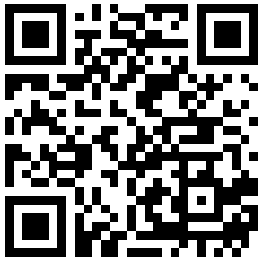

TM 11-909

WAR DEPARTMENT TECHNICAL MANUAL

POWER UNITS PE-74
PE-74-B, PE-74-( )

NOTE: This is a reprint of TM 11–909, Power Units PE-74, PE-74-B, PE-74-( ), 15 January 1944. No distribution will be made to personnel possessing the original publication.

WAR DEPARTMENT · *15 JANUARY 1944*

WAR DEPARTMENT TECHNICA

TM 11-909

POWER UNITS PE-74

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WAR DEPARTMENT • 15 JANUARY 1944

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WAR DEPARTMENT,
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TM 11–909, Power Units PE–74, PE–74–B, PE–74—( ) is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

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DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—Ordered by your commander.

HOW —1. Smash—Use sledges, axes, hand-axes, pick-axes, hammers, crowbars, heavy tools, etc.

2. Cut—Use axes, hand-axes, machetes, etc.

3. Burn—Use gasoline, kerosene, oil, flame-throwers, incendiary grenades, etc.

4. Explosives—Use fire arms, grenades, TNT, etc.

5. Disposal—Bury in slit trenches, fox-holes, other holes. Throw in streams. Scatter.

6. USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT —1. Smash—Engine crankcase, cylinder block, cylinder head, radiator; electrical control panel, alternator frame.

2. Cut—Ignition and electrical cables and wires, radiator hose, fan belt.

3. Burn—Alternator windings, after drenching with fuel, Technical Manual.

4. Bury or scatter—Any or all of the above pieces after breaking. Spill all excess fuel and oil on ground.

DESTROY EVERYTHING

SAFETY NOTICE

GUARDS — SHIELDS

The manufacturers of this equipment have taken every precaution to safeguard the operating personnel. All moving or operating parts have been adequately guarded or shielded to provide maximum protection.

IMPORTANT: Do not remove any guards, shields, screens, etc. to perform service or maintenance work while power unit is in operation. To do so removes the safety features provided for your protection.

CARBON MONOXIDE

CAUTION: Never attempt to operate the engine in a small, unventilated room. Carbon monoxide gas, produced by all gasoline engines, is a deadly insidious poison when inhaled. Make certain exhaust gases are piped outside and all connections are gas-tight at all times.

CARBON MONOXIDE POISONING TREATMENT

The first thing to do is to get the patient into fresh air quickly.

If breathing has stopped, or is present only in occasional gasps, start artificial respiration at once and continue until normal breathing is resumed, or until rigor mortis has set in. See "Resuscitation Procedure."

ELECTRIC SHOCK

WARNING: 208 VOLTS EXIST IN ELECTRICAL SYSTEM WHILE POWER UNIT IS IN OPERATION. Stop power unit before attempting any service work involving these parts.

ELECTRICAL SHOCK TREATMENT

See "First Aid Instructions for Electric Shock," next page.

First-Aid Treatment for Electric Shock

Electric shock is caused by the passage of electric current through the body. If current of sufficient magnitude passes through the breathing center at the base of the brain, breathing stops and the victim loses consciousness. The pulse becomes very weak or ceases entirely and the body turns blue or very white. Occasionally the body becomes stiff. This condition is caused by the electricity and is not an indication of death.

In most cases of electric shock, the victim's life may be saved by the prompt and continued application of artificial respiration. By this means air is supplied to the body until the breathing center resumes its normal function. Resuscitation may take a long time; cases are recorded in which recovery occurred after 8 hours of artificial respiration.

Rescue

To rescue a person from a live source of electric current, first shut off the current if a switch can be reached without loss of time. If shutting off the current will cause delay, use a dry nonconductor, such as a rope, a board, or rubber gloves, to prevent contact, and free the victim or remove the live conductor. Do not use metal or any moist material. Should it be necessary to cut a live wire, use an ax or a hatchet with a dry wooden handle and turn away to avoid the resulting flash.

Never allow any part of your body to come into contact with the victim's body or the live conductor. Do not attempt a rescue at the hazard of your own life.

Fig. A. Artificial Respiration—Proper Position

Resuscitation

Begin artificial respiration at once, as near the scene of the accident as possible. Every minute counts. Do not wait to loosen the patient's clothing, but do remove false teeth, chewing gum, or tobacco from his mouth, as any such obstruction interferes with the passage of air. Wrap the patient in a blanket, coat, or anything available, since warmth is very important. While one person starts artificial respiration, another should go at once for the nearest physician.

The procedure for artificial respiration follows:

1. Lay the patient face downward, with one arm bent at the elbow and placed so that the patient's cheek rests on the hand or forearm. The face is turned outward to leave the nose and mouth free for breathing. The other arms is extended overhead. (See Fig. A.)

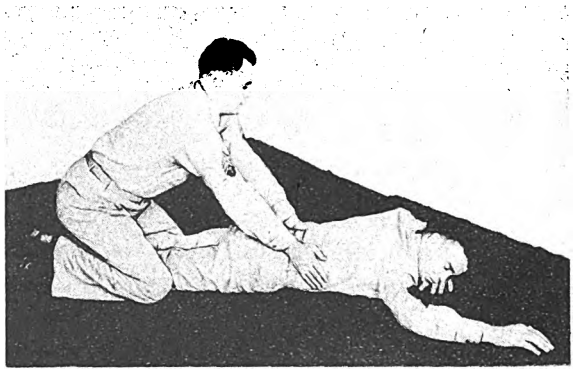


Fig. B. Artificial Respiration—Ready to Apply Pressure

2. Kneel straddling the patient's thighs, with your knees placed far enough from the hip bones to allow you to assume the position shown in Fig. B. If the patient is a large, heavy person, it may be more convenient to straddle only one leg. Place the palms of your hands on the small of the patient's back, with the little fingers just touching the lowest ribs. The thumbs and fingers should be in a natural position as shown in Fig. B.

3. With arms held straight, swing forward slowly, so that a gradual pressure is brought to bear upon the patient. At the end of the forward swing, your shoulders should be directly over the heels of your hands. Do not

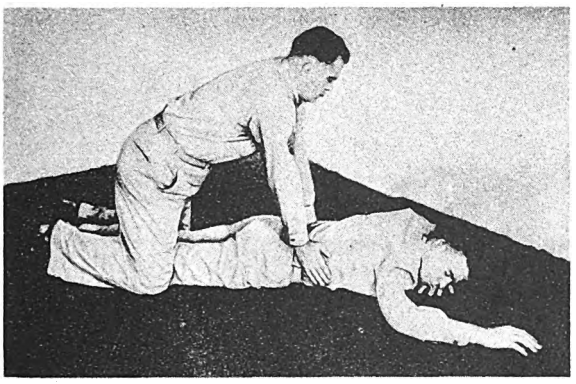


Fig. C. Artificial Respiration—Pressure Applied

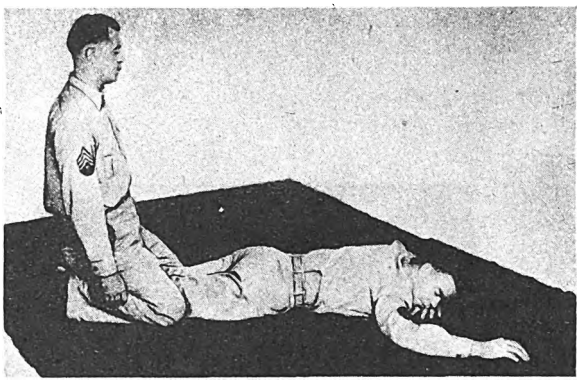


Fig. D. Artificial Respiration—Pressure Released

bend your elbows. The forward swing should take about two seconds. See Fig. C.

