the filter, using the old filter element if it is found satisfactory. If the filter element is badly clogged, replace it with a new one. Open the air vent in the top of the filter. Fill the day tank with clean fuel oil and operate the unit until fuel oil appears at the vent. Close the vent as soon as oil appears.

(5) *Lubricating-oil filters.*—Drain and disassemble the lubricating-oil filters. Wash all parts thoroughly in solvent (SD). Reassemble the filters, using new filter elements. Run the engine for a few minutes. Check the level of the oil in the crankcase and add enough oil to bring the level up to the full mark.

(6) *Fuel injection pump.*—Drain the lubricating oil from the injection pump. Refill the base of the pump with the same grade of oil (OE) as used in the engine crankcase. Do this when the engine is warm.

(7) *Governor.*—On Power Unit PE–215–C, remove the breather cap from the governor housing and wash it thoroughly in Diesel oil. Allow the breather cap to dry and then dip it in oil (OE). Wipe off all excess oil and replace it on the governor.

34. Unit Mechanic's Maintenance Operations

The following services will be performed by the unit mechanic. The unit operator will assist in all operations. Proceed as follows:

a. EVERY 256 HOURS. After every 256 hours of operation, make all checks called for in paragraph 33*b*, *c*, and *d* and proceed as follows:

(1) *Crankcase breather.*—Remove the crankcase breather and wash all parts thoroughly in solvent (SD). Saturate the element with clean oil (OE) and reinstall the breather.

(2) *Charging generator drive housing.*—Remove the level plug and fill the charging generator drive housing to the level of the plug hole with grease (CG). Replace the plug securely.

(3) *Spark plugs.*—Remove the spark plugs and wash them in solvent (SD). Inspect the plugs for cracked insulators or any other unsatisfactory condition. Replace any unsatisfactory plugs with new ones. Remove all combustion deposits from the inside of the plugs and check the gap between the electrodes with a .035-inch gage. The gage should be a snug fit. If the gap is too close or too wide, adjust it by bending the electrode attached to the shell of the plug. Never bend the center electrode. Inspect the condition of the electrodes carefully. If the electrodes are badly burned, replace the spark plug with a new one.

(4) *Magneto.*—Inspect the magneto breaker points. If they are slightly worn or pitted, dress them with a contact point dresser. If the points are badly burned or pitted, replace both points with new ones. Adjust the gap between the breaker points to .020 inch. Make this adjustment with the points in fully open position.

(5) *Generator and exciter.*—Inspect the condition of the commutator of the exciter and the slip rings of the generator. A slight discoloration of the commutator and slip rings is normal. Do not attempt to maintain a surface that appears newly machined. The surfaces should, however, be smooth and free from nicks, pitting, and dirt. To clean these parts, first make a commutator cleaning tool as instructed in paragraph 24. To clean the commutator of the exciter, remove the two inspection plates. Insert the cleaning tool through the openings and hold it in contact with the surface of the commutator while the commutator is turning. The slip rings of the generator may be cleaned by inserting the cleaning tool through the vent holes. Be extremely careful not to contact any live parts. If either the commutator of the exciter or the slip rings of the generator are badly burned or pitted or the commutator mica of the exciter is higher than the surface of the commutator bars, return the exciter or generator to a field or depot repair shop.

(6) *Belts and pulleys.*—Inspect the exciter and fan drive belts and pulleys. See that they are in proper alinement and that the belts are adjusted properly and in good condition. Make sure that they are free from oil and grease. Replace any belts that are unsatisfactory and correct adjustment, if necessary. When multiple belts are used, replace all belts at the same time.

b. EVERY 512 HOURS. After every 512 hours of operation, make all checks called for in paragraph 33 and *a* above. Proceed as follows:

(1) *Generator.*—Remove the rear bearing plug from the under side of the bearing housing. Remove, fill, replace, and screw down the grease cup. Repeat this operation until clean grease appears at the plug opening. Run the unit until it has reached operating temperature and then replace the plug in the bearing housing. This will expel any excess lubricant.

(2) *Exciter.*—Apply grease (WB) sparingly to both bearings through the fittings in the bearing housings.

(3) *Magneto.*—Fill the distributor bearing oil cup with oil (PL-Special). Remove the breaker cover and the breaker arm and pack the recess in the breaker arm post and the small pocket in the cam with grease (WB). Remove all old grease from the breaker cam and apply a thin film of grease to the cam surface. Clean the breaker spring and wipe it with a cloth to which oil (PL-Special) has been applied. Reassemble all parts.

(4) *Cooling system.*—Open all drains in the cooling system and drain the system completely. Dissolve six packages of Compound, cleaning (Federal stock No. 51–C–1568–500) in 13 gallons of water. Close all drains and pour this

solution into the cooling system. Add sufficient water to fill the system completely. Start the unit, bring it up to operating temperature, and run it for about 10 minutes. At the end of this period, drain the cleaning solution from the system.

Caution: The cleaning compound comes in a package consisting of two containers. One container is the cleaner and the other is a neutralizer. Be sure to use the right container. The cleaning compound is a strong acid. Avoid getting it on painted surfaces and parts of the body.

When the cleaning solution has been drained from the cooling system, dissolve six packages of neutralizer in 25 gallons of water and pour the mixture into the cooling system. Again bring the unit up to operating temperature and operate it for about 15 minutes. Drain the system, close the drains, and refill with clean water. Operate the unit for another 15 minutes and again drain the system. Close the drains and refill the cooling system with clean water.

Note.—In freezing temperatures, be sure to add sufficient antifreeze to protect the cooling system from freezing.

(5) *Valve mechanism.*—Remove the valve housing cover and inspect the valve mechanism. Check for broken valve springs and loose fastenings. With a feeler gage, check the clearance between the valve stems and rocker arms. This clearance should be .017 inch when hot or .019 inch when cold.

35. Field Maintenance

The following operations will be performed in field maintenance shops. Complete instructions on the disassembly, repair, and reassembly of components are given in chapter 4. At the end of every 1,024 operating hours, return the equipment to the field maintenance shop for a technical inspection. The following operations will be performed at that time:

a. MAGNETO. Disassemble the magneto and remove the rotor bearings. Thoroughly clean them in solvent (SD) and relubricate with grease (WB). Clean the distributor gears and coat their teeth lightly with grease (CG). Reassemble all parts.

b. ALTERNATOR. Remove, disassemble, and thoroughly clean the interior of the alternator and exciter. Check the condition of the commutator and slip rings. Inspect all brushes and check their fit in the brush holders. Replace any brushes that appear unsatisfactory and perform such service as the condition of the commutator and slip rings may indicate. Reassemble the exciter and alternator and lubricate the bearing on the outboard end of the alternator with grease (WB–2).

c. STARTING MOTOR. Remove the starting motor and thoroughly clean the Bendix drive mechanism. Lubricate the outboard bearing with oil (OE) and apply oil (PL-Special) to the worm of the Bendix drive shaft. Do not apply oil or grease to the drive gear. Inspect the condition of the commutator and brushes and clean the interior of the motor. Perform such services as the condition of the commutator and brushes indicate.

d. BATTERY-CHARGING GENERATOR. Treat the battery-charging generator in the same manner as the starting motor. Inspect the voltage regulator and cut-out, and clean and adjust as the condition found may indicate.

Note.—When any of the above services are performed, make appropriate entries on DA AGO Form 464.

36. Preventive Maintenance and Technical Inspections

a. DA AGO FORM 464. DA AGO Form 464 (Work Sheet for Preventive Maintenance and Technical Inspection of Engineer Equipment) is provided as a guide in the performance of necessary periodic services and inspections. The use of this form is explained in paragraph 18, TM 37–2810. Make appropriate entries on this form whenever any of the operations listed below are performed.

b. DA AGO FORM 464 SERVICES. Following are detailed instructions for the items on DA AGO Form 464 which apply to Power Units PE–215–C and PE–215–E.

TI M	TI W	
S	S	1. *Before Operation Services.*—Perform all before operation services in accordance with paragraph 32.
L	L	2. *Lubrication.*—Lubricate the equipment in accordance with the lubrication order for the equipment. If the lubrication order becomes defaced, follow instructions in paragraphs 33, 34, and 35.
C	C	3. *Tools and Equipment.*—Inspect all tools and equipment. Thoroughly clean both the tools and toolbox. See that all tools are in good condition and properly stowed. Wipe all tools with a cloth that has been moistened with oil (PL-Special) and lubricate all adjustable tools, such as wrenches and pliers.
x	x	4. *Fire Extinguisher.*—Inspect all fire extinguishing equipment to see that it is in satisfactory condition and that extinguishers are fully charged.
x	x	5. *Publications.*—See that all technical manuals, technical bulletins, and other pertinent publications are present and in legible condition.
x	x	6. *Appearance.*—Check the equipment for any damage to painted surfaces, traces of rust or corrosion, and clean and refinish as needed.
x		7. *Modifications.*—Check to find if any modification work orders have been issued for the equipment. Make sure that all MWO's have been completed.
		Engine and Accessories
x	x	11. *Cylinder Head, Manifold, and Gaskets.*—See that the cylinder head, manifold, and all gaskets are in good condition. Check for leaks at all gasketed joints. Check all cylinder-head and manifold fastenings to see that they are tight.
A		12. *Valve Mechanism.*—Remove the valve mechanism cover and inspect the valve mechanism. See that all valve springs, rocker arms, and push rods are in good condition. Check the clearance between the rocker arms and valve stems, and adjust, if necessary. See that all nuts, bolts, and cap screws are tight. See that all moving parts are properly lubricated and replace the cover.
x		13. *Compression Test.*—Secure a compression test meter suitable for the cylinder pressures of the unit, and test the compression in each cylinder in accordance with instructions supplied with the test unit. Enter all compression test readings in the spaces provided on DA AGO Form 464. This test should be made semiannually or at the time of each technical inspection.
x	x	14. *Crankcase, Breathers.*—See that the crankcase breather is clean and unobstructed. If the lubrication order calls for servicing at this time, perform the necessary service.
x	x	15. *Oil Filters, Oil Coolers.*—Check all fuel and lubricating-oil filters and fuel and oil lines for possible leaks. Correct any leaks that are evident.
S	S	16. *Radiator.*—Weekly and monthly, inspect the condition of the radiator core. Check for obstructed air passages, leaks, and other possible damage. See that the radiator is securely mounted and that all hose is in good condition, secure, and does not leak. Replace any hose that appears in unsatisfactory condition. See that the radiator cap is not damaged, that the gasket is in good condition, and that it fits properly on the filler neck. Semiannually, clean the cooling system in accordance with instructions in paragraph 34.
x	x	17. *Water Pump, Fan, Shroud.*—See that the water pump mounting is secure and the pump does not leak. See that the drive belt is in good condition, properly adjusted, and that the pulleys are in correct alinement. Inspect the fan to see that it is mounted securely and not damaged. See that all shrouds and guards are mounted securely and in good condition.
A	A	18. *Belts and Pulleys.*—See that all drive belts and pulleys are in good condition and in alinement.
x		19. *Oil Pump, Pressure Relief Valve.*—At the time of technical inspection or semiannually, remove the oil pan from the engine and inspect the oil pump. See that the intake screen is clean and in good condition. Once each month, inspect all exterior lubricating-oil lines and connections to see that they are in good condition and do not leak. Check the oil pressure and make appropriate entry on Form 464.
x		20. *Governor and Linkage.*—Alternately apply and remove load from the unit and observe the action of the governor. See that all linkage is in good condition and secure. If the governor fails to function properly, prepare a report of the condition for field maintenance personnel. Make necessary repairs or adjustments, if possible.

TI M	TI W		
x	x	21.	*Noise and Vibration.*—(Enter this item on DA AGO Form 464.) Operate the unit at normal speed and check for any unusual noise and vibration. If unusual noise or vibration is noticed, investigate and correct the cause, if possible. Otherwise, prepare a report for field maintenance personnel and have them make necessary repairs or adjustments.
			Fuel Systems
x	x	38.	*Fuel Pumps and Housing.*—Inspect both the gasoline and fuel oil systems. See that all mountings are secure and that there are no leaks. See that the injector pump drive coupling is secure and in correct alinement. See that the fuel supply pump is secure, that its drive belt is in good condition, and that the drive pulleys are correctly alined. Inspect all gasoline and fuel oil lines and connections to see that they are secure and do not leak. Perform any lubrication service indicated for the number of hours that the unit has been operated.
x	x	39.	*Carburetor and Linkage.*—See that the carburetor does not leak and that it is mounted securely. Check for leakage at the gasketed connection to the manifold. Check the throttle and choke to see that they operate properly.
x	x	40.	*Filters.*—Inspect the fuel oil filters and lubricating-oil filters to see that they are securely mounted and do not leak. Perform any scheduled services for the number of hours that the unit has been operated.
CS	CS	41.	*Air Cleaners and Precleaners.*—Check the body and connections of the air cleaner for leaks. See that hose connections are secure and in good condition. See that all mountings are secure. Perform any services scheduled for the number of hours that the unit has been operated.
x	x	42.	*Nozzles, Injector Pumps, and Housings.*—Inspect all fuel injector nozzles to see that their mountings are secure and that they do not leak. See that all fuel oil lines and connections are secure and free from leaks. Inspect all fastenings to see that they are secure.
x	x	43.	*Tank, Cap, and Gaskets.*—Inspect the fuel oil day tank to see that its mountings are secure. See that all plugs or caps are secure and that the gaskets are in good condition and in place. Inspect the gasoline tank for security of mounting and leakage. See that the filler cap is in good condition, that the gasket is in good condition and in place, and that the air vent in the filler cap is not obstructed.
x	x	44.	*Fuel Lines.*—Carefully inspect all gasoline lines and fuel oil lines to see that they have not been bent, dented, or otherwise damaged. See that all connections are tight and do not leak.
			Electric System
x		46.	*Spark Plugs.*—Remove the spark plugs and wash them in solvent (SD). Inspect the insulators for cracks or other damage. Inspect the condition of the electrodes. Check the gap between the electrodes and correct it, if necessary. Replace any plug in doubtful condition.
x	x	47.	*Battery.*—See that all connecting cables are in good condition, the connector lugs are clean and secure on the cables, and that the connections are tight. See that the battery cases are clean and do not leak. Inspect the battery hold-downs to see that they are in place and secure. Inspect the level of the electrolyte in the battery cells and test the specific gravity. Check the voltage of each cell with a battery tester, and make appropriate entries on DA AGO Form 464. Correct the level of the electrolyte if necessary, after testing.
x	x	48.	*Generator Starter.*—See that the battery-charging generator and starter motor mountings are secure. Inspect the generator drive belt to see that it is in good condition and correctly adjusted. Perform any services scheduled for the number of hours that the unit has been operated.
x		49.	*Distributor or Magneto.*—See that the magneto is mounted securely. Inspect the cable connections to see that they are secure and in good condition. See that shielding is in good condition and secure. Perform any services scheduled for the number of hours that the unit has been operated.
x		50.	*Coil, Wiring, Switches.*—Inspect all electrical wiring on the power unit and the switchboard to see that it is in good condition and secure. See that all electrical connections are clean and tight. Operate all switches to see that they operate freely and that all associated instruments respond correctly. Repair or replace any faulty wiring.

TI M	W		
x		51.	*Voltage Regulator.*—Check the battery-charging voltage regulator to see that it functions properly. See that its mounting is secure and that all connections are clean and tight.
x	x	52.	*Lights.*—Inspect the phase lamps and all indicator lights to see that they are not burned out, that their sockets are securely mounted, and that contacts are clean. See that connecting wires are in good condition and that their connections are clean and tight.
x	x	57.	*Gages.*—Inspect the lubricating oil pressure gage, the water temperature gage, and the battery charge ammeter to see that they are in good condition. Check for loose mountings, broken or cracked glass, bent indicator needles, and faulty connections.
x		58.	*Meters.*—Inspect all meters on the switchboard to see that they are in good condition. Check for broken or cracked glass, bent indicator needles, loose mountings, and loose or dirty electrical connections. Operate associated switches to see if instruments respond correctly.
x	x	59.	*Regulator, Safety Valves, Check Valves, Rheostat.*—Inspect the automatic safety cut-off to see that it is mounted securely and not damaged. See that all connections are secure and in good condition. Operate the trip mechanism to see that it functions properly. See that the rheostat on the switchboard is in good condition and securely mounted. Check the contacts and contact arm to see that they are clean and make satisfactory contact.
			Frames and Mountings
x		80.	*Frame.*—See that the skid base of the unit is in good condition and that all hold-down bolts are secure. Check for cracks at welded joints and look for distortion caused by uneven contact with the foundation.
x		84.	*Mountings.*—(Enter this item on Form 464.) See that the alternator and exciter mounting bolts are secure. Inspect the fastenings that hold the engine to the skid base to see that they are tight. Be alert to detect any evidence of the engine or alternator having shifted on the skid base. See that the radiator mountings are secure.
			Generators
x	x	172.	*Armature, Commutator, Slip Rings.*—Once a week, inspect the commutator of the exciter, slip rings of the alternator, and all brushes and brush holders to see that they are in good condition. Perform any services indicated by conditions found and perform all services scheduled for the number of hours that the unit has been operated. Semiannually or at the time of technical inspections, inspect the armatures of the exciter and alternator for faulty insulation. Check the armature clearance in relation to the pole shoes. Clean the armature and field windings with a soft brush and blow dust and dirt from the interior of the frames with light air pressure.
x	x	173.	*Controls, Switch Gear, Wiring.*—Operate the automatic cut-out to see that it functions properly. Check all wiring and connections to see that they are in good condition and secure. See that the connecting cables between the alternator and switchboard are in good condition and that connections are clean and secure.
x		174.	*Drive Coupling.*—Inspect the generator drive coupling to see that it is secure and correctly alined.
x	x	175.	*Temperatures.*—(Enter this item on DA AGO Form 464.) With the unit in operation, feel the bearing housings to determine any evidence of overheating. The temperature should not be too hot to touch with the bare hand.
x	x	176.	*Automatic Voltage Regulator.*—(Enter this item on DA AGO Form 464.) With the unit operating, operate the automatic voltage regulator switch to see if it functions properly. With the automatic voltage regulator switch on, apply and remove load from the unit and observe the action of the automatic voltage regulator. Inspect the condition of the regulator contacts and perform any service indicated by the condition found. See that all connections are clean and tight and that the mountings are secure.

37. Theory of Operation

a. GENERAL. Information concerning the functioning of the following is contained in TM 10–580:

(1) Starting motor.
(2) Battery-charging generator.
(3) Magneto.

b. GASOLINE STARTING SYSTEM. The gasoline starting system consists of a gasoline tank, gasoline strainer (of the sediment-bowl type), conventional carburetor, and a special dual passage manifold and change-over mechanism. The theory of carburetion and the functioning of the gasoline strainer are explained in TM 10–550. A magneto is used to provide the necessary spark for ignition when the unit is operating on gasoline. For gasoline starting purposes, the engine is converted temporarily to a low-compression unit by moving the compression release lever clockwise as far as possible. This operates certain mechanisms which close the air passage (in the dual intake manifold) used for Diesel operation and open the passage which permits the gasoline-air mixture from the carburetor to reach the combustion chambers. A magneto cut-out switch which is contained within the manifold, is opened, thus allowing the magneto to deliver the necessary spark to the spark plugs. When the compression release lever is placed in gasoline starting position, the opening of valves within the manifold assembly enlarges the combustion chambers and reduces the compression ratio from 14 to 1 to 6 to 1.

c. ACTION OF COMPRESSION RELEASE MECHANISM (fig. 27).

(1) With the governor control in the shut-off position (extreme clockwise rotation), setting the compression release lever for gasoline starting moves the top of lever D to the rear and turns the cross shaft J. This rotates lever E into contact with lever B at point X. Lever E turns lever B until the latch A drops behind the notch in lever B and holds it in that position until changing to Diesel operation.
(2) As lever B turns, rod G is raised and rotates lever V and shaft CC against the tension of the spring attached to the lever AA. The gear on shaft CC turns the gear of the starting valve shaft to press roller H against retainer I and opens the starting valve. With this valve open, the compression ratio is reduced for gasoline starting.
(3) As lever B rotates, link Y advances to remove the cam from the spring on the flat in the carburetor, which allows the needle valve to open and admit gasoline from the gasoline tank.
(4) Lever V pushes rod DD as it rotates and this movement turns the shaft in the air valve housing. Valve lever 1 is keyed to the shaft and is turned upward, thus lifting the valve from the lower seat. When this lever passes center, the spring in the air valve housing snaps the valve against the upper seat. The air path is now through the carburetor and manifold, through the opening formerly covered by the air valve on the lower seat. Copper contact 3 attached to lever 1 is lifted off the insulated contact 4, breaks the ground connection to the magneto, and thus allows it to distribute high-voltage current to the spark plugs.

d. CHANGING TO FUEL OIL OPERATION. After starting on gasoline, set the compression release lever for Diesel operation.

(1) This advances the top of lever D, turns cross shaft J, and rotates lever E. The upper end of lever E contacts latch A and raises it to release lever B from the offset in latch A. Spring tension on lever AA is applied to lever B through shaft CC, lever V, and rod G. Lever B snaps completely around, strikes setscrew R, and pulls link Y. This turns the cam on the carburetor down onto the float spring and reseats the needle valve cutting off the gasoline supply.
(2) As rod G moves down with lever B, lever V rotates shaft CC. The gear on the shaft rotates the starting valve

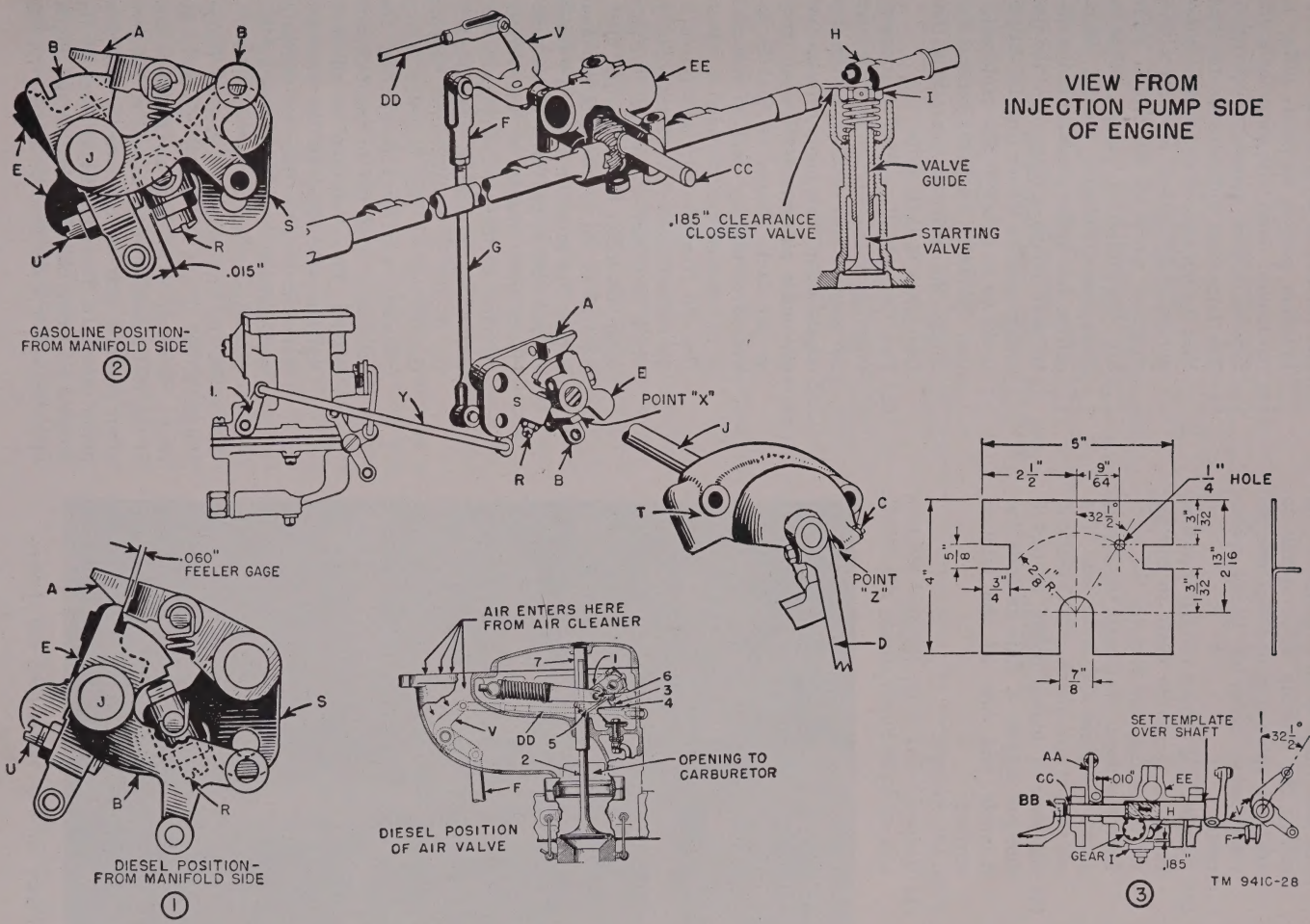


Figure 27.—Power Unit PE-215-C—change-over mechanism.

and lifts roller H off retainer I. This allows the starting valve spring to snap the valve shut and increase the compression ratio for Diesel operation.

(3) As lever V is turned, rod DD is pushed forward, turns the shaft in the air valve housing, and removes the valve from the upper seat until the spring snaps it against the lower seat. The air path is now direct to the manifold.

(4) As lever 1 moves down, contact 3 engages contact 4. This grounds the magneto and cuts off the ignition current.

e. FUEL OIL SYSTEM.

(1) *General.*—Basically, the fuel oil system of both Power Units PE–215–C and PE–215–E are the same. The fuel injection pumps, however, differ in mechanical detail with some slight difference in their manner of operation. The important difference is the fact that the distributor and fuel injection pumps of PE–215–C perform a dual function, while on PE–215–E, there are two injection pumps, separate from the distributor pumps, which deliver fuel under pressure to the distributor pumps. A diagram of the fuel system used on Power Unit PE–215–E is shown in figure 7. The explanation that follows is somewhat general and covers the essential operations that take place in both units.

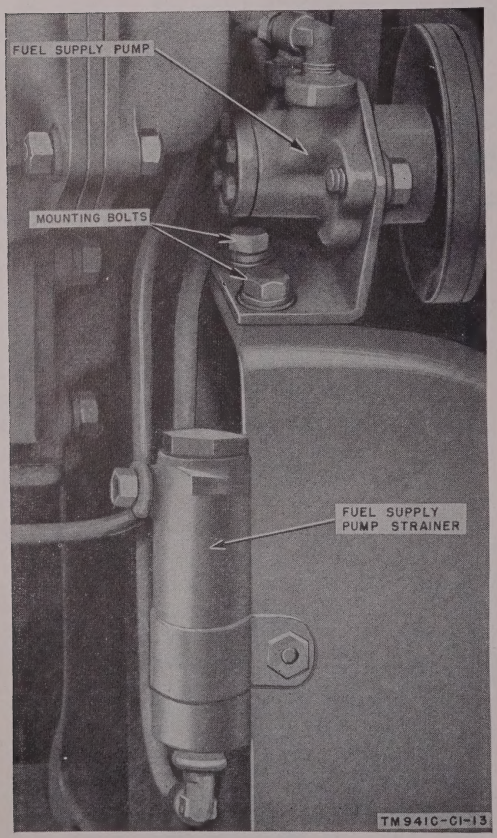


Figure 23.—Fuel supply pump and strainer.

(2) *Fuel flow* (fig. 7).—Fuel oil is drawn from the fuel oil storage tank, through the primary fuel strainer, by the fuel supply pump. This pump delivers fuel oil, under pressure, to the air trap or day tank. Excess oil that is delivered to the day tank is returned to the storage tank through a return line. Oil from the day tank is fed to the fuel oil filter by the transfer pump, which is a part of the fuel injection pump assembly. From the fuel filter, the fuel is fed to the fuel injection pumps. The injection pumps are timed so that fuel is delivered to the individual spray nozzles of the various cylinders at the precise moment that combustion is desired. The speed of the engine is controlled by varying the stroke of the injection pump plungers and thus controlling the amount of fuel fed to the injection nozzles. This variation is automatically accomplished by the governor mechanism or it may be manually accomplished by adjustment of the governor control.

f. GOVERNOR. The governors used on Power Units PE–215–C and PE–215–E are fully inclosed, flyweight type, and an integral part of the fuel injection pump assembly. The governor shaft is gear-driven from the injection pump camshaft. The centrifugal force of the weights is spring balanced, and as the engine operates, either under load or at no load, any

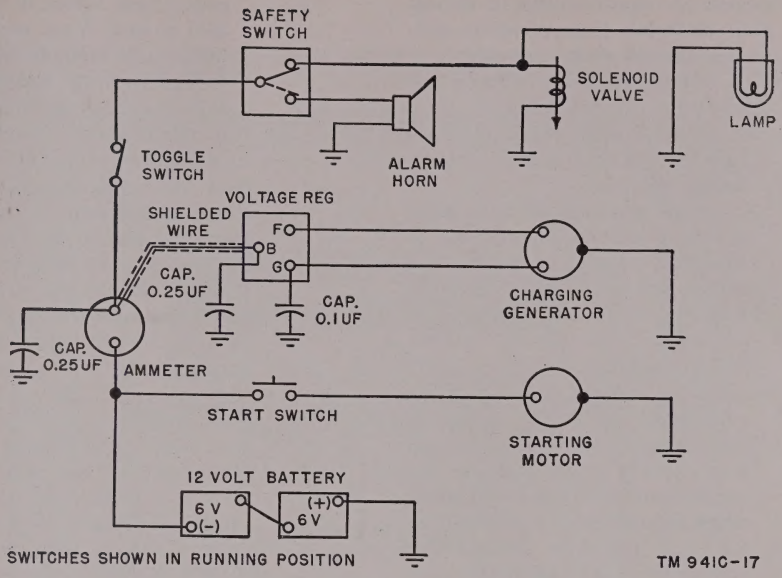


Figure 29.—Power Unit PE-215-E—engine wiring diagram.

change in position of the weights (resulting from fluctuation of engine speed) is transmitted to the injection pump plungers through a yoke. The movement of this yoke operates a toothed rack that engages toothed sections of the injection pump plungers and causes them to rotate. This rotation increases or decreases the amount of fuel allowed to reach the injection nozzles and thus controls the speed of the unit to meet load conditions.

g. SAFETY SWITCH. The safety switch is a solenoid-operated device which shuts off the fuel supply when the temperature of the engine coolant becomes too high or the lubricating-oil pressure becomes too low. The safety switch is located in the fuel oil line, ahead of the fuel injection pump. Fuel enters the solenoid housing, passes through it, and is delivered to the fuel injection pump. The safety switch has two floating poppet valves which are precisely guided to insure tight closure. These valves are held open by a trigger arrangement which is released by a release mechanism in a housing above the main body of the switch. Both releases are spring-loaded and held in open position by the trigger arrangement. Operation of either the oil pressure or temperature release trips the trigger, releases the lever that actuates the poppet valves, and shuts off the fuel supply. Whenever the safety switch operates, it must be reset manually before the engine can be started again.

h. VOLTAGE REGULATOR (figs. 30 and 31).

(1) *Power Unit PE-215-E.*—The automatic voltage regulator is designed to maintain almost constant generator output voltage under varying load conditions. The voltage regulator used in Power Unit PE-215-E consists of four major components: a regulating resistor, a voltage-sensitive element, four fixed resistors, and a selenium rectifier. A voltage adjusting rheostat, a compensating resistor, a current transformer, and a potential transformer are also part of the automatic voltage-regulator assembly.

(*a*) The regulating resistor is mounted directly above the voltage-sensitive element and consists of two identical sections which are connected in series. Each section has 13 taps,

located in opposite rows in imbedding material, thus dividing each section into 12 resistance steps.

(*b*) The voltage-sensitive element is composed of the following:

1. A U-shaped core which forms a base for the control and compensating windings.
2. A control winding, on both sides of the U-shaped core, which is energized from the rectified a-c output and designed to vary the strength of the electromagnet in accordance with the a-c voltage. A compensating winding, energized by tapping off some of the voltage across the d-c exciter, is on only one pole of the U-shaped core. This winding balances the ampere turns of the voltage-sensitive element so that the regulator will maintain normal a-c voltage from no load to full load.
3. A pivoted lever, with an armature attached to one end and a control spring to the other.
4. Twenty-four silver-tipped contact fingers which rest on a stationary silver shorting bar when no current flows in the coil windings. Each finger is wired at its stationary end to a tap of the regulating resistor.
5. A silver shorting bar which makes electrical contact between the tips of the fingers that touch it. This bar is not wired to any circuit.
6. A fiber finger-lifter is attached to the pivoted lever. This lifts the fingers when the armature operates to close the air-gap of the magnetic circuit. When all fingers rest on the silver shorting bar, the regulator resistance in the exciter-field circuit is zero. When the control winding is energized sufficiently to overcome the pull of the control spring, the pivot lever moves and causes the finger-lifter to lift some of the fingers off of the silver shorting bar. This inserts a tap of resistance, for each finger lifted, in the exciter-field circuit. When all fingers are lifted, the amount of regulator resistance in the exciter-field circuit is at its maximum.

(*c*) The third major component, the four fixed resistors, are located behind the voltage-sensitive element. Three of the resistors are rated at 100 ohms, and one at 25 ohms. They are connected as follows: one of the 100-ohm resistors in series with the regulating coil; the 25-ohm resistor in parallel with the compensating winding; the two remaining 100-ohm resistors in the two input lines to the rectifier.

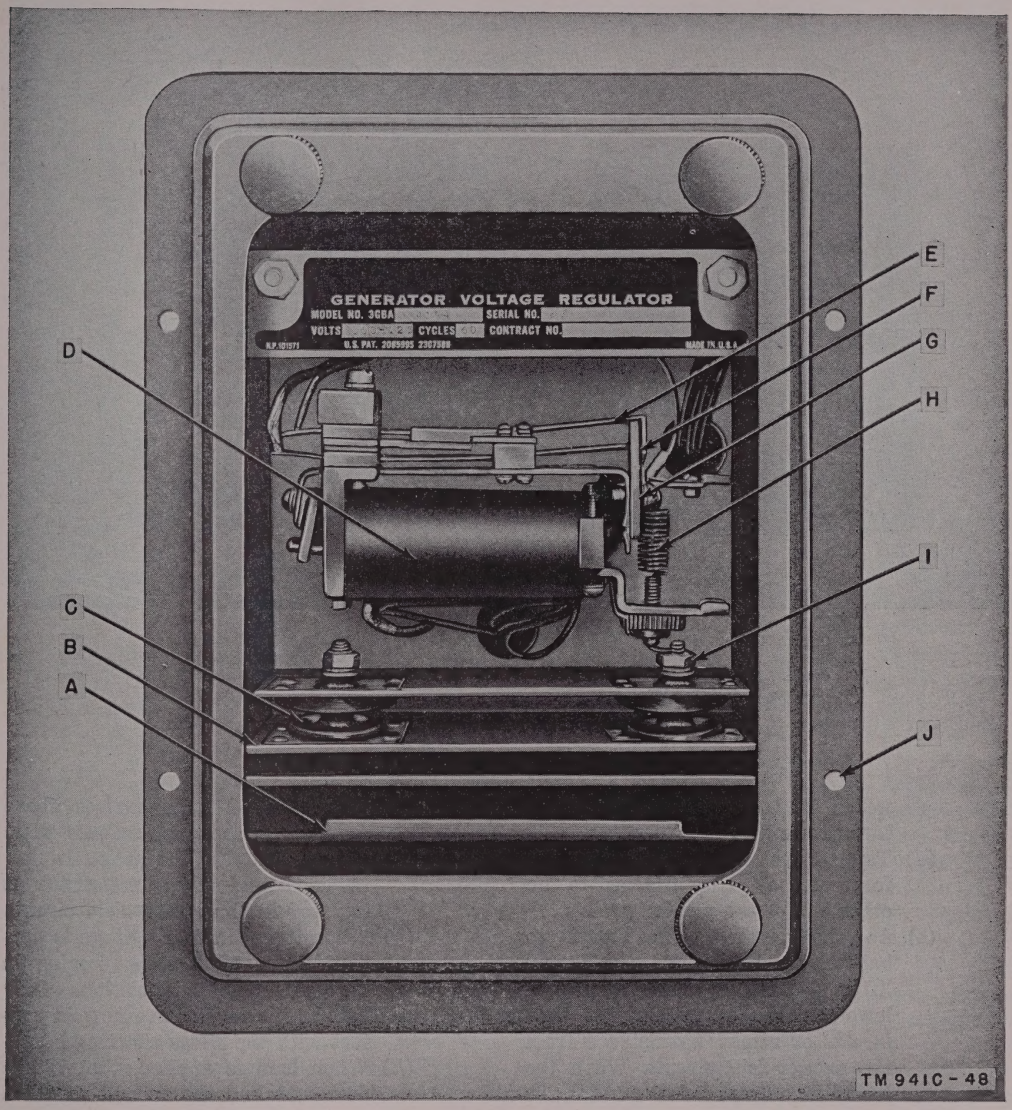
(*d*) The selenium rectifier, the fourth component of the regulator, supplies d-c voltage to the voltage-sensitive element.

(2) *Theory of voltage-regulator operation (PE–215–E)* (figs. 30 and 31).—When the exciter-field rheostat is turned to the resistance-all-out position, the voltage regulator automatically assumes control of the generator output voltage by varying the resistance in the exciter-field circuit. This resistance is varied by the movement of the contact fingers in the voltage-sensitive element. Lifting or lowering the contact fingers adjusts the regulating resistance in the exciter-field circuit, thereby changing the exciter-field current. This, in turn, adjusts the exciter armature voltage to produce the desired output voltage from the a-c generator. The action of the voltage-sensitive element takes place in the following sequence:

(*a*) The selenium rectifier converts the a-c generator output to pulsating dc.

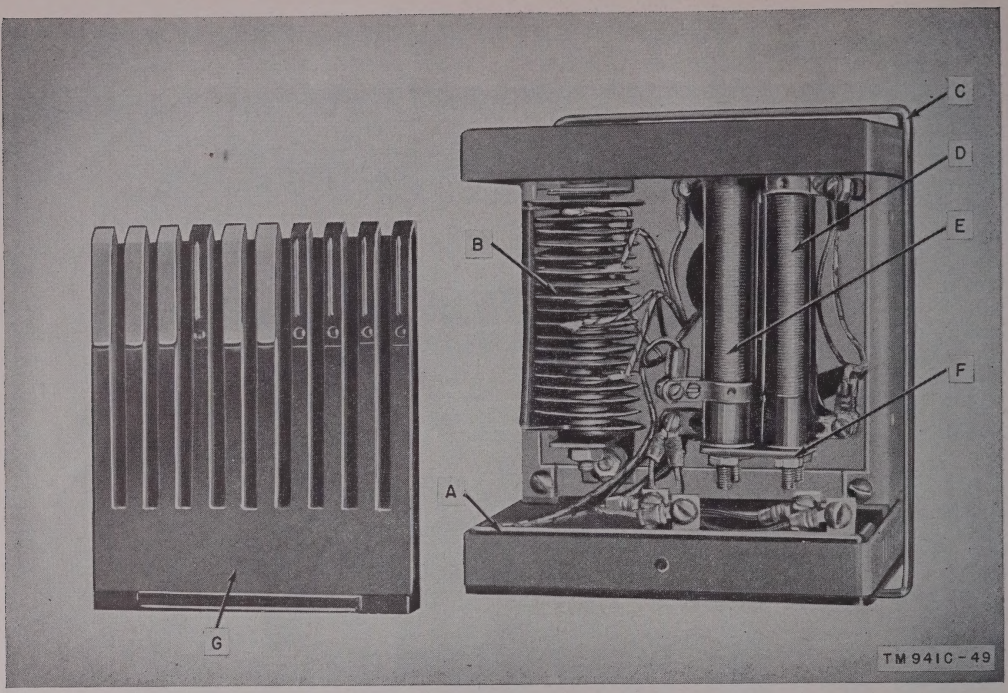
(*b*) This d-c voltage produces current in the regulating coil windings which, in turn, produce magnetic flux in the magnetic core.

(*c*) This magnetic flux acts on the armature, attached to one end of the pivoted arm, and sets up a force



A. Pull-out tray.
B. Mounting bracket for vibration dampers.
C. Vibration dampers.
D. Core for control and compensating windings.
E. Silver-tipped contact fingers.
F. Silver shorting bar.
G. Fiber lifting piece.
H. Control spring.
I. Cover with glass window.
J. Mounting hole.

Figure 30.—Power Unit PE-215-E—voltage-regulator exterior.



A. Contact block.
B. Rectifier.
C. Cradle.
D. 100-ohm, 50-watt, resistor.
E. 25-ohm, 50-watt resistor.
F. Lower resistor bracket.
G. Pull-out tray.

Figure 31.—Power Unit PE–215–E—voltage-regulator, interior.

which tends to pull the armature toward the coil.

(*d*) This force counterbalances the force of the spring attached to the other end of the pivoted arm.

(*e*) As the pivoted arm moves to balance the two forces, the finger-lifter also moves, either raising or lowering the silver fingers. This inserts or removes resistance from the exciter-field circuit. When the a-c voltage drops below normal, the magnetic force decreases proportionately. The spring force overcomes the magnetic force causing the pivoted arm to move to a new position with fewer fingers lifted and, therefore, less resistance in the exciter-field circuit.

(*f*) When the a-c voltage rises above normal, the magnetic force rises proportionately. The action is now reversed and more resistance is inserted in the exciter-field circuit.

(*g*) When the generator voltage is normal, the pivoted arm remains in approximately midposition. Only half of the fingers are now in contact with the silver shorting bar.

(*h*) When load is applied, the voltage decreases and the voltage-sensitive element reacts immediately to short-out resistance from the exciter-field circuit. This permits the voltage to rise.

(*i*) As the a-c voltage reaches normal, and goes above normal, the voltage-sensitive element inserts resistance

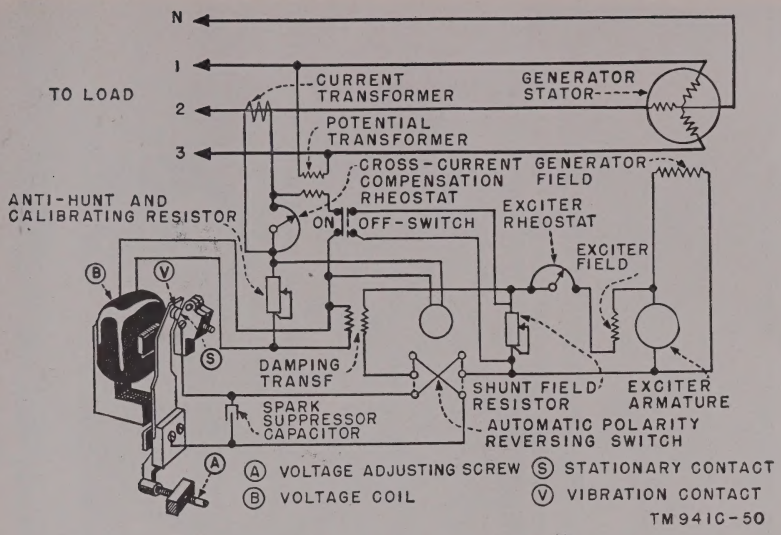


Figure 32.—Power Unit PE–215–C—voltage-regulator diagram.

until the magnetic pull on the armature balances the pull of the control spring.

(3) *Theory of voltage regulator operation (PE–215–C)* (fig. 32).—The automatic voltage regulator used in Power Unit PE–215–C differs both physically and electrically from that used in Power Unit PE–215–E. A diagram of the voltage regulator used in Power Unit PE–215–C is shown in figure 32.

(*a*) The automatic voltage regulator used in Power Unit PE–215–C consists of a laminated core, with a coil (B), and a spring steel vibrator (V). The vibrator (V) is held under tension by a voltage adjusting screw (A), so that when the coil is not energized, the vibrating contact (V) and the the stationary contact (S) are pressed together and short-circuit the shunt-field resistor. The voltage coil (B) is connected to the a-c generator and hence is energized by the ac of the generator.

(*b*) The contacts are connected in the exciter-field circuit. When the coil is not energized, the contacts are pressed together, the vibrator being held under tension by the voltage adjusting screw. In this position, they short-circuit the shunt-field resistor, which is in series with the exciter-field winding. The resulting lower resistance in the exciter-field circuit gives rise to higher exciter-field current, and finally results in higher alternator output voltage.

(*c*) The operating coil is connected across the alternator output through a potential transformer. When the coil is energized by the ac of the generator, the vibrator pulsates 120 times per second. Every 1/120th of a second, when the voltage wave reaches a certain value, the moving vibrator contact is pulled toward the core; the contacts are held open until the voltage wave drops, at which time the contacts close again.

(*d*) While the contacts are open, the exciter current flows through the shunt-field resistor; this tends to

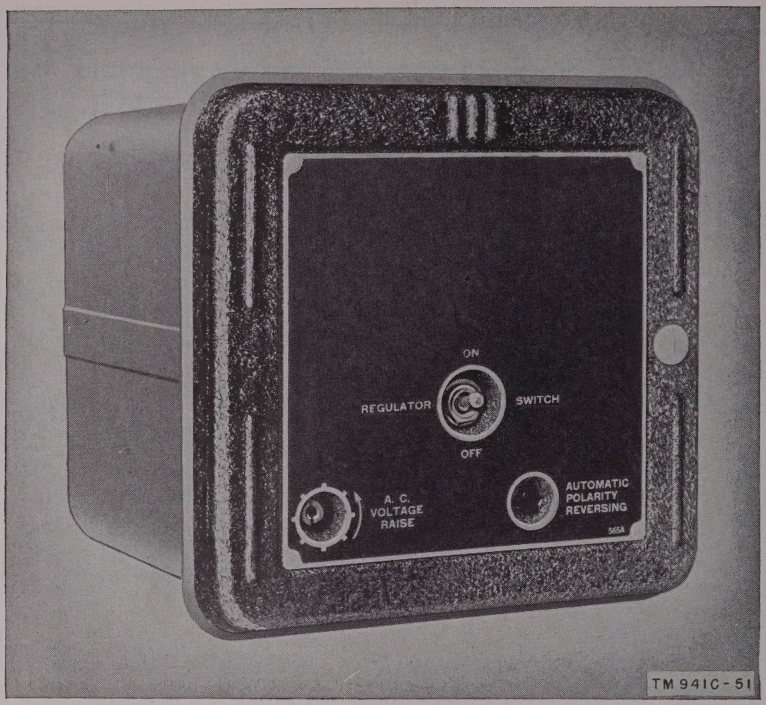


Figure 33.—Power Unit PE-215-C—voltage-regulator exterior.

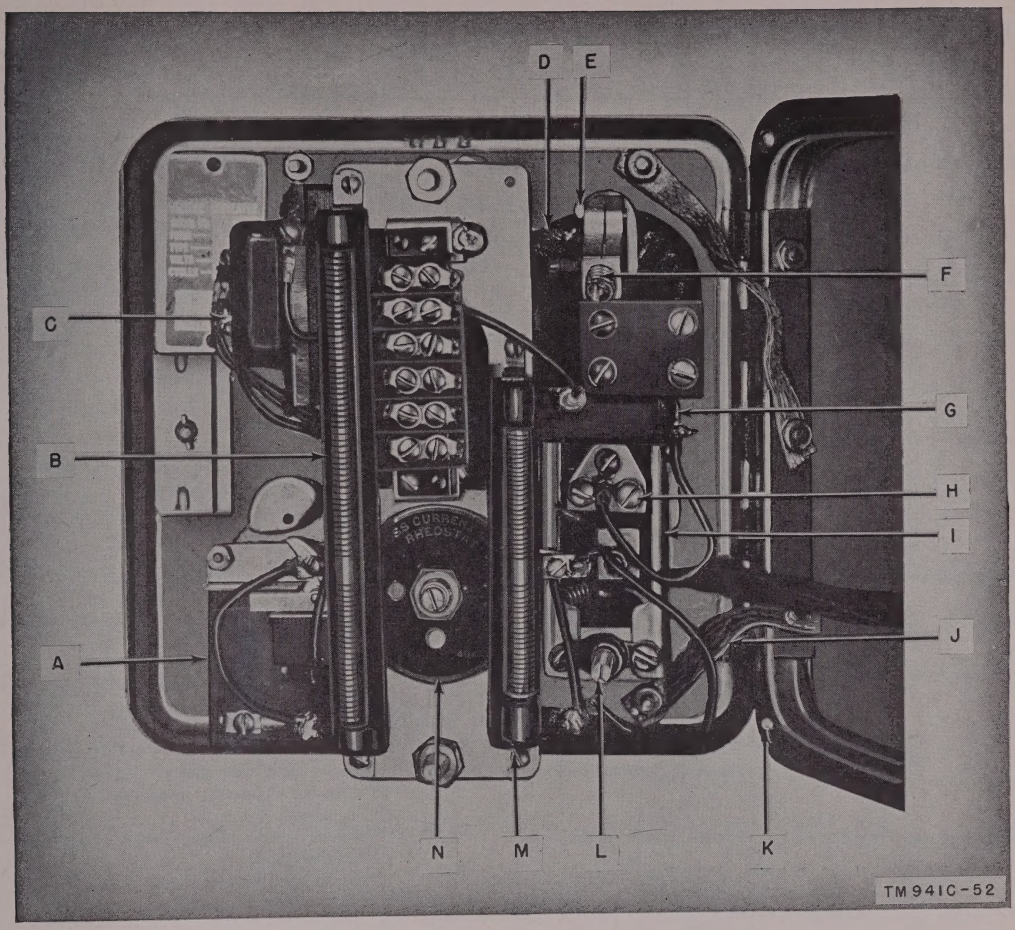
decrease the alternator voltage. The length of time that the shunt-field resistor is inserted in the exciter-field circuit determines the alternator output voltage.

(*e*) When the alternator is operating without load, the shunt-field resistor is inserted in the exciter-field circuit for a certain time during each pulsation. This results in the desired no-load voltage. When load is applied, the generator voltage tends to drop. This immediately increases the duration of the closing of the contacts which results in an increase in generator voltage. On the other hand, when load is removed from the generator, the duration of the openings of the contacts will increase, thus preventing a rise in voltage.

(*f*) The polarity of the contacts is reversed automatically at regular intervals by the automatic polarity-reversal switch. This insures even wear and prolongs the life of the contact points.

38. Meaning of Trouble Shooting

Trouble shooting involves the detection and location of the cause of faulty operation of equipment and the correction of the fault before it develops into a break-down which will necessitate major repairs. Trouble shooting consists of sectionalization and then localization of the cause of faulty operation or failure. In sectionalization, the cause is traced through a series of checks to determine the component of the equipment or system in which the cause of trouble is located. The cause is then local-



A. Automatic polarity-reversal switch.
B. Shunt-field resistor.
C. Damping transformer.
D. Regulator coil.
E. Stationary contact clamping bolt.
F. Stationary contact adjusting screw.
G. Spark suppressor capacitor.
H. Vibrator clamping screws.
I. Regulator relay (vibrator assembly).
J. Bonding strap.
K. Regulator mounting screw.
L. Voltage adjusting screw.
M. Antihunt and calibrating resistor.
N. Cross-current compensation rheostat.

Figure 34.—Power Unit PE–215–C—voltage regulator-interior.

ized by a further series of checks to determine the specific part that is responsible for the difficulty or failure. All operational difficulties have certain rather definite symptoms which will serve as clues to the cause of trouble. Operators should learn to identify these clues as they will save valuable time in localizing troubles. Having identified the clue, reference to the trouble chart that follows will enable rapid localization of the cause of trouble.

39. Trouble Chart

a. ENGINE.

Symptom	Possible cause	Remedy
Failure to start on gasoline	Gasoline shut-off valve closed	Open gasoline valve.
	Gasoline tank empty	Fill gasoline tank.
	Engine flooded through excessive choking.	Open choke and crank engine until excess mixture is expelled from cylinders.
	Engine flooded because of float valve in carburetor being stuck.	Tap carburetor to free float.
		Disassemble carburetor and remove cause of sticking float valve.
	Obstruction in gasoline supply line or gasoline strainer.	Remove obstruction.
	Compression release lever in Diesel position.	Correct position of lever.
	Moisture on ignition wiring or spark plugs causing short circuit.	Wipe off moisture.
	Magneto or magneto cut-out switch short-circuited.	Disconnect magneto ground wire until trouble can be corrected.
	Magneto breaker points out of adjustment, pitted, or dirty.	Clean, adjust, or replace points.
	Safety switch tripped	Reset switch.
Electric starter fails to function.	Storage batteries in discharged condition.	Test storage batteries.
		Replace with batteries that are fully charged.
	Battery connections loose or corroded	Clean and tighten connections.
	Loose connections at starter switch	Clean and tighten connections.
	Defective starter switch	Use jumper wire across switch. If starter functions, replace switch.
	Bendix drive jammed	Loosen starter motor to free drive gear.
	Defective starter motor	Remove and test motor. Replace if defective. Crank by hand until motor is replaced.
Engine starts but misfires	Fouled spark plugs	Inspect spark plugs. Clean or replace faulty plugs.
	Loose wire in ignition system	Inspect and tighten wires.
	Magneto breaker points out of adjustment.	Adjust breaker points.
	Magneto breaker points pitted	Clean or replace points.
	Defective magneto capacitor	Test capacitor. Replace capacitor if defective.
	Water in gasoline	Inspect sediment bowl for foreign matter. Drain gasoline system if foreign matter is present. Refill with clean gasoline.
	Air leaks around manifold gaskets	Check manifold for leaks. Tighten fastenings. Replace gaskets, if necessary.
	Starting valves not properly seated	Check compression release lever position. Pull lever all the way to correct position.
Engine fails to run on fuel oil	Starting valve mechanism stuck	Check valve spring. Clean and lubricate valve stem and guide.
	Air in injection system	Bleed air from system.
	Fuel supply pump not delivering oil	Check fuel oil supply. Test pump.
	Safety switch tripped	Check and reset switch.
	Governor control incorrectly adjusted	Set governor control in correct position.

Symptom	Possible cause	Remedy
	Water in fuel oil	Drain and clean entire fuel oil system. Refill with clean oil. Bleed air from system after refilling.
	Fuel supply pump strainer or fuel filter clogged.	Clean strainer and filter. Bleed air from system after cleaning.
	Starting control linkage out of adjustment.	Check linkage for broken or missing parts.
	Injection pump out of time	Retime fuel injection pump.
Engine misfires in Diesel operation position.	Injection plunger sticking	Disconnect one injector tube at a time to locate missing cylinder. Check fuel delivery. Report condition to officer in charge.
	Injector nozzle fouled	Check for missing cylinder. Remove and clean or replace faulty nozzle.
	Fuel oil pressure low	Check fuel oil filters. Replace dirty filter elements. Check pressure at primary pump with pressure gage. Pressure should be 35 pounds.
	Intake or exhaust valve sticking	Check valves and valve mechanism. Lubricate.
	Intake and exhaust valve clearance incorrect.	Check and adjust tappet clearance.
Puffs of smoke in exhaust	Air leak in fuel lines admitting air into fuel system.	Check all fuel lines and connections for leaks. Tighten connections.
	Dirty fuel oil strainer	Clean fuel oil strainers.
	Valves sticking or clearance adjustment incorrect.	Check tappet adjustment. Lubricate valve stems.
Excessive exhaust smoke	Injector nozzles dirty	Check condition of nozzles. Clean or replace nozzles.
	Valves not properly adjusted	Adjust valves.
	Injection of fuel timed too early	Check injection timing. Correct, if necessary.
	Lack of compression	Check cylinder compression. Notify officer in charge.
	Unsatisfactory grade of fuel oil	Change to specified grade.
	Engine overloaded	Reduce load.
	Air intake obstructed	Clean air cleaner.
	Air in fuel system	Bleed air from system.
	Excessive fuel injection	Notify officer in charge.
Engine knocking	Engine overloaded	Reduce load.
	Injection nozzles fouled	Clean or replace nozzles.
	Air in fuel system	Bleed air from system.
	Loose piston pin, connecting rod, or crankshaft bearings.	Notify officer in charge.
	Worn pistons or cylinders. This will cause low compression.	Notify officer in charge.
	Leaky injection nozzle causing combustion knock.	Check nozzles. Replace faulty nozzle.
	Unsatisfactory grade of fuel oil or water in fuel oil.	Change to specified fuel oil. Clean out fuel system and refill with clean oil.
	Excessive combustion deposits in cylinders.	Report to officer in charge.
Crankcase oil diluted	Stuck or broken piston rings	Report to officer in charge.
	Engine operating at too low temperature.	Check operation of thermostats. Cover portion of radiator.
	Worn pistons or cylinders	Check compression. Report to officer in charge.
	Leaky injector connections	Tighten connections.

Symptom	Possible cause	Remedy
Excessive lubricating-oil consumption.	Leaky oil lines, connections, and/or gaskets.	Tighten oil line connections and gasketed connections.
	Worn pistons and/or cylinders	Check compression. Report to officer in charge.
	Worn or sticking pistons	Report to officer in charge.
	Lubricating oil too light	Use heavier oil.
	Worn bearings and/or oil seals	Report to officer in charge.
	Piston rings stuck	Check compression. Report to officer in charge.
	Oil control rings clogged	Check for excessive smoke from breather pipe. Report to officer in charge.
Low lubricating oil pressure	Lubricating oil too light	Use heavier oil.
	Worn bearings	Report to officer in charge.
	Oil pump strainer clogged	Clean strainer.
	Loose oil line connections	Tighten connections.
	Broken oil lines	Check oil lines. Repair or replace broken lines.
	Dirt under pressure regulating valve	Remove and clean valve.
	Defective oil-pressure gage	Replace gage.
	Line to pressure gage broken or connections loose.	Tighten connections. Repair or replace line.
Low fuel oil pressure	Air leaks in fuel oil lines	Check and tighten lines. Bleed system after tightening.
	Fuel oil filter clogged	Clean filter.
	Stoppage in fuel oil lines	Blow out lines.
	Transfer pump worn or leaking	Repair or replace pump.
Engine overheating	Insufficient coolant	Safety switch should operate. Check operation of switch. Add coolant.
	Thermostats stuck	Check thermostats. Replace, if necessary.
	Water pump drive belt slipping	Adjust belt.
	Defective water pump	Replace pump.
	Overload on unit	Reduce load.
	Radiator air passages clogged	Clean air passages.
	Insufficient ventilation in engine room	Provide more ventilation.
	Sludge or lime formation in cooling system.	Flush out cooling system.
	Wrong grade of lubricating oil	Change to correct grade.
	Lack of oil pressure	Safety switch should stop unit. Check operation of safety switch. Check oil in crankcase. Add oil if needed. Check items under *Low lubricating-oil pressure.*
Lack of compression	Sticking, dirty, or improperly adjusted valves.	Check valves. Adjust and/or clean. Notify officer in charge if need of grinding is indicated.
	Stuck, worn, or broken piston rings	Notify officer in charge.
	Loose cylinder-head or leaking head gasket.	Tighten head. Replace faulty gasket.
	Worn pistons and/or cylinders	Notify officer in charge.
	Leaky gasoline starting valves	Check valves. Check position of compression release lever. Correct position of lever.
	Loose injector nozzles	Tighten nozzles.
Lack of power	Injection system air bound	Bleed air from system.
	Injector nozzles fouled	Clean or replace nozzles.
	Leaky or impropely adjusted valves	Check valve tappet clearance. If need of grinding is indicated notify officer in charge.
	Governor control not properly set	Check governor control and correct setting.

Symptom	Possible cause	Remedy
Engine stops	Faulty lubrication	Check lubricating system.
	Air intake clogged	Check and clean air cleaner.
	Clogged exhaust	Check and clean exhaust.
	Faulty injection pump	Notify officer in charge.
	Stuck or worn piston rings	Notify officer in charge.
	Worn pistons and/or cylinders	Notify officer in charge.
	Out of fuel	Check fuel supply. Refill tank.
	No fuel oil pressure	Check injection and supply pumps. Check filters. Clean filters. If pumps are at fault, notify officer in charge.
	Broken fuel oil line	Check oil lines. Repair or replace faulty line.
	Water in fuel oil forming ice	Clean out fuel oil system and refill with clean fuel.
	Engine overheated	Check coolant. Refill cooling system. Reset safety switch.
	Failure of lubricating-oil pressure	Check lubricating-oil level. Check for broken oil line. Add oil. Make necessary repairs. Reset safety switch.

b. GENERATOR.

Symptom	Possible cause	Remedy
Fails to build up a-c voltage	Voltmeter not indicating	Check voltmeter, voltmeter switch, and connections.
	Open circuit in alternator or exciter wiring.	Check all wiring. Tighten connections. Repair or replace faulty wiring.
	Open circuit in exciter rheostat	Replace rheostat.
	Defective exciter winding	Notify officer in charge.
	No residual magnetism in exciter	Remove exciter wire from terminal 2 on rear of switchboard and connect to ground. Remove the three wire lugs from terminal A2 on capacitor panel in alternator end shield and separate so they will not touch. Excite for a few moments by connecting the negative terminal of the unit battery or other d-c source to capacitor panel terminal A1.
	Exciter-field connections reversed	Reverse exciter-field connections.
	Exciter connections reversed	Check and correct connections.
	Exciter drive belt slipping	Tighten belt.
	Dirty commutator or slip rings	Clean.
	High mica on commutator	Undercut mica.
	Exciter or alternator brushes worn. Not making contact.	Replace brushes.
	Exciter brushes not making proper contact.	Reseat brushes.
	Insufficient brush spring tension	Adjust or replace brush springs.
	Exciter or alternator brushes sticking in holders.	Clean brushes and holders.
	Defective alternator winding	Report to officer in charge.
	Short circuit in suppression system	Locate and replace faulty part.
Voltage too high	Engine speed too high	Reduce engine speed.
	Voltage-regulator switch in OFF position. Little or no exciter-field rheostat resistance in circuit.	Throw switch ON. Adjust rheostat.
	Voltage-regulator switch ON but regulator not operating.	Correct cause if possible. Report to officer in charge.

Symptom	Possible cause	Remedy
	Open or short circut in regulator coil circuit, potential transformer, anti-hunt resistor, or voltage coil.	Use manual control. Check for trouble and make necessary replacements.
	Voltage adjusting rheostat advanced too far in raise-voltage direction.	Adjust rheostat.
	Regulator contacts stuck or vibrator bent (PE–215–C only).	Replace contacts.
	Voltage adjustment set too far in raise-voltage direction.	Correct adjustment.
Erratic voltage (hunting) (PE–215–C).	Loose switchboard wiring connections	Check wiring. Clean and tighten connections.
	Voltage regulator contacts stuck or pitted.	Clean or replace contacts.
	Shunt-field resistor in regulator not properly adjusted.	Adjust resistor.
	Antihunt resistor in regulator not properly adjusted.	Correct adjustment.
	Air gap between regulator contacts not properly adjusted.	Adjust air gap.
	Exciter brushes off neutral	Check for loose brush-holder yoke. Adjust position of brushes.
Erratic voltage (hunting) (PE–215–E).	Loose switchboard wiring connections	Check wiring. Clean and tighten connections.
	Voltage-regulator, pivoted lever bent	Straighten and clean lever.
	Voltage-regulator, fiber finger-lifter rubbing on shorting bar.	Straighten and clean.
	Regulator resistor section open	Replace regulator.
	Fingers making poor contact with shorting bar.	Straighten and clean fingers.
Excessive voltage drop upon generator load increase (PE–215–E).	Exciter leads F1 and A2 reversed	Reverse leads connected to terminals 3 and 4 on regulator terminal board.
	Open compensating winding in voltage regulator.	Replace regulator.
	Open compensating resistor in voltage regulator.	Replace resistor.
	Open regulator resistor step	Replace regulator.
	Regulator fingers not making contact with shorting bar.	Straighten and clean fingers.
	Exciter-field rheostat not fully out	Turn rheostat to end of INCREASE VOLTAGE travel.
	Excessive engine speed drop	Check for obstruction in fuel system. Check for overload.
Sparking at commutator or slip-ring brushes.	Dirty commutator, slip rings, or brushes	Clean.
	Exciter or slip-ring brushes worn	Replace brushes.
	Brush spring tension weak	Correct tension or replace springs.
	Brushes worn or chipped	Replace brushes.
	Brushes sticking in holders	Clean brushes and brush holders.
	Commutator or slip rings rough	Clean with #4/0 sandpaper.
	High mica between commutator bars	Undercut mica.
	Loose brush holders	Tighten.
	Loose brush leads	Tighten.
	Open, shorted, or grounded field coils	Replace faulty coils.
	Excessive load	Reduce load.
Generator heats excessively	Overload	Reduce load.
	Shorted stator windings	Replace or repair windings.
	Air passages obstructed	Clean air passages.
	Poor ventilation in operating area	Improve ventilation.

CHAPTER 4

FIELD MAINTENANCE INSTRUCTIONS

Section I. GENERAL

40. Scope

The instructions and information in this chapter cover maintenance and repair operations to be performed only by field maintenance personnel. These instructions cover complete repair and overhaul of the equipment. Appropriate tables of clearances and tolerances are provided and information included on interchangeable and noninterchangeable parts. Additional information on the theory of operation is included where such information is necessary. Appropriate instructions on final testing before returning the equipment to service are also given.

41. References

a. All Department of the Army publications that will prove helpful to personnel working on the equipment are listed in appendix I.

b. For information on appropriate supply publications, see appendix II of this manual.

Section II. DIFFERENCES IN MODELS

42. Interchangeable Parts

a. ENGINES. The engine used in Power Unit PE–215–C is very similar to the engine used in Power Unit PE–215–E. Many parts of these engines are interchangeable. There are, however, sufficient differences in various accessories and subassemblies to necessitate extreme certainty as to the correct part before attempting replacements. Check the appropriate supply catalogs for the correct parts for the particular unit on which work is being performed.

b. GENERATORS. The alternator and exciter assemblies used in Power Units PE–215–C and PE–215–E may be interchanged as complete assemblies. However, subassemblies and parts of these components are not interchangeable.

c. SWITCHBOARDS. The switchboards and their components are not interchangeable.

43. Parts Reference

The appropriate parts for Power Unit PE–215–C and Power Unit PE–215–E are shown in the identification table of parts, appendix II. This table contains a description and also states the function of each part.

Section III. PREREPAIR PROCEDURE

44. Technical Inspection

Before proceeding with repairs, unless the unit is in a nonoperating condition, operate the unit and check all appropriate items appearing on DA AGO Form 464. Check carefully for any deficiencies and enter the appropriate symbol in the box opposite the item requiring attention.

45. Tools

In addition to the tools listed in paragraph 7, the following tools are necessary for complete disassembly, repair, and reassembly:

Item	Sig C stock No.
Wrench, torque indicating, ½-inch square drive, 150-pound.	6R43150
Wrench, pipe, adjustable, 14-inch, ½- to 1½-inch pipe capacity.	6R56614
Lifter, valve, compression type	6Q63180
Puller, gear remover	6R7392
Scale, spring balance	

46. Meters and Gages

The following meters, gages, and test instruments are necessary for determining serviceability, measuring clearances and tolerances, and final testing and adjustment of equipment:

Item	Stock No.	
	Sig C	Federal
Tachometer, engine, electric		18–T–230
Tester, battery, universal type		17–T–5505
Tester, low-voltage circuit		17–T–5575
Ammeter, alternating current, portable.		17–A–5510
Voltmeter, alternating-current, portable.		17–V–932
Gage, cylinder, dial type	6Q45211	
Gage, connecting rod bore		41–G–99–300
Light, timing, neon tube type		41–L–1440

Section IV. CLEANING, INSPECTING, AND STRIPPING

47. Cleaning

Thoroughly remove all grease, oil, dust, and dirt from the exterior of the equipment. Wash with Diesel oil or solvent (SD), if necessary. Be sure that all accumulations of dirt and grease are removed. Blow all foreign matter from between the tubes of the radiator.

48. Inspection

After thoroughly cleaning the equipment, inspect the entire unit for any traces of damage, misalinement, or any other unsatisfactory condition. Check for cracks in the manifolding, cylinders, and cylinder heads. Check for damaged mounting brackets and damaged fastenings. Carefully inspect all hose connections to determine if replacement is necessary. Inspect all wires and cables to see if the insulation is in such condition as to necessitate replacement of the wire. Carefully inspect all phenolic parts for cracks or other damage. Feel for play in all shafts, couplings, and mountings.

49. Stripping

a. GENERAL. Strip the unit of all subassemblies and small parts. Plan this work so that all operations are in logical sequence. Perform the more simple operations first and then proceed with those that are more complicated. Tag all small parts, fuel lines, oil lines, wire connections, etc., as they are removed, to insure their correct replacement.

b. BATTERY REMOVAL.

(1) Disconnect the cables from the storage batteries and remove the batteries from the unit.

(2) Test the batteries with the battery tester and take hydrometer readings of each cell. If any unsatisfactory condition is noted, record the deficiency and mark the faulty battery for repair or replacement.

(3) If the battery test is satisfactory, wash the outside with a solution of warm water and baking soda. Do not permit any of the solution to get into the battery cells.

(4) Place the batteries on charge, and when they have become fully charged, store them in a moderately warm, dry place. A freshening charge will be necessary every few months while the batteries are in storage.

c. BATTERY-CHARGING GENERATOR REMOVAL.

(1) Tag for future identification and remove all wires and cables from the generator and voltage regulator.

(2) Loosen the drive belt adjustment, remove the mounting bolts, and remove the generator from the unit.

(3) Remove the cover band from the generator and inspect the condition of the commutator and brushes. Make a

note of any unsatisfactory condition on a tag and attach the tag to the generator. Place the generator aside for future attention or pass it along to generator repair personnel.

d. STARTING MOTOR REMOVAL.

(1) Disconnect the battery cable from the starting motor.

(2) Remove the cap screws that secure the starting motor to the flywheel housing and remove the motor from the unit.

(3) Remove the cover band and inspect the brushes and commutator.

(4) Make a note of any unsatisfactory condition on a tag and attach the tag to the motor. Place the motor aside for future attention or pass it along to motor repair personnel.

e. CARBURETOR REMOVAL.

(1) Close the gasoline shut-off valve at the gasoline tank.

(2) Disconnect the gasoline line from the carburetor.