4. Immediately on completing the forward swing, release the pressure and swing backward to the position shown in Fig. D. Wait 2 seconds; then swing forward as before.

Repeat this cycle of pressure and release, which creates a complete respiration, 12 to 15 times a minute. Continue without interruption until natural breathing is restored, or until a physician declares the patient dead. If no physician can be reached, continue until you are sure there is no chance of recovery. Remember that artificial respiration often has to be kept up for hours.

While artificial respiration is being given, some one other than the operator should loosen the clothing about the patient's neck, chest, and waist. Keep the patient warmly wrapped. Apply hot-water bottles, hot bricks or stones, if possible. Do not give the patient liquids until he is fully conscious.

The first attempt to breathe may be a gasp, a faint sigh, or a catch of the breath. Artificial respiration should be withheld when the first breathing begins. Be very careful not to exert pressure as the first spontaneous breath occurs. Continue to watch the patient carefully, as he may stop breathing again after a temporary recovery. In that case, artificial respiration must be resumed at once.

When the patient revives, he must be kept warm and quiet. Do not allow him to sit or stand. If no physician has arrived, give the patient a teaspoonful of aromatic spirits of ammonia in a small glass of water, or a drink of hot coffee or tea, as a stimulant.

If possible, avoid moving the patient until he is breathing normally. Even then, he should be moved only in a lying position. If extreme weather conditions or other hazards make it necessary to move a patient before normal breathing has been restored, continue artificial respiration while he is being moved.

It may be necessary to change operators while administering artificial respiration. The change must be made without interrupting the rhythm of respiration. The relief operator should kneel beside the person giving the artificial respiration. As the pressure is released, the operator falls aside, the relief operator takes his place, and the cycle of pressure and release continues without interruption.

—Adapted from The American Red Cross First-Aid Textbook.

RESUSCITATION DRILLS SHOULD BE HELD REGULARLY BY ALL OPERATING PERSONNEL

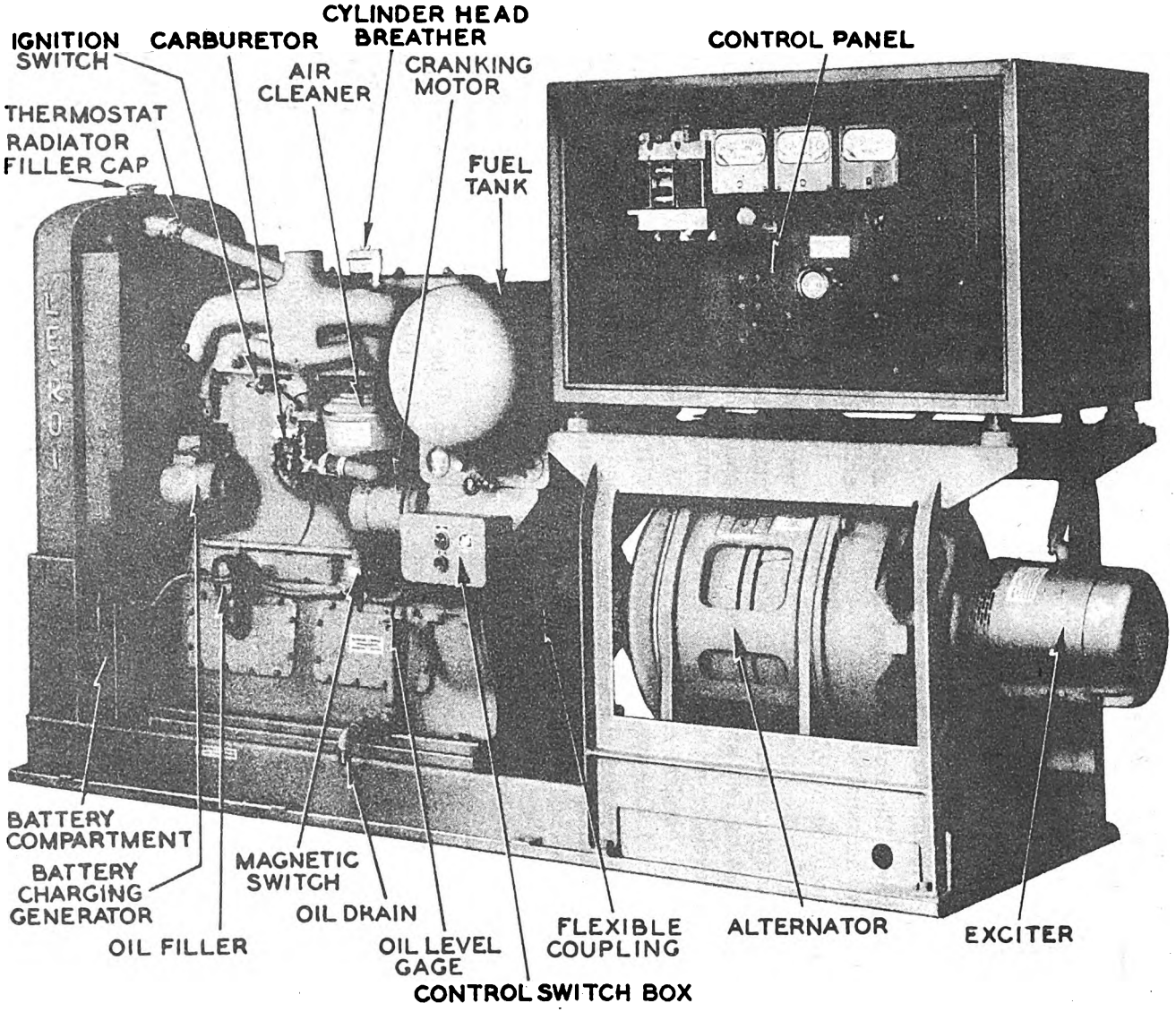


Fig. 1. Power Unit, PE-74-(*), Carburetor Side

SECTION I. DESCRIPTION

1. General Description of Power Unit.

a. Power Unit PE-74-(*)† is a portable, self-contained, gasoline-electric power plant, consisting of a four-cylinder gasoline engine, directly connected through a full metallic coupling to an alternating current generator. The entire unit, including radiator, engine, alternator, and control panel, is mounted on an electrically welded steel bedplate. A 15-gallon gasoline tank is mounted over the flywheel housing. The engine is equipped with a fuel pump for supplying gasoline to the carburetor either from this tank or from drums of gasoline which may be placed alongside the power unit. A gear-type lubricating oil pump, equipped with a renewable cartridge-type oil filter, furnishes oil under pressure to all engine bearings. Carburetion is by means of a conventional-type carburetor with the air intake passing through an Air-Maze oil-bath air cleaner and backfire arrester. Shipping weight—4460 lbs.

b. Starting is accomplished by a heavy-duty 12-volt battery and electric starting motor, with ignition supplied by a Bosch magneto. Speed is regulated by a Woodward type SGX governor. The entire unit is completely radio shielded, even to the extent of shielding the battery-charging circuit and the use of bypass condensers on the battery-charging generator. A grounding lug is located on the bedplates near the left-hand front leg of the control cabinet support.