(3) Remove the drain plug from the bottom of the carburetor and drain the carburetor. Replace the drain plug to prevent its loss.

(4) Disconnect the throttle linkage and remove the carburetor mounting screws.

(5) Remove the carburetor from the unit. Make a note of any unsatisfactory condition on a tag and attach the tag to the carburetor. Place the carburetor aside for future attention or pass it along to carburetor repair personnel.

f. MAGNETO REMOVAL.

(1) Tag the spark plug wires and magneto grounding lead for future identification when reassembling.

(2) Disconnect the shielding and pull the spark plug wires from the distributor cap.

(3) Remove the cover band from the magneto drive coupling.

(4) Remove the cap screws that secure the magneto to the magneto mounting bracket and slide the magneto away from the coupling.

(5) Make a note of any unsatisfactory condition on a tag and attach the tag to the magneto. Place the magneto aside for future attention or pass it along to magneto repair personnel.

g. FUEL SUPPLY PUMP STRAINER REMOVAL. Disconnect the fuel line between the fuel supply tank and the strainer at the strainer. Disconnect the fuel line between the strainer and the fuel supply pump at the pump. Remove the support fastening and remove the strainer from the unit. Place it aside for future attention.

h. FUEL SUPPLY PUMP REMOVAL. Remove the drive belt from the fuel supply pump drive pulley. Disconnect the fuel line between the fuel supply pump and the day tank at the supply pump. Remove the mounting bolts and remove the pump. Place the pump aside for future attention.

i. FUEL FILTER REMOVAL.

(1) Remove the drain plug and drain the fuel filter. Catch the drainings in a suitable container. Replace the plug to prevent its loss.

(2) Disconnect the fuel inlet and outlet connections from the filter.

(3) Remove the mounting screws from the fuel filter mounting and remove the filter and mounting from the engine. Place the assembly aside for future attention.

j. SAFETY SWITCH REMOVAL.

(1) *PE–215–C.*—Disconnect the two fuel line connections and the lubricating-oil line connection from the safety switch. Remove the thermal element from the cylinder block. Be very careful when removing this element. Hold the bushing that is screwed into the cylinder block with a wrench while turning the floating bushing that secure the capillary tube with another wrench. Remove the clamps that hold the capillary tube and carefully coil the tube. Be very careful not to kink this tube. Remove the fastenings that hold the safety switch to the base of the unit and remove the switch. Place it aside for future attention.

(2) *PE–215–E.*—Remove the cover from the safety switch on the injector side of the engine. Disconnect the wires from the switch and tag them for identification when reassembling. Re-

move the fuel line connection and disconnect the capillary tube as instructed in (1) above. Remove the fastenings that hold the switch and mounting bracket and remove the complete assembly. Place it aside for future attention.

k. LUBRICATING-OIL FILTER REMOVAL. Remove the drain plugs. Drain the oil from the lubricating-oil filters into a suitable container. Replace the drain plugs to prevent their loss. Remove the fastenings that secure the lubricating-oil filter mounting and remove the filters and mounting as a complete unit. Place the filters aside for future attention.

l. SOLENOID SWITCH REMOVAL. Tag for future identification and remove the wires from the top of the solenoid switch. Disconnect the two fuel line connections. Remove the solenoid from the unit and place it aside for future attention.

m. COMPRESSION RELEASE LEVER REMOVAL. Loosen the clamping screw and slide the compression release lever from the shaft.

n. FUEL INJECTOR PUMP REMOVAL.

(1) Tag for future identification and remove the fuel injection tubes from the injection pump and injector nozzles. Plug the openings in both the injection pump and nozzles to prevent the entrance of foreign matter.

Note.—On PE–215–C, drain all fuel oil from the day tank.

(2) Disconnect all fuel line connections from the injection pump and tag the lines for future identification.

(3) Remove the shield from the injection pump drive assembly.

(4) Pry the leather boot from the groove in the adjuster. Remove the cap screws that secure the sections of the drive coupling.

(5) Remove all control linkage.

(6) Remove the mounting fastenings and remove the entire injection pump assembly from the unit.

o. GASOLINE AND DAY TANK REMOVAL.

(1) *PE–215–C.*—Open the drain cock on the bottom of the gasoline tank and drain the gasoline into a suitable container. Tag and remove all fuel lines that are still attached to the tank.

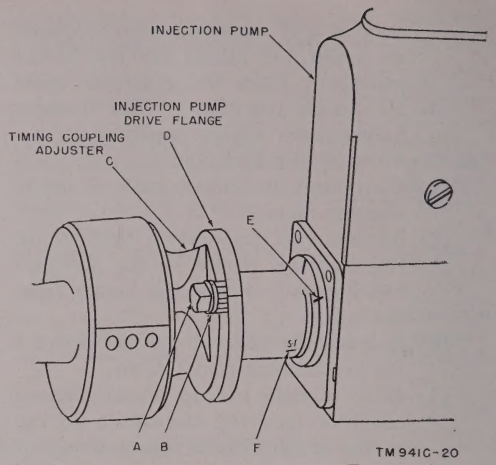


Figure 35.—Power Unit PE–215–E—injection pump drive.

Remove the mounting fastenings and remove the tank from the rear of the radiator.

(2) *PE–215–E.*—The day tank and gasoline tank on these units are mounted side by side, above the engine instrument panel, on the rear of the engine. Drain both tanks into suitable containers before removing them. Disconnect the fuel lines. Remove the fastenings that secure the tanks to the unit and remove them from the unit. Tag the fuel lines to insure their correct replacement when reassembling.

p. AIR CLEANER REMOVAL. Remove and empty the oil cup on the bottom of the air cleaner. Replace the oil cup. Loosen the clamps on the connecting hose and remove the hose from the air cleaner. Remove the fastenings that secure the air cleaner assembly and remove the complete assembly from the unit. Place it aside for future attention.

q. ENGINE INSTRUMENT PANEL REMOVAL.

(1) Disconnect the control linkage and tag it for future identification.

(2) Remove the housing from the instrument panel.

(3) Remove the heat indicator, thermal element, and capillary tube.

Caution: Do not kink this tube.

(4) Disconnect the oil-pressure tube from the lubricating-oil pressure gage.

(5) Tag and disconnect the wires from the starting switch.

(6) Tag the wires connected to the ammeter and, on PE–215–E, the wires connected to the indicator light and ON-OFF switch, and remove them. Remove the fastenings that secure the instrument panel and remove the panel. Remove the fastenings that secure the governor control and remove it from the unit. Place these items aside for future attention.

r. RADIATOR REMOVAL.

(1) Remove the drain plug from the under side of the radiator and drain the coolant from the radiator. Replace the plug after the radiator has been drained to prevent its loss.

(2) Loosen the hose clamps on the hose connection to the bottom tank of the radiator and remove the hose.

(3) Loosen the hose clamps and remove the upper radiator connecting hose.

(4) Remove the fastenings that secure the fan guard and remove the fan guard. Replace the fastenings to prevent loss.

(5) Remove the radiator overflow pipe.

(6) Remove the radiator filler cap and insert a steel bar crosswise in the upper radiator tank. Attach a hoist to this bar and take up on the hoist until there is a slight lift.

(7) Remove the tie rods that support the top of the radiator.

(8) Remove the fastenings that secure the radiator to the unit and hoist the radiator assembly clear of the unit.

(9) Place the radiator aside for future attention and be sure to protect it from any possible damage.

s. WATER PUMP AND FAN REMOVAL. Loosen the hose clamps that secure the connecting hose between the water pump and manifold, and remove the hose. Remove the fastenings that secure the water pump to the cylinder block and remove the pump and fan assembly. Place the assembly aside for future attention.

50. Detailed Inspection

a. BATTERY-CHARGING GENERATOR. Before proceeding with disassembly of the generator, place it on a test stand and check the output and the action of the cut-out and voltage control. At approximately 2,200 revolutions per minute, a cold generator should show an output of 8 to 10 amperes and 14.4 to 14.9 volts. After about 30 minutes of operation, the output should be between 6 to 8 amperes and 14.1 to 14.5 volts at approximately 2,400 revolutions per minute. At a temperature of 70° F., the voltage control contacts should open at 15.4 to 16.35 volts and close at 13.9 to 15.1 volts. At 180° F., the contacts should open at 14.4 to 15.35 volts and close at 12.8 to 14.1 volts. Make a note of any unsatisfactory condition and proceed with the disassembly as follows:

(1) Remove the cover from the voltage regulator, disconnect the leads, remove the regulator mounting screws, and remove the regulator from the generator.

(2) Remove the cover band on the commutator end of the generator.

(3) Disconnect the brush leads.

(4) Remove the two through-bolts and remove the commutator end head. If necessary, tap the head lightly with a soft hammer to loosen it.

(5) Tap the field frame lightly with a soft hammer to loosen it from the drive end head and remove the field frame.

(6) Clamp the armature in a soft-jawed vise and remove the drive pulley nut. Remove the drive pulley with the aid of a gear puller.

(7) Place the armature and drive end assembly in an arbor press and press the armature shaft out of the drive assembly.

(8) Do not proceed with further disassembly until the various parts have been checked or tested to determine if replacement is necessary. Check the condition of the bearings in the drive end and commutator end heads. The inside diameter of the plain bearing should be 0.562 to 0.563 inch. The inside diameter of the ball bearing should be 0.6693 inch. Test the field coils and armature windings for open circuits, short circuits, or grounds, and proceed with any further disassembly indicated.

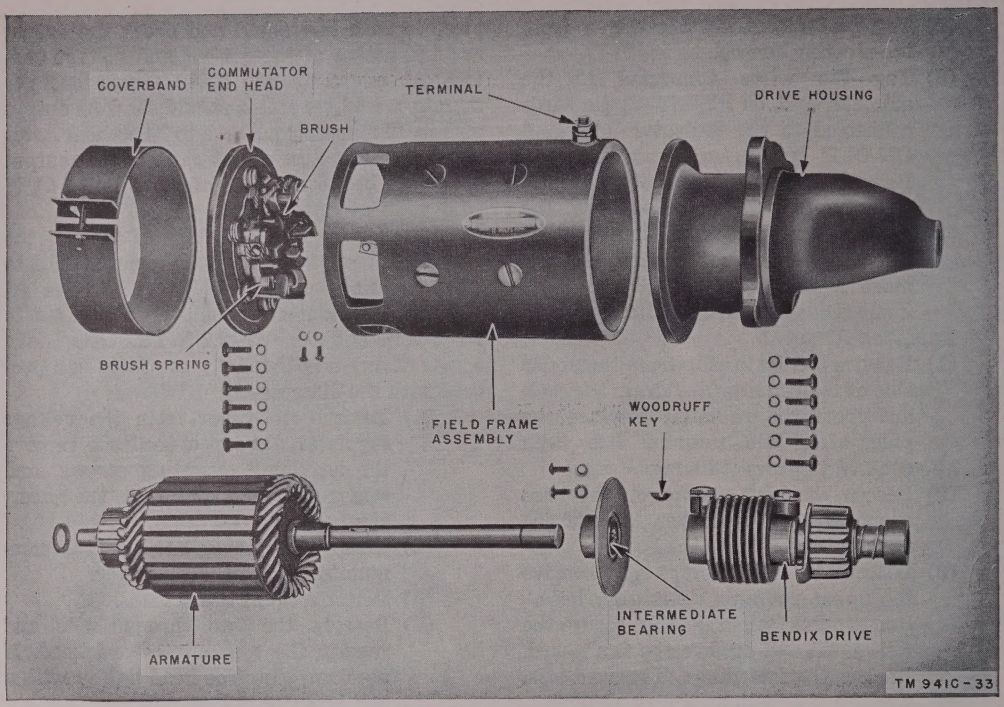


Figure 36.—Electric starting motor—disassembled.

b. STARTING MOTOR (fig. 36). Follow the same general procedure in disassembling and testing the starting motor as was used for the battery-charging generator. At no load, the starting motor should draw 65 amperes at 12 volts and develop a speed of 4,500 revolutions per minute.

c. CARBURETOR. Before disassembling the carburetor, prepare a clean space on the workbench and cover it with clean paper. Wash the outside of the carburetor thoroughly in Diesel oil or solvent (SD). On PE–215–C, remove the primer assembly before proceeding with other disassembly. (This primer is not used on PE–215–E.) Do not disassemble the primer. Proceed with the disassembly of the carburetor as follows:

(1) Remove the screws that secure the fuel bowl to the upper half of the carburetor and remove the bowl. The bowl assembly contains the float, float valve, and strainer assemblies.

(2) Unscrew the screen retainer and remove the screen. Remove the float pivot screw and remove the float and float valve assembly.

(3) Remove the bottom plate and unscrew the metering well. Inspect all passages for obstructions. Also inspect the drip hole filler which is located in the bottom plate. This filler must be a snug fit and must not be clogged.

(4) Remove the nut from the end of the control shaft and withdraw the shaft with the dust washer, retainer, and spring. Check the shaft bearing and unscrew it from the body if replacement is indicated.

(5) File the ends of the screws that secure the throttle butterfly valve. Remove the screws and take out the butterfly valve. When reassembling, be sure to stake the new screws after they are installed.

(6) File the ends of the two screws that secure the starting shutter. Remove the screws and take out the shutter.

(7) Clean all carburetor parts in a solution consisting of half benzol and half alcohol or use acetone. Do not run wires through the jets as this may cause enlargement of the orifice.

d. MAGNETO. Do not attempt a more extensive disassembly of the magneto than that for which the need is indicated. Certain disassembly, however, is necessary.

(1) The rotor and rotor bearings must be removed and inspected. To remove the rotor, detach the impulse coupling, the distributor block with mechanism and capacitor, and the breaker housing cover. Remove the primary lead-out screw below the cam in the breaker housing and take the housing from the magneto frame. Pry the key from the rotor shaft and pull the rotor assembly from the housing end of the magneto. The primary lead-out shield will come out as the rotor is removed.

(2) If inspection indicates that it is necessary to remove the coil, proceed as follows: Remove the magnet, distributor block, and magneto cover. Remove the distributor mechanism. Take out the coil core screw from each interpole on the magneto housing and force the coil upward with a screw driver. Lift out the coil together with the two end insulators. Place a keeper across the poles of the magnet as soon as it is removed.

e. FUEL SUPPLY PUMP. Disassemble the fuel supply pump as follows:

(1) Remove the cap screws that secure the front cover. The gasket and idler gear will come off with the cover.

(2) Place the pump in a vise with the jaws of the vise across the fuel ports and remove the cap with a spanner wrench. The metal gasket will also come off in this operation.

(3) Place a wrench across the flat at the drive end of the shaft and, with a box wrench, back the seal nut at least 6 full turns. Remove any burrs and scratches from the rotor shaft with a smoothing stone so that subsequent removal of the seal assembly will not groove the diaphragm bushing.

(4) Fasten the seal nut in the vise and pull the rotor shaft through the seal assembly. If the assembly is tight on the shaft, place a wooden block against the drive end face of the housing and tap the block sharply with a hammer. Remove the pin key with a pair of pliers. If the rotor shaft is burred where the pin key fits, dress it with a smooth file.

(5) Replace the pump housing in the vise and remove the housing plug and gasket with a spanner wrench.

(6) Disassemble the seal by unscrewing the seal nut from the threaded collar on the diaphragm. This will free the spring, metal washer, and metal locking ring.

(7) Carefully inspect all parts for grooves and wear. Remove all rust and corrosion. Check for excessive clearance between the idler gear and the crescent on the cover. Clearance of 0.0005 to 0.001 inch will cause loss of pressure in the pump. Check the fit of the idler gear on the pin. It should turn freely with no perceptible play. Check the bearing for wear. Check the bushing inside of the diaphragm. It normally has from 0.0002- to 0.0005-inch play in the shaft and is slotted to permit installation and removal of the seal assembly. Inspect the diaphragm for cracks and holes. Check the surface of the rotor head that contacts the inner surface of the housing. Check for wear and grooves in the bushing. If wear causes a loose fit, replacement of the housing will be necessary.

f. LUBRICATING-OIL FILTER. Completely disassemble the lubricating-oil filters. Wash all parts thoroughly in Diesel oil or solvent (SD). Inspect all threaded connections for possible damage to the threads. Replace all filter elements and gaskets when reassembling.

g. WATER PUMP AND FAN ASSEMBLY. Disassemble the water pump and fan assembly and inspect all parts for wear and/or damage.

Disassemble the water pump as follows:

(1) Remove the pump body cover and withdraw the impeller and shaft.

(2) Remove the bearing clamp nut, bearing retainer, and oil seal.

(3) Support the pulley in a press and push on the forward end of the sleeve. The pulley, bearing, and retainer ring will push free of the sleeve.

(4) Pry the rear bearing, spacer, and seal from the sleeve.

(5) The water pump sleeve is a press fit and can be pressed from the pump body after the pump has been disassembled.

(6) Check the impeller shaft and impeller shaft bushings. The running clearance of the shaft in the bushings is 0.0015 to 0.0025 inch. The diameter of the impeller shaft is 0.6215 to 0.6220 inch. Replace any parts that show excessive wear.

51. Fits and Tolerances

Item	PE–215–C	PE–215–E
Compression pressure (Diesel operation).	465 lb	512 lb.
Compression ratio	13.67 to 1	15.5 to 1.
Magneto rotation (facing coupling end).	Clockwise	Clockwise.
Magneto breaker point gap	0.020 in.	Same.
Spark advance	15°	Same.
Impulse coupling trips	4° after TDC	Same.
Spark plug size	⅞–18	Same.
Spark plug gap	0.035 in.	Same.
Firing order	1–5–3–6–2–4	Same.
Piston skirt clearance:		
Top (measured 90° from pin hole).	0.0096 to 0.0104 in.	Same.
Bottom (at bottom of skirt).	0.0076 to 0.0084 in.	Same.
Piston check with ½ x .007 in. shim stock.	7 to 10 lb	Same.
Width of piston ring grooves:		
Top compression	0.128 to 0.129 in.	Same.
Second compression	0.127 to 0.128 in.	Same.
Third compression	0.1265 to 0.1275 in.	Same.
Oil control (2)	0.2515 to 0.2525 in.	Same.
Fourth compression	0.1265 to 0.1275 in.	Clockwise.
Piston ring gap:		
First, second, and third compression rings.	0.010 to 0.020 in.	Same.
Fourth compression and oil control rings.	0.010 to 0.018 in.	Same.
Piston ring clearance in groove:		
First compression ring	0.004 to 0.005 in.	0.004 to 0.006 in.
Second compression ring.	0.003 to 0.004 in.	0.003 to 0.005 in.
Third and fourth compression rings.	0.0025 to 0.0035 in.	0.0025 to 0.0045 in.
Oil control ring	0.0025 to 0.0035 in.	Same.
Piston pin length	4.105 in.	Same.
Piston pin diameter	1.6250 to 1.6253 in.	Same.
Piston pin clearance:		
In connecting rod bushing.	0.0003 to 0.0005 in.	0.0005 to 0.0007 in.
In piston bore	0.0001 to 0.0003 in.	Same.
Connecting rod length (C to C).	13¼ in.	Same.
Crank pin diameter	3.2480 to 3.2485 in.	Same.
Bearings, crankshaft:		
Main journal diameter	3.4980 to 3.4985 in.	Same.
Running clearance	0.003 to 0.005 in.	Same.
End clearance	0.006 to 0.014 in.	Same.
Cap nut torque, foot-pounds.	150	Same.
Length, front	1.870 in.	Same.
Length, intermediate	1.620 in.	Same.
Length, center	2.624 in.	Same.
Length, rear	2.0575 in.	Same.
Camshaft bearings:		
Running clearance	0.0015 to 0.0035 in.	Same.
Length, front	2 5/16 in.	Same.
Length, second	2 in.	Same.
Length, third	2 in.	Same.
Length, rear	1 15/16 in.	Same.
End clearance	0.005 to 0.011 in.	Same.
Journal diameter, front.	2.618 to 2.619 in.	Same.
Journal diameter, second.	2.4305 to 2.4315 in.	Same.
Journal diameter, third.	2.368 to 2.369 in.	Same.
Journal diameter, rear.	1.9305 to 1.9315 in.	Same.

Item	PE–215–C	PE–215–E
Connecting rod:		
Bearing end clearance	0.005 to 0.012 in.	0.0005 to 0.0007 in.
Large end bearing diameter.	3.248 to 3.2485 in.	Same.
Running clearance	0.003 to 0.004 in.	Same.
Bearing length	2 1/16 in.	Same.
Nut tension, foot-pounds.	70	Same.
Cylinder sleeves:		
Inside diameter	4.749 to 4.751 in.	Same.
Length	11 3/4 in.	Same.
Allowable taper	0.001 in.	Same.
Allowable out of round	0.001 in.	Same.
Intake valves:		
Stem diameter	0.432 to 0.433 in.	Same.
Port diameter	1 25/32 in.	Same.
Tappet clearance (hot).	0.018 in.	Same.
Tappet clearance (cold).	0.020 in.	Same.
Head diameter	2 in.	Same.
Stem clearance in guide.	0.002 to 0.004 in.	Same.
Seat angle	45°	Same.
Valve seat width	3/32 in.	Same.
Exhaust valves:		
Stem diameter	0.431 to 0.432 in.	Same.
Port diameter	1 17/32 in.	Same.
Tappet clearance (hot).	0.018 in.	Same.
Tappet clearance (cold).	0.020 in.	Same.
Head diameter	1 3/4 in.	Same.
Stem clearance in guide.	0.003 to 0.005 in.	Same.
Seat angle	45°	Same.
Valve seat width	3/32 in.	Same.
Valve springs:		
Free length	2 7/8 in.	Same.
Test length, closed	2 1/2 in.	Same.
Test load, closed	53 lb	Same.
Valve timing:		
Intake valve opens	20° before TDC.	Same.
Intake valve closes	40° after BDC.	Same.
Exhaust valve opens	40° before BDC.	Same.
Exhaust valve closes	10° after TDC.	Same.
Valve tappets:		
Diameter	1 9/16 in.	Same.
Length	4 1/8 in.	Same.
Clearance in guide	0.0005 to 0.003 in.	0.0005 to 0.0007 in.
Push rod diameter	7/16 in.	Same.
Push rod length (overall).	17 3/32 in.	Same.
Starting valve lever and shaft:		
Shaft diameter	0.9660 to 0.9665 in.	Same.
Lever clearance on shaft.	0.0005 to 0.002 in.	Same.
Lever bushing diameter (inside)	0.967 to 0.968 in.	Same.
Lever bushing length	1.245 in.	Same.
Starting valves:		
Seat angle	45°	Same.
Head diameter	1 3/32 in.	Same.
Stem diameter	0.3085 to 0.3095 in.	Same.
Stem clearance in guide.	0.002 to 0.004 in.	Same.
Stem guide diameter (inside).	0.3115 to 0.3125 in.	Same.
Guide length	2 11/16 in.	Same.
Valve spring diameter	2 9/32 in.	Same.
Valve spring free length.	1 31/32 in.	Same.
Valve spring test length.	1 5/32 in.	Same.
Valve spring test load	23.9 lb	Same.
Cylinder-head gasket thickness.	0.064 in.	Same.
Timing gear backlash	0.003 to 0.006 in.	Same.
Lubricating-oil pump:		
End play between gear and end plate.	0.003 to 0.006 in.	Same.
Gear clearance in housing.	0.012 to 0.015 in.	Same.
Backlash of gears	0.004 to 0.006 in.	Same.
Drive shaft diameter (at journals).	0.8595 to 0.8600 in.	Same.
Drive shaft running clearance.	0.0015 to 0.0035 in.	Same.
Idler gear running clearance.	0.0015 to 0.003 in.	Same.
Clearance between body and drive pinion.	0.005 to 0.010 in.	Same.
Oil-pressure valve regulating spring:		
Free length	2 13/16 in.	Same.
Test length	2 3/32 in.	Same.
Test load	37 lb	Same.
Nut and bolt torque data (foot-pounds):		
Cylinder head, nut to stud.	190 to 215	Same.

Item	PE–215–C	PE–215–E
Connecting rod bolts	70 to 75	0.0005 to 0.0007 in.
Main bearing, nut to stud.	250 to 275	Same.
Flywheel bolt	150 to 155	Same.
Manifold nut to stud	75 to 80	Same.
Nozzle body to nozzle body stud. Nut to stud.	45 to 50	Same.
Idler gear shaft nut or cap screw.	225 to 250	0.0005 to 0.0007 in.
Water pump drive shaft, nut to stud.	150 to 175	Same.
Camshaft gear nut	225 to 250	Same.
Injector nozzle discharge pressure.	700 psi	Same.

Section V. DISASSEMBLY, REPAIR, AND REASSEMBLY

Note.—The following instructions are applicable *after* the equipment has been stripped in accordance with instructions in paragraph 49.

52. Intake Manifold Removal

a. POWER UNIT PE–215–C.

(1) Remove the four cap screws that secure the air cleaner connection to the top of the valve housing.

(2) Remove the cap screws that secure the valve housing cover and lift off the cover.

(3) Disconnect the air valve control rod from the cross shaft.

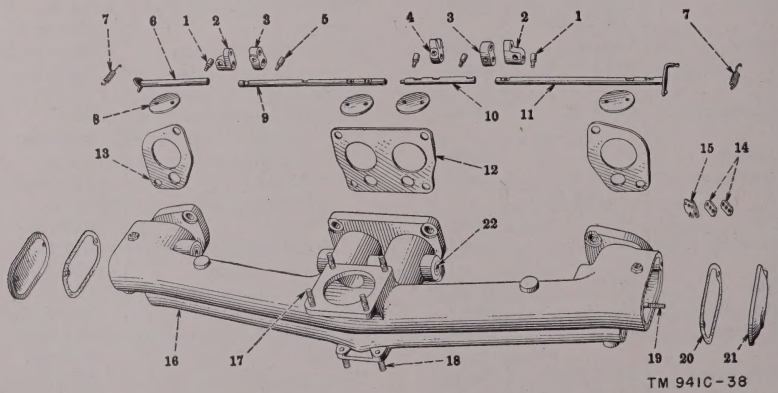
(4) Remove the plate from the manifold housing above the carburetor. Disconnect the wires from the switch on the inside of the the housing and pull out the wires. Mark the wires for future identification.

(5) Remove the stud nuts that hold the manifold to the engine cylinder heads and remove the manifold assembly.

b. POWER UNIT PE–215–E (fig. 43).

(1) Disconnect the locking shaft from the lever at the back of the carburetor.

(2) Remove the link connecting the carburetor shut-off to the cross-shaft jaw.



1. Manifold control shaft flange pin.
2. Manifold control shaft coupling.
3. Manifold control shaft flange.
4. Manifold control lever.
5. Manifold control lever pin.
6. Manifold control shaft, front, with lever.
7. Manifold control spring.
8. Manifold butterfly valve.
9. Manifold control shaft, front, intermediate.
10. Manifold control shaft, rear, intermediate.
11. Manifold control shaft, rear, with lever.
12. Intake manifold gasket, center.
13. Intake manifold gasket, end.
14. Ignition cutout switch insulation plate.
15. Ignition cutout switch contact and terminal plate.
16. Intake manifold, complete.
17. Carburetor stud.
18. Air intake flange stud.
19. Intake manifold end cover stud.
20. Intake manifold end cover gasket.
21. Intake manifold end cover.
22. Manifold control shaft seal.

Figure 37.—Power Unit PE–215–E—intake manifold assembly.

(3) Remove the cover plate from the radiator end of the manifold and disconnect the wires from the switch on the inside of the housing. Mark the wires for future identification. Pull out the wires.
(4) Remove the air cleaner connection from the top of the manifold.
(5) Remove the stud nuts that hold the manifold to the engine cylinder heads and remove the complete carburetor and manifold assembly as a unit.

53. Manifold Cleaning, Inspection, and Repair

a. Wash all parts in solvent (SD) and dry them with compressed air. Inspect all parts for wear or damage and replace any parts that appear in an unserviceable condition.

b. On Power Unit PE–215–E, install new seals in the manifold where the butterfly valve shafts pass through. Face the edges of these seals toward the outside. Install the control shafts and levers in the manifold and install the butterfly valves in the slots in the control shafts. Secure each butterfly valve with the two screws provided for each valve. Hook the spring onto the stud and the lever on the end of the butterfly valve shaft at the front of the manifold. Loosen the locknuts on the top of each end of the manifold and adjust the butterfly valves. Do this by means of the setscrews. Adjust the setscrews until the valves are horizontal inside of the manifold with the levers in contact with the setscrews.

c. On Power Unit PE–215–C, reassemble the manifold by reversing the procedure for disassembly.

d. Reinstall the manifold assembly by reversing the disassembly procedure. Install new gaskets on the studs that hold the manifold to the cylinder heads and install the manifold. Be sure to place lockwashers under each nut and tighten the nuts to between 75 and 80 foot-pounds torque. Reconnect the wires to the magneto short-circuiting switch on the inside of the manifold.

54. Cylinder Head Removal

a. Remove the intake manifold as instructed in paragraph 51.

b. Disconnect the exhaust lines and remove the exhaust manifolds. Disconnect the yoke from the starting valve operating shaft. On PE–215–E, disconnect the valve housing breather tube.

c. Loosen all valve lever adjusting screws, remove all valve housing and valve mechanism fastenings, and lift the complete valve mechanism and valve housing assembly straight up and off the cylinder heads.

d. Disconnect the spark plug wires from the spark plugs and remove the spark plug wire assembly.

e. Remove the cooling-water connections, the cooling system manifolds, and the thermostat units.

f. Remove the cylinder-head fastenings and lift off the cylinder heads.

55. Intake and Exhaust Valve Removal

a. Remove the manifold as instructed in paragraph 52 and the cylinder heads as instructed in paragraph 54.

b. Mark the valves for identification or prepare a numbered valve board to hold the removed valves. Compress the valve springs and remove the valve spring retainers. Tag the valve springs for identification and remove the springs. The valves may now be removed from their guides.

56. Injector Nozzle Removal

Remove the nuts from the injector nozzle-holder studs and pull the nozzles out of the cylinder heads. If necessary, tap the nozzles with a soft hammer to loosen them. Wrap each nozzle in a piece of clean cloth to protect it from foreign matter and damage. Remove the precombustion chambers and metal spacer gaskets.

57. Rocker Arm Removal

a. Disconnect the operating rod yoke from the cross shaft that passes through the valve housing. On PE–215–E, remove the valve housing breather tube.

b. Remove the valve housing and the valve mechanism assembly.

c. Remove the setscrews from the rocker arm shaft center bracket.

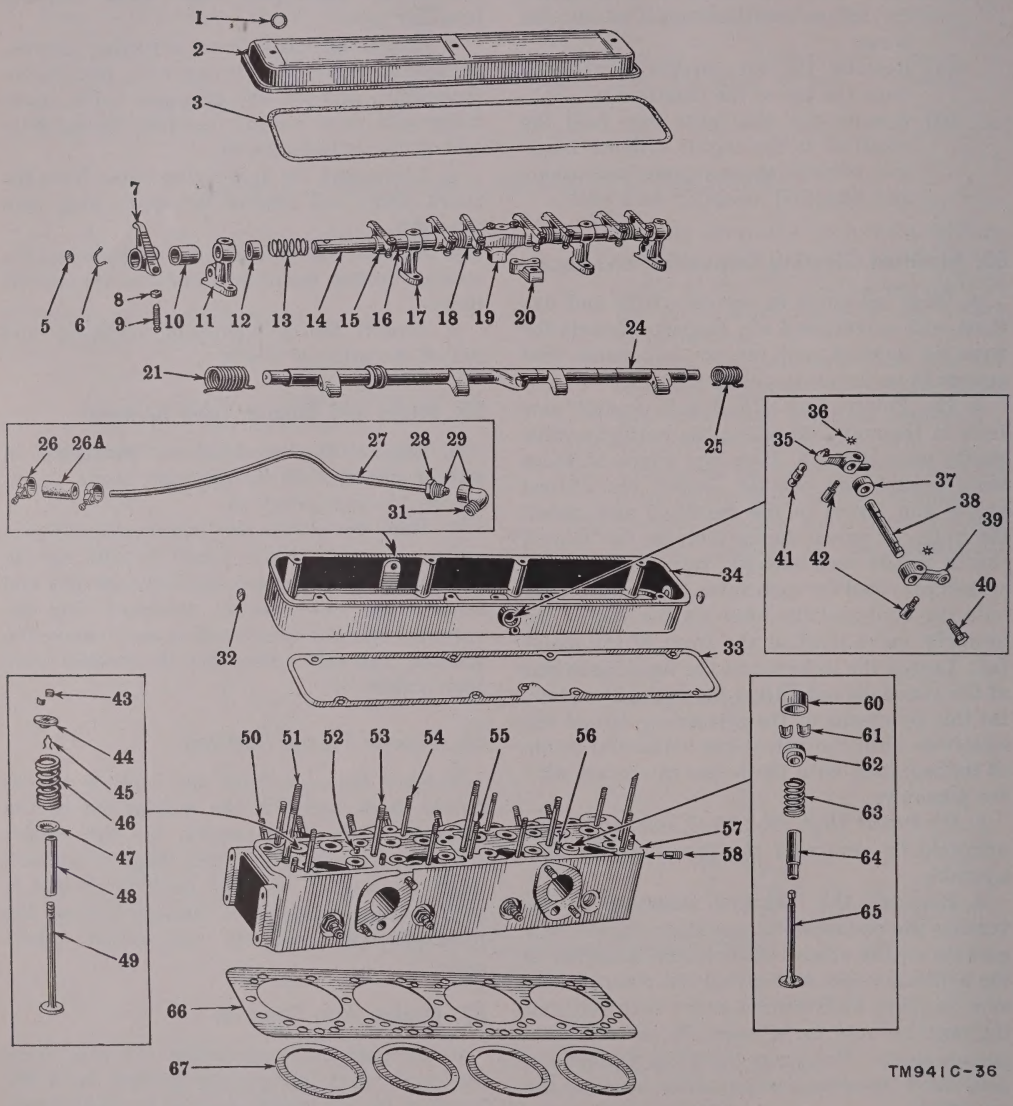


Figure 33.—Power Unit PE-215-E—cylinder-head assembly.

1. Washer.
2. Valve housing cover.
3. Valve housing cover gasket.
5. Expansion plug.
6. Retainer ring.
7. Exhaust valve lever.
8. Valve lever adjusting screw locknut.
9. Valve lever adjusting screw.
10. Valve lever bushing.
11. Valve mechanism outer bracket.
12. Valve lever outer spacer.
13. Valve lever spacer spring.
14. Valve lever shaft.
15. Intake valve lever.
16. Valve lever intermediate spacer.
17. Valve mechanism intermediate bracket.
18. Exhaust valve lever.
19. Valve mechanism center bracket, upper half.
20. Valve mechanism center bracket, lower half.
21. Starting valve shaft spring, rear.
24. Starting valve shaft with lever.
25. Starting valve shaft spring, front.
26. Hose clamp.
26A. Breather tube hose.
27. Valve cover breather tube.
28. Breather tube retainer nut.
29. Breather tube connection elbow.
32. Expansion plug.
33. Valve housing gasket.
34. Valve housing.
35. Starting valve operating shaft inner lever.
36. Lever pin lockwasher.
37. Starting valve operating shaft oil seal.
38. Starting valve operating shaft.
39. Starting valve operating shaft outer lever.
40. Operating shaft lever stop screw.
41. Starting valve shaft push rod.
42. Starting valve operating shaft lever pins.
43. Valve spring seat key.
44. Upper valve spring seat.
45. Valve stem retainer key.
46. Valve spring.
47. Lower valve spring seat.
48. Valve guide.
49. Valve (exhaust and intake).
50. Fuel injection nozzle body retainer stud.
51. Valve mechanism bracket stud (long).
52. Starting valve shaft bracket locating pin.
53. Valve mechanism bracket stud (intermediate).
54. Valve housing stud (long).
55. Valve housing stud (short).
56. Valve mechanism bracket stud (short).
57. Cylinder-head section (two sections required).
58. Oil header plug.
60. Starting valve spring retainer.
61. Starting valve spring retainer keys.
62. Starting valve spring seat.
63. Starting valve spring.
64. Starting valve guide.
65. Starting valve.
66. Cylinder-head gasket.
67. Cylinder gasket rings.