2. Engine

a. Cooling System.
The by-pass-type cooling system is thermostatically controlled. A positive centrifugal pump circulates the water through the engine block. The water temperature is controlled by the thermostat located in the engine outlet to the radiator, which does not allow water to flow through the radiator until the engine has reached the operating temperature. With the thermostat closed the water circulates only through the engine.

b. Air Cleaner.
The Air-Maze oil-bath air cleaner is attached to the side of the cylinder block by means of a cast-iron connection. Air passes through the intake opening down into the bowl of the cleaner through a bath of oil, and then through the filter element, where the oil is removed and returned into the oil bowl, allowing clean air to pass on into the engine. The oil drained back from the screen washes the dirt away. Proper functioning of the air cleaner is important in obtaining maximum power from the engine.

c. Manifolds.
Both intake and exhaust manifolds are combined in one casting. The manifold is equipped with a water jacket and is known as a water-cooled type.

d. Oil Filter.
The replaceable cartridge-type lubricating oil filter is located on the left side of the engine. A quantity of oil is bypassed from the main circulatory system through the filter element to the crankcase. Filter elements cannot be cleaned and should be replaced every time oil begins to get black and dirty.

e. Oil Pump.
The single-stage, gear-driven pump operates

†*PE-74-(*) covers power units PE-74, PE-74-B, and PE-74-( )*

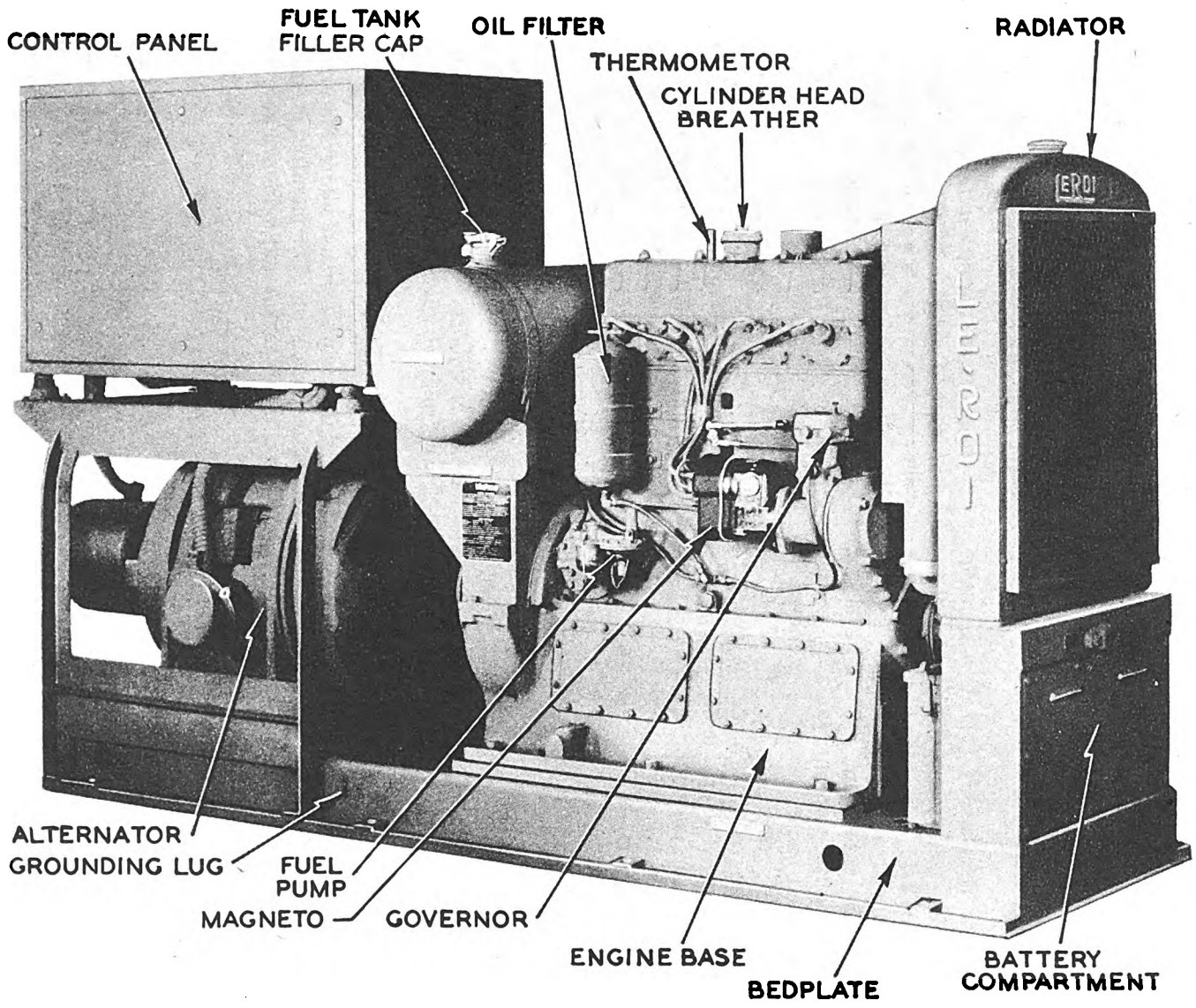


Fig. 2. Power Unit, PE-74-( ) Magneto Side

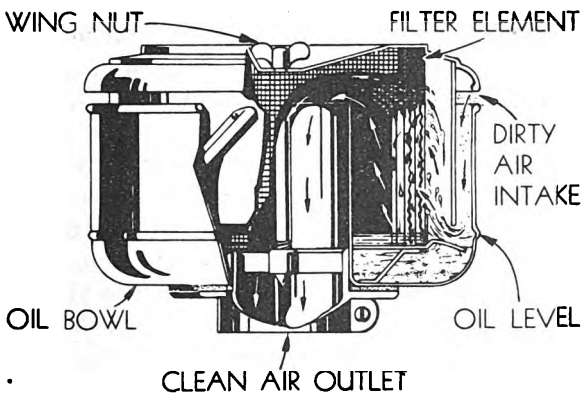


Fig. 3. Cross Section through Air Cleaner

off the camshaft, and is attached to the crankcase by cap screws. Oil travels through the screen, which strains out any large dirt particles, up through the pump body to the opening between the pump body and the crankcase, where it enters drilled passages in the crankcase. Both drive pinion and idler gear are keyed to their shafts. The upper drive gear, which meshes with the camshaft, is also keyed to the shaft.

f. Timing Gears.

The timing-gear train is accessible with the engine front cover removed. The camshaft gear operates directly off the crankshaft gear and drives the accessory shaft drive gear. These three gears must be in their proper places to have the engine timed properly.

g. Magneto.