Figure 38.—Continued.

d. Remove the nuts from the bracket studs, and the retainer rings from the ends of the shaft. Mark all parts for indentification and slide them from the shaft.

58. Starting Valve Shaft Removal

a. Remove the pin from the starting valve cross-shaft inner lever.

b. Remove the valve housing and valve mechanism as instructed in paragraph 57.

c. Remove the valve rocker arm shaft end brackets, and remove the starting valve shaft assembly. Carefully observe the position of the various parts to insure replacing them correctly when reassembling.

59. Cylinder-Head Assembly Cleaning, Inspection, and Repair

a. CLEANING. *Wash* all parts thoroughly in clean fuel oil. Flush the water jackets and water passages with water pressure. Clean all combustion deposits from the cylinder heads, valve ports, valve guide bores, and valves.

b. INSPECTION. Inspect all parts for serviceable condition (see paragraph 51 for fits and tolerances). Carefully inspect the valve stems and valve guide bores for scores. Inspect the valve faces and valve seats for burns or pitting. Measure and test all valve springs for conformity with limits in paragraph 51. Carefully inspect the cylinder heads for cracks and inspect all studs and threaded holes for damaged threads.

c. REPAIRS.

(1) *Cylinder head.*—Replace all parts that appear in worn or doubtful condition. Reface all valve seats and check the width of the seats. The valve seat width must not exceed three thirty-seconds inch. Press out worn valve stem guides and press new ones in their place. When replacing the valve stem guides, make sure that the chamfered end of the guide is toward the top of the cylinder head. Intake and exhaust valve guides must extend $1\frac{3}{8}$ inches above the surface of the cylinder-head casting. Starting valve guides must be sunk $\frac{15}{16}$ inch below the top of the cylinder-head surface. Ream the exhaust and intake valve guides with a 0.4335-inch reamer. Ream the starting valve guides with a 0.374-inch reamer. Other valve dimensions are given in paragraph 51.

(2) *Valve mechanism.*—Replace any worn or doubtful valve rocker arm bushings. Be sure to line up the oil holes in the bushings with the oil holes in the rocker arms. Ream the new bushings to between 0.967 and 0.968 inch. Replace all valve springs that do not conform with the measurements given in paragraph 51.

(3) *Valve grinding.*—Before replacing the valves in the cylinder heads, match each valve to the seat from which it was removed and grind it into the seat with fine valve grinding compound. Be sure to remove all grinding compound when the grinding operation is finished.

d. REASSEMBLY.

(1) *Intake and exhaust valves.*—Coat the valve stems with oil (OE) and insert them in the seats from which they were originally removed and to which they were ground. Slip the lower valve spring seat over the valve stem, slide the hairpin-type valve stem retainers into the grooves in the valve stems nearest the head, and place the valve springs and upper valve spring seats on the valve stems. Depress the valve springs and insert the wedge-shaped valve spring keys. If difficulty is experienced, place a dab of grease on the valve stem to hold the keys until the valve spring compressor is released.

(2) *Starting valves.*—Match the starting valves to the seats from which they were originally removed and insert the valve stems in their guides. Install the valve springs and spring seats and compress the springs with the valve spring compressor. Insert the retainer keys and release the spring compressor. Install the covers over the valves. Replace the starting valve shaft.

(3) *Valve mechanism.*—Replace the valve levers and spacers on the rocker arm

shaft. Make sure that spacers are installed in their correct places and that the right, left, and straight valve levers are in their correct locations. In each group of four, the two center levers are straight with a left and right lever on their respective ends.

(4) *Injection nozzles.*—Install the fuel injection nozzles as follows:

(*a*) Install the metal spacer gasket in the cylinder-head opening.

(*b*) Insert the precombustion chamber into the cylinder head with the word UP, which is stamped on the side of the chamber, toward the top of the cylinder head.

(*c*) Install the second metal gasket.

(*d*) Dip the dust seal into a thick soap solution and roll it into the groove in the nozzle body retainer.

(*e*) Place the nozzle body retainer in position on the retainer studs, install the retainer stud nuts and tighten them to 90 foot-pounds torque.

(*f*) Place the fuel injection nozzle in position in the injector nozzle retainer body. Be sure that the connection for the fuel injection tube is correctly faced, install the cap screws, and tighten them to 20 foot-pounds torque.

(5) *Cylinder heads.*—Make sure that all combustion deposits have been cleaned from the tops of the pistons and from the inside of the cylinder heads. Make sure that the gasket faces of the cylinder block and cylinder heads are thoroughly clean. Install a new cylinder-head gasket, with the word TOP facing up, under each cylinder head. Install a new gasket ring, with the flat side down, in position for each cylinder. Select the correct head section and install it over the cylinder-head studs. Lower the head sections into position and install the cylinder-head nuts. Tighten the nuts to between 190 and 215 foot-pounds torque. Tighten cylinder heads in accordance with the sequence shown in figure 40.

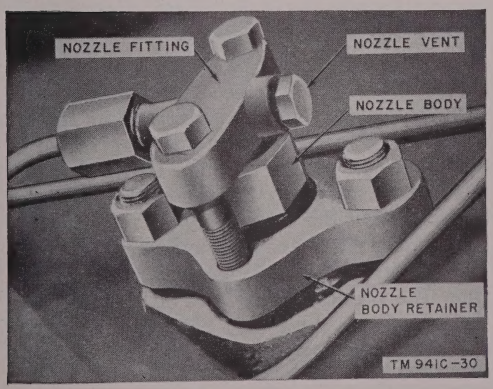


Figure 39.—Fuel injector nozzle mounting.

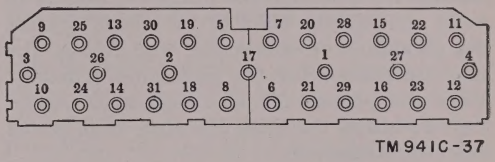


Figure 40.—Cylinder-head tightening chart.

(6) *Valve push rods.*—Place the push rods in position and install the valve mechanism. Adjust the clearance between the valve stems and valve levers to 0.020 inch.

(7) *Final operations.*—Remove the protective caps from the injector nozzles and from the fuel injection tubes and connect the tubes to the nozzles. Be sure thermostat units are in satisfactory condition, place them in position, and then install the water manifolds and exhaust manifolds. Replace the spark plugs and reconnect the spark plug wires. Close the drains on the under side of the radiator and on the side of the cylinder block and fill the cooling system.

60. Piston and Connecting Rod Removal

The piston and connecting rod assembly can be removed through the bottom of the crankcase. Removal of the cylinder heads is not necessary for this operation. Proceed as follows:

a. Drain all lubricating oil from the base of the engine and remove the engine oil pan and gasket.

b. Remove the spark plugs and rotate the engine crankshaft until one connecting rod is at the bottom of its stroke.

c. Remove the cotter pins and nuts from the bearing cap bolts. Tap the bearing cap lightly to loosen it and remove the bearing cap and bearing shell. Replace the nuts on the bolts to prevent their loss and to protect the threads against damage. Push up on the connecting rod until it clears the crankshaft and remove the upper bearing shell.

d. Rotate the crankshaft until the crank throw is to one side of the crankcase and pull the connecting rod and piston assembly out through the bottom of the crankcase. Be sure to avoid striking the skirt of the piston against the crankcase or connecting rod. Repeat the same operations for the remaining cylinders. Mark the pistons for identification to insure their return to the same cylinders from which they were removed.

e. After the piston and connecting rod assemblies have been removed, replace the bearing caps. The cylinder number is stamped on one side of each connecting rod and each bearing cap. Keep matching parts together.

61. Piston and Connecting Rod Disassembly

When all pistons and connecting rods have been removed, remove the piston rings from the pistons and remove the connecting rod. Proceed as follows:

a. Use a piston ring expander and remove the piston rings. Start with the top ring and remove them in order.

b. Remove the piston pin retainer rings from each side of the piston and push the piston pin out of the piston and connecting rod. If the piston pin does not push out freely, set the piston in water that has been heated to between 160° F. and 180° F. Do not attempt to drive the piston pin from the piston as this may cause distortion of the piston.

62. Piston and Connecting Rod Cleaning, Inspection, and Repair

a. Wash all parts in solvent (SD) and dry them with compressed air. Clean out the oil passages in the pistons and oil control rings. Clean the piston ring grooves with a groove cleaning tool or a piece of broken piston ring of the same width as the ring that belongs in the groove to be cleaned. Run a soft wire through the rifled oil passage in the connecting rod. Blow out all oil holes and oil passages with compressed air.

b. Measure the insides of the cylinder sleeves with an inside micrometer at both the top and bottom of the sleeve. Take measurements 90° apart at both the top and bottom to determine if the sleeves are out of round. Measure the outside of each piston with an outside micrometer. Tolerances will be found in paragraph 51. Carefully inspect the pistons and the walls of the cylinder sleeves for evidence of scoring. If either the piston or sleeve is scored, new pistons and sleeves must be installed. Check the fit of the piston in the cylinder sleeve by the use of a spring scale and a piece of 0.007-inch shim stock, one-half inch wide. Place the shim stock in the cylinder and insert the piston. Pull on the scale and note the number of pounds pull required to withdraw the shim stock. A 7- to 10-pound pull should be required. If the shim can be pulled out with less than a 7-pound pull, the piston or cylinder sleeve is worn and both should be replaced. Check the clearance of the piston rings in their respective grooves. The correct clearances are given in paragraph 51.

c. If the compression test, recorded on DA AGO Form 464, at the time of the technical inspection was unsatisfactory or excessive lubricating-oil consumption was reported, new piston rings may be required. When fitting new piston rings, place the new ring inside of the cylinder to which it is to be fitted and push it about half way down into the cylinder sleeve with the piston. Refer to paragraph 51 for the correct ring gap and, with the ring inside of the cylinder, measure the gap. If the ring gap is too close, carefully file the butting ends of the ring until the correct gap is reached. The three upper rings are plain compression rings. The fourth ring is a taper faced compression ring. The two lower rings are oil control rings.

Note.—If new piston rings are being installed in used pistons and sleeves, file the sharp edge from the top of the top compression ring. Unless this is done, noisy operation and possible breakage of either the ring, ring land, or both may result.

d. Check the fit of the piston pin in the piston and connecting rod. The correct clearance for the fit in the piston and in the connecting rod bushing is given in paragraph 51.

e. Carefully inspect the connecting rod for twists, cracks, and alinement. The piston pin must be in perfect, parallel alinement with the crankpin. Replace any connecting rods that appear unsatisfactory. If new piston pin bushings are installed, be sure that the oil hole in the bushing lines up with the oil hole in the connecting rod. Burnish the new bushing in place with a burnishing tool and hone it to size.

63. Piston and Connecting Rod Reassembly

Before proceeding with reassembly, assemble matched pistons, connecting rods, and bearings. The cylinder number is stamped on each connecting rod and bearing cap and the pistons should have been marked for identification upon disassembly. Each piston has an arrow on its top.

a. Heat the piston by placing it in water heated to between 160° F. and 180° F. Place the upper end of the connecting rod inside of the piston, line it up with the piston pin holes in the piston, and press the piston pin in by hand. Install the two piston pin retainer rings, one on each side of the piston. When assembling the connecting rod to the piston, hold the piston so that the arrow is pointing toward your left hand and assemble the connecting rod to the piston with the numbered side facing you. When the pistons are installed in the cylinders, the arrows must face toward the radiator end of the unit and the numbered side of the connecting rods and bearing caps must be toward the camshaft side of the engine.

b. Use a piston ring expander and install the piston rings on the pistons. Start with the bottom oil ring and work toward the top of the piston. Position the piston rings so that the ring gaps are staggered around the piston. With the aid of a piston ring compressor, install the pistons through the bottom of the cylinder sleeves. Be sure that the assembly numbered 1 is installed in the No. 1 cylinder and that the others are installed in correct order.

c. Wash the lower end of the connecting rod with solvent (SD), wipe it with a clean cloth, and dry it thoroughly with compressed air. Do the same with the bearing. Clean and dry the lower bearing and bearing cap in the same manner and place the bearing in the cap. Apply oil (OE) to the bearing surface of the bearing and place it in position on the crankshaft. Pull the connecting rod down onto the bearing. Make sure that the notch in the connecting rod fits over the nib on the bearing. The lower half of the bearing and the bearing cap have similar notches and nibs which must fit together. Make sure that the number on the bearing cap is the same as that on the connecting rod and facing the same side of the engine. Coat the face of the bearing with oil (OE) and assemble the bearing and cap to the connecting rod. Install the nuts on the bearing cap bolts and tighten them to 70 foot-pounds torque. Be sure to replace the cotter pins in each bolt and nut.

d. Make sure that the face of the oil pan and the gasket surface of the crankcase are clean. Apply shellac to the gasket face of the oil pan and set a new gasket in place on the oil pan. Make sure that all holes in the gasket line up with the holes in the oil pan. Install the oil pan and secure it with the cap screws. Be sure to install a lockwasher on each cap screw.

64. Cylinder Sleeve Replacement

a. Remove the cylinder heads as instructed in paragraph 54. Remove the pistons and connecting rod (par. 60).

b. Check the condition of the cylinder sleeves as instructed in paragraph 62*b*.

c. As soon as the pistons and connecting rods are removed, wrap the crankshaft bearing journals in clean rags to protect them from foreign matter when the cylinder sleeves are removed. Mark each cylinder sleeve for identification so as to insure its correct replacement in the event that it is to be re-used. It is also important that the sleeves be marked in such a manner as to insure their reinstallation in the exact same position.

d. Use a cylinder sleeve puller and pull the sleeves from the cylinder block. When each sleeve is removed, also remove the cylinder sleeve ring at the bottom of the cylinder block.

e. Wash the cylinder sleeves in solvent (SD) and dry them with compressed air. Clean all rust and scale from the inside of the water

jacket and clean out the grooves from which the sleeve rings were removed.

f. When reinstalling cylinder sleeves, be sure to match the sleeve to the cylinder bore from which it was removed. If a new sleeve is being installed, place it in position before installing the sleeve ring to check it for fit.

g. Make sure that the cylinder sleeve ring grooves are clean and install the rings and sleeves as follows:

(1) Use only new cylinder sleeve rings.
(2) Make a solution consisting of 1 pint of water, ½ ounce of glycerine, and 1 tablespoonful of soap flakes.
(3) Dip the new sleeve rings into the above solution and fit them into the grooves in the cylinder block.
(4) Apply a liberal coating of the soap solution to the sleeve ring after it is installed and press the sleeve into place. Place a clean wooden block across the top of the sleeve and tap the sleeve down into place. Make sure that the sleeve ring has not been forced out of place when installing the sleeve.

h. Reinstall the pistons and connecting rod as instructed in paragraph 63, and replace the cylinder heads in accordance with pertinent instructions in paragraph 59*d*.

65. Lubricating-Oil Pump Disassembly
(fig. 53)

a. Drain the lubricating oil from the oil pan and remove the oil pan from the base of the engine.

b. Remove the locking wire that secures the oil pump mounting screws, remove the screws, and remove the pump from the engine.

c. Withdraw the cotter pin that secures the oil pump screen assembly to the bottom of the pump and remove the screen assembly.

d. Remove the cap screws that hold the bottom plate of the pump and remove the bottom plate and gasket. The oil regulating valve spring and oil regulating valve may now be removed.

e. Slide the idler gear from the idler gear shaft.

f. Drive the retaining pin out of the drive pinion at the top of the pump shaft and withdraw the shaft and body gear from the bottom of the pump housing.

g. Drive the retaining pin out of the body gear and pull the gear from the shaft. Do not loose the Woodruff key that fits in the keyway in the gear.

66. Lubricating-Oil Pump Cleaning, Inspection, and Repair

a. Wash all pump parts thoroughly in solvent (SD). Remove all foreign matter from the float and screen and blow out all passages with compressed air.

b. Check for possible damage to the float and screen assembly. Do not attempt to repair a crushed float but replace it with a new one.

c. Carefully inspect all gears for chipped teeth, scoring, and wear. Check the fit of the idler gear on the idler gear shaft. Replace any parts that appear in an unsatisfactory condition.

d. Inspect the oil pump body for evidence of wear through gear contact and see that the idler gear shaft is tight in the pump body. If this shaft is loose or the pump body is worn or damaged, a new pump body will be required.

e. Assemble the body gear to the pump shaft and slip the shaft and gear into position in the pump body. Slip the idler gear onto the idler shaft. Check the clearance between the pump gears and the pump body. The clearance between the body and both gears should be between .012 and .015 inch. Slip an appropriate size feeler gage between the body gear and the pump body. Hold the gage in one position while the gear is rotated one complete revolution. Repeat this operation at all points around the entire body bore. Transfer the feeler gage to the idler gear and go through the same procedure. If the clearance is excessive at any point, determine the cause and replace the faulty part.

f. Check the backlash between the body gear and idler gear. This should be between 0.004 and 0.006 inch. The clearance between the drive pinion and the pump body should be between 0.005 and 0.010 inch. The clearance between the gears and the cover should be between 0.003 and 0.006 inch. This clearance is provided by the cover gasket which should be 0.006 inch thick. It is important that this clear-

ance be maintained to prevent wear to both the gears and the cover.

g. Inspect the regulating valve and spring. The outside diameter of the valve should be between 0.900 and 0.901 inch. The valve bore in the pump body should be between 0.905 and 0.906 inch. The running clearance between the valve and pump body should be between 0.004 and 0.006 inch. The free length of the spring is $2\frac{3}{32}$ inches. The test load is 37 pounds. Make sure that the valve slides freely, is in good condition, and that the valve seat in the pump body is not damaged.

67. Lubricating-Oil Pump Reassembly

Replace any worn or defective pump parts. Reassemble the pump as follows:

a. Insert the Woodruff key in the keyway in the lower end of the pump shaft and install the body gear on the shaft. Drive the gear retaining pin into place and install the pump shaft in the pump body.

b. Insert the Woodruff key in the keyway in the upper end of the pump shaft and install the drive pinion on the shaft. Drive the pinion retaining pin into place. Check the clearance between the face of the pinion and the pump body. With the shaft forced as far as possible toward the top of the pump body, the clearance should be between 0.005 and 0.010 inch. If this clearance is satisfactory, peen both ends of the two gear retaining pins to prevent their working out. If the clearance is not satisfactory, determine the cause and replace the faulty part.

c. Insert the regulating valve, closed end first, and then the regulating valve spring into the pump body. Make sure that the spring does not cause the valve to cock in the body bore.

d. Place the idler gear on the idler gear shaft. Put a thin coating of grease on the gasket surface of the pump body and the cover. Place a new gasket in position and install the cover. Turn the pump pinion by hand to make sure that all parts turn freely.

e. Insert the tube end of the screen assembly into the opening in the pump cover. Make sure that the V-shaped lug at the inlet opening of the cover fits between the projecting lugs on the tube. Push the tube into place and secure it with the cotter pin.

f. Replace the oil pump assembly in the base of the engine. Be sure to secure the cap screws with a locking wire. Shellac a new gasket to the oil pan and replace the oil pan on the engine.

68. Generator Removal

To remove the generator from the unit, loosen the generator mounting bolts, attach a hoist to the lifting ring in the top of the generator, and lift the generator slightly. Slide the generator away from the engine flywheel, but only far enough to enable placing a sling around the coupling on the flywheel end of the generator. Place a sling around the coupling and take a slight strain on the sling to support the coupling end of the rotor shaft. Completely disengage the coupling and lift the generator from the skid base of the unit. Be sure that the sling supports the free end of the rotor while the generator is being removed and block up the rotor when the generator is lowered to the floor.

69. Engine Removal

To remove the engine, disengage the generator as instructed in paragraph 68 and remove the radiator assembly as instructed in paragraph 49*r*. Attach a hoist to the engine, remove the bolts that secure the engine to the skid base, and lift the engine from the base.

70. Front Cover and Timing Gear Disassembly

a. Remove the engine from the skid base as instructed in paragraph 69.

b. Remove the front engine support. Remove the cotter pin from the crankshaft nut and remove the nut.

c. Remove the fan drive pulley and the vibration damper from the crankshaft. Be careful when removing the pulley and damper as the key may spring outward.

d. Remove the cap screws that secure the front end of the oil pan to the front cover and remove the cap screws that secure the front cover to the crankcase. Pry the cover from the crankcase.

e. Remove the two cap screws that secure the idler gear and remove the gear.

f. The magneto drive gear and magneto drive idler gear are a part of the magneto bracket assembly and may be removed with the

bracket assembly by removing the cap screws that secure the bracket.

g. To remove the fuel injection pump drive gear, use a bar to hold the injection pump drive flange from turning and remove the nut and washer from the injection pump drive shaft. The gear may now be pulled from the shaft.

h. Wash all parts in solvent (SD) and dry them with compressed air. Inspect all parts for wear and damage. Pay special attention to the gear teeth and check for chipped or broken teeth. Check all parts against the specifications in paragraph 51 and replace all parts that do not meet specifications. Carefully inspect all oil seals and replace any that appear in an unsatisfactory condition. Check the camshaft bearings for wear and make any replacements indicated.

71. Front Cover and Timing Gear Reassembly

a. If inspection indicates the need, replace the camshaft bearings and then replace the camshaft. To replace the camshaft, reverse the procedure followed in disassembly.

b. Install the gears in the reverse order to that followed in their removal (par. 70). Be sure to match up the letters C, P, and S. The letter P on the fuel injection pump drive gear must match with the letter P on the idler gear. The letter S on the crankshaft gear must match with the letter S on the idler gear. The letter C on the idler gear must match with the letter C on the camshaft gear.

c. Install the oil flinger and spacer on the crankshaft. Shellac a new gasket onto the front cover and install the front cover. Unless other work is to be done within the crankcase, replace the oil pan and install the front engine support.

d. Place the Woodruff key in position on the crankshaft and install the pulley and vibration damper. Install the nut lock and nut on the crankshaft. Install the starting crankpin in the crankshaft and secure it with a setscrew.

72. Camshaft Removal

The camshaft is located on the side of the crankcase opposite to that on which the fuel injection pump is located. It is held in place by a thrust plate bolted to the end of the crankcase. It revolves in four bearings which are pressed into the crankcase. Remove the camshaft as follows:

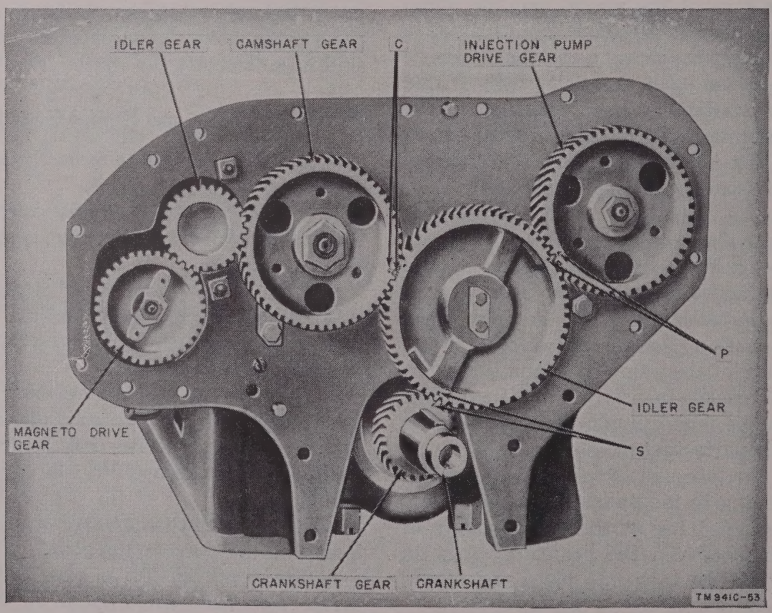


Figure 41.—Timing gears.

a. Remove the valve cover and remove the valve lever mechanism as instructed in paragraph 54*c*.

b. Remove the oil pan and lubricating-oil pump as instructed in paragraph 65.

c. Remove the crankcase front cover and idler gear as instructed in paragraph 70.

d. Turn the crankshaft until the hole in the camshaft gear lines up with one of the cap screws that hold the thrust plate and remove the cap screw. Now line up the hole in the gear with the second cap screw and remove the cap screw and thrust plate.

e. Remove the valve tappet inspection cover and the push-rod bracket and remove the valve tappets. Mark the tappets to insure returning them to the same positions from which they were removed.

f. Draw the camshaft, gear, and thrust plate from the crankcase.

g. Inspect the camshaft journals and bearings and check their dimensions against those given in paragraph 51.

h. If camshaft bearing replacement is necessary, remove the engine flywheel and rear engine support. Use a long bar, inserted from the opposite end of the crankcase and drive out the rear camshaft bearing expansion plug. Drive out the worn bearings and replace them with new ones. When inserting new bearings, make sure that the oil holes in the bearings line up with the oil holes in the crankcase.

73. Camshaft Installation

a. Before installing the camshaft, coat the rear camshaft bearing expansion plug and the recess in the crankcase with sealing compound. Place the plug in the recess and tap the center of the plug to expand it into place.

b. Place a thrust washer on the camshaft, with the countersunk surface toward the threaded end of the shaft. Insert the Woodruff key in the keyway, place the thrust plate on the shaft, and press on the camshaft gear. Make sure that the markings on the edge faces of the gear face toward the threaded end. Install the valve guides and tappets, and install the camshaft in the crankcase.

c. Make sure that the letters stamped on the camshaft, gear are lined up in accordance with instructions in paragraph 71. Install the nut lock and nut on the threaded end of the camshaft and secure the thrust plate with the cap screws and lockwashers through the holes in the camshaft gear. Replace the crankcase cover, oil pump, oil pan, and valve mechanism.

74. Crankshaft and Bearing Removal

a. Turn the engine bottom side up and remove the flywheel.

b. Remove the lubricating-oil pump as instructed in paragraph 65.

c. Remove the connecting rod bearing caps as instructed in paragraph 60.

d. Remove the dust seal, dust seal gasket, oil seal retainer plate and gasket, and oil seal retainer felt plugs located on the flywheel end of the crankcase.

e. Remove the cotter pins and nuts that secure the main bearing caps and remove the bearing caps. Pull the bearing caps straight up or they will bind on the studs. Keep the bearing caps and bearings together to insure correct replacement. Each bearing cap is stamped with a number which corresponds with a number stamped into the crankcase on the camshaft side.

f. Lift the crankshaft from the engine and wash it thoroughly in clean fuel oil. Also wash all bearings, bearing caps, and oil seals. Inspect the crankshaft journals for scoring and check the diameter at each journal for wear. Measure the journals at points 90° from each other and compare the measurements with those in the specifications in paragraph 51.

g. Inspect the crankshaft gear for wear and damaged teeth.

75. Crankshaft Installation

a. See that the back of the bearing shells are free from oil and grease and set the upper bearing shells in place in the crankcase. See that the nibs on the bearing shells fit into the notches in the crankcase. Insert the thrust washers on both sides of the center main bearing shell. Make sure that the oilholes in the bearing shells line up with the holes in the bores in the crankcase.

b. Wipe the lower bearing shells and bearing caps clean and place the bearing shells in the bearing caps. See that the numbers on

the bearing caps match those on the crankcase and have the numbers on the bearing caps facing those on the crankcase. Install the bearings and bearing caps, install the bearing cap nuts, and turn them up moderately tight.

c. Check the running clearance of each bearing as follows: Remove the bearing and place a piece of .007-inch virgin lead, about 1½ inches long, on the bearing journal and parallel with the crankshaft. Install the bearing and tighten the bearing nuts moderately tight. Gently rock the crankshaft, take up on the nuts, and again rock the shaft. Now draw the nuts up to the torque specified in paragraph 51. Remove the bearing and measure the thickness of the piece of lead with a micrometer. The thickness of the lead should be the same as the running clearance specified in paragraph 51. Repeat this process for each bearing. Replace the bearings and tighten the nuts to the specified number of foot-pounds (par. 51). Be sure to replace the cotter pins in all nuts.

d. Reassemble the connecting rods and connecting rod bearings to the crankshaft after it has been replaced in the crankcase.

76. Remounting Engine and Generator

a. Before remounting the engine on the skid base, inspect the flexible coupling. If the rubber bushings or coupling pins are worn, a new coupling may be necessary or the rubber bushings may require replacement. The rubber bushings are cemented into the engine half of the coupling and must be pried or dug out. When installing new rubber bushings, apply cement to both the inside of the bushing holes and the surface of the rubber bushing. Use a hammer and soft wooden block to drive the rubber bushings into the coupling holes. The rubber bushings must be driven in until the face of the bushing is flush with the face of the coupling.

b. Attach a hoist to the engine and lift it into place on the skid base. Insert the mounting bolts and tighten them moderately tight. Make sure that a locknut has been placed under each nut.

c. Transfer the hoist to the generator assembly and lift the generator onto the skid base. Keep the engine end of the rotor shaft supported by means of a sling and enter the pins of the coupling into the holes in the rubber bushing. As soon as the coupling pins are entered in the bushing holes, slide the generator into place and insert the mounting bolts. Crank the engine by hand and have some one check the alinement of the coupling. Shift the engine or generator slightly to correct any misalinement and then tighten all engine and generator mounting bolts. Replace the fastenings that secure the generator to the engine flywheel housing and tighten them securely.

d. Install the water pump, fan, fuel supply pump, fuel pump pulley, and drive belts. Attach the hoist to the radiator assembly and lift it into place. Insert the radiator mounting bolts and tighten them securely.

77. Installing Engine Instrument Panel (fig. 52)

a. Carefully inspect all gages and switches before installing them on the instrument panel. Mount the oil-pressure gage in the hole in the upper left-hand corner of the panel, mount the ammeter in the hole in the lower center of the panel, and mount the starting switch in the hole directly above the ammeter. Replace the connections to the starting switch and the ammeter in accordance with the tags which were attached to the wires when disassembling. Reconnect the oil-pressure line to the back of the oil-pressure gage.

b. Carefully pass the heat indicator element and capillary tube through the hole in the upper right-hand corner of the panel and mount the temperature gage to the panel. *Do not kink the tube.* Carefully unroll the tube and install the element in the hole in the engine water jacket from which it was removed. Replace any clamps that may be provided to secure the capillary tube.

c. Recheck all connections to make sure they are correctly made and that they are secure. Slip the instrument panel housing over the instrument panel and secure it with the four roundhead screws and lockwashers provided. Carefully inspect the governor control to see that it is in satisfactory condition and mount it to the flywheel housing at the left-hand side of the engine instrument panel.

78. Installing Fuel Injection Pump (fig. 35)

a. Before remounting the fuel injection pump, slip the coupling boot over the drive shaft. Set the injection pump assembly in place and secure it with the cap screws provided.

b. The fuel injection pump coupling is so made that it can be assembled in only one way to give correct timing. Remove the spark plugs and crank the engine until the piston of No. 1 cylinder is coming up on the compression stroke. This may be determined by holding the thumb on the spark plug hole until pressure is felt. Continue cranking until the SI mark (F, fig. 35) on the pump drive flange hub registers with the timing indicator mark on the front end plate of the pump (E, fig. 35). This mark is 45° to the right of the vertical centerline when looking at the pump from the drive end.

c. Install the cap screws (A) so that they are approximately centered in the elongated holes in the coupling flange (D). This will give an approximate timing adjustment. Final adjustment cannot be made until the engine is running. With the engine in operation and the compression change-over lever in Diesel position, the engine should operate smoothly, with a clear exhaust. If operation of the engine is not satisfactory, stop it and readjust the fuel injection pump timing. To do this, loosen the cap screws (A, fig. 35) and move the coupling flange slightly in either direction. Tighten the cap screws and restart the engine. If operation is still unsatisfactory, stop the engine again and try moving the coupling flange in the opposite direction. Continue moving the flange one way or the other until a satisfactory adjustment has been reached. Turning the flange clockwise advances the timing; turning the flange counterclockwise retards the timing.

79. Installing Magneto

a. Set the compression change-over lever in gasoline operating position. Crank the engine until the piston of No. 1 cylinder is moving upward on the compression stroke. Continue cranking until the mark DC1&6 on the flywheel is in line with the point on the injection pump side of the flywheel housing. This pointer is covered by a plate which must be removed.

b. Remove the link (attached to the arm of the breaker housing), and rotate the breaker housing as far as possible in a counterclockwise direction. Remove the cover from the breaker housing.

c. Insert a nail through the oil cup in the impulse coupling housing. Using the nail, pry the main pawl of the impulse coupling up so that the pawl latch will hold it out of engagement. Turn the magneto rotor clockwise until the rubbing block on the breaker assembly is on the high point of the cam. With the breaker and cam in this position, adjust the breaker point opening to .020 inch.

d. Place the magneto in position on the magneto mounting bracket, engage the magneto coupling, and insert the mounting screws loosely. Remove the magneto distributor block, slide the magneto back far enough to disengage the coupling, and rotate the magneto half of the coupling clockwise until the brush in the distributor disk is directly under the distributor block terminal marked No. 1. At this point, the breaker points should be just starting to open.

e. Locate the two holes in the adjustment coupling that are in alinement. Insert shims between the halves of the coupling so that the cap screws will pass through them and enter the holes in the tapped half of the coupling. The holes are so spaced that only two pairs of holes will line up exactly. Do not try to force the cap screws as they should screw into the tapped holes freely if the holes are correctly matched.

f. Tighten the magneto mounting screws. Lift the arm of the breaker housing as far as it will go. Crank the engine until the breaker points are just starting to open. If the timing

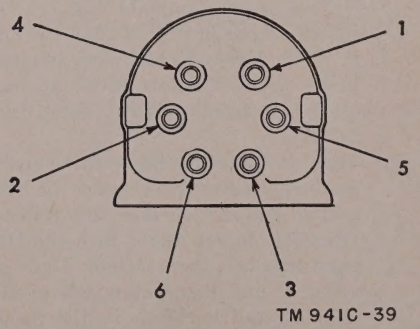


Figure 42.—Distributor block terminal diagram.

is correct, the DC1&6 mark on the engine flywheel will be in line with, or not more than 8° (1 inch on flywheel rim) below, the timing pointer. The DC1&6 mark must never be above this pointer.

g. Replace the distributor arm locking link and distributor cap. Attach the spark plug wires to the distributor to correspond with the engine firing order. The firing order is 1, 5, 3, 6, 2, 4. Attach the wire for No. 1 plug to the No. 1 socket and proceed clockwise around the distributor in the above order.

80. Miscellaneous Parts and Assemblies

Replace all remaining parts and assemblies by reversing the disassembly procedure. Use only new gaskets and be sure to replace all lockwashers. Make all necessary connections in accordance with the tags which were attached when disassembling. Make sure that all suppression equipment such as bonding straps, bonding washers, and capacitors have been replaced. See paragraph 89 for suppression details.