The Bosch magneto (see Figs. 4 and 5) employs the induction principle of current generation. The coil windings ⑩ are stationary and the magnets ⑦ are rotated between laminated pole shoes ㉕ . The condenser ㉔ and interrupter ㉗ are also stationary. Brush ⑭ and the rotating track combinations are confined solely to the high-tension distributor ⑯ . Screened ventilators on either side of the housing ① and the fan action of the magnet rotor ⑦ insure constant change of air throughout the interior of the magneto. A single casting ① , the open end of which is covered by the distributor plate ⑫ and the radio shield cover ⑬ , incloses the magneto. The observation cover ⑱ on the radio shield cover ⑬ and the observation window ⑰ in the distributor plate ⑫ , plus the arrow on the distributor motor ⑯ , facilitate timing of the magneto to the engine.

(1) Impulse Coupling

The purpose of an impulse coupling is to facilitate the starting of an engine without the aid of an auxiliary ignition system.

The coupling is so designed that, when attached to the magneto, it gives the rotor a short quick turn regardless of how slow the engine is cranked. It automatically disengages when the magneto attains a speed of approximately 180 rpm and then acts as a positive drive only.

h. Cranking Motor.

(1) Function of Cranking Motor

The cranking motor electrically cranks the engine so that the engine will start and run. Current from the battery is utilized to operate the cranking motor; this current being subsequently replaced in the battery by operation of the electric generator.

(2) Bendix Drive

The Bendix drive provides meshing of the drive pinion with the engine flywheel when the cranking motor operates and demeshes the drive pinion as soon as the engine begins to operate. When the cranking motor switch is closed and the cranking motor armature begins to turn, the drive assembly, excepting the drive pinion, picks up speed with the armature. However, the pinion is counterbalanced and does not pick up speed as rapidly as the remainder of the rotating parts. The screw sleeve turns within the pinion, forcing the pinion to move endwise along the armature shaft and into mesh with the flywheel teeth. The drive spring takes up the shock of meshing. When the engine starts, the pinion is driven faster than the remainder of the assembly, causing the pinion to turn

relative to the sleeve, thus demeshing from the flywheel.

i. Magnetic Switch.

The starting switch is of the magnetic type with the control switch mounted in the automatic safety control box below the instrument panel.

j. Generator.

The generator is a machine for converting mechanical energy into electrical energy. The generator is a hinge mounted, third brush, two pole, 6-volt, 9-11 ampere (hot output) unit, with the ball bearing in the drive end and a bronze bushing in the commutator end to support the armature and driven by a pulley and V belt off of crankshaft pulley. A step-voltage control is mounted on the field frame consisting of a cutout relay and a voltage control unit. The function of the cutout relay is to close the generator-to-battery circuit when the generator is operating at charging speeds, to open the circuit when the generator slows or stops and current begins to flow from the battery to the generator. The function of the voltage control unit is to control the maximum output by inserting a fixed resistance into the field circuit.

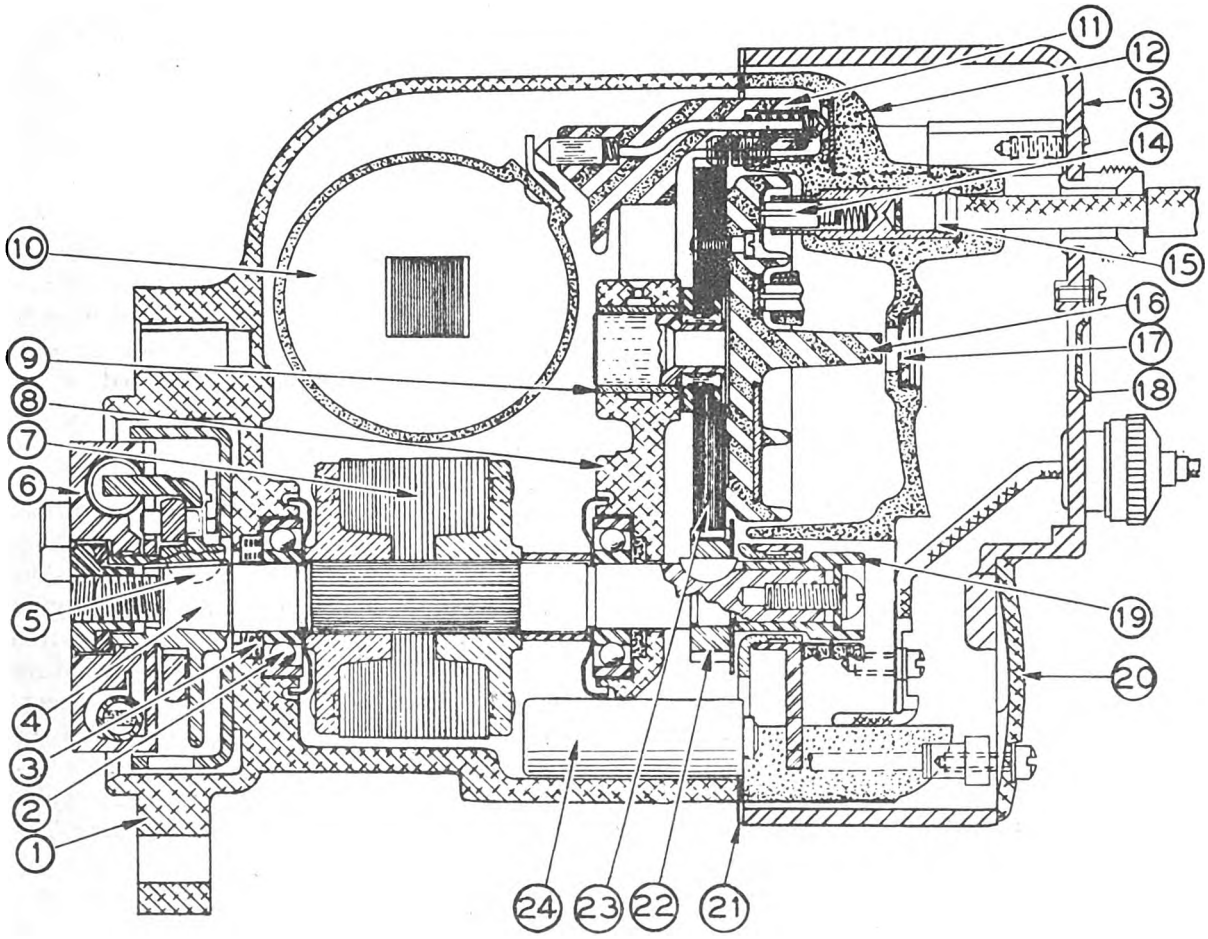


Fig. 4. Longitudinal Section through Magneto

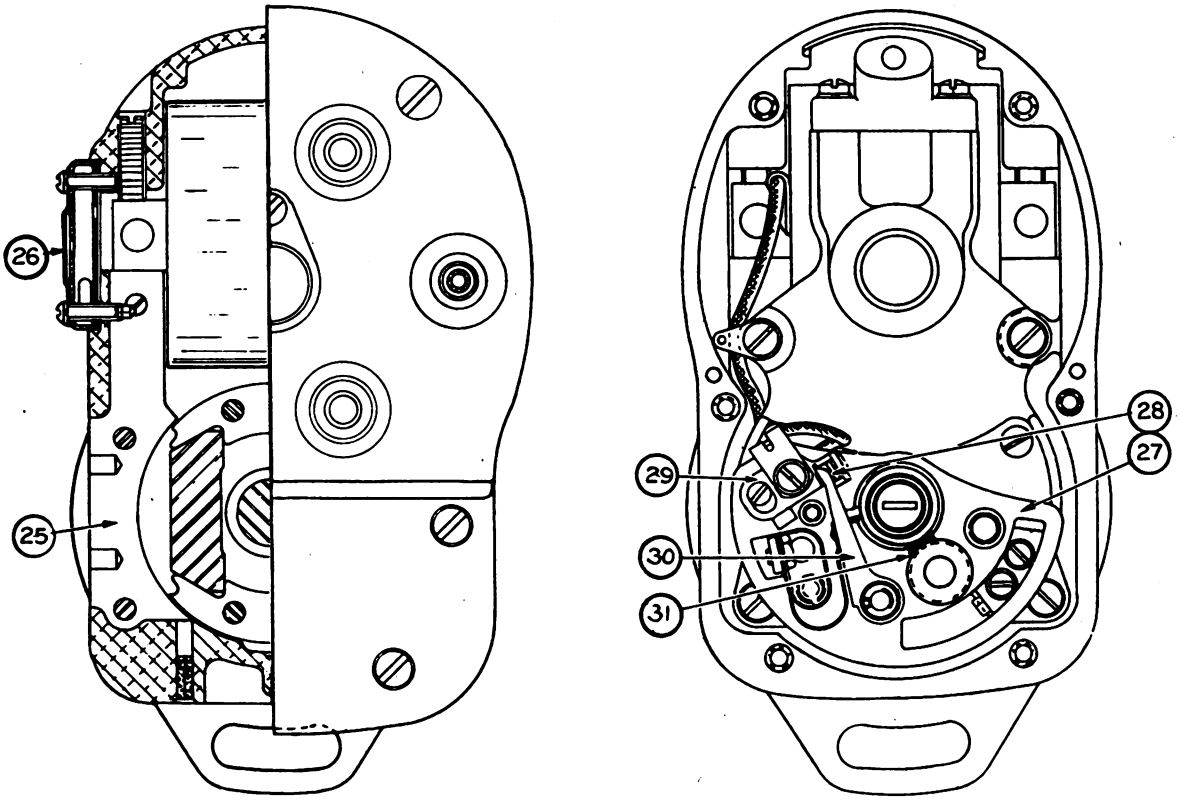


Fig. 5. Cross Sections through Magneto

k. Control Switch Box.

The purpose of these controls is to shut down the engine if the oil pressure drops below five pounds per square inch, or if the water temperature rises above 195 degrees Fahrenheit, while the engine is running.

The thermostat has a two-circuit single-throw switch which connects both of the terminals to the grounded side of the battery whenever the temperature of the water in the engine becomes too high. One of these terminals is connected to the magneto so that the magneto is shorted when the thermostat switch closes. The other terminal is connected to one side of the pilot light, which indicates that shutdown has been caused by high-water temperature. The other side of this pilot light is connected to the live side of the battery so that when the thermostat switch closes this pilot light will be lighted.

The oil pressure switch closes whenever the oil pressure drops to less than five pounds per square inch, and opens when the oil pressure rises above nine pounds per square inch.

l. Carburetor.

The general purpose of the carburetor is to discharge the desired amount of fuel into the air stream entering the engine, to atomize the fuel, and to make a homogeneous air-fuel mixture. The air-to-fuel ratio is not constant for all speeds and loads. The carburetor varies that ratio to give the best operating performance for all conditions. The carburetor has been calibrated to meter the correct amount of fuel for smooth operation throughout the operating range. The function of the carburetor cannot extend beyond the proportionate mixing of fuel and air. The carburetor throttle is equipped with a hand lever, and has only two positions, STOP and RUN. In the STOP position, the carburetor lever makes contact with a switch which serves as the grounding means for the magneto.

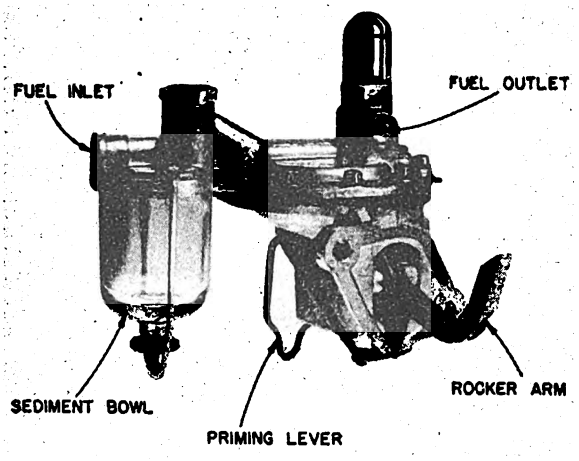


Fig. 6. External View of Fuel Pump

m. Fuel Pump.

The fuel pump is connected to the tank by a valve located beneath the tank and just behind the instrument panel. The valve which connects the fuel pump to an outside supply is located on the outside just below the instrument panel. Both of these valves should not be open at the same time, except momentarily, when shifting from one source of gasoline to the other.

n. Governor.

The governor is of the hydraulic type, using engine lubricating oil under pressure as an energy medium. It acts through oil pressure to increase fuel supply. It has a useful work capacity of about six inch-pounds over the full terminal shaft range of thirty degrees. A spring acting to cut off the fuel supply has been incorporated in the fuel control linkage. This spring should oppose the action of the governor with a total resistance of 12 inch-pounds of work for full terminal shaft travel.

3. Description of Generator.

a. General.

The alternating current generator is a three-phase, four-wire generator of the revolving field type, rated at 120/208 volts, 60 cycles, 1200 rpm, 31.25 kva at 80 per cent power factor. A direct connected d-c exciter supplies direct current to the field windings of the alternator. Both the alternator and the exciter will carry the rated full load continuously with a temperaure rise not exceeding 72 degrees Fahrenheit above the ambient temperature. Temperatures can be measured by placing a thermometer on the hottest available portion of the machine windings. Both the alternator and exciter were built and tested to withstand high-potential tests in accordance with AIEE standards. The generator field windings were tested at 1,500 volts and the other windings were tested at twice their normal rated voltages plus 1,000 volts.

The open type alternator frame is of a good grade, of cast iron and of rigid and rugged construction to withstand the vibration and jarring of transportation in a truck or trailer. The armature, of high grade laminated steel slotted to receive the stator coils, is held rigidly in place in the frame by end plates and keys. The windings are held in the slots by moisture-proof wedges. The coils are formed and insulated before winding into the slots. The wound stator is impregnated with an acid-, oil-, and moisture-resistant varnish which protects the entire winding from abrasive dust and oil, weak acid, and moisture.