Section VI. ADJUSTMENTS

81. Change-Over Mechanism Adjustment

a. Power Unit PE–215–C (fig. 27).

(1) Before making any adjustments, see that the engine cylinder heads, starting valve shafts, cross shaft, levers, and rods are in place as illustrated in figure 27. The intake manifold and the intake and exhaust valve housing cover should be removed.

(2) Yoke F (fig. 27) should be disconnected from lever V. See that there is .030-inch clearance between the control lever and the cross-shaft bracket (D and T, fig. 27).

(3) Make a sheet-metal template conforming to the dimensions and pattern of figure 27. Slide the template over shaft CC so that it is between lever V and the valve housing (fig. 27). There must be no gasket on the surface on which the housing and the bottom of the template rest.

(4) Insert a ¼-inch pin through the holes in both lever V and the template. Lever V should now be at an angle of 32½° from vertical (see detail, fig. 27).

(5) Select the starting valve which has the smallest clearance between the valve spring retainer I and the roller H (fig. 27). Insert a .185-inch thickness gage between the retainer I and the roller H and turn screw BB in until all play and backlash in the mechanism has been taken up. Check the other five starting valves. None of the remaining valves should have a greater clearance between retainer I and roller H than .205 inch. When a satisfactory adjustment has been reached, lock adjusting screw BB.

(6) Check the end clearance between lever AA and bracket EE. This clearance must be between .010 and .015 inch when the clearance adjustment between the retainers and rollers has been made.

(7) Set the control lever in Diesel operating position and check the clearance between cross-shaft jaw B and latch A (insert 2, fig. 27). This clearance should be .060 inch. Clearance is adjusted by means of screw R.

(8) Hold jaw B against screw R and adjust yoke F so that its holes line up with the hole in lever V. Insert the pin through the holes in yoke F and lever V and secure the pin with a cotter pin.

(9) Move the control lever to a point where lever E just contacts the offset pick-up face of lever B, at point X. Adjust setscrew C, on the opposite side of the engine, so that the clearance between the setscrew and the stop on the control lever is .100 inch (point Z, fig. 27).

(10) Move the control lever toward the starting position until latch A locks in the jaw B (fig. 27). Adjust setscrew U in lever B until a clearance of .015

inch is obtained between the setscrew and the stop on bracket S (detail 1, fig. 27). This is the overtravel of lever B.

(11) Install the intake manifold and connect rod DD to lever V (fig. 27). Adjust the yoke on rod DD so that the pin will be in the longitudinal center of the slot at the end of rod DD opposite to that to which the yoke is attached. This pin must be in the same position in relation to the center of the slot regardless of whether the control lever is in Diesel or starting position.

(12) When all adjustments have been completed, connect link Y between lever B and the carburetor throttle arm.

b. Power Unit PE–215–E (fig. 43).

(1) Adjust the yoke on the operating rod so that the distance between the centers of the holes in the yokes is $9\frac{7}{16}$ inches.

(2) Adjust the control cross shaft so that there is .030-inch end play between the operating lever and the bracket. This may be adjusted by removing the nut from the tapered pin that secures the lever to the cross shaft. After releasing the nut, tap the threaded end of the pin back about three-sixteenths inch. This will release the lever. Shift the lever in or out until a .030-inch thickness gage is a snug fit between the bracket and control lever. Leave the gage in place, screw the nut onto the threaded end of the pin, and tighten the nut. This will draw the pin into place. Remove the gage when finished.

(3) Back off the adjusting screws on the cross-shaft latch bracket, the cross-shaft jaw, and on the cross-shaft bracket. Adjust the screw on the cross-shaft latch bracket until there is .060-inch clearance between the cross-shaft lever and jaw. Lock the adjusting screw by means of the locknut and recheck the adjustment.

4) Set the control lever in Diesel position and then move it back toward starting position until a slight tension is felt. This is an indication that the cross-shaft jaw lever and the cross-shaft jaw, on the opposite end of the cross shaft, are in contact. Insert a .100-inch thickness gage between the setscrew on the cross-shaft bracket and the stop on the control lever. Adjust the setscrew until the gage is a snug fit and then tighten the locknut on the setscrew.

(5) Move the control lever to starting position. Disconnect the yoke on the operating rod and increase the length by turning the yoke a one-half turn at a time until the starting valve cover with the closest clearance has approximately one-sixty-fourth inch additional travel before touching bottom. After each one-half turn of the yoke, check the six starting valve covers by applying pressure to the top of the covers to determine which has the least additional travel. When this adjustment has been completed, lock the yoke on the cross-shaft operating rod by means of the locknut. Secure the yoke pins with cotter pins.

(6) Check the clearance between the flat-point headless setscrew in the upper end of the cross-shaft jaw and the cross-shaft latch bracket. This clearance should be .015 inch. If this clearance is not satisfactory, loosen the locknut and turn the setscrew in or out until the .015-inch gage is a snug fit. Tighten the locknut and remove the gage.

(7) Move the control lever to Diesel position and see that there is clearance between the starting valve covers and the starting valve shaft at all six valves.

(8) When the foregoing adjustments have been completed, set the control lever in starting position and make sure that each starting valve cover has a slight additional travel before touching bottom. If there is no additional travel on any of the valves, recheck the entire adjustment procedure.

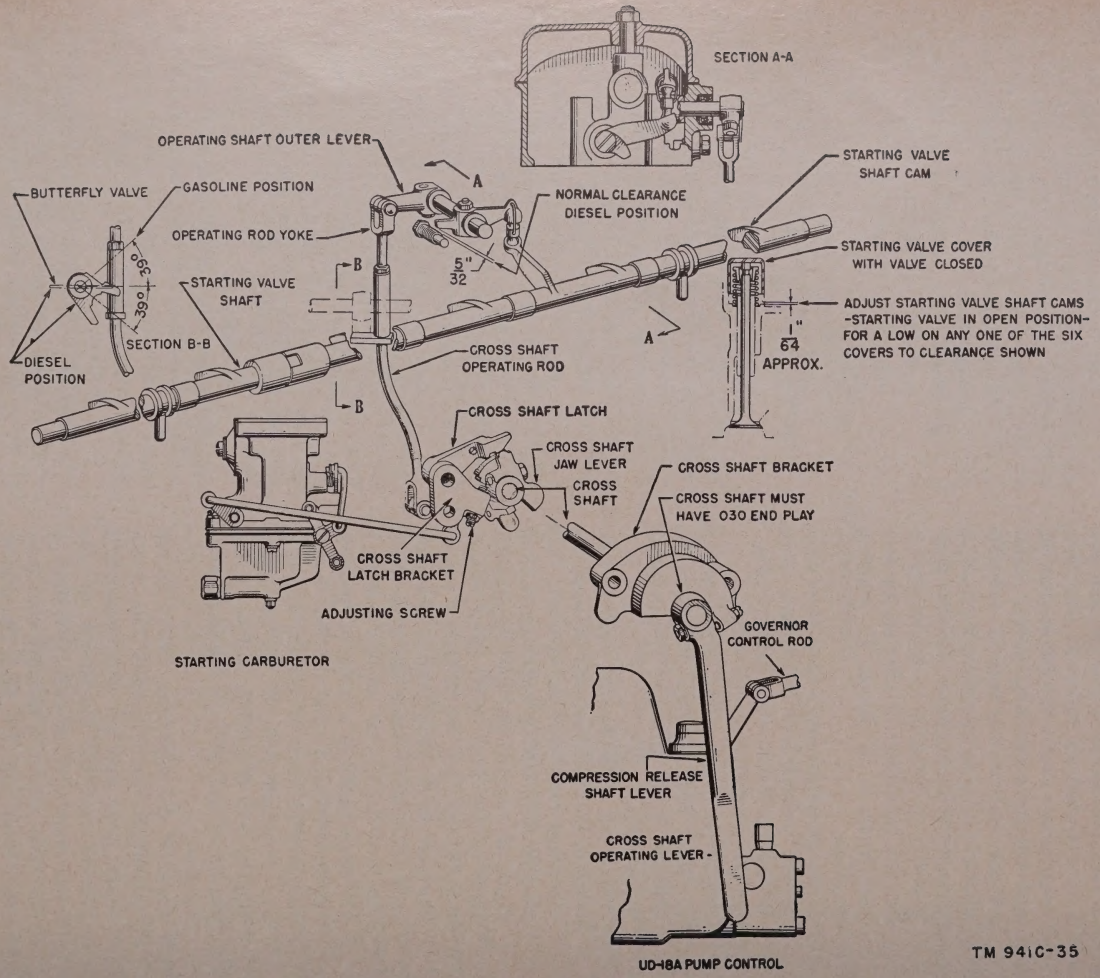


Figure 43.—Power Unit PE-215-E—change-over mechanism.

82. Governor Control Adjustment

The governor control, located on the flywheel bell housing, to the left of the engine control panel, is provided with a spring actuated poppet which locates the control lever in low idle position. Move the control lever toward stop position until the poppet drops into place and then adjust the length of the control rod until the desired idle speed has been reached. Move the control lever to full speed position and adjust the stop screw until the desired engine speed or electrical output has been attained. The governor control is provided with a friction mechanism which will hold the control lever in any desired position. If the control lever will not remain where desired, tighten the tension nut on the back of the control (fig. 44).

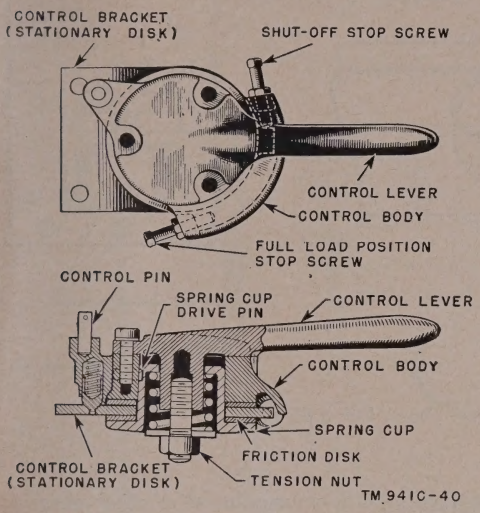


Figure 44.—Engine governor control.

83. Final Adjustments

Operate all manual controls and check their action. See that all controls are correctly adjusted and that associated parts, assemblies, or accessories respond properly. Recheck all clearances and make any necessary corrections. Recheck the wire connections from the magneto to the spark plugs to see that they are connected in the correct firing sequence. Recheck all fuel and oil line connections to see that they are tight. See that the exciter, fan, and accessory drive belts are propertly adjusted and that all safety shields are in place and secure.

Section VII. FINAL TESTING

84. General

Set the equipment up in accordance with the instructions in chapter 2. Carefully check all connections on the switchboard to see that they are secure and correctly made. Operate all manual controls and switches on the switchboard to see that they move freely.

85. Preparation for Test

a. Remove any corrosion preventives in accordance with paragraph 8*e*.

b. Make fuel and electrical connections in accordance with instructions in paragraph 9.

c. Prepare the unit for operation in accordance with instructions in paragraph 12.

d. Recheck to see that nothing has been overlooked and start the unit in accordance with instructions in paragraph 13.

e. Immediately after starting, observe the precautions outlined in paragraph 14 and apply load to the unit in accordance with instructions in paragraph 15. Make any necessary adjustments to bring the unit up to the correct frequency and voltage output. If the generator frequency is too high or too low, adjust the governor in accordance with instructions in paragraph 82.

86. Final Inspection

a. While the unit is operating, carefully check the cooling system for possible leaks. Inspect all points where hoses are connected. Inspect all gasketed joints at water manifolds, fan mounting, cylinder-head mountings, and manifold mountings. Correct any leaks that are found.

b. Carefully inspect all parts of the fuel

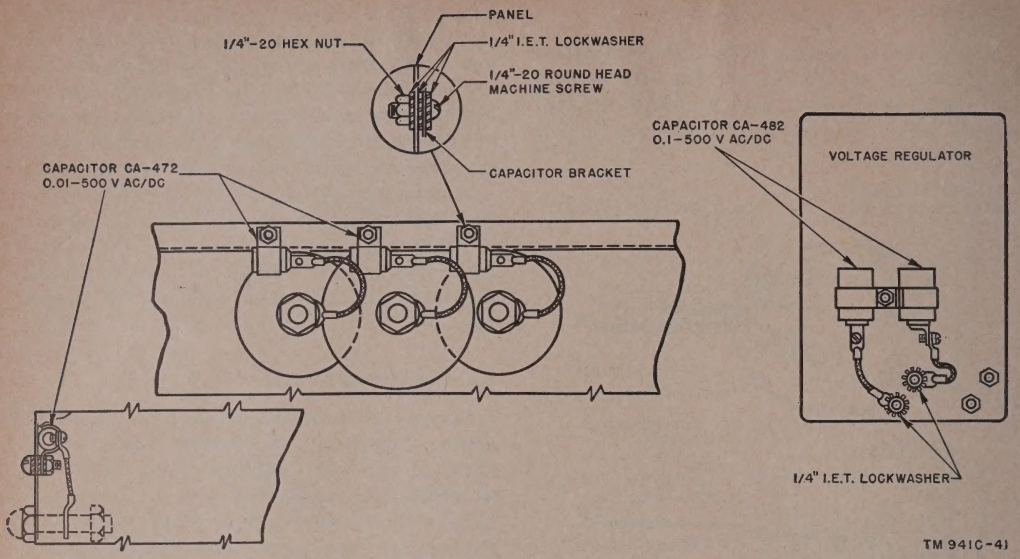


Figure 45.—Switchboard suppression, Power Unit PE-215-C.

system to see that there is no leakage. Inspect connections to the fuel injector nozzles, fuel injector pump, filters, and fuel supply pump. Inspect the fuel injector mountings to see that there is no compression leakage.

c. Carefully inspect all lubricating-oil connections and equipment for possible leakage.

d. Observe the operation of the engine and be alert for any unusual noise or other unsatisfactory conditions. Observe the engine exhaust to see that it is clear and that there is no excessive exhaust smoke.

e. Feel the exciter and generator to see that they are not running excessively hot. Pay special attention to exciter and generator bearing housings.

Section VIII. PRESERVATION

87. Weatherproofing After Repairs

a. Thoroughly clean all oil and grease from the exterior of the equipment. Use a clean cloth and solvent (SD). Before proceeding to weatherproof the equipment, make sure that all necessary repairs and adjustments have been completed.

b. Proceed to moistureproof and fungiproof the equipment in accordance with TB SIG 13. Be sure to mask all electrical connections and contacts. Pay special attention to rheostats, switches, and voltage regulators. Avoid getting varnish or lacquer on electrical contacts, commutators, slip rings, and brush-holder assemblies.

88. Refinishing

Carefully inspect painted surfaces of the equipment for scratches or other damage.

a. Remove all traces of oil, grease, or rust. Sandpaper all surfaces to be refinished. Apply light, even coats of paint with a small brush. Two light coats are better than one heavy coat.

b. If the painted surfaces are blistered from heat or extensive areas require refinishing, remove all old paint with paint remover.

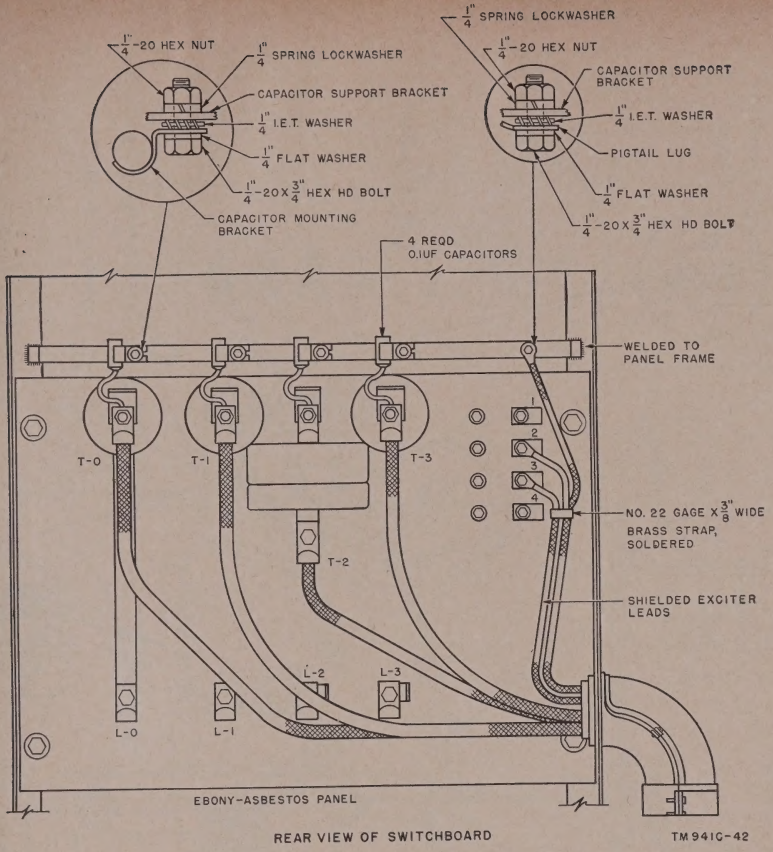


Figure 46.—Switchboard and voltage regulator suppression.

Thoroughly sandpaper the surfaces or rub them down with steel wool. Apply a smooth, even priming coat, sand it down lightly with No. 000 sandpaper, and then apply a finish coat.

Caution: Avoid getting paint on moving parts in such a manner as to hinder their movement. Do not paint electrical contacts and avoid getting paint into oil holes and breather holes.

Section IX. SUPPRESSION

89. Interference Suppression

To reduce interference with nearby radio equipment, Power Units PE–215–C and PE–215–E are suppressed through the use of capacitors, bonding straps, internal-tooth (IT) and internal-external-tooth (IET) lockwashers, and shielding. A complete technical inspection of the equipment must include a thorough inspection of the suppression components. The suppression equipment is intended to suppress interference under normal operating conditions with the power unit in normal satisfactory condition. An abnormal condition of the power unit, or of the load, may result in greater interference than the suppression equipment can control. Do not assume that the suppression equipment is at fault until the power unit has been thoroughly checked. When any work is performed on the equipment, it is vitally important that each suppression component be reinstalled in its exact original position.

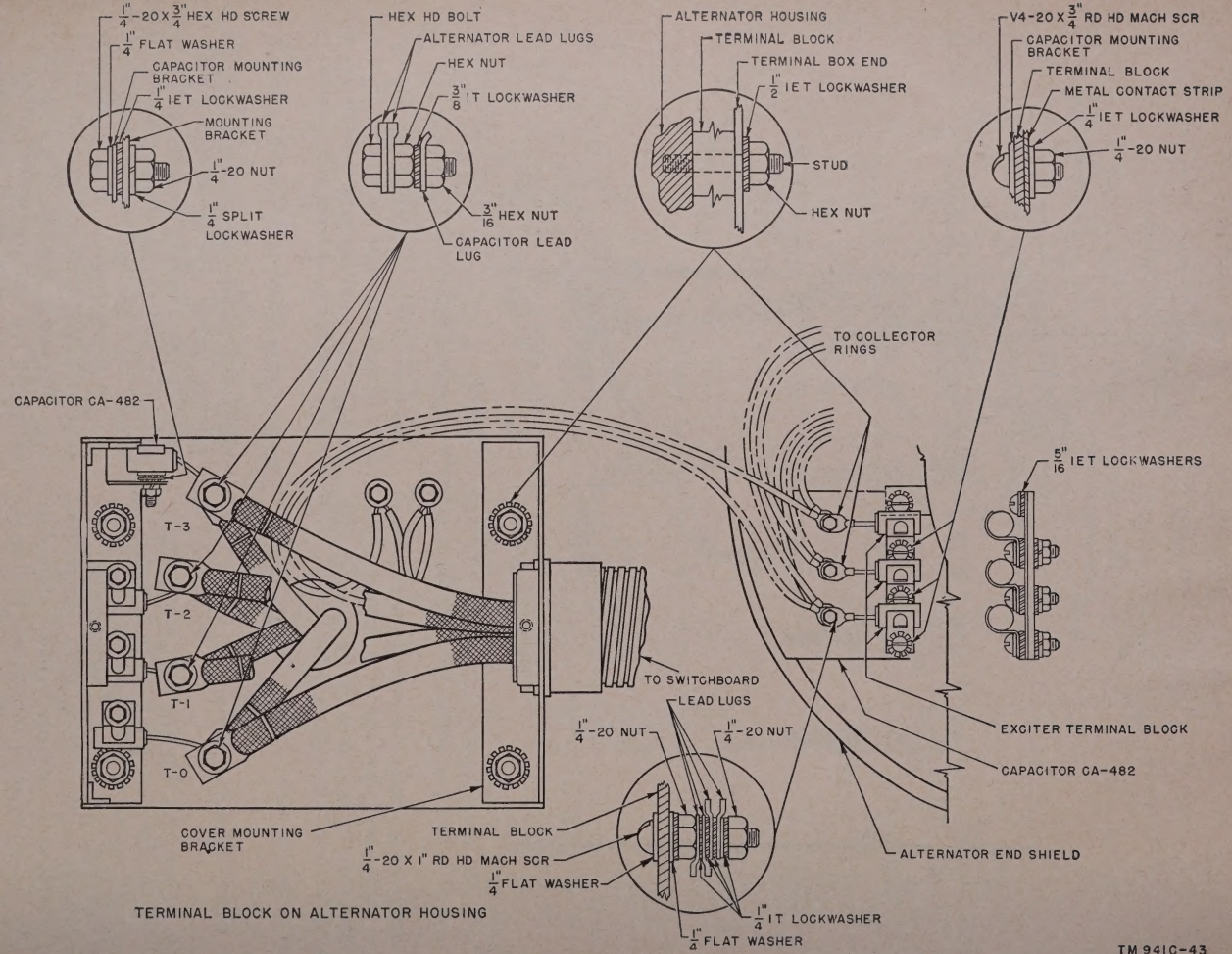


Figure 47.—Alternator suppression.

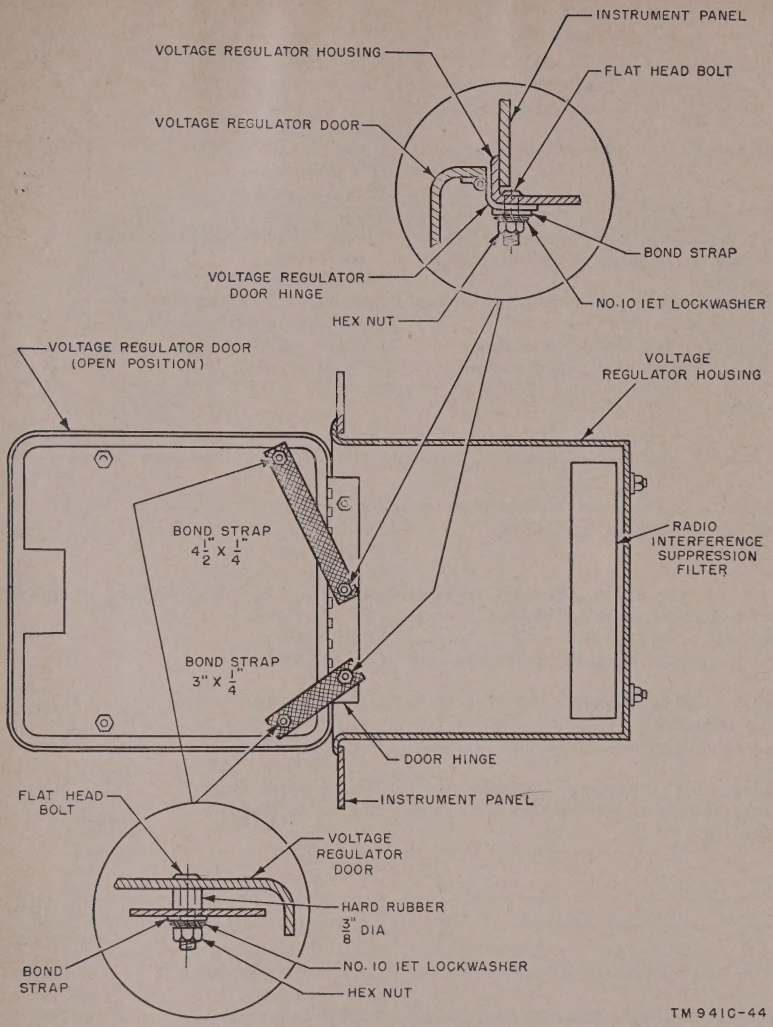


Figure 48.—Voltage regulator bonding, Power Unit PE–215–C.

90. Suppression Application

The location and application of the various suppression components are given below.

a. ENGINE.

Application of suppression components	Suppression components	Figure reference	
		PE–215–C	PE–215–E
Armature terminal of battery-charging generator voltage regulator bypassed to battery-charging generator housing.	Capacitor, 0.1 uf, 100 v dc..... IET lockwashers. Tinned copper lug.	Fig. 51	Fig. 51

Application of suppression components	Suppression components	Figure reference	
		PE–215–C	PE–215–E
Battery terminal of battery-charging generator voltage regulator bypassed to battery-charging generator housing.	Capacitor, 0.25 uf, 100 v dc IT lockwasher. Tinned copper lug.	Fig. 51	Fig. 51
Battery terminal of ammeter bypassed to instrument panel brace.	Capacitor, 0.25 uf, 100 v dc IET lockwasher. IT lockwasher. Tinned copper lug.	Fig. 51	Fig. 51
Lead from battery terminal of battery-charging generator voltage regulator to ammeter on instrument panel.	Tinned copper braid shielding and clamps.	Fig. 51	Fig. 51
Each spark plug shielded	Spark plug shield	.....	Fig. 49
High-tension leads from magneto to spark plugs shielded	Integrally shielded ignition cable	.....	Fig. 49
Suppression resistor at each spark plug	10,000-ohm resistor suppressor	.....	Fig. 49
Magneto shielded by means of shield and gasket	Magneto shield	.....	Fig. 49
Magneto mounting bolts bonded to support bracket	IET lockwasher	.....	Fig. 49

b. ALTERNATOR.

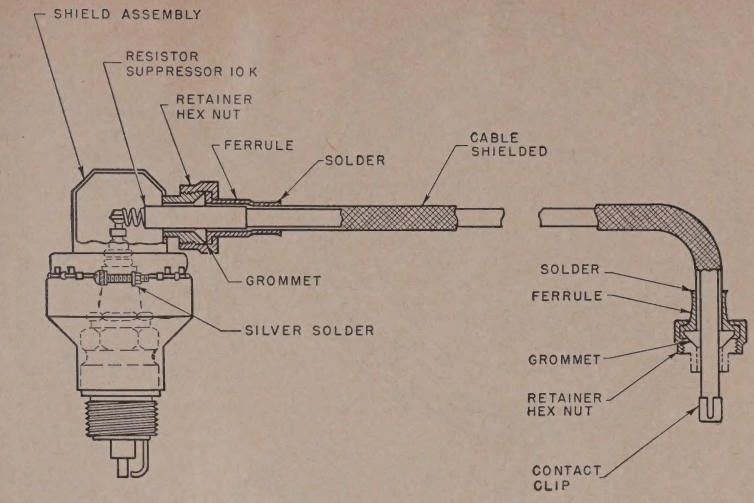
Application of suppression components	Suppression components	Figure reference	
		PE–215–C	PE–215–E
Terminals F1, A1, and A2 at exciter terminal block bypassed to metal contact strip on exciter block.	Capacitor, 0.1 uf, 500 v ac/dc IET lockwasher. Tinned copper lug. IT lockwasher.	Fig. 47	Fig. 47
Terminals T3, T2, T1, and T0 at alternator terminal block bypassed to capacitor mounting bracket. Bracket spot-welded to inside of terminal box.	Capacitor, 0.1 uf, 550 v ac/dc IET lockwasher. IT lockwasher.	Fig. 47	Fig. 47
Exciter bonded to alternator housing at exciter mounting bolts.	IET lockwasher	Fig. 50	Fig. 50
Exciter belt guard bonded to alternator end-bell housing at belt guard mounting bolt.	IET lockwasher	Fig. 50	Fig. 50
Exciter belt guard mounting bracket bonded to alternator end-bell housing.	IET lockwasher	Fig. 50	Fig. 50
Exciter belt guard bonded to exciter end-bell housing	Tinned copper braid	Fig. 50	Fig. 50
Alternator terminal block cover mounting bracket bonded to alternator housing.	IET lockwasher	Fig. 47	Fig. 47

c. EXCITER.

Application of suppression components	Suppression components	Figure reference	
		PE–215–C	PE–215–E
Each set of exciter brushes bypassed to exciter end-bell housing.	Capacitor, 0.1 uf, 100 v dc IET lockwasher.	Fig. 50	Fig. 50
Exciter armature and field leads from terminals 2 and 3 on alternator terminal board to terminals 2 and 3 of switchboard terminal block shielded.	Tinned copper braid IET lockwasher.	Fig. 46	.....

d. SWITCHBOARD.

Application of suppression components	Suppression components	Figure reference	
		PE–215–C	PE–215–E
A-c input terminals T3, T2, T1, and neutral terminal T0 of circuit breaker bypassed to capacitor support bracket at rear of switchboard.	Capacitor, 0.01 uf, 500 v ac/dc IET lockwasher.	Fig. 46	Fig. 46
Voltage regulator terminals RR–1 and RR–2 bypassed to voltage regulator mounting bolts.	Capacitor, 0.1 uf, 500 v ac/dc IET lockwasher.	Fig. 45	.....
Voltage regulator cover bonded to voltage regulator case at hinge side.	Tinned copper braid IET lockwasher.	Fig. 48	.....



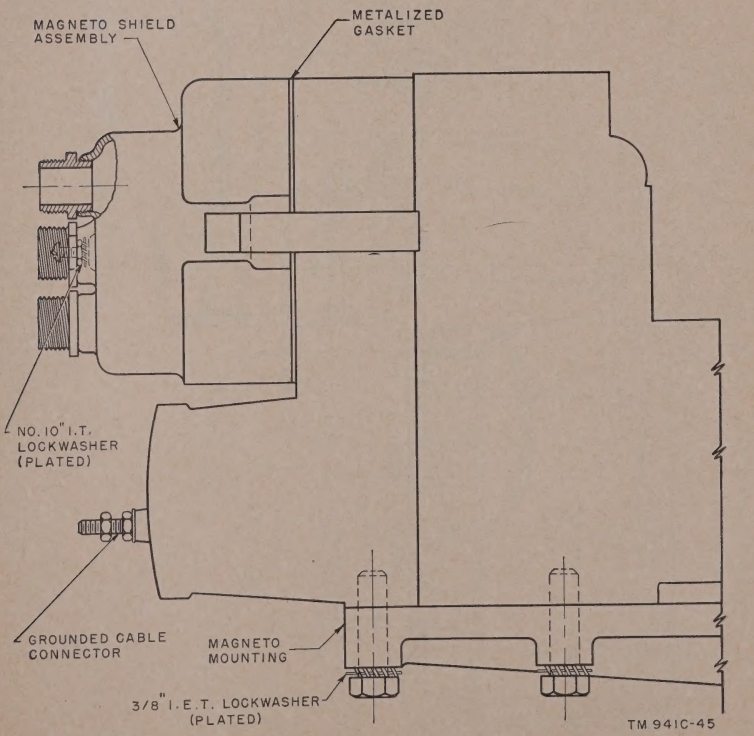


Figure 49.—Ignition suppression, Power Unit PE-215-E.

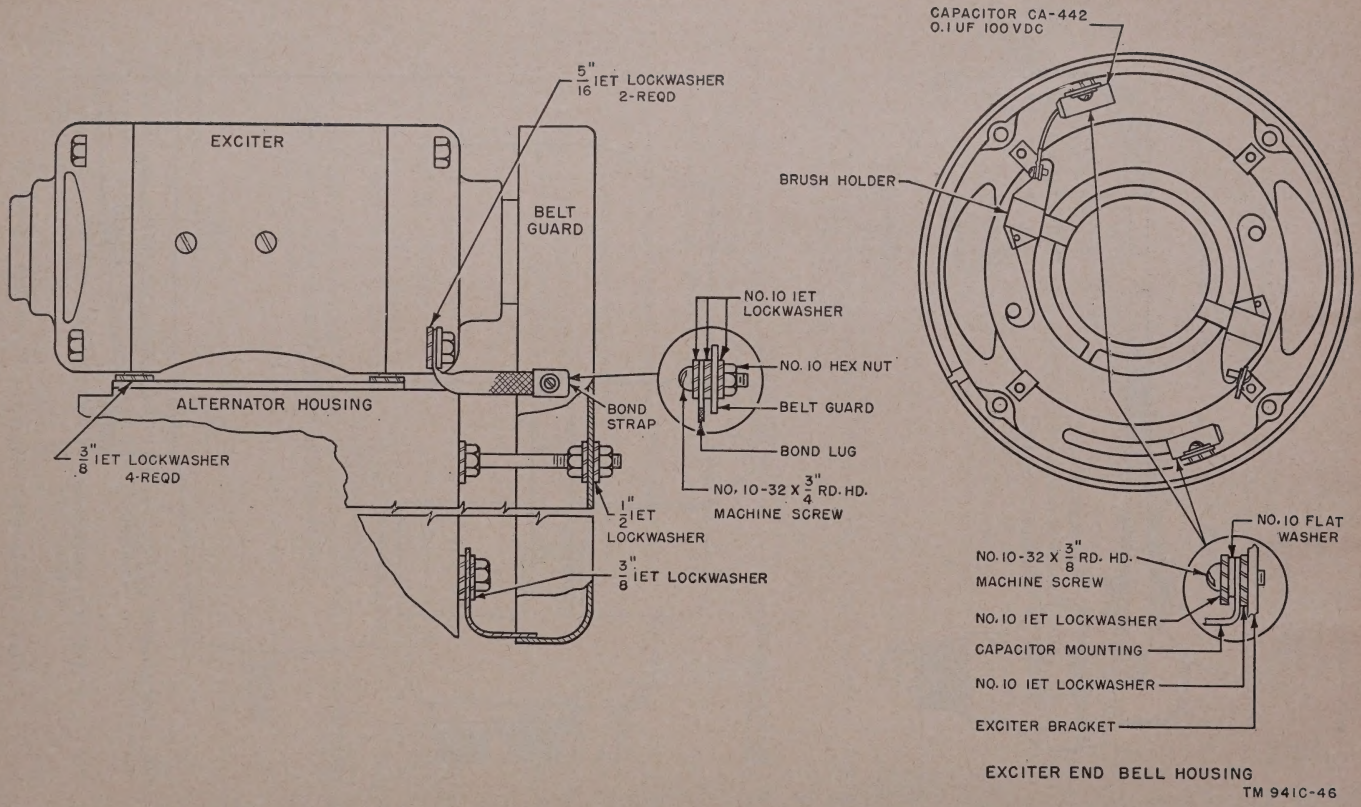


Figure 50.—Exciter suppression.