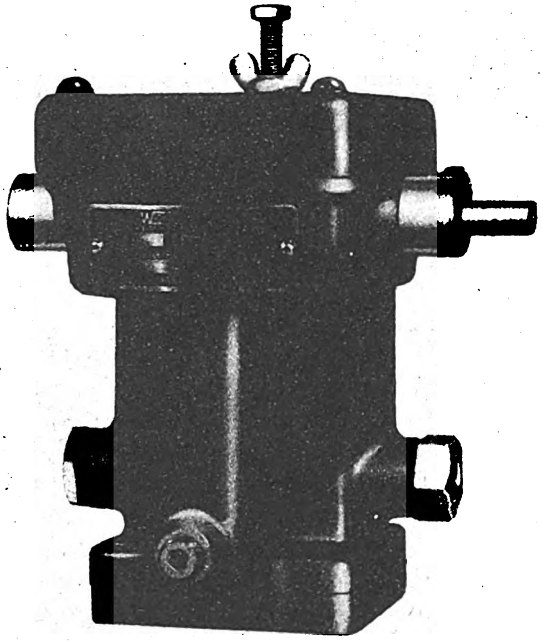


Fig. 7. External View of Governor

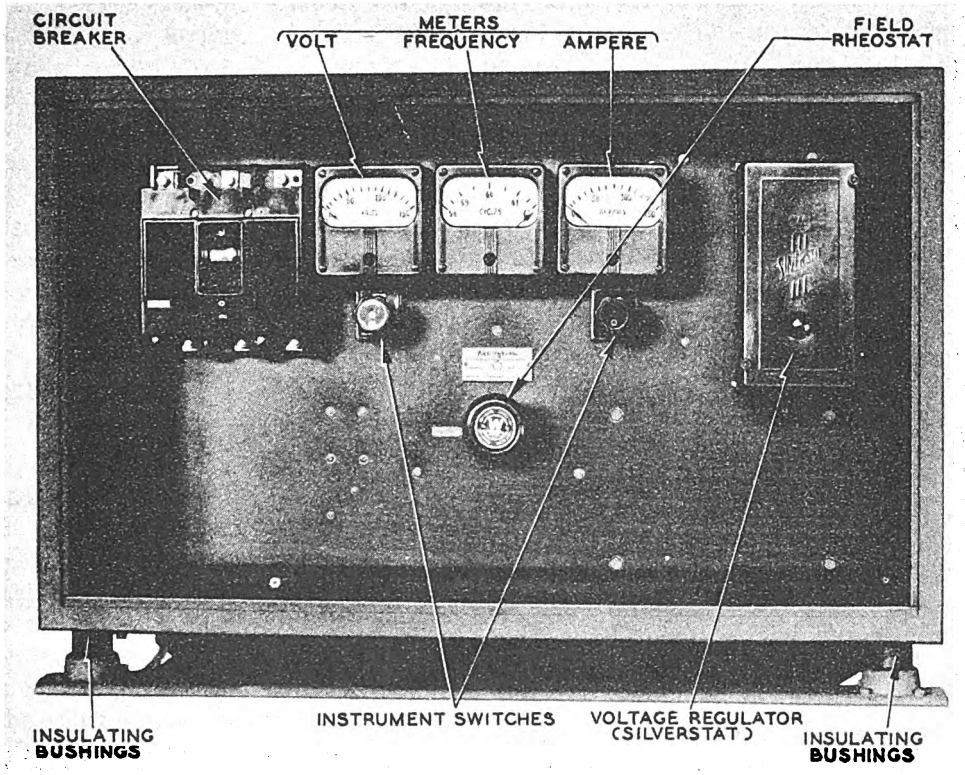


Fig. 8. Generator Control Panel Front View

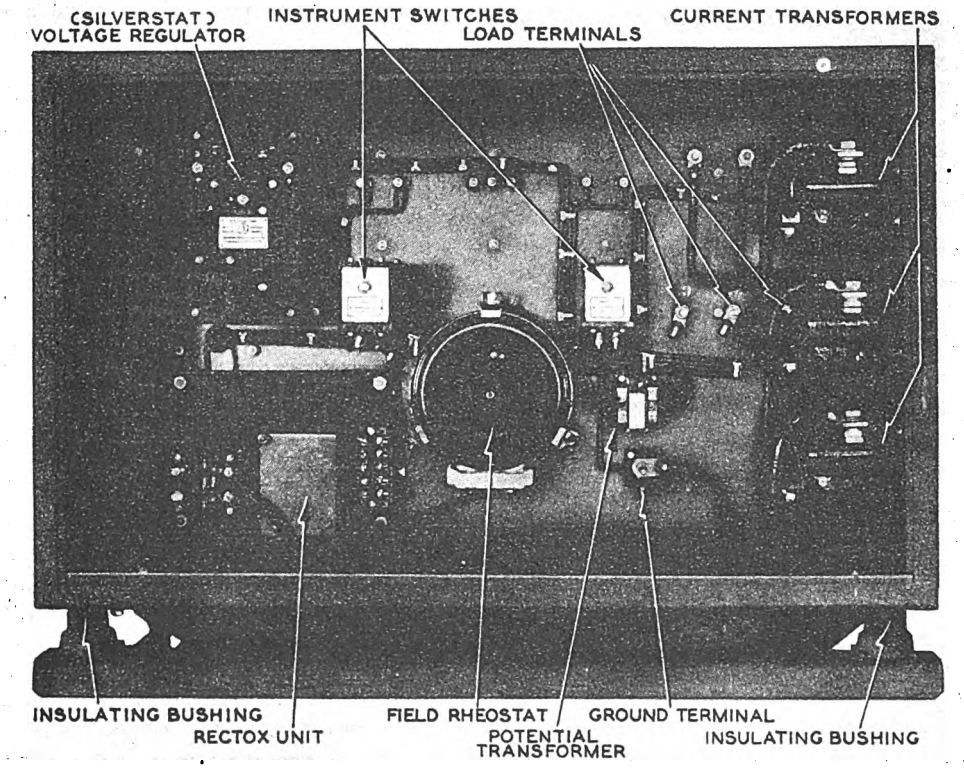


Fig. 9. Generator Control Panel—Rear View

The field coils are wound directly on the poles, each layer of the coil being well saturated with a bakelite varnish as it is wound and the final coil treated with moisture-resistant varnish. An amortisseur winding especially designed for use on single-phase generators is connected between poles.

The generator has two ball bearings designed so that adding new grease flushes out the old grease and forces it into an overflow reservoir. The bearings are suitable for coupled drive. The collector-ring brush holders, when assembled at the factory, are mounted so that the lower edge has a clearance of from one-eight to one-quarter of an inch from the collector rings. The brush holders the located so that the brushes do not override the edges of the collector rings under normal conditions (when the generator is coupled to the engine).

The rotor is dynamically balanced so that vibration, measured by a vibrometer is less than 0.003 inch when the generator is standing on a solid bedplate. When the alternator feet are resting on a level surface the shaft is on a level plane within 0.007 inch per foot of shaft length. The minimum air gap for the generator is not less than 70% of the nominal gap.

The brushes of the d-c exciter are mounted so that the lower edge has a clearance of one-sixteenth to one-eighth of an inch from the commutator surface. The commutator segments are of best quality hard drawn copper and are insulated from the shaft and from each other. The insulation between segments is undercut. All coils, leads, terminals and other connections are secured so that they cannot become damaged, displaced, or loosened by vibration. The leads from the alternator are brought to the control box and are enclosed in armored conduit. Access to the generator collector rings and to the exciter brushes can be gained through the openings in the end brackets and by removal of the exciter cover. All generator and exciter covers should be in their proper locations when the engine is being operated under load. The exciter cover is for the proper distribution of the exciter cooling air and to provide an effective shield against radio-frequency interference.

b. Control Panel.