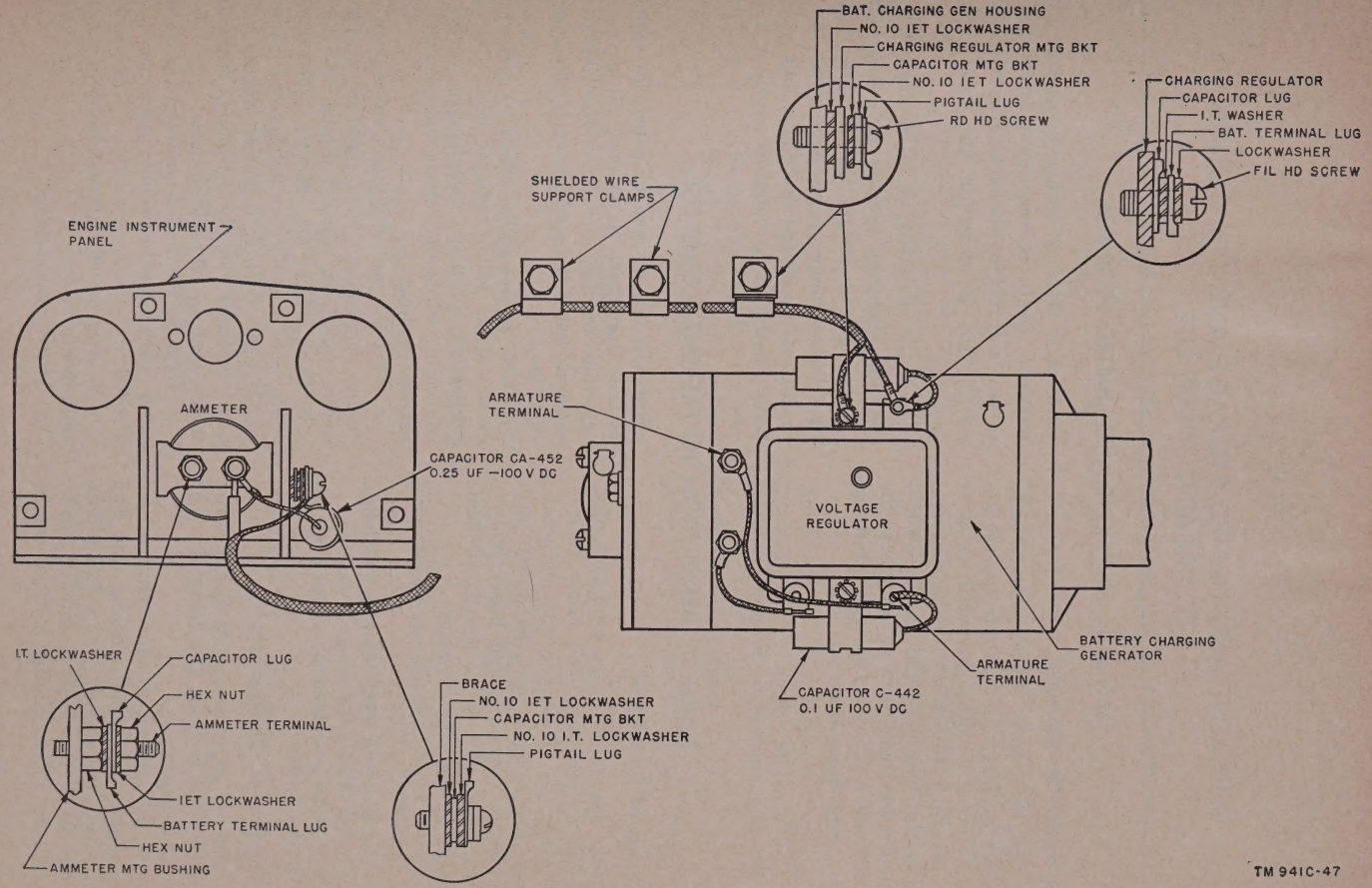


Figure 51.—Charging generator and engine control panel suppression.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

91. Preparation for Storage

Rustproof the engine in accordance with instructions in paragraph 30. Protect the equipment by covering it with a tarpaulin or other suitable covering. If possible, store the complete equipment within a building. The switchboard should be boxed in a wooden box, the interior of which has been suitably protected with weatherproofing material.

92. Shipment

a. If the equipment is to be moved a short distance by truck or trailer, no crating will be required. Drain the cooling system, gasoline system, and fuel oil system and cover the equipment with a tarpaulin or other suitable covering.

b. If the equipment is to be shipped a considerable distance, process the equipment in accordance with instructions in paragraph 30. Pack the equipment in suitable crates or boxes in accordance with applicable Joint Army-Navy Specifications listed in appendix I.

Section II. DEMOLITION TO PREVENT ENEMY USE

93. Methods of Demolition

a. Smash. Use sledges, axes, hand axes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Use axes, handaxes, and machetes.

c. Bend. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

d. Burn. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

e. Explode. Use firearms, grenades, and TNT.

f. Dispose. Bury in slit trenches, fox holes, and other holes. Throw in streams. Scatter.

Note.—Use anything immediately available for destruction of this equipment.

94. Destruction of Components

When ordered by your commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash the cooling system radiator, air cleaner, crankcase breather, cooling fan, fuel injection pump, fuel supply pump, fuel filters, lubricating oil filters, engine cylinder heads, engine cylinder block, engine pistons, engine crankcase, engine control panel, switchboard, voltage regulator, all meters, all gages, fuel injection nozzles, drive pulleys, intake and exhaust manifolds, and generator and exciter castings.

b. Cut the fan belts, accessory drive belts, exciter drive belts, radiator hose, fuel lines, lubricating oil lines, switchboard wiring, all connecting wires and cables, and generator and exciter windings.

c. Bend the unit skid base, valve push rods, engine connecting rods, engine crankshaft, engine camshaft, exhaust piping, and tools.

d. Burn all fuel oil, gasoline, lubricating oil, wires, cables, generator and exciter windings, switchboard wiring, technical manuals, technical bulletins, supply bulletins, other documents, crates, and packing cases.

e. Explode the fuel oil storage tank and all other parts that can not otherwise be destroyed.

f. Bury or scatter all remaining parts of the equipment.

g. Destroy everything.

APPENDIX I

REFERENCES

Note.—For availability of items listed, check SR 310–20–3, SR 310–20–4, and Department of the Army Supply Catalog SIG 1.

1. Supply Publications

SIG 1	Introduction and Index.
SIG 3	List of Items for Troop Issue.
SB 11–47	Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11–76	Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.
SB 38–5–3	List of Standard Lubricants, Hydraulic Fluids, Liquid Fuels and Preservative Materials Used by the Department of the Army.

2. Packaging and Packing Instructions

a. NATIONAL MILITARY ESTABLISHMENT PUBLICATION.

JAN–P–658	Electrical Equipment and Spare Parts.

b. JOINT ARMY-NAVY PACKAGING SPECIFICATIONS.

JAN–B–121	Barrier-Materials, Greaseproof.
JAN–D–169	Desiccants, Activated.
JAN–P–100	General Specification.
JAN–P–106A	Boxes, Wood, Nailed.
JAN–P–116	Preservation, Methods of.
JAN–P–125	Barrier-Materials, Waterproof, Flexible.
JAN–P–131	Barrier-Material, Moisture-Vaporproof, Flexible.
JAN–P–140	Adhesives, Water-Resistant, Case-Liner.
JAN–P–197	Anti-Friction Bearings and Bearing Parts.

c. U. S. ARMY SPECIFICATION.

100–2E	Marking Shipments by Contractors (and Signal Corps Supplement thereto).

d. SIGNAL CORPS INSTRUCTIONS.

720–1	Preparation of Gasoline and Diesel Engines.
720–3	Preservation of Internal Combustion Engines.
720–7	Standard Pack.
726–15	Interior Marking.

3. Other Publications

SB 11–100	Serviceability Standards for Signal Equipment in Hands of Troops.
TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 23	Rustproofing of Engines.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 183	Preventive Maintenance Guide for Power Equipment.
TB SIG 187	Maintenance of Diesel Fuel Injection Nozzles.
TB ORD 313	Spark Plugs.
TB 11–2525–1	Starting Power Units in Arctic Areas Using Miller Utility Heater Model OG–31–A.
TM 1–455	Electrical Fundamentals.
TM 9–2857	Storage Batteries Lead-Acid Type.

TM 9–2858	Cooling Systems: Vehicles and Powered Ground Equipment.
TM 10–550	Fuels and Carburetion.
TM 10–580	Automotive Electricity.
TM 11–453	Shop Work.
TM 11–462	Signal Corps Reference Data.
TM 11–483	Suppression of Radio Noises.
TM 37–2810	Motor Vehicle Inspection and Preventive Maintenance Services.
TM 55–405	Preventive Maintenance of Electric Motors and Generators.

APPENDIX II

IDENTIFICATION TABLE OF PARTS FOR POWER UNITS PE–215–C AND –E

Note.—The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/A, T/BA, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalogs applicable to Power Unit PE–215–C are SIG 7–PE–215 and SIG 8–PE–215. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

Identification Table of Parts for Power Units PE–215–C and –E

(Power Unit PE–215–C is indicated by the letter C in the column headed "Equip. ref."; Power Unit PE–215–E is indicated by the letter E.)

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
			Air Cleaner Group		
		E	BRACKET: air cleaner support; U shaped, steel; Interharvco #251095R11.	Supports air cleaner assembly to engine block.	3H437.2–5
	C	E	CAP: air cleaner intake; #18 ga steel; dome shaped; Interharvco #49364DA.	Prefilters air entering air cleaner.	3H685.13
	C	E	CLAMP: engine radiator outlet hose; steel, galv; Interharvco #91406HA.	Connects air cleaner to manifold air duct.	3H1918–2/C15
		E	CLAMP: air cleaner oil cup retaining; steel; Donaldson #P–7079.	Secures air cleaner oil cup to air cleaner body.	3H948–17
2	C	E	CLEANER ASSEMBLY, air: c/o body, bolts, screws, washers, wingnuts, clamps, bracket, nuts, oil cup, and pipe brace; Interharvco #51232D.	Filters air entering combustion chambers.	3H1918/C25
	C	—	CLEANER ELEMENT, air: bronze wire screen filtera gent; re-usable; Interharvco #67119D.	Filters foreign matter from air passing through air cleaner.	3H1918/S1
		E	CLEANER ELEMENT, air: 16 mesh per inch wire screening; re-usable; Donaldson #P–7073.	.....do.....	3H956–3
	C	—	FITTING, tubing: air cleaner; straight coupling; 2-ply molded rubber; Interharvco #41640–D.	Provides flexible connection between air intake pipe and air cleaner.	3H1918/6
	C	—	GASKET: pipe, air cleaner; Donaldson #10; 3/16"; Interharvco #41638–D.	Provides seal between air intake pipe and intake manifold.	3H1918/G6
		E	HOSE: air cleaner intake; RC, 8-ply, fabric reinforcement; heat resisting; Interharvco #58029D.	Provides flexible connection between air intake pipe and air cleaner.	3H2546–8
			Camshaft Group		
	C	E	BEARING, sleeve: camshaft rear; steel backed, babbit lined; std size; Interharvco #32283DBR.	Provides bearing for camshaft at flywheel end of engine.	3H1918/B6
	C	E	BEARING, sleeve: camshaft #2; steel backed, babbit lined; std size; Interharvco #32281DBR.	Provides intermediate bearing for camshaft.	3H1918/B9
	C	E	BEARING, sleeve: camshaft front; std size; Interharvco #32280DCR.	Provides bearing for camshaft at timing gear end of engine.	3H1918/B15
	C	E	BEARING, sleeve: camshaft #3 brg; steel backed, babbit lined; std size; Interharvco #32282DCR.	Provides intermediate bearing for camshaft.	3H1918/B17
	C	—	CAMSHAFT: 51 19/32" lg; Interharvco #56464D....	Actuates valve tappets.....	3H1918/C10

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
		E	CAMSHAFT: forged steel, smooth mach finish cams integrally forged; Interharvco #251060R1.	Actuates valve tappets...	3H679–1
41	C	E	GEAR: spur type; gray iron mach finish; camshaft driven; helical teeth; LG helix; 54 teeth; Interharvco #32284DB.	Drives camshaft.....	3H1918/G25
41	C	E	NUT, hexagon: steel, parkerized; 1"–14 NF thd; Interharvco #58253D.	Secures camshaft gear to camshaft.	6L3601–14–24
	C	E	PLATE, thrust: camshaft gear; cast iron, mach finish; diamond shape; Interharvco #5960D.	Acts as spacer and takes thrust of camshaft.	3H1918/P70
			Carburetor Group		
	C	E	BOWL, fuel: with adapter; Interharvco#35691DX.	Acts as gasoline reservoir to supply fuel to carburetor jets.	3H745/B5
4	C	E	CARBURETOR: engine starting only; die-cast aluminum; Interharvco #251413R91.	Mixes gasoline and air in proper proportions for combustion.	3H745
	C	E	FLOAT, carburetor: cork, steel, and brass; circular w/lever extension; mts w/pivot pin to lever end; incl upper and lower spring leaf; Interharvco #53079D.	Actuates float bowl intake valve and maintains constant gasoline level in float bowl.	3H745/F5
	C	E	GASKET: body mtg; 7 holes; irregular shape; Interharvco #32606DA.	Provides seal between main carburetor body and fuel bowl.	3H715/G1/1
	C	E	GASKET: float lever pivot; fiber; 1 hole; ring shape; Interharvco #25948D.	Provides seal between float lever pivot and float chamber.	3H715/G1/2
	C	E	GASKET: carburetor throttle lever cover; 1 hole; irregular rectangular shape; Interharvco #32607DA.	Provides seal between throttle lever cover and carburetor body.	3H745/G2
	C	E	GASKET: carburetor mtg; fiber; 6 holes; rectangular shape; wax coated; Interharvco #42769D.	Provides seal between carburetor and intake manifold.	3H745/G3
	C	E	GASKET: carburetor bottom plate; fiber; 10 holes; irregular shape; wax coated; Interharvco #32597D.	Provides seal between carburetor and bottom plate.	3H745/G4
	C	E	GASKET: metering well jet; fiber; 1 hole; ring shape; Interharvco #32615D.	Provides seal between metering well and carburetor bottom plate.	3H1918/G76
	C	E	LEVER: float; brass; Interharvco #32575D.....	Provides mounting for carburetor float. Transmits float movement to float bowl intake valve.	3H1918–2/L18
	C	E	PACKING: butterfly valve shaft; Interharvco #14581.	Provides dust seal on starting shutter shaft.	3H1918/P3
	C	—	PIVOT: float lever; Interharvco #24672D.....	Provides axle for float lever..	3H745/P15
	C	—	PIPE: primer, LH; Interharvco #43369D.....	.....	3H1918/P15
	C	—	PRIMER ASSEMBLY: starting; incl; primer inlet pipe connector nut, primer sleeve, primer inlet tube gland, primer inlet tube packing, primer inlet valve; Interharvco #32949DBX.	Injects raw gasoline into fuel mixture intake to enrich fuel mixture for starting.	3H1918/P50
	C	E	SCREW, pivot: float lever pin; 5/16" NF; Interharvco #32576DX.	Provides axle for float lever..	3H745/S3
	C	E	SHAFT AND LEVER: Interharvco #42871D.....	Locks throttle in closed position for Diesel operation.	3H745/S6
	C	E	SPRING: helical compression type; locking shaft dust cover; mts over locking shaft; Interharvco #32586D.	Provides pressure to hold dust washer in place.	3H715/S5
	C	E	SPRING: carburetor float lever; lower leaf; Interharvco #32577D.	Provides tension to carburetor float valve lever.	3H745/S11

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	SPRING: carburetor float lever; upper leaf; Interharvco #32578D.	Provides tension to carburetor float valve lever.	3H745/S12
	C	E	SPRING: helical compression; air valve; mts over shaft; Interharvco #27452D.	.....	3H1918–2/S27
	C	E	STRAINER: 32 mesh brass screening; Interharvco #29902DX.	Prevents solid matter from entering carburetor float bowl.	3H5342.2
	C	—	TUBING: center intake and exhaust manifold; ⅛″ copper, approx 4″ lg w/male fittings; Interharvco #43368D.	Fuel connection between primer and intake manifold.	3H1918/T15
	C	—	VALVE, needle: incl seat and gasket; Interharvco #32581DXLB.	Opens and closes fuel inlet to carburetor float bowl.	3H2699–7/C1
		E	VALVE, needle: carburetor gasoline inlet; incl cage w/gasket; Interharvco #251648R11.	.....do.....	3H6682–9
	C	E	WASHER, flat: locking shaft gasket; soft copper; Interharvco #58836D.	Seal for locking shaft bearing.	3H715/G1/3
	C	E	WASHER, flat: cork; Armstrong #242.....	Dust seal for float lever pivot screw.	3H1918–2/G53
	C	E	WASHER, flat: fiber; Interharvco #18377D.....	Seal between carburetor intake screen and float bowl.	3H4580A/W3
			Charging Generator Group		
	C	—	ARMATURE, generator: Delco-Remy #1878273...	Produces emf.....	3H2406–10/A25
		E	ARMATURE, generator: 12 v dc, 8 to 10 amp; ball brg one end, bronze sleeve brg other end; Delco-Remy #1874337.	.....do.....	3H135–30
	C	E	BEARING, ball: single row radial; plain; light duty, type K; 12 steel balls; pkd w/h temp grease; ND #3204.	.....	3H1915–1/B20
	C	E	BEARING, sleeve: battery charging generator commutator end; bronze; Delco-Remy #812823.	Bearing between rotor shaft and commutator end plate.	3H2411/B15
	C	E	BEARING, ball: single row radial; plain; medium duty; 8 steel balls; pkd w/std slush type grease; ND #3203.	.....	3H4575A/199
	C	E	BRUSH, electrical contact: commutator brush, armature, and field gnd; carbon; rectangular; slot at holder end; Delco-Remy #809637.	Provides electrical contact between brush holder and commutator.	3H2411/B1
	C	E	COUPLING: couples gen to idler shaft; Delco-Remy #1839478.	Transmits driving force from belt pulley to generator.	3H2406–10/C10
	C	E	CUP, oil: commutator end; Delco-Remy #1101737..	.....	3H2406–10/P1
5	C	E	GENERATOR, DC: 8 to 10 amp at 2,200 rpm; 12 v; closed type frame, 2 poles; 3 brush type, counterclockwise rotation; Delco-Remy #1101737.	Generates dc for charging storage batteries.	3H2406–10
	C	E	HOLDER, contact brush: batt charging gen; 1½″ lg x ¾″ x ⅝″ wd o/a; two 3/16″ diam holes for mtg on pivot pin; 1 tab bent at 90° for #6 screw; Delco-Remy #809642.	Provides mounting for generator brush.	3H2411/H10
	C	E	OILER: drive end; Delco-Remy #1880641.....	.....	3H2406–10/P2
	C	E	PULLEY: batt gen drive; grooved; fan belt idler, complete; Interharvco #63007D.	Permits adjustment of drive belt tension.	3H1918/J6
	C	E	PULLEY: charging gen drive (fan belt idler), 4 9/16″ OD, 2 7/16″ thk o/a; 1½″ diam x .6245″ d bore; 2 V grooves, 13/16″ wd x ½″ d, approx; ⅛″ wd 1/16″ d keyway; Interharvco #5989D.	Idler pulley for belt adjustment.	3H1918/P90
4	C	E	REGULATOR, voltage: batt charging gen; 12 v; 3⅞″ lg x 3⅝″ wd x 3″ h o/a; two 7/32″ wd slotted holes for mtg; w/3 term; Delco-Remy #5838.	Regulates charging current through storage batteries.	3H4971–6

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	SEAL, oil: charging gen drive pulley; felt; ring shape; fits inside of pulley hub; Interharvco #W–16210.	Retains lubricant.....	3H1918/F13
	C	E	SPRING: torsion type; contact brush holder; 9 turns; Delco-Remy #809644.	Holds brush in contact with commutator.	3H2411/S15
	C	E	SPRING: torsion type; contact brush holder; 9 turns; Delco-Remy #809658.	.....do.....	3H2411/S16
			Connecting Rod and Piston Group		
	C	E	BEARING, sleeve: connecting rod to crankshaft, 2 halves; steel backed, copper-lead lined; std size; Interharvco #42688DAX.	Provides bearing between connecting rod lower end and crank journal.	3H1918/B1
	C	E	BEARING, sleeve: connecting rod to crankshaft, 2 halves; bronze; .003″ undersize; Interharvco #64368DX.	Same as above. (For replacement only.)	3H330–41
	C	E	BEARING, sleeve: connecting rod to crankshaft, 2 halves; bronze; .030″ undersize; Interharvco #42690DAX.	.....do.....	3H330–42
	C	E	BEARING, sleeve: connecting rod to wrist pin; bronze; std size; Interharvco #32942D.	Provides bearing between connecting rod upper end and piston pin.	3H1918/B30
	C	E	BOLT, machine: RH; heat treated steel; ½″–20 NF thd; w/castellated hex nut and cotter pin; Interharvco #2873DX.	Secures connecting rod lower end bearing cap to connecting rod.	3H1918/3
	C	E	PIN, piston: .005″ oversize; Interharvco #53612D..	Provides axle upon which upper end of connecting rod swings. Transmits power impulse from piston to connecting rod.	3H1918/P10
	C	E	RING, piston: oil regulating; for 4¾″ cyl, std; Interharvco #42219D.	Prevents excessive amount of lubricating oil from reaching combustion chamber.	3H1918/R13
	C	E	RING, piston: compression, lower; for 4¾″ cyl, std; Interharvco #42694D.	Acts as seal between piston and cylinder wall. Prevents passage of gases past piston.	3H1918/R21
	C	E	RING, piston: compression, upper; for 4¾″ cyl, std; Interharvco #31458D.	.....do.....	3H1918/R22
	C	E	RING, retainer: piston pin; heat treated spring steel; semicir shape w/internal hooked ends; 1 27/32″ diam x .091″ thk; Interharvco #26916D.	Prevents lateral movement of piston pin.	3H1918/R24
	C	E	ROD, connecting: forged steel; 17″ lg x 5¼″ wd, 2⅜″ thk; Interharvco #254924R11.	Connecting link between piston and crankshaft.	3H1918/R20
			Cooling System Group		
	C	E	BEARING, ball: single row radial; plain; bore 20 mm, OD 47 mm, wd 14 mm; ND #3204.	Provides bearing between fan belt idler bracket and idler pulley shaft.	3H1915–1/B20
	C	—	BEARING, ball: single row; water pump; MRC #7308.	Provides bearing between water pump impeller shaft and water pump body.	3H1918–2/B6
	C	E	BEARING, ball: single row radial; plain; medium duty; 8 steel balls; packed w/std slush type grease; ND #3203.	Bearing for water pump and idler pulley.	3H4575A/199
	C	—	BEARING, sleeve: bronze; Interharvco #24017D..	Bushing between water pump shaft and water pump sleeve.	3H1918/B33
	C	—	BELT, V: Interharvco #42937DX.....	Drives fan, water pump, and charging generator.	3H1918/B11
		E	BELT, V: matched pair; Interharvco #251180R11..	.....do.....	3H340–12

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	—	BLADE ASSEMBLY: fan; 6 blades; Interharvco #59240D.	Pushes current of air between tubes of radiator.	3H1918/F5
		E	BLADE ASSEMBLY: fan; 6 blades; Interharvco #251430R91.	.....do.....	3H370.2–17
	C	—	BUSHING, bearing: bronze; Interharvco #20303D.	Bushing between water pump shaft and water pump sleeve. Receives thrust of water pump impeller.	3H1918/15
	C	E	CAP: radiator filler; cast-iron; complete; Interharvco #42611D.	Cover for radiator filler opening.	3H1918/C14
	C	E	CLAMP: hose; steel, galv; Interharvco #91406HA..	Secures hose to radiator outlet and inlet, and to water manifold outlet.	3H1918–2/C15
		E	COLLAR, spacing: steel tubing; Interharvco #251146R1.	Spacer between pulley and water pump shaft bearing.	3H987.2–2
		E	COLLAR, spacing: steel tubing; Interharvco #251135R1.	Spacer between water pump shaft bearings.	3H987.2–3
	C	E	CORE, radiator: w/upper and lower tanks; Interharvco #42538DA.	Aids in dissipation of heat from engine coolant.	3H1917/C35
	C	—	FITTING, pressure lubrication: Ideco #QA3628...	Means of lubricating water pump.	3H1918/L25
	C	E	FITTING, pipe: radiator drain; Interharvco #27843D.	Permits draining radiator...	3H1918/P75
		E	GASKET: fiber; 9 holes; Interharvco #251133R1...	Seal between water pump body and engine block.	3H2154.8–20
		E	GASKET: fiber; 4 holes; Interharvco#251148R1...	Seal between water pump body and oil seal housing.	3H2154.8–24
		E	GASKET: vellumoid; 4 holes; triangular shape; Interharvco #251169R1.	Seal between cylinder-head coolant outlet elbow and cylinder head.	3H2154.8–23
		E	GASKET: vellumoid; 3 holes; diamond shape; Interharvco #251170R1.	Seal between cylinder-head coolant outlet elbow and coolant manifold.	3H2154.8–22
		E	GASKET: rubber; 1 hole; Interharvco #254753R1..	Prevents flow of coolant around thermostat element in manifold.	3H2154.1–23
	C	E	GASKET: radiator cap; circular; Interharvco #10429D.	Seal between radiator cap and filler opening.	3H1918/G8
	C	—	GASKET: pump body; Interharvco #30824D.....	Seal between water pump body and cylinder block.	3H1918/G47
	C	—	GASKET: bearing retainer; Interharvco #32624D..	Seal between water pump bearing retainer and pulley.	3H1918/G48
	C	E	GASKET: cork; radiator, top and bottom; rectangular; 32 holes; Interharvco #42537D.	Seal between radiator core and upper and lower coolant tanks.	3H1918/G62
	C	E	GASKET: vellumoid; triangular; 4 holes; Interharvco #42536D.	Seal between upper coolant tank and inlet connection.	3H1918/G63
	C	E	GASKET: vellumoid; 3 holes; diamond shape; Interharvco #32181D.	Seal between lower coolant tank and outlet connection.	3H1918/G64
	C	—	GASKET: thermostat housing; Interharvco #42655D.	Seal between the thermostat housing and coolant outlet.	3H1918/G73
	C	—	GASKET: water outlet; Interharvco #42654D.....	Seal between thermostat housing and engine block.	3H1918/G74
	C	—	GASKET: pump body cover; Interharvco #32351D.	Seal between pump body and pump body cover.	3H1918/G22

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	—	GLAND: water pump packing; brass; Interharvco #20296D.	Retains water pump packing.	3H1918–2/G45
	C	—	HOSE: radiator inlet; Interharvco #42612D.....	Connects radiator inlet to thermostat housing.	3H1918/H21
	C	—	HOSE: thermostat bypass; Interharvco #42656....	Bypass between water pump and thermostat housing.	3H1918/H22
		E	HOSE: coolant outlet to bypass; Interharvco #15435D.	Connection between coolant manifold and bypass pipe and between bypass pipe and radiator.	3H2546–7
	C	E	HOSE: radiator; Interharvco #42614D.....	Connection between radiator outlet and engine block.	3H1918/H20
	C	—	IMPELLER, pump: Interharvco #5008DCX.....	Circulates coolant through cooling system.	3H1918/J3
		E	IMPELLER, pump: Interharvco #251134R11.....	.....do.....	3H2565–12
	C	—	PACKING: water pump shaft; Crane Packing #115.	Prevents leakage around pump shaft.	3H1918/P1
	C	—	PULLEY: fan drive; 2 grooves; Interharvco #6517DX.	Driver for water pump and fan belts.	3H1918/P22
		E	PULLEY: fan drive; 2 grooves; Interharvco #2511704R11.	.....do.....	3H4600/9
	C	—	PULLEY: fan and water pump; Interharvco #5010DAX.	Drive for water pump and fan assembly.	3H1918/4
	C	—	PUMP, water: complete; Interharvco #56357D....	Circulates coolant through cooling system.	3H1918/P80
	C	E	RADIATOR ASSEMBLY: Interharvco #52527DA.	Acts as condenser and dissipates heat from engine coolant.	3H1918/R1
	C	E	SEAL, grease: felt; mts in water pump housing; Interharvco #20300D.	Prevents leakage between water pump and pulley.	3H1918/W2
	C	E	SEAL, oil: fan idler brg; Interharvco #42940D....	Prevents leakage of oil into water pump.	3H1918/S58
	C	—	SEAL, oil: water pump; fits into fan hub; Interharvco #20290D.	Prevents leakage between pump and bearing.	3H1918/S5
	C	—	SEAL, oil: water pump; fits into brg retainer; Chi Rawhide #262120.	Retains lubricant in bearing.	3H1918/S6
		E	SEAL, oil: water pump shaft; Interharvco #48956D.	Oil seal at pulley end of water pump shaft.	3H5225.2–21
		E	SEAL, oil: water pump shaft; Interharvco #19707D.	Oil seal at inner end of water pump shaft.	3H5225.2–22
		E	SHAFT: water pump drive; Interharvco #251136R1.	Provides mounting and drive for water pump impeller.	3H5220–5
	C	—	SLEEVE ASSEMBLY: fan and water pump; Interharvco #32353D.	Houses water pump impeller shaft.	3H1918/S42
	C	—	SPRING: water pump drive; Interharvco #43217D.	.....	3H1918/S26
	C	E	SPACER: radiator core, RH; Interharvco #5945D..	Protects radiator core and acts as spacer between upper and lower tanks.	3H1918/S52
	C	E	SPACER: radiator core, LH; Interharvco #5944D..	.....do.....	3H1918/S53
	C	E	TANK: coolant, upper; Interharvco #5940DA.....	Provides reservoir at top of radiator.	3H1918/T5
	C	E	TANK: coolant, upper; Interharvco #8261D.....	Provides reservoir at bottom of radiator.	3H1918/T6
	C	—	THERMAL ELEMENT: (thermostat); Interharvco #37634D.	Controls flow of coolant in cooling system.	3H1918–2/T10
		E	THERMAL ELEMENT: (thermostat); Interharvco #250670R91.	.....do.....	3H6656–6

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	TUBE: radiator repair; Interharvco #42589D.....	Part of radiator core assembly. Permits replacement of damaged tube.	3H1918/T17
	C	E	TUBING: copper; ¼"; w/fittings; Interharvco #42601DAX.	Overflow pipe for radiator...	3H1918/8
			Cylinder Block, Crankcase, and Camshaft Group		
	C	E	BEARING, sleeve: crankshaft, main rear, 2 halves, copper-lead, steel backed; Interharvco #47759DX.	Bearing between engine block and crankshaft.	3H301
	C	E	BEARING, sleeve: crankshaft, main front, 2 halves, copper-lead, steel backed; Interharvco #256898R91.	.....do.....	3H301–1
	C	E	BEARING, sleeve: crankshaft, main center, 2 halves, copper-lead, steel backed; Interharvco #63327DBX.	.....do.....	3H301–2
	C	E	BEARING, sleeve: crankshaft, main intermediate, 2 halves, copper-lead, steel backed; Interharvco #47757DX.	.....do.....	3H301–3
	C	E	BEARING, sleeve: crankshaft, main front, 2 halves, copper-lead, steel backed; .003" undersize; Interharvco #64369DX.	.....do.....	3H330–43
	C	E	BEARING, sleeve: crankshaft, main front, 2 halves, copper-lead, steel backed; .030" undersize; Interharvco #47760DX.	.....do.....	3H330–50
	C	E	BEARING, sleeve: crankshaft, main center, 2 halves, copper-lead, steel backed; .003" undersize; Interharvco #64371DBX.	.....do.....	3H330–51
	C	E	BEARING, sleeve: crankshaft, main center, 2 halves, copper-lead, steel backed; .030" undersize; Interharvco #63328DBX.	.....do.....	3H330–48
	C	E	BEARING, sleeve: crankshaft, main intermediate, 2 halves, copper-lead, steel backed; .003" undersize; Interharvco #64372DX.	.....do.....	3H330–47
	C	E	BEARING, sleeve: crankshaft, main intermediate, 2 halves, copper-lead, steel backed; .030" undersize; Interharvco #47761DX.	.....do.....	3H330–46
	C	E	BEARING, sleeve: crankshaft, main rear, 2 halves, copper-lead, steel backed; .003" undersize; Interharvco #64370DX.	.....do.....	3H330–45
	C	E	BEARING, sleeve: crankshaft, main rear, 2 halves, copper-lead, steel backed; .030" undersize; Interharvco #47763DX.	.....do.....	3H330–44
	C	E	BOLT, stud: steel, crankshaft bearing cap; Interharvco #43113D.	Secures crankshaft bearing cap to engine block.	3H1918/2
	C	E	CAP: lubricating oil filler; cast-iron; Interharvco #3713DA.	Cover for oil filler. Keeps out dirt.	3H1918/C15
	C	—	CRANKCASE: Interharvco #6542DEX.....	Houses major engine components.	3H1918/C28
	C	E	CRANKSHAFT: forged steel; std size; Interharvco #32288DBX.	Converts reciprocating movement of piston and connecting rod assembly into rotary motion.	3H1918/C31
2 and 3	C	E	GAGE, oil level: Interharvco #43156DX.....	To measure depth of lubricating oil in engine oil pan.	3H1918/G75
	C	E	GASKET: crankshaft rear oil seal; Interharvco #32308D.	.....	3H1918/G5
	C	E	GASKET: plate; crankshaft; Interharvco #32312D.	Seal between crankcase oil seal retainer plate and crankcase.	3H1918/G14

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	GASKET: oil seal; Interharvco #32309D.....	Seal between rear oil seal retainer and crankcase.	3H1918/G16
	C	E	GASKET: crankcase; front plate; Interharvco #32368DA.	Seal between crankcase front plate and crankcase.	3H1918/G17
	C	E	GASKET: push rod chamber; front plate; Interharvco #39762D.	Seal between plate and engine block.	3H1918/G18
	C	E	GASKET: vellumoid; 6 mtg holes; crankcase side cover; Interharvco #42733D.	Seal between crankcase side cover plate and crankcase.	3H1918/G21
	C	E	GASKET: breather pipe flange; Interharvco #25121D.	Seal between breather pipe flange and engine block.	3H1918/G19
	C	E	GASKET: engine oil pan; Interharvco #42715D...	Seal between crankcase oil pan and bottom of engine block.	3H1918/G46
	C	E	GASKET: push rod chamber rear plate; Interharvco #39764D.	Seal between push rod chamber rear plate and engine block.	3H1918/G54
	C	E	GASKET: push rod chamber side plate; Interharvco #39757D.	Seal between push rod chamber side plate and engine block.	3H1918/G55
	C	E	GASKET: timing gear cover; vellumoid; 19 holes; Interharvco #32371DA.	Seal between crankcase front cover and case front plate.	3H1918/G20
	C	—	GASKET KIT: engine overhaul; Interharvco #52726D.	To provide replacement gaskets when needed.	3H1918/G1
		E	GASKET SET: engine overhaul; Interharvco #255985R91.	.....do.....	3H2155–11
41	C	E	GEAR: crankshaft; spur type; Interharvco #25134DA.	Drives timing and accessory drive gears.	3H1918/G26
41	C	E	GEAR: magneto drive; spur type; Interharvco #32497DX.	Magneto drive idler gear...	3H1918/G29
41	C	E	GEAR: spur type; Interharvco #25140DBX.....	Idler gear between crankshaft gear and camshaft gear.	3H1918/G80
	C	E	LINER KIT: cylinder; incl cyl sleeves, pistons, piston pins, and piston rings; Interharvco #251338R91.	To provide replacement parts when needed.	3H1918/S17
	C	E	NUT, castellated: crankshaft brg cap; Interharvco #39423D.	Secures crankshaft bearing cap on bearing cap studs.	3H1918/N20
	C	—	PAN, oil: Interharvco #5963DAX.....	Acts as lubricating-oil reservoir, houses lubricating-oil pump, and incloses bottom of engine.	3H1918/P11
	C	E	PLUG, expansion: steel; Interharvco #13062D.....	Safety plug to prevent damage to engine block in event of excessive pressure in water jacket.	3H1918/23
	C	—	PLUG, camshaft bearing: Interharvco #21826H...	Seals hole through which camshaft may be driven out of crankcase.	3H1918/P77
		E	PLUG, expansion: steel; Interharvco #113537.....	.....do.....	3H4408–2
	C	E	RETAINER, oil seal: crankshaft front; Interharvco #36799D.	Retains crankshaft front oil seal.	3H1918/R10
	C	E	RETAINER, oil seal: crankshaft rear; Interharvco #39401D.	Retains crankshaft rear oil seal.	3H1918/R11
	C	E	SEAL, dust: bell housing; Interharvco #32313D...	Engine crankcase rear dust seal.	3H1918/S4
	C	E	SEAL, oil: crankshaft rear oil seal; felt; Amer felt #7544.	Part of crankshaft rear oil seal.	3H1918/F11
	C	E	SEAL, oil: crankshaft front oil seal; felt; Interharvco #36798D.	Part of crankshaft front oil seal.	3H1918/W1