The generator control panel contains the connections for the generator and all the accessory equipment necessary to the performance of the generator. It consists of a steel cabinet with the panel mounted in the front, an easily removable back, fixed top cover and knock-out holes in the bottom. The unit is supported on special vibration-proof fittings which, in turn, are supported by a steel frame that extends directly over the generator. All connections to external equipment are made through the knock-out holes in the bottom. The unit is shown in Figs. 8 and 9.

The front of the panel contains a voltmeter, an ammeter, a frequency meter, a generator voltage regulator, a circuit breaker, an exciter field rheostat, and transfer switches. In addition to these some power unit panels contain a panel lamp with dimming rheostat, Duplex convenience outlets, and plug fuses. The circuit breakers are fully adjusted and tested at the factory and should require no further adjustments for operation. The frequency meter and ammeter must be level for accurate operation. Schematic diagrams are shown in Figs. 105 and 106.

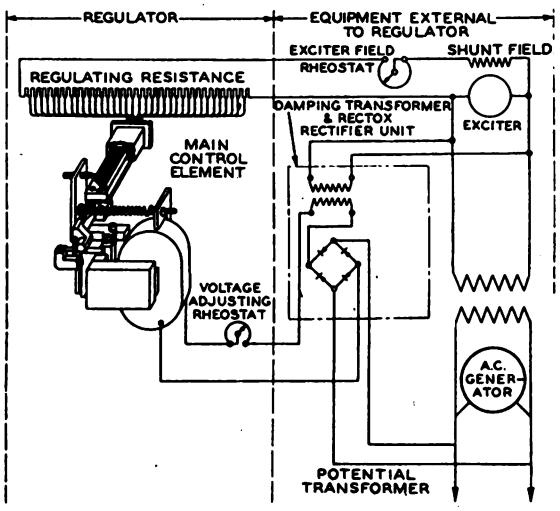


Fig. 10. Schematic Wiring Diagram of Voltage Regulator

Each pole of the circuit breaker is equipped with nonadjustable thermal and instantaneous overcurrent tripping element. The thermal element provides overcurrent protection

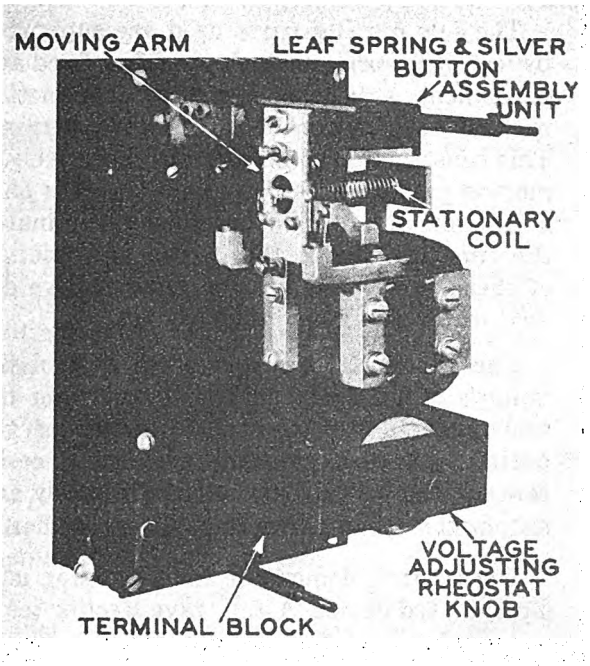


Fig. 11. Voltage Regulator with Front Cover Removed

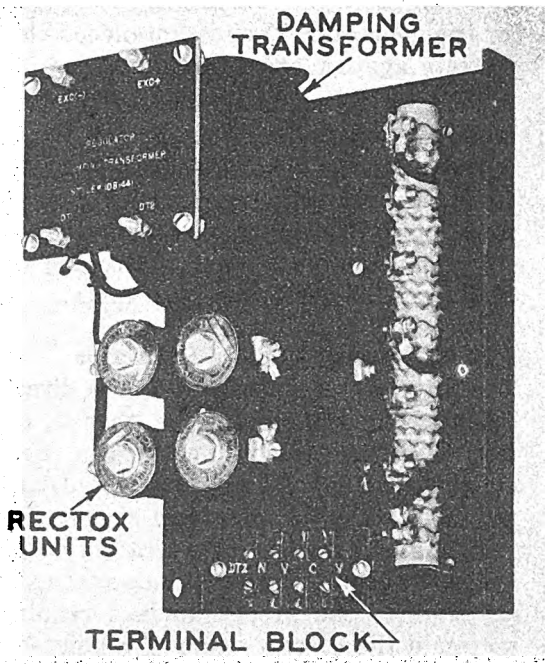


Fig. 12. Damping Transformer

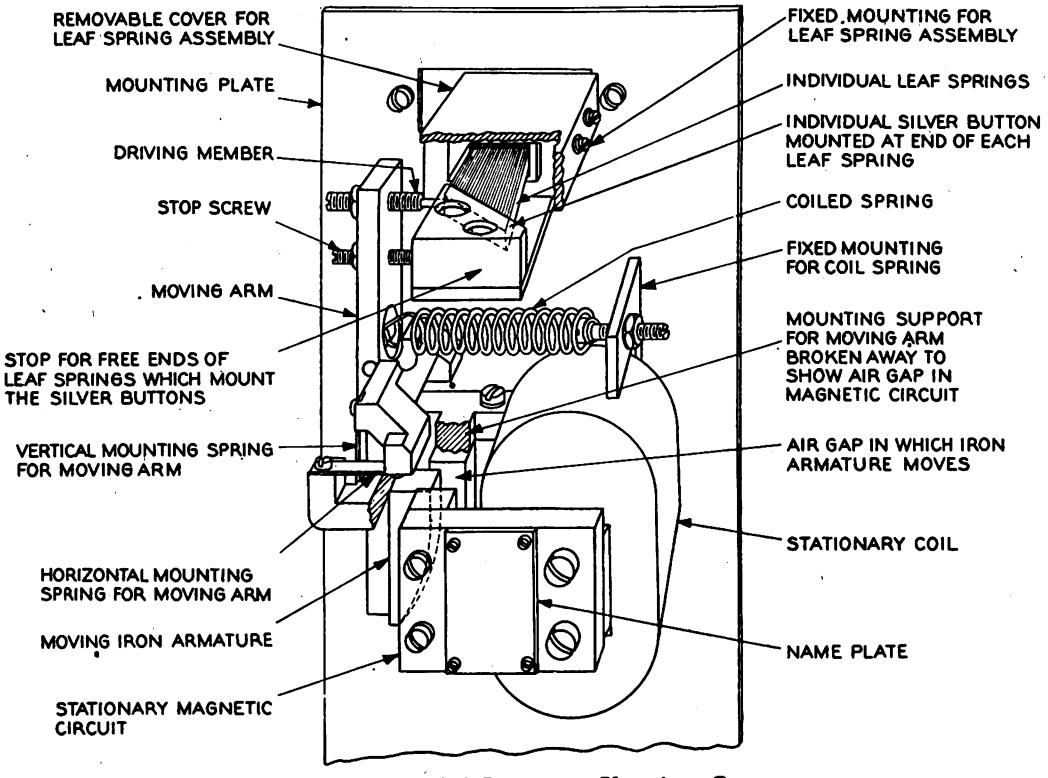


Fig. 13. Pictorial Diagram Showing Construction of Main Control Element in Voltage Regulator

for the generator. The instantaneous element protects against short circuit.