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	SEAL, water: cyl sleeve to engine block; Interharvco #4222D.	Seal between bottom of cylinder sleeve and engine block.	3H1918/R16
	C	E	SLEEVE: cyl; w/piston, piston pin, and piston rings fitted; Interharvco #42695DB.	Provides repair parts when needed.	3H1918/S40
	C	E	STUD: steel; crankshaft main brg cap; Interharvco #43113D.	Mounting stud for crankshaft main bearing cap.	3H1918/2
	C	E	WICK: crankshaft rear brg retainer plate plug; felt; Interharvco #25093DA.	.....	3H1918-2/P35
			Cylinder Head and Valve Group		
33	C	—	ARM: rocker, valve, exhaust, LH; Interharvco #32467DX.	Transmits push rod action to valve stem.	3H1918/L16
38	C	—	ARM: rocker, valve, exhaust, RH; Interharvco #32468DX.	.....do.....	3H1918/L17
38	C	—	ARM: rocker, valve, intake; straight; Interharvco #32466DX.	.....do.....	3H1918/L18
33	—	E	ARM: rocker, valve, exhaust, LH; Interharvco #251123R11.	.....do.....	3H119.4-4
38	—	E	ARM: rocker, valve, exhaust, RH; Interharvco #251124R12.	.....do.....	3H119.4-3
38	—	E	ARM: rocker, valve, intake; straight; Interharvco #251122R11.	.....do.....	3H119.4-2
38	C	E	BEARING, sleeve: valve rocker arm; Interharvco #24965DA.	Bearing between valve rocker arm and rocker arm shaft.	3H1918/B31
38	C	E	CLIP: exhaust and intake valve safety lock; Interharvco #18539D.	Prevents valve from dropping into cylinder.	3H1918/R9
	C	—	FELT, lubricating: valve mechanism; Interharvco #32462D.	Lubricates mechanism within valve housing.	3H1918/F10
38	C	E	GASKET: cyl sleeve; Interharvco #25090DD.....	Seals top of cylinder sleeve to cylinder block.	3H1918/G58
33	C	E	GASKET: valve housing cover; cork; Interharvco #32458DA.	Seal between valve housing and cover.	3H1918/G65
38	C	E	GASKET: valve housing; fiber; Interharvco #32457DA.	Seal between valve housing and cylinder head.	3H1918/G66
	C	—	GASKET: water manifold; Interharvco #42762D...	Seal between water manifold and cylinder head.	3H1918/G67
38	C	E	GASKET: cyl head, front and rear; McCord Gasket Co #6159.	Seal between cylinder head and engine block.	3H1918/G68
38	C	—	GUIDE, valve: intake and exhaust; Interharvco #5025DBR.	Holds valve in correct alinement.	3H1918/G15
38	—	E	GUIDE, valve: intake and exhaust; Interharvco #251078R1.	.....do.....	3H2485-4
	C	E	GUIDE, valve tappet: Interharvco #4988D.....	Holds valve tappet and push rod in alinement.	3H1918/G85
38	—	E	HEAD, cylinder: rear; Interharvco #251138R11....	Houses valves and covers combustion chambers.	3H2500-8
38	—	E	HEAD, cylinder: front; Interharvco #251137R11...	.....do.....	3H2500-7
38	C	—	HEAD, cylinder: rear; Interharvco #5968DAY....	.....do.....	3H1918/H1
38	C	—	HEAD, cylinder: front; Interharvco #5967DAY...	.....do.....	3H1918/H2
38	C	E	HOLDER, spring: valve key retainer; Interharvco #42748DA.	Provides seat for top of valve spring.	3H1918/S59
	C	E	NUT, hexagon: ½"-20 NF thd; Interharvco #32454D.	Holds cylinder head to cylinder block.	GL3510-18-16
	C	—	PLUG, expansion: cyl head; Interharvco #13000D..	.....	3H1918/P76
		E	PLUG, expansion: cyl head; Interharvco #106517..	.....	3H4408-1
38	C	E	RETAINER, spring: valve key; intake and exhaust valve; Interharvco #32485D.	Holds valve spring seat on valve stem.	3H1918/K15
38	C	E	RING, retainer: rocker arm shaft; Interharvco #27141D.	Prevents lateral movement of rocker arm shaft.	3H1918/R23

Fig. No.	Equip ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	ROD, valve push: Interharvco #32486DAX.....	Transmits action of cams and valve tappets to rocker arms.	3H1918/R25
38	C	E	SCREW, valve rocker arm adjusting: Interharvco #10951D.	Permits adjustment of clearance between rocker arm and valve stem.	3H1918/S60
38	C	E	SEAT, lower: valve spring; Interharvco #18746DA.	Provides seat for lower end of valve spring.	3H1918/S14
38	C	E	SHAFT: valve rocker arm; front and rear; Interharvco #27140DCX.	Provides axle for valve rocker arms.	3H1918/S16
38	C	E	SHAFT: center; cyl head valve; Interharvco #32464D.	.....do.....	3H1918/S19
38	C	—	SPRING: valve; intake and exhaust; Interharvco #32483DA.	Returns valve to seat.....	3H1918/S25
38	C	E	SPRING: valve; intake and exhaust; outer; Interharvco #61808D.	.....do.....	3H1918–2/S37
38	C	E	SPRING: valve lever rocker arm shaft; Interharvco #24961D.	Spaces rocker arms on shaft..	3H1918/S30
38	C	E	STUD, cylinder head: Interharvco #39810D.....	Provides means for positioning and holding cylinder head onto cylinder block.	3H1918/S70
38	C	E	STUD, cylinder head: Interharvco #42717D.....	.....do.....	3H1918/S71
	C	E	TAPPET, valve: Interharvco #25043DB.....	Transmits cam action to push rods.	3H1918/T1
38	C	E	VALVE, exhaust: Interharvco #32482DC.....	Opens and closes exhaust port.	3H1918/V1
38	C	E	VALVE, intake: Interharvco #42747D.....	Opens and closes intake port.	3H1918/V2
			Engine Control Group		
23	C	E	GAGE, oil: pressure; Rochester Mfg Co #OP–60...	Indicates pressure of lubricating oil flowing through lubricating system.	3H1918/G78
23	C	E	GAGE, temperature: engine coolant; Rochester Mfg Co #VTCS–44.	Indicates temperature of coolant in cooling system.	3H1918–2/J2
23	C	E	METER, ammeter: dc, for batt charging; 20–0–20 amp; panel type.	Indicates rate of charge or discharge of storage battery.	3F1030–25
	C	E	PIPE: indicator; oil pressure; Interharvco #52544DX.	Connects lubricating-oil system to oil pressure gage.	3H1918/J1
23	C	E	SWITCH, foot: electric starter; Delco-Remy #405C.	Closes and opens electrical circuit between storage battery and electric starting motor.	3H3114–14/S30
9	—	E	SWITCH, pressure: automatic cut-off; Penn Elec #261APO1X.	Automatically cuts off fuel supply when lubricating-oil pressure drops too low or temperature of engine coolant becomes too high.	3H1918/C58
9	—	E	VALVE, solenoid: Gen Control #PV–1–#40R458, w/⅜" IPS connections.	Part of automatic safety control.	3H1926–2/S100
	C	—	VALVE, thermostatic: safety control; Fulton Sylphon #530–8.	Automatically cuts off fuel supply when lubricating-oil pressure drops too low or temperature of engine coolant becomes too high.	3H1918/C58
			Flywheel and Flexible Coupling Group		
	C	E	COUPLING, flexible: Ajax Flex Cplg type 3–1/8A.	Couples flywheel to generator rotor shaft.	3H1918/C60

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	GASKET: dust seal; Interharvco #32314D.....	Part of engine crankcase rear dust seal.	3H1918/G77
	C	E	GEAR, flywheel ring: 195 teeth; Interharvco #36237DA.	Permits starting motor to crank engine when engaged by starting motor gear.	3H1918/G27
			Manifold Group		
	C	—	CONTACT: switch; ignition cut-out; Interharvco #42673D.	Part of magneto short-circuiting switch. Cuts off ignition when engine is on Diesel operation.	3H1918/C50
	C	—	GASKET: air valve housing; Interharvco #42659D.	Seal between air valve housing and intake manifold.	3H1918/G60
	C	—	GASKET: air valve housing cover; Interharvco #42672D.	Seal between air valve housing and cover.	3H1918/G69
	C	—	GASKET: exhaust manifold; Interharvco #32360D.	Seal between exhaust manifold flanges and cylinder head.	3H1918/G50
		E	GASKET: exhaust manifold; Interharvco #251167R1.	.....do.....	3H2154.14-2
	C	E	GASKET: exhaust pipe flange; Interharvco #39398D.	Seal between exhaust manifold flange and exhaust pipe flange.	3H1918/G49
	C	—	GASKET: manifold; ignition cut-out switch cover; Interharvco #42680D.	Seal between magneto short-circuiting switch cover and air valve housing.	3H1918/G7
	C	—	GASKET: intake manifold; Interharvco #32366D..	Seal between intake manifold center flange and cylinder head.	3H1918/G51
37	—	E	GASKET: intake manifold; Interharvco #251330R1.	.....do.....	3H2154.14-4
	C	—	GASKET: intake manifold; Interharvco #32495D..	Seal between intake manifold flanges and cylinder head.	3H1918/G52
37	—	E	GASKET: intake manifold; Interharvco #251329R1.	.....do.....	3H2154.14-3
	C	—	HOSE: steel; exhaust; Ideco #631-8A-4A.....	Flexible connection between engine exhaust outlet and muffler.	3H1918/H23
		E	HOSE ASSEMBLY: exhaust; Ideco G-2564-4....	.....do.....	3H2546-9
	C	—	INSULATOR: ignition cut-out switch spring; Interharvco #42676D.	Insulates spring from switch mechanism.	3H1918/J8
	C	—	LEVER: air valve; inner; Interharvco #42670D....	Part of air valve operating mechanism.	3H1918/L15
		E	MANIFOLD, intake: dual passage; Interharvco #254900R11.	Distributes air for Diesel operation and gasoline air mixture for gasoline operation to combustion chambers.	3H2702.2-3
	C	—	MANIFOLD, intake: duel passage; Interharvco #5955DX.	.....do.....	3H1918/M3
4	C	—	MANIFOLD, exhaust: Interharvco #52709D.....	Conducts exhaust gases from combustion chambers to exhaust outlet.	3H1918/M2
		E	MANIFOLD, exhaust: Interharvco #251252R91...	.....do.....	3H2702.3-2
	C	E	MUFFLER: exhaust; Burbatco #STC-3.....	Silences engine exhaust.....	3H1918/S43
37	—	E	PLATE, contact: magneto ground; Interharvco #52515DA.	Provides connection point for switch wires.	3H4328-6
	C	—	PLUG, expansion: air valve housing cover; Interharvco #23007V.	.....	3H1918/P78

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	—	RING: intake manifold; Interharvco #42657D	Prevents leakage at air valve housing mounting.	3H1918/R17
		E	SEAL, oil: manifold control shaft; Chi Rawhide #10014.		3H1918–2/S3
	C	—	SPRING: ignition cut-out switch; Interharvco #42674D.	Part of magneto short-circuiting switch.	3H1918/S28
	C	—	SPRING: air valve; Interharvco #42663D	Holds air valve in Diesel or gasoline operating position.	3H1918/S31
	C	—	VALVE, air: intake manifold; Interharvco #42660D.	Opens or closes ports to Diesel or gasoline sections of intake manifold.	3H1918/V4
27	C	—	YOKE AND ROD ASSEMBLY: air valve; Interharvco #42666DX.	Part of air valve operating mechanism.	3H1918/Y2
			Fuel Oil Cleaner Group		
	C	E	COCK: fuel oil filter drain	Permits draining water and foreign matter from fuel filter.	3H983.3
		E	ELEMENT, fuel filter: Interharvco #250702R91	Removes foreign matter from fuel oil passing through filter.	3H956–2
	C	—	ELEMENT, fuel filter: Interharvco #28809D	do	3H1918/E10
	C	—	ELEMENT, fuel filter: Interharvco #29501DA	do	3H1918/E11
	C	E	FITTING, tubing: straight compression sleeve; for ⅜″ OD tubing; Imperbrass #29463G.	Connects water trap to fuel supply pump, air trap to water trap, and fuel oil inlet.	3H1918/C41
	C	E	FITTING, tubing: 90° elbow; Interharvco #37323D.	Connection in bottom of fuel supply pump strainer and to fuel supply pump intake. Connection to day tank.	3H1918–2/E7
	C	—	GASKET: fuel oil filter base; Interharvco #42959B.	Seal between filter base and engine block.	3H1918/G9
	C	E	GASKET: lubricating-oil filter stud; Motor Improvements Co #8529.	Seal around center stud of filter at top of filter shell.	3H1918–2/G8
	C	E	GASKET: fuel oil filter case; Motor Improvements Co. #8536.	Seals bottom of filter shell to base.	3H1918–2/G18/1
		E	GASKET: filter top plate; Interharvco #250705R1		3H2154.12–23
		E	STRAINER: fuel oil filter; 40 mesh brass screening; Interharvco #250712R11.	Prevents solid matter from entering filter.	3H5340.S–1
7	C	E	VALVE, air: fuel oil filter bleeder; Interharvco #39677D.	Permits bleeding air from fuel filter.	3H1918–2/B44
			Fuel Injection Pump Drive Group		
	C	E	BEARING, ball: single row radial; fuel injection pump drive, front; ND #7505.	Bearing for fuel injection pump drive shaft.	3H1901–A/B2
	C	E	BEARING, ball: single row radial; fuel injection pump drive, rear; ND #3206.	Bearing for fuel injection pump drive shaft.	3H4585A/378
	C	E	BOOT: fuel injection pump drive coupling; Interharvco #31441D.	Protects drive coupling from dust and dirt.	3H1918/B18
	C	E	CAP: fuel injection pump drive shaft housing; Interharvco #5006DAX.	Houses drive shaft oil seal	3H1918/C16
	C	E	GASKET: injection pump drive housing; Interharvco #32342DB.	Seal between injection pump drive shaft housing cap and drive housing.	3H1918/G59
	C	E	GASKET: fuel injection pump drive housing; Interharvco #32340D.	Seal between drive shaft housing and crankcase.	3H1918/G61

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	PLATE, spacer: fuel injection pump timing coupling spacer; Interharvco #31439DB.	Acts as coupling and spacer between injection pump drive shaft flange and timing coupling adjuster.	3H1918/12
	C	E	RETAINER, oil seal: fuel injection pump drive felt retainer; Interharvco #32343D.	Retains oil seal felt.....	3H1918/R12
	C	E	SEAL, oil: felt, fuel injection pump; Interharvco #32362D.	Prevents oil seepage along shaft.	3H1918/F12
41	C	E	GEAR: injection pump drive; Interharvco #25362D.	Drives fuel injection pump assembly.	3H1918/G32
	C	E	SEAL, oil: injection pump drive shaft housing; Interharvco #12480L.	Prevents oil seepage along shaft.	3H1918/S10
	C	E	SHAFT: injection pump drive; Interharvco #32345D.	Transmits drive from drive gear to coupling.	3H1918/S20
	C	E	SPACER: injection pump drive shaft bearing spacer; Interharvco #32344D.	Spaces bearings on injection pump drive shaft.	3H1918/S51
			Fuel Injection Pump, Nozzle, and Lines Group		
	C	—	BEARING, ball: fuel injection pump camshaft; ND #3202.	Supports fuel injection pump camshaft.	3H305.1
	C	—	BEARING, ball: fuel injection pump camshaft; ND #3204.	.....do.....	3H1915–1/B20
	C	—	GASKET: fuel injector nozzle body spacer; Interharvco #43002D.	Spacer between precombustion chamber and retainer body.	3H1918/G2
	C	—	GASKET: fuel injector nozzle body; Interharvco #42767D.	Seal between injector nozzle body and body retainer.	3H1918/G3
		E	GASKET: fuel injector nozzle injector plate; Interharvco #250605R1.	.....	3H2154.8–21
		E	GASKET: precombustion chamber; Interharvco #251042R1.	Provides seal between precombustion chamber and nozzle body and between precombustion chamber and cylinder head.	3H2154.18
	C	E	GASKET: injector nozzle bleeder valve; Interharvco #37148D.	Seal between bleeder valve and nozzle fitting.	3H1918–2/G22/1
	C	—	LINE, fuel: No. 1 cyl; Interharvco #54911DX....	Connection between No. 1 injector nozzle and fuel injection pump.	3H1918/P16
	C	—	LINE, fuel: No. 2 cyl; Interharvco #54912DX....	Same for No. 2 cylinder....	3H1918/P57
	C	—	LINE, fuel: No. 3 cyl; Interharvco #54913DX....	Same for No. 3 cylinder....	3H1918/P58
	C	—	LINE, fuel: No. 4 cyl; Interharvco #54914DX....	Same for No. 4 cylinder....	3H1918/P59
	C	—	LINE, fuel: No. 5 cyl; Interharvco #54915DX....	Same for No. 5 cylinder....	3H1918/P60
	C	—	LINE, fuel: No. 6 cyl; Interharvco #54916DX....	Same for No. 6 cylinder....	.....
		E	LINE, fuel: Nos. 1 and 6 cyl; Interharvco #254411R11.	Same for Nos. 1 and 6 cylinders.	3H2694–17
		E	LINE, fuel: No. 2 cyl; Interharvco #254412R11...	Same for No. 2 cylinder....	3H2694–21
		E	LINE, fuel: No. 3 cyl; Interharvco #254413R11...	Same for No. 3 cylinder....	3H2694–20
		E	LINE, fuel: No. 4 cyl; Interharvco #254414R11...	Same for No. 4 cylinder....	3H2694–18
		E	LINE, fuel: No. 5 cyl; Interharvco #254415R11...	Same for No. 5 cylinder....	3H2694–19
	C	—	NOZZLE: fuel injection; complete; Interharvco #52613D.	Atomizes fuel entering combustion chamber.	3H1918/N10
		E	NOZZLE: fuel injection; complete; Interharvco #251079R91.	.....do.....	3H3985N.3
	C	E	NUT, hexagon: nozzle body stud; Interharvco #31121D.	Holds nozzle body retainer in cylinder head.	6L3508–20–8
	C	—	PIPE: fuel injection pump overflow; Interharvco #54928DAX.	.....	3H1918/P13
	C	—	PLATE: injector nozzle; Interharvco #43192DA...	.....	3H1918/P85
	C	—	PUMP, fuel injection; Interharvco #63877D–12...	Supplies fuel oil under pressure to injector nozzles.	3H1918/19

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
		E	PUMP, fuel injection: Interharvco #253771R91	Supplies fuel oil under pressure to injector nozzles.	3H4601-51
	C	—	SEAL, dust: nozzle body; Interharvco #61208D	.....	3H1918/S8
	C	—	SEAL, dust: nozzle body retainer; Interharvco #61209D.	Seals nozzle body retainer to precombustion chamber.	3H1918/S9
		E	SEAL, dust: nozzle body retainer; Interharvco #251044R1.	.....do.....	3H5225.5-2
		E	SEAL, dust: injector nozzle fitting; Interharvco #250608R1.	.....	3H5225.5-1
	C	—	SPACER: injection nozzle body; Interharvco #56291D.	.....	3H1918/S50
	C	—	STUD: nozzle body; Interharvco #54158D	Secures nozzle body holder to cylinder head.	3H1918/5
		E	STUD: injector nozzle; Interharvco #251064R1	.....do.....	6L31158-1
	C	—	TUBE: oil level equalizing; Interharvco #60743DX	.....	3H1918/T20
39	C	—	VALVE, air: injector nozzle bleeder; Interharvco #32493D.	Permits bleeding air from fuel system.	3H1918-2/V9
	C	E	VALVE, needle: injector nozzle; Interharvco #37152DA	Part of injector nozzle assembly.	3H1918-2/V7
	C	E	BELT, V: fuel supply pump drive; Interharvco #49341D.	Draws fuel from fuel tank and delivers it to engine fuel system.	3H1918/B10
28	C	E	CLEANER, fuel: fuel oil strainer; Imperbrass #42998.	Prevents solid matter from being drawn through fuel supply pump.	3H1918-2/S55
	C	—	COVER: fuel oil tank (day tank); Interharvco #8272D.	Provides cover and mounting bracket for fuel oil day tank.	3H1918/T4
	C	—	FITTING, tubing: primary fuel pump inlet; Interharvco #51434DX.	Inlet connection at bottom of fuel injection pump.	3H1918/13
	C	E	FITTING, tubing: straight compression sleeve type; for ⅜" OD tubing; Imperbrass #29463G.	.....	3H1918/C41
	C	E	GASKET: vellumoid; primary fuel pump mounting; Interharvco #54363DB.	Seal between primary fuel pump and injection pump.	3H1918/9
	C	E	GASKET: lubricating-oil filter hold down bolt to cover; Motor Improvements Co #8529.	.....	3H1918/G8
	C	—	GASKET: fuel oil tank (day tank) cover; Interharvco #52561D.	Seal between cover of day tank and tank.	3H1918/G
		E	GASKET: primary fuel pump; Interharvco #59729D.	Seal between primary fuel pump and fuel injection pump.	3H1918/G56
		E	GASKET: primary fuel pump brg cage; Interharvco #59746D.	.....	3H1918/G57
	C	E	GASKET: fuel supply pump; Interharvco #60352D	Provides seal between fuel strainer top plug and strainer body.	3H1918-2/G22/3
	C	—	LINE, fuel: fuel passage between day tank and primary fuel pump; Interharvco #61741DX.	Provides fuel connection between day tank and primary fuel pump.	3H1918/18
	C	—	PULLEY: fuel supply pump; Interharvco #8273DX	Provides drive for fuel supply pump.	3H1918/P20
		E	PULLEY: fuel supply pump; Interharvco #252339R1.	.....do.....	3H4600P11
	C	E	PULLEY: fuel supply pump drive; Interharvco #8253D.	Drives fuel supply pump from engine crankshaft through belt.	3H1918/P23
	C	—	PUMP: primary fuel pump; Interharvco #62125D	Supplies fuel from day tank to fuel injection pump.	3H1918/20
		E	PUMP: primary fuel pump; Interharvco #251000R91.	.....do.....	3H1918/P27

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
28	C	E	PUMP: rotary; fuel supply; Interharvco #52568D..	Supplies fuel from storage tank to day tank.	3H1918/P50
	C	E	SCREEN: fuel supply strainer; Interharvco #60351D.	Prevents solid matter from passing through fuel supply pump strainer.	3H1918–1/E1
2	C	—	TANK: fuel supply day tank; Interharvco #8271D..	Fuel reservoir for fuel injection pump.	3H1918–2/T2
	C	—	TUBE: fuel filter to safety control; Interharvco #59201DX.	Fuel connection between fuel filter and safety fuel cut-off.	3H1918/T24
	C	—	TUBE: fuel supply pump to day tank; Interharvco #52564DX.	Connection between fuel supply pump and day tank.	3H1918/T18
	C	—	TUBE: fuel supply pump inlet; Interharvco #52566DX.	Connection between fuel strainer and fuel supply pump.	3H1918/T19
	C	E	TUBING, copper: ⅜″ OD, ¼″ size, soft drawn, 50 ft coils.	Used for repairs as needed...	6Z3320–3
			Gasoline Tank, Fittings, and Cleaner Group		
	C	E	BOWL, glass: fuel cleaner; Imperbrass #25858.....	Provides sediment bowl for foreign matter in gasoline.	3H1918–2/B20
	C	—	CAP: gasoline tank; Eaton Mfg. Stmpg #1E1162..	Gasoline tank cap.....	3H1918–2/C10
		E	CAP: gasoline tank; Interharvco #40756D.....	.....do.....	3H685.12
	C	E	CLEANER, fuel: gasoline; Interharvco #51066DBX.	Filters foreign matter from gasoline.	3H1918–2/S56
2	C	—	CONTAINER: 1.4 gal; gasoline; Interharvco #4157DCX.	Gasoline supply tank.....	3H1918/T7
5	—	E	CONTAINER: 1 gal; gasoline; Interharvco #251253R91.	.....do.....	3H1035
	C	E	GASKET: gasoline cleaner bowl; cork; Imperbrass #25857–C.	Prevents leakage around top of sediment bowl.	3H1918–1/G3
	C	—	GASKET: gasoline tank cap; Eaton Mfg. Stmpg #1070.	.....	3H1918–1/G6
	C	—	GASKET: vellumoid; gasoline strainer; Interharvco #68367D.	.....	3H1918–2/G22/2
	C	—	LINE, fuel: gasoline; Interharvco #60015DX.....	Connection between gasoline strainer and carburetor.	3H1918/T16
	C	E	STRAINER: 96 mesh screening; Interharvco #13194D.	Prevents solid matter from passing through gasoline strainer.	3H1918–2/S10
22	C	E	VALVE, needle: gasoline shut-off; Interharvco #52855D.	Fuel shut-off for gasoline supply. Part of gasoline strainer.	3H1918/V3
			Governor Group		
		E	BEARING, ball: single row radial; ND #7505.....	Supports center of governor shaft.	3H1901A/B2
		E	BEARING, ball: single row radial; ND #3202.....	Supports rear end of governor shaft.	3H305–1
	C	E	DISK, brake: governor control, friction; Interharvco #48356D.	Aids in holding governor control where set.	3H1918–2/D10
	C	E	ROD, control: engine governor; complete assembly; Interharvco #53832D.	Control linkage between governor control and engine governor.	3H1918/R28
	C	E	SPRING: helical compression; governor control friction; Interharvco #48358D.	Provides tension for friction holding mechanism in governor control.	3H1918–2/S30
	C	E	SPRING: helical compression; governor control rod; Interharvco #52638D.	.....	3H1918–2/S34

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
			Magneto Ignition Group		
	C	E	ARM: magneto breaker; Interharvco #21373DBY–1.	Makes and breaks high-tension ignition circuit.	3H2699–7/A2
	C	E	BEARING, sleeve: magneto drive shaft; Interharvco #32506DA.	Bearing for magneto drive shaft.	3H1918/B32
	C	E	BEARING, ball: single row radial; magneto rotor shaft; ND #15.	Support magneto rotor shaft.	3H4574/M1/1
	C	E	BLOCK, bearing· magneto distributor shaft support; Interharvco #2551DAY6.	Support for distributor, shaft, and gear assembly.	3H2699–7/B4
	C	E	BRUSH, electrical contact: magneto distributor; Interharvco #21463DAXA.	Contact between distributor rotor and distributor disk.	3H2699–11/B3
	C	E	CAP: distributor; magneto; Interharvco #28656DYA.	Provides cover for distributor mechanism and terminal points for spark plug wires.	3H2699–7/B5
	C	E	CAPACITOR, fixed: paper; Interharvco #21409DB.	Minimizes pitting of magneto breaker contacts.	3H1918/C17
	C	E	CONTACT, magneto: stationary breaker; Interharvco #21388DBX.	Part of magneto breaker point assembly.	3H2699–7/P5
	C	E	COUPLER, impulse: magneto; Interharvco #36246D.	Snaps magneto rotor over at speed to aid in starting engine.	3H2699–7/C10
	C	E	CUP: magneto breaker; complete with spring; Interharvco #21368DBY6.	Houses breaker assembly...	3H1918/C65
	C	E	CUP: magneto breaker with points; Interharvco #25796D.	.....	3H2699–7/C8
	C	—	DISK: Interharvco #28657DX.....	Provides contact for distributor rotor brush and distributes ignition spark to spark plug wire terminals of distributor block.	3H2699–7/D5
	C	E	DISTRIBUTOR: Interharvco #21460DY.....	Rotating member of magneto distributor.	3H2699–7/D7
	C	E	FELT: magneto brg oil seal; Interharvco #E4–226..	Prevents seepage of rotor shaft lubricant.	3H2699–7/F8
	C	E	FELT: magneto brg oiler; Interharvco #E4–216...	Distributes lubricating oil to magneto front bearing.	3H2699–7/F10
	C	E	GASKET: magneto drive bracket; Interharvco #32505DB.	Seal between magneto drive bracket and engine.	3H1918/G10
	C	E	GASKET: magneto bracket bolt; Interharvco #25352D.	.....	3H1918/G11
	C	E	GASKET: spark plug; Victor Gasket #2066C.....	Prevents compression leakage around spark plug.	3H1920/G13
	C	E	GASKET: magneto frame cover; Interharvco #21319D.	Seal between magneto frame and cover.	3H2699–7/G1
41	C	E	GEAR: magneto drive; 36 teeth; Interharvco #32500DA.	Drives magneto drive shaft.	3H2699–7/G8
	C	E	GEAR: magneto rotor drive; 40 teeth; Interharvco #33138D.	Drives magneto rotor.....	3H2699–7/G7
6	C	E	MAGNETO: ignition; Interharvco #32361D.....	Provides ignition spark for starting.	3H2699–7
	C	E	PACKING: paper; breaker cover; Interharvco #21327D.	Seal between breaker housing cover and breaker housing.	3H2699–11/P10
	C	E	PAWL: impulse coupling; Interharvco #32671D..	Part of impulse coupling assembly.	3H1918/P2
	C	E	PAWL, latch: impulse coupling; Interharvco #24611D.	Engages impulse coupling pawl.	3H2699–7/L1
	C	E	PLUG, spark: 7/8"–18 NF thd; hot type; Champion #44.	Conducts ignition spark into combustion chamber.	3H4418

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	RACE: rotor shaft brg; inner; Interharvco #E4A351.	Provides inner race for magneto rotor shaft ball bearing.	3H2699–7/B1
	C	E	RACE: rotor shaft brg; outer; Interharvco #E4A352.	Provides outer race for magneto rotor shaft ball bearing.	3H2699–7/B2
	C	E	RETAINER, felt: magneto rotor shaft inner felt retainer; Interharvco #30379D.	Retains felt on magneto rotor shaft to prevent seepage of lubricant.	3H2699–7/R7
	C	E	RETAINER, felt: magneto rotor shaft outer felt retainer; Interharvco #30378D.	.....do.....	3H2699–7/R8
	C	E	RETAINER, bearing: magneto rotor shaft (with balls); Interharvco #E4A353.	Bearing cage to hold bearing balls.	3H2699–7/R9
	C	E	ROTOR, magneto: Interharvco #21333DX6.....	Magneto armature.....	3H2699–7/R10
	C	E	SEAL, oil: magneto drive shaft; Interharvco #33788D.	.....	3H1918/S11
	C	E	SEAL, dust: distributor block; lower; Interharvco #21347DC.	Seals bottom of distributor block to magneto frame.	3H1918/S35
	C	E	SEAL, dust: distributor block; upper; Interharvco #21348DB.	Seals face of magneto distributor block to magneto frame cover.	3H2699–7/S3
	C	E	SHAFT: magneto idler gear; Interharvco #32499DAX.	Axle for magneto idler gear. Part of magnetic drive assembly.	3H1918/S23
	C	E	SHAFT: distributor; w/gear attached; Interharvco #21360DX6.	Distributor rotor and mounting.	3H1918/S24
	C	E	SHIM: magneto shaft brg adjusting; Interharvco #E4A305.	Provides spacing adjustment for magneto rotor shaft bearing.	3H2699–27/S10
	C	E	SPRING: helical compression; distributor disk contact; Interharvco #28674D.	.....	3H1918/S54
	C	E	SPRING: distributor contact; Interharvco #21464DX.	Provides contact between distributor rotor and distributor disk.	3H2699–7/S6
	C	E	STOP, breaker: with gasket; Interharvco #21443DX.	.....	3H2699–11/S30
	C	E	WICK: oiler; magneto cam lubricator; Interharvco #21383D.	Lubricates magneto breaker cam.	3H2699–7/F9
	C	E	WICK: oiler; magneto distributor brg; Interharvco #38041D.	Lubricates magneto distributor bearing.	3H8390–1
			Lubricating Oil Cleaner Group		
	C	—	BAR AND ADAPTER: lubricating oil filter case retaining; Interharvco #41747DX.	Stand pipe through center of oil filter.	3H1918/B40
		E	CLEANER ELEMENT, oil: paper; one time use; Interharvco #63884D.	Filters foreign matter from lubricating oil passing through filter.	3H1918–2/E13
	C	—	COVER: oil filter case; Interharvco #42356DA....	Closes top of filter assembly.	3H1918/C55
	C	—	ELEMENTS: oil filter; carton of 10; Interharvco #50310D.	Provides replacements for used elements.	3H1918/E13
	C	E	FITTING, tubing: 90° elbow; Interharvco #36613DX.	Connection for safety control oil pressure line to crankcase.	3H1918/14
	C	—	GASKET: lubricating oil filter case; Interharvco #41746D.	Seals bottom of oil filter case to mounting.	3H1918/G12
	C	—	GASKET: lubricating oil filter case cover; Interharvco #42371DA.	Seals lubricating oil filter cover to case.	3H1918/G71
		E	GASKET: lubricating oil filter; hold down bolt to cover; Motor Improvements Co #8529.	.....	3H1918–2/G8
		E	GASKET: lubricating oil filter cover to base; Motor Improvements Co #8536.	Seals oil filter case to mounting.	3H1918–2/G18/1

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	—	GASKET: oil filter drain plug; Purolator Products Inc #19666.	Prevents leakage at drain plug.	3H4580A/W42
			Lubricating Oil Pump Group		
53	C	E	BODY: lubricating oil pump; with shaft; Interharvco #45963D.	Houses moving parts of lubricating-oil pump.	3H1918/B28
53	C	E	FLOAT: lubricating oil pump; Interharvco #41791DA.	Adjusts level of oil intake to level in oil pan.	3H745/F6
53	C	E	GEAR: pinion; lubricating oil pump drive; 14 teeth; Interharvco #46054DA.	Drives lubricating-oil pump.	3H1918/G28
53	C	E	GASKET: lubricating oil pump cover; Interharvco #42789D.	Seal between oil pump body and bottom cover.	3H1918/G45
53	C	E	GEAR: lubricating oil pump idler; 12 teeth; Interharvco #50336D.	.....	3H1918/G30
53	C	E	GEAR: lubricating oil pump body; 12 teeth; Interharvco #50335D.	.....	3H1918/G31
53	C	E	PIN: lubricating oil pump drive pinion; Interharvco #5312T3.	Prevents gear from turning on shaft.	3H1918/P9
	C	E	PLUNGER: lubricating oil pressure regulating valve; Interharvco #45285DA.	.....	3H1918–2/V2
53	C	E	PUMP, liquid gear: lubricating oil; complete; Interharvco #43990D.	Circulates lubricating oil to engine parts.	3H1918/P25
53	C	E	SHAFT: lubricating oil pump idler gear; Interharvco #43158D.	Provides axle for lubricating-oil pump idler gear.	3H1918/S85
	C	E	SPRING: lubricating oil pump; oil pressure regulating valve; Interharvco #48695D.	.....	3H1918/S29
			Starting Valve Mechanism Group		
	C	—	BEARING, sleeve: starting mechanism cross shaft; Interharvco #50827D.	Bearing for starting mechanism cross shaft.	3H1918–2/B37
27	C	—	GEAR: starting valve shaft; worm; 8 teeth; Interharvco #32471DA.	Rotates starting valve camshaft.	3H1918/G33
27	C	—	GUIDE, starting valve: Interharvco #5024DAR...	Guides starting valve stem..	3H1918/G35
	E		GUIDE, starting valve: Interharvco #251103R1...	.....do.....	3H2485–5
	C	—	SEAL, oil: starting valve cross shaft; Interharvco #42760D.	Prevents leakage of oil from valve housing along cross shaft.	3H1918/S7
	C	—	SEAL, oil: starting valve cross shaft; Interharvco #32460D.	.....do.....	3H1918/S12
	C	E	SEAL, oil: starting valve operating shaft; Chi Rawhide #10016.	.....	3H1918–1/S4
27	C	—	SHAFT, cross: starting valve; Interharvco #56456D.	Rotates starting valve camshaft gear.	3H1918/S18
	C	—	SHAFT: starting valve; front and rear; w/rollers; Interharvco #32469DX.	Operates starting valves....	3H1918/S22
	C	—	SHAFT: starting valve: center; w/rollers; Interharvco #32470DX.	.....do.....	3H1918/S69
43	C	E	SHAFT: starting valve mechanism; control cross shaft; Interharvco #56460D.	Transmits action of operating lever to opposite side of engine.	3H5220.6
43	—	E	SHAFT: starting valve operating; Interharvco #50672D.	.....do.....	3H5220–9
38	—	E	SHAFT: starting valve; front; Interharvco #251214R1.	Operates starting valves....	3H5220–7
38	—	E	SHAFT: starting valve; rear; Interharvco #251215R1.	.....do.....	3H5220–8
	C	—	SPRING: starting valve; Interharvco #32479D....	Returns valve to seat.....	3H1918/S32
		E	SPRING: starting valve; Interharvco #46211D....	.....do.....	3H1918–2/S33
	C	E	SPRING: helical extension type; cross shaft return; Interharvco #42755D.	Holds starting valve mechanism in set position.	3H1918/S80

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
		E	SPRING: helical extension type; cross shaft return; Interharvco #52176DC.	Holds starting valve mechanism in set position.	3H5255.18–1
	C	—	VALVE, starting: Interharvco #42749D.....	Opens and closes ports to gasoline intake manifold.	3H1918/V5
		E	VALVE, starting: Interharvco #251074R1.....	.....do.....	3H6682–10
			Starting Motor Group		
	C	E	BATTERY, storage; Sig C Battery BB–55; lead acid storage; 6 v; Sig C type #4H.	Provides current to electric starting motor.	3B55
	C	E	BRUSH, electrical contact: negative commutator; Delco-Remy #38367.	Provides electrical contact to starting motor commutator.	3H4574/B24
	C	E	CABLE ASSEMBLY, power: batt connector; Interharvco #731523D.	Used to connect batteries in series.	3E4528–1
	C	E	CABLE ASSEMBLY, power: batt to starter switch; Interharvco #38098DA.	Connects storage battery to starting motor switch.	3E4528–2
	C	E	CABLE ASSEMBLY, power: batt to ground; Interharvco #38099D.	Connects storage battery to ground.	3E4528–3
	C	E	CRANK, starting: Interharvco #52522D.....	Used manually to turn engine crankshaft for starting.	3H1918/C30
36	C	E	DRIVE, starting motor: Bendix drive assembly; Delco-Remy #1881585.	Automatically engages and disengages starting motor gear with flywheel ring gear.	3H3114–17/D15
36	C	E	MOTOR, DC: series type; engine starting; Delco-Remy #1109106.	Electrically cranks engine...	3H3114–17
	C	E	SPRING: torsion type; brush holder; Delco-Remy #34846.	Holds starting motor brush in contact with motor commutator.	3H114/S11
			Exciter Group		
	C	E	ARMATURE, generator: for exciter; Interharvco #214X52.	.....	3H2405–1/A1
	C	E	BEARING, ball: single row radial; ND #7504.....	Supports commutator end of armature shaft.	3H4577A/B3
	C	—	BELT, V: exciter drive; Gates Rub #2–64A.....	Drives generator exciter....	3H2405–1/B5
		E	BELT, V: exciter drive; Gates Rub #51A.....	.....do.....	6Z879–9
	C	E	BRUSH, electrical contact: exciter commutator; GE #8104785AAG2.	Provides electrical contact to exciter commutator.	3H2405–1/B21
	C	E	CAPACITOR, fixed: 3 section; .02 to .002 uf; 250 v dc; noise suppression; GE #5073650.	.....	3H2405–1/C10
4	C	E	GENERATOR, DC: exciter; 1½ kw, 23.4 amp at 2000 rpm; 64 v; GE model #5BC78DB2A.	Supplies dc for excitation of alternator.	3H2405–1/E15
	C	E	HOLDER, brush: exciter; GE #8104782AAG2.....	Provides mounting for exciter brushes.	3H2411–2/Y5
	C	E	SEAL, oil: exciter; commutator end; felt; GE #5859706AAP1.	Prevents leakage of lubricant.	3H2405–1/W10
	C	E	SPRING: exciter brush holder; GE #K5023472....	Holds exciter brush in contact with commutator.	3H2405–1/S15
			Main Generator Group		
	C	E	BEARING, ball: single row radial; pkd w/h temp grease; SKF #6315.	Supports generator rotor shaft.	3H305–88
		E	BRUSH, electrical contact; slip ring; GE #1491535..	Provides electrical contact to alternator slip rings.	3H525GE–19
	C	—	BRUSH, electrical contact; slip ring; GE #5829438..	.....do.....	3H2405–1/B20
	C	E	CAP: cartridge; ball brg; GE #5848564P1.....	Bearing cover.....	3H4600–215A/C1
	C	E	CARTRIDGE: ball brg; GE #5888705P1.....	Bearing retainer cage.....	3H2405–1/C1

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
4	C	—	GENERATOR, AC: 50 kw, 80% pf, 62.5 kva, 174 amp; 120 to 208 v, 60 cyc, 3 ph, 4 wire; GE frame #953E; separate exciter GE #12G857; type AT1, Form BA.	Generates ac	3H116–3
		E	GENERATOR, AC: 50 kw at 1200 rpm, 80% pf, 150 amp; 120 to 240 v, 60 cyc, 3 ph, 4 wire; GE type AT1 frame #9538; separate exciter GE #12G308.	do	3H2440–21
	C	E	HOLDER, brush: main gen; GE #M5844427ABG1.	Provides mounting for alternator brushes.	3H2405–1/H15
	C	E	NUT, lock: for ball brg; GE #213X89		3H2411–2/N15
	C	E	SPRING: torsion type; brush holder; GE #243928.	Holds alternator brushes in contact with slip rings.	3H2411–9/S10
	C	E	STUD: brush holder; a-c gen; GE #5823467ADG1.	Supports brush holder	3H2411–2/S20
	C	E	WASHER, lock: gen brg nut; GE #213X90		3H2411–12/W15
			Switchboard Group		
10	C	—	CIRCUIT BREAKER: thermal; 3 pole; 250 v ac; 125/250 v dc, 225 amp; Sq D #956327.	Protects generator against overload.	3H900–225–4
11	—	E	CIRCUIT BREAKER: magnetic and thermal; 3 pole, 2 position; 250 v, 175 amp; Wemco type K 175 amp, #1310874.	do	3H900–175.1
		E	FUSE, cartridge: 3 amp; 250 v; Fusetron #403	Circuit protection	3Z2603.9
10	C	—	LAMP, incandescent: 120 v, 15 w; S11 clear bulb; candelabra screw base; GE #15811/13.		6Z6820–25
11	—	E	LAMP, incandescent: 110 v, 6 w; S6 clear bulb; candelabra screw base; GE #6S–6.		2Z5941
10 and 11	C	E	METER, ammeter: ac; 0 to 200 amp; AWS type #MR34W200ACAA.	Measure ac drawn by load	3F1200–8
10	C	—	METER, frequency: ac or interrupted dc; 57 to 63 cps; 7 vibrating reeds; operates on 100 to 150 v; Aero Instr #7007.	Indicates frequency of alternator output.	3F2789–2
11	—	E	METER, frequency: 150 v, 58 to 62 cps; Biddle #MF–9–4964.	do	3F2746
10 and 11	C	E	METER, voltmeter: JAN type MR34W 300ACVV.	Indicate a-c voltage output of generator.	3F8300–33
10	C	—	REGULATOR, voltage: Synchrostat #GR–2 SM–1.	Automatically maintains constant voltage.	3H4982–6
11	—	E	REGULATOR, voltage: GE #GBA–41A	do	3H4995–3
	C	—	RESISTOR, adjustable: wire wound; 15,000 ohms; 25 w; Ohmite #0387.		3Z6615–136
	C	—	RESISTOR, fixed: wire wound; 2,500 ohms; 25 w; Hard-Hindle #2A–16.	Current-limiting resistor	3Z6250–82
		E	RESISTOR, fixed: wire wound; 2,250 ohms; 10 w; IRC #1–3/4–A.	do	3Z6225–9
12	C	—	RESISTOR, variable: single section; wire wound; 80 ohms in 28 steps; .9 amp min to 4.5 amp max; C–H #11111–H–535.	Exciter-field rheostat; controls flow of current through exciter field.	3Z7080–1
		E	RESISTOR, variable: wire wound; 5 ohms; 100 w; Ohmite model K #0440.	Used as cross-current compensating rheostat.	3H7005–13
13	—	E	RESISTOR, variable: wire wound; 80 ohms; C–H #11111–11115.	Used as exciter-field rheostat.	3Z7080–2
		E	RESISTOR, variable: wire wound; 35 ohms; 25 w; Ohmite model H #0147.	Used as voltage adjusting rheostat.	3Z7035–2
10 and 12	C	—	SWITCH, rotary: 8 pole, 4 position; Rol-Smith type R2 #C56614.	Permits switching ammeter from one phase to another.	3Z9825–3.2
11 and 13	—	E	SWITCH, rotary: 2 pole, 3 position; Ahlers #8320–A.	do	3Z9825–40.15
10	C	—	SWITCH, toggle: 3 TPST; Cutler Hammer #8342.	Connects synchronizing lamps into desired circuits.	3Z9849.160

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
11	—	E	SWITCH, rotary: TPST, 2 position, 3 pole; 4 decks; Ahlers #83607.	Connects synchronizing lamps into desired circuits.	3Z9825–40.17
10	C	—	SWITCH, rotary: 2 pole, 6 position, 2 off positions; 4 sect; Rol-Smith type R2 #40373	Permits switching voltmeter from one phase to another.	3Z9825–3.3
11	—	E	SWITCH, rotary: 2 pole, 4 position; 5 deck; Ahlers #82658F.	.....do.....	3Z9825–40.16
12 and 13	C	E	TRANSFORMER, power: cross current compensation; Elec Mach #2625.	Feed cross-current compensation resistor on voltage regulator.	2Z9614–116
12 and 13	C	E	TRANSFORMER, power: current transformer; Elec Mach #222–200705.	Feed ammeter.....	3Z9614–117
12 and 13	C	E	TRANSFORMER, power: potential type; Wemco #MT–1198119.	Potential transformer; steps down voltage.	2Z9602–33
			Ignition Suppression Group		
	C	E	CABLE, power: high-tension ignition; single conductor; Packard Elec #55186R.	Wire braid sheathing prevents r-f radiation.	1B3016–1.6
	C	E	CLIP: plug-in connection at magneto distributor block; Delco-Remy #829833.	Provides contact to magneto terminal.	3Z1104–4
	C	E	FERRULE: ignition cable shielding; Breeze #E–110–88–1.	Connects magneto cable shielding to magneto shield.	6Z3823–10
	C	E	FERRULE: ignition cable shielding; Breeze #E–110–161–1.	Connects ignition cable shielding to spark plug shield.	6Z3823–9
	C	E	FITTING, conduit: Breeze #E–1026–29–B4.....	Provides watertight connection at each end of ignition cable.	6Z7249–35
	C	E	GASKET: magneto shield; Ideco #G–3984.....	Bonds magneto shield to magneto frame.	3H2154.14.1
	C	E	GROMMET: rubber w/copper clad ring; Breeze #E–1201–9–10.	Bonds magneto cable ferrule to cable shielding. Magneto end.	3H2479
	C	E	GROMMET: rubber w/copper clad ring; Breeze #E–1201–10–10.	Bonds magneto cable ferrule to cable shielding. Spark plug end.	3H2479–1
	C	E	SHIELD, ignition distributor: Ideco #G–3906.....	Shields distributor end of magneto.	3H5240.10
	C	E	SHIELD, spark plug: #4, 5, and 6 cyl; Breeze #E–1031–22–20.	Shields spark plugs.....	3H5240.11
	C	E	SHIELD, spark plug: #1, 2, and 3 cyl; Breeze #E–1031–22–10.	.....do.....	3H5240.12
	C	E	SUPPRESSOR, electrical noise: resistor type w/spring contact; 10,000 ohms; Erie #S–14.	Spark plug suppressor.....	3Z1891–43
	C	—	CAPACITOR CA–442: fixed; 1 sect; .10 uf, 100 v dc.	Noise suppression.....	3D442
	C	E	CAPACITOR CA–452: fixed; 1 sect; .25 uf, 100 v dc.	.....do.....	3D452
	C	E	CAPACITOR CA–472: fixed; 1 sect; .01 uf, 500 v dc.	.....do.....	3D472
	C	E	CAPACITOR CA–482: fixed; 1 sect; .1 uf, 500 v ac/dc.	.....do.....	3D482
			Tool Group		
	C	E	CLOTH: textile, 36″ wd.....	.....	6N1636
	C	E	DRESSER: contact point; magneto.....	.....	41–D–1410
	C	E	GAGE: breaker point; magneto.....	.....	41–G–198–300
	C	E	GAGE: spark plug gap.....	.....	41–G–350
	C	E	HANDLE: socket wrench, sliding T, ½″ sq drive..	.....	6Q51207–3

Fig. No.	Equip. ref.		Name of part and description	Function of part	Signal Corps stock No.
	C	E	HAMMER: ball-peen, 8 oz		6Q49708
	C	E	HYDROMETER: TL–386/U; batt testing		3B2250–386
	C	E	LUBRICATOR: Alemite, 9 oz		6Z4935–6
	C	E	OILER: ½ pt		6Z7308.4
	C	E	PAPER: sand, flint #0000		6Z7500–0000
	C	E	PLIERS: slip joint; w/cutters; 6″		6R4721–6
	C	E	SCREW DRIVER: 2″ blade, ⅛″ wd		6R15290
	C	E	SCREW DRIVER: 4″ blade, ¼″ wd		6R15693
	C	E	SCREW DRIVER: 8″ blade, ⅜″ wd		6R16491
	C	E	WRENCH: adjustable, single open end, 8″ lg		6R55018.1
	C	E	WRENCH: double open end; 5/16″ and 13/32″		6R55561.1
	C	E	WRENCH: double open end; 5/16″ and 31/32″		6R55572
	C	E	WRENCH: double open end; 1⅛″ and 1 5/16″		6R55536–42
	C	E	WRENCH: double open end; 1¼″ and 1⅝″		6R55540–52
	C	E	WRENCH: setscrew; ⅜″ hex		6R57400–7
	C	E	WRENCH: socket; ⅞″; ½″ sq drive (spark plug)		6R24308–28
	C	E	WRENCH: socket; 31/32″; ½″ sq drive		41–W–3026
	C	E	WRENCH: spanner; adjustable hook type (water pump).		6RK57502–1
			Combustion Chamber Cleaning Group		
	C	E	ABRASIVE COMPOUND: grinding; 2 oz can, medium and coarse.		6G245.2
	C	E	CLEANER: valve guide		41–S–980
	C	E	LIFTER: valve grinding (valve spring compressor)		6Q63180
	C	E	SCRAPER: carbon; flexible wire		6R14010
	C	E	TOOL: valve grinding		6Q46334

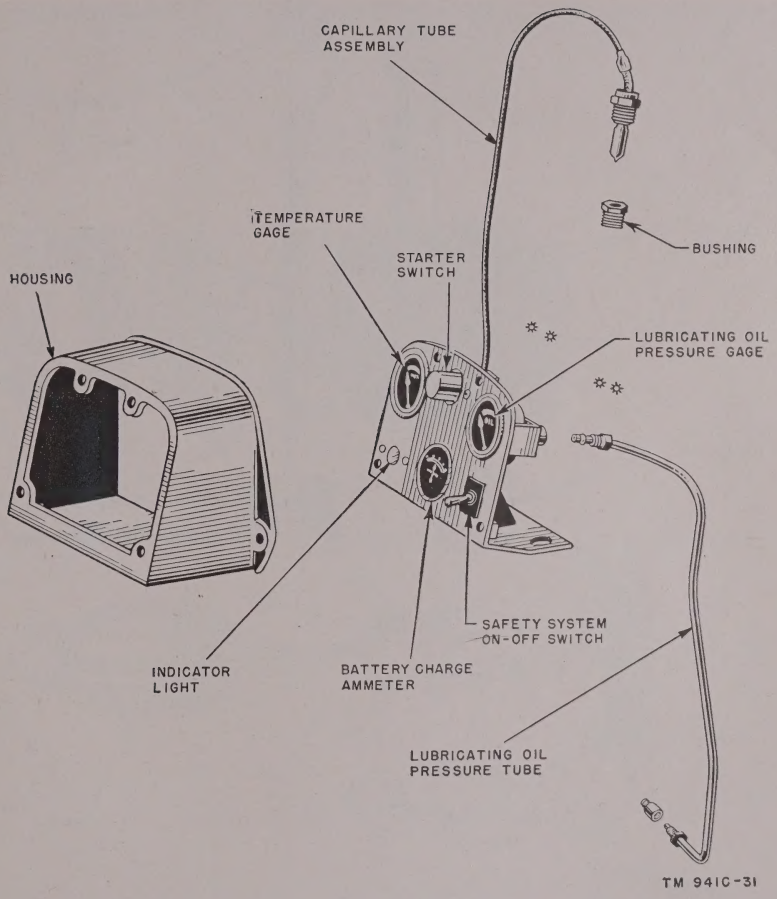


Figure 52.—Engine control panel assembly.

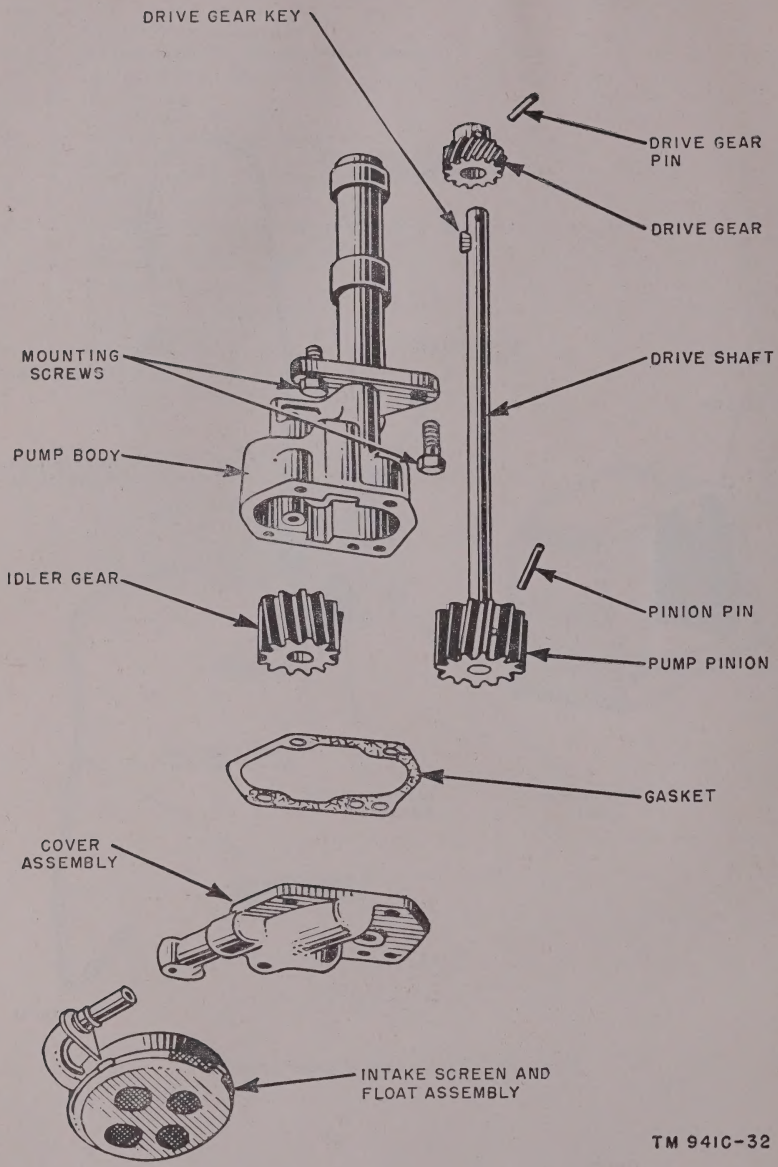


Figure 53.—Lubricating-oil pump assembly.

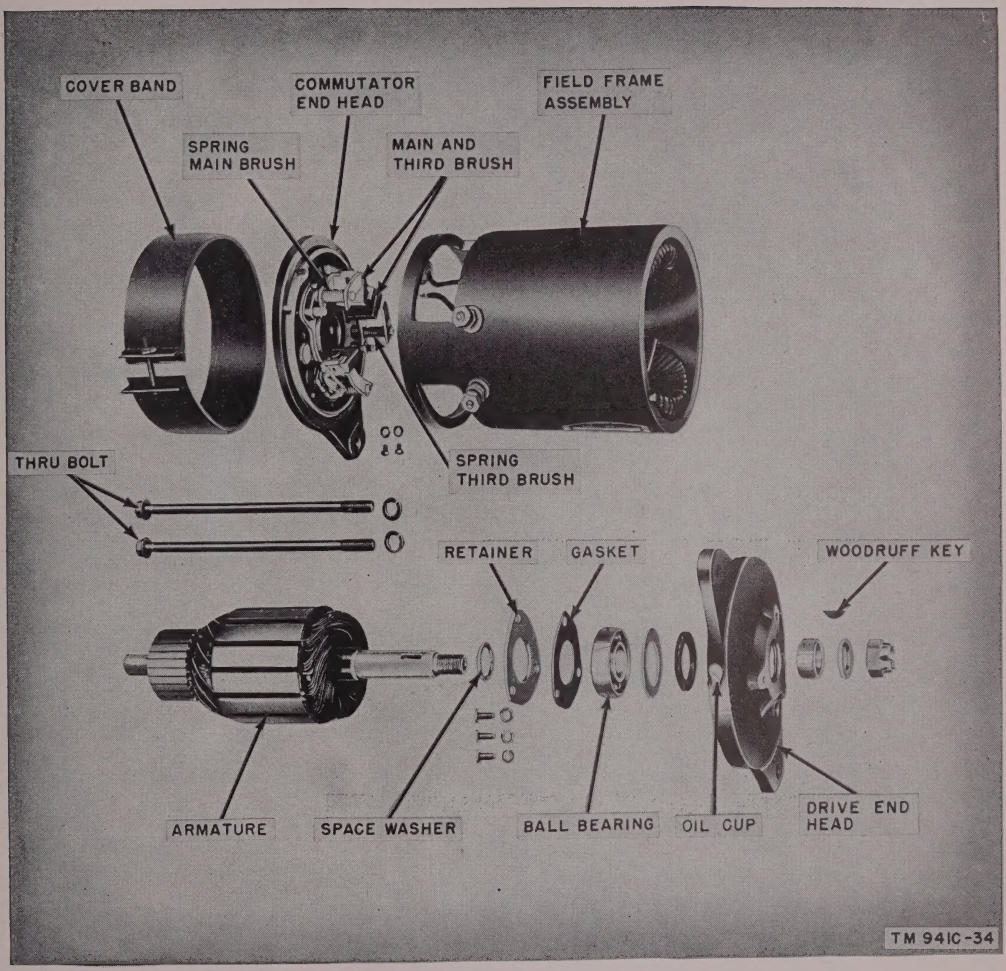


Figure 54.—Battery-charging generator.

INDEX

	Paragraph	Page
A-c generator, description	6*k*	11
Adjusting voltage	15*a*	36
Adjustments for parallel operation	18*f*	39
After starting, precautions	14	36
Air cleaner, preparation	12*d*	35
Application (of equipment)	4	6
Applying load	15	36
Approved lubricants	28	43
Arctic operation	19	39
Automatic controls	11	34
Balancing units for parallel operation	18*d*	38
Battery:		
Connections	9*g*	26
Preparation	12*f*	35
Battery-charging generator removal	49*c*	70
Battery hydrometer, use	25*b* (4)	42
Bulletins:		
Supply	App. I	105
Technical	App. I	105
Camshaft:		
Installation	73	89
Removal	72	88
Carburetor:		
Parts inspection	50*c*	74
Removal	49*e*	71
Charging-generator:		
Parts inspection	50*a*	73
Removal	49*c*	70
Cleaner, air, preparation	12*d*	35
Cleaning cooling system	34*b* (4)	49
Commutator burnishing tool	24*a*	41
Commutator undercutting tool	24*b*	41
Compression release, action	37*c*, *d*	54
Connections:		
Battery	9*g*	26
Electrical	9*c*	25
Exhaust	9*b*	25
Ground	9*d*	26
Load	9*e*	26
Parallel	9*f*	26
Controls:		
Automatic	11	34
Location	10*b*	30
Switchboard	10*c*	31
Cooling system:		
Description	6*i*	11
Preparation	12*c*	34
Cranking system, description	6*b*	7
Crankshaft bearing:		
Installation	75	89
Removal	74	89

	Paragraph	Page
Cylinder head, reassembly	59*c*	82
DA AGO Form 464 services	36*b*	50
DD Form 110, use	32*b*	46
Day tank removal	49*o*	72
Depot maintenance	35	50
Description, general	3	1
Description of—		
Cooling system	6*i*	11
Cranking system	6*b*	7
Engine	6*a*	6
Fuel oil system	6*f*	10
Gasoline starting system	6*c*	8
Generator (a-c)	6*k*	11
Governor	6*g*	10
Intake manifold	6*d*	8
Lubricating system	6*j*	11
Magneto	6*e*	10
Safety control system	6*h*	10
Switchboard	6*l*	12
Desert operation	20	39
Detailed inspection (of parts):		
Carburetor	50*c*	74
Charging generator	50*a*	73
Fuel supply pump	50*e*	75
Magneto	50*d*	75
Starting motor	50*b*	74
Water pump and fan	50*g*	75
Disassembly of—		
Engine	69	87
Front cover and timing gears	70	87
Lubricating-oil pump	65	86
Piston and connecting rod	61	84
Electrical connection	99*c*	25
Engine:		
Description	6*a*	6
Specifications	7*b* (1)	15
Trouble chart	39*a*	64
Engine instrument panel removal	49*q*	72
Exciter specifications	7*b* (3)	17
Exhaust connections	9*b*	25
Fits and tolerances	51	76
Form, DD 110, use	32*b*	46
Foundation, preparation	8*b*	21
Front and back, definition	3	1
Front cover and timing gear:		
Disassembly	70	87
Reassembly	71	88
Fuel:		
Supply pump removal	49*h*	71
Supply pump, parts inspection	50*e*	75
Fuel filter removal	49*i*	71
Fuel injection pump, preparation	12*e*	35
Fuel oil day tank removal	49*o*	72
Fuel oil system:		
Description	6*f*	10
Preparation	12*c*	34
Gasoline starting system, description	6*c*	8
Gasoline tank removal	49*o*	72

	Paragraph	Page
Generator (a-c):		
Description	6*k*	11
Specifications	7*b*(2)	17
Trouble chart	39*b*	67
Governor, description	6*g*	10
Ground connections	9*d*	26
Growler, use	25*b*(3)	42
Hydrometer (battery), use	25*b*(4)	42
Improvised tools	24	41
Injection pump removal	49*n*	72
Injector nozzle reassembly	59*d*(4)	83
Installation of—		
Camshaft	73	89
Crankshaft bearings	75	89
Equipment	8*d*	24
Foundation	8*b*	21
Timing gears	71	88
Intake and exhaust valve reassembly	59*c*	82
Intake manifold:		
Description	6*d*	8
Inspection	53	79
Installation	53	79
Removal	52	78
Interchangeable parts:		
Engine	42*a*	69
Generator	42*b*	69
Switchboard	42*c*	69
Load:		
Applying	15	36
Connections	9*c*	25
Locating equipment (siting)	8*a*	21
Location of controls	10*b*	30
Lubricants, approved	28	43
Lubricating-oil filter removal	49*k*	72
Lubricating-oil pump:		
Disassembly	65	86
Inspection	66	86
Reassembly	67	87
Lubrication—		
Periods	26	43
Routine	28	43
System:		
Description	6*j*	11
Preparation	12*b*	34
Magneto:		
Description	6*e*	10
Parts inspection	50*d*	75
Maintenance, depot	35	50
Maintenance schedule:		
Daily	33*a*	47
Every 8 hours	33*b*	47
Every 64 hours	33*c*	47
Every 128 hours	33*d*	48
Motor tune-up set, use	25*b*(1)	41
Nozzle, injector, reassembly	59*d*(4)	83
Oil filter, lubricating, removal	49*k*	72
Oil pump, lubricating	65–67	86

	Paragraph	Page
Operation in—		
Arctic climates	19	39
Desert areas	20	39
Tropical climates	21	39
Operation of equipment	16	37
Operator's maintenance	32	46
Parallel connections	9*f*	26
Balancing	18*d*	38
Connections	18*c*	38
Operation	18	38
Adjustments	18*f*	39
Requirements	18*a*	38
Wattless current	18*e*	39
Phasing-out	18*b*	38
Piston and connecting rod—		
Disassembly	61	84
Inspection	62	84
Reassembly	63	85
Removal	60	83
Precautions after starting	14	36
Preliminary preparation of—		
Air cleaner	12*d*	35
Batteries	12*f*	35
Cooling system	12*c*	34
Fuel:		
Injection pump	12*e*	35
Supply	12*c*	34
Lubrication system	12*b*	34
Preparation of—		
Air cleaner	12*d*	35
Batteries	12*f*	35
Cooling system	12*c*	34
Fuel injection pump	12*e*	35
Lubrication system	12*b*	34
Preventive maintenance	36	50
Push-rod (valve) reassembly	59*d*(6)	83
Radiator, removal	49*r*	73
Reassembly:		
Cylinder head	59*d*(5)	83
Injector nozzle	59*d*(4)	83
Intake and exhaust valves	59*d*(1)	82
Mechanism	59*d*(3)	82
Push rods	59*d*(6)	83
Starting valve	59*d*(2)	82
Reference material	41	69
Refinishing	31	46
Removal of—		
Camshaft	72	88
Carburetor	79*e*	91
Charging generator	79*c*	91
Crankshaft bearings	74	89
Engine instrument panel	49*q*	72
Fuel:		
Filter	49*i*	71
Injection pump	49*n*	72
Supply pump	49*h*	71
Supply pump and strainer	49*g*	71
Gasoline and day tank	49*o*	72
Generator (from line)	18*g*	39

	Paragraph	Page
Removal of—(contd)		
Lubricating-oil—		
Filter	49*k*	72
Pump	65, 66	86
Magneto	49*f*	71
Piston and connecting rod	60	83
Radiator	49*r*	73
Safety switch	49*j*	71
Solenoid switch	49*i*	71
Starting motor	49*d*	71
Rocker arms	57	79
Removing generators from line	18*g*	39
Requirements for parallel operation	18*a*	38
Routine lubrication	28	43
Rustproofing	30	45
Safety control system, description	6*h*	10
Safety switch, removal	49*j*	71
Setting up equipment	8*d*	24
Siting equipment	8*a*	21
Solenoid switch, removal	49*i*	71
Specifications:		
Engine	7*b*(1)	15
Exciter	7*b*(3)	17
Generator	7*b*(2)	17
Starting motor, parts inspection	50*b*	74
Starting procedure:		
New equipment	13*a*	35
Used equipment	13*b*	36
Stopping procedure	17	37
Storage battery, preparation	12*f*	35
Stripping (parts from) equipment:		
Battery removal	49*b*	70
Carburetor removal	49*e*	71
Charging-generator removal	49*c*	70
Engine instrument panel removal	49*q*	72
Fuel—		
Filter removal	49*i*	71
Injection pump removal	49*n*	72
Supply pump removal	49*h*	71
Gasoline and day tank removal	49*o*	72
Lubricating-oil filter removal	49*k*	72
Magneto removal	49*f*	71
Radiator removal	49*r*	73
Rocker arm removal	57	79
Safety switch removal	49*j*	71
Solenoid switch removal	49*l*	72
Starting motor removal	49*d*	71
Water pump and fan removal	49*s*	73
Switchboard controls	10*c*	31
Description	6*l*	12
Tank, day, removal	49*o*	72
Technical inspection:		
Cleaning equipment	47	70
Inspection	48	70
Meters and gages, required	46	70
Tools, required	45	69
Test equipment:		
List	25*a*	41

	Paragraph	Page
Test Equipment—(contd)		
Use of—		
Battery hydrometer	25*b*(4)	42
Electrical testing	25*b*(2)	42
Growler	25*b*(3)	42
Motor tune-up set	25*b*(1)	41
Theory of operation of—		
Compression release mechanism	37*c*, *d*	54
Fuel oil system	37*e*	56
Gasoline starting system	37*b*	54
Governor	37*f*	56
Safety switch	37*g*	57
Tools	24, 25	41, 69
Tropical operation	21	39
Trouble chart:		
Engine	39*a*	64
Generator	39*b*	67
Tune-up set (motor), use	25*b*(1)	41
Unit mechanic's maintenance:		
Every 256 hours	34*a*	48
Every 512 hours	34*b*	49
Use of equipment	4	6
Valve mechanism, reassembly	59*c*	82
Valve push rod, reassembly	59*c*	82
Voltage adjustment	15*a*	36
Water pump and fan, parts inspection	50*g*	75
Wattless current	18*e*	39
Weatherproofing:		
Materials required	30*a*	45
Procedures	30*b*	45
Weights and dimensions	7*a*	15

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