The current transformers for the line ammeter are on the rear of the panel together with the thermal boards and the protective fuses. The current transformer has a 20:1 ratio with five-ampere secondary. The wiring diagram for the unit is located on the inside of the left rear side cover.

c. Silverstat Voltage Regulator.

The Silverstat regulator is of the direct and quick acting rheostatic type, that is, correction of voltage is obtained by the regulator element varying directly the regulating resistance in the machine field circuit. The direct acting principle of operation employed keeps the regulating resistance automatically adjusted to the proper amount required to maintain the correct value of regulated voltage. The regulating resistance is entirely stationary, thus eliminating the complication involved where linkage and lever systems mechanically move the resistance assembly in order to vary its resistance, as necessary with some types of regulators.

The few moving parts used are supported by leaf type springs which provide a fixed and permanent axis that permits free action without the friction of pivots and bearings. This construction combined with light weight moving parts, whose maximum travel is only a fraction of an inch, practically eliminates the time lag due to the inertia and friction of these parts. This results in a sensitive device which functions quickly.

The type SRA a-c regulators control the voltage of an a-c generator by varying the resistance in the shunt field circuit of the exciter. In each case the regulating resistance in the field circuit is varied directly and automatically by the action of the regulator.

The control element of the regulator is a d-c operated device. A full wave Rectox (copper oxide) rectifier is interposed between the element and the a-c machine, to supply direct-current to the regulator element. Since the rectified d-c voltage is proportional to the a-c voltage, the d-c operated element of the regulator responds to changes in the a-c machine voltage.

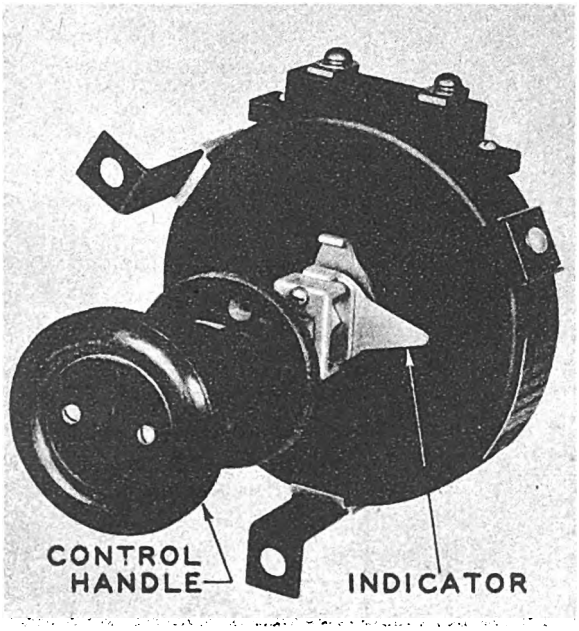


Fig. 14. Field Rheostat—Front

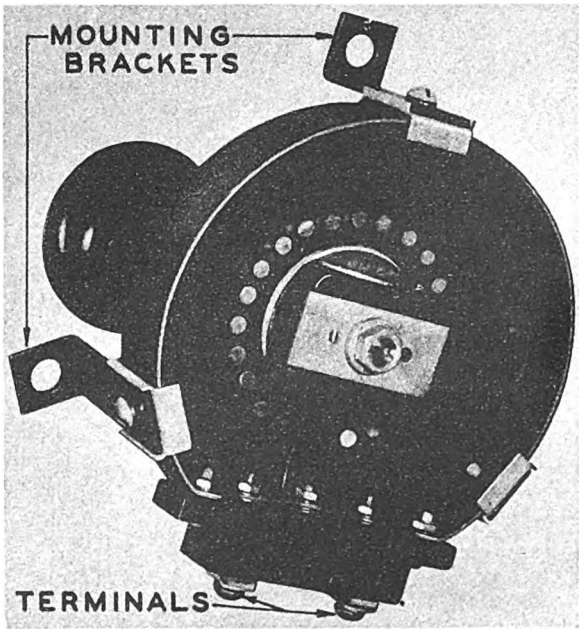


Fig. 15. Field Rheostat—Rear

SECTION II. INSTALLATION AND OPERATION

4. Installation and Preliminary Checks.

a. Extreme care should be taken in transporting and handling the power unit. The windings of the alternator especially are easily damaged. A blow on any part of the windings may be sufficient to injure the insulation and cause a coil to burn out. When the unit is unpacked, or whenever it arrives at a new site, it should be given a careful visual inspection for possible damage in transit and shipping.

b. The alternator must be protected against moisture both before and after installation. It is important that all windings be kept dry, since moisture lowers the insulation resistance and therefore increases the likelihood of a breakdown. If the unit is brought from cold surroundings to a warm room, the generator should be kept covered until its temperature has risen to room temperature. This will prevent condensation on the windings and other parts.

c. After installation of the power unit, turn the engine and generator over with the hand crank to make certain that the engine and the generator rotor turn freely. This should be done particularly if the unit is not put into service immediately after installation.

d. When the completely assembled unit is mounted in a truck or on a floor, place shims as required under each foundation bolt so that, when the bolts are tightened, the bedplate will not be distorted. If the unit is shipped in the installed position, check to see that all bolts are tight.

e. Make fuel connections to a drum of gasoline and make a good ground connection with a grounding peg. The generator connections and the connection for the d-c exciter are shown in Figs. 105 and 106.

f. Remove the muffler from its packed position and install it with the fittings supplied. These fittings may be found either mounted in place on the unit or packed in the spare parts box.

5. Checks Before Starting Engine.

a. Routine Checks.

Before attempting to start the engine, check **water, oil, gasoline,** and **battery electrolyte level.**

(1) The cooling system has a capacity of nine U. S. gallons and should be kept filled with clean water.

(2) The crankcase has an approximate capacity of seven U. S. gallons. The proper level can be checked by means of the dip stick gauge which stands out from the side of the engine below the starting motor. To check the oil level, remove the dip stick; wipe it clean; insert it slowly into the oil filler pipe (located on the carburetor side of the engine below the battery charging generator). Leave it there for two or three minutes before withdrawing it for a reading. The oil should reach the FULL mark.

(3) Gasoline is supplied from an external drum (capacity 55 U. S. gallons) and from a 15-gallon tank located just above the flywheel. Check these to see that there is a sufficient supply of gasoline for running the engine.

(4) Examine the battery to see that the level of the electrolyte is approximately one half inch over the top of the plates.

b. Additional Checks for New or Idle Engine.

(1) Remove the spark plugs and pour about two tablespoonfuls of a mixture of half oil and half gasoline into each cylinder to furnish lubrication to the pistons and cylinders.

(2) After connecting the fuel supply, prime the fuel pump and carburetor by manipulating the priming ball which will be found un-

FREEZING POINT		ANTI-FREEZE SOLUTIONS					
		METHYL ALCOHOL		ETHYL ALCOHOL		ETHYLENE GLYCOL	
CENT.	FAHR.	SPECIFIC GRAVITY	PER CENT BY VOLUME	SPECIFIC GRAVITY	PER CENT BY VOLUME	SPECIFIC GRAVITY	PER CENT BY VOLUME
-7°	20°	.9822	12.5%	.9796	16.5%	1.022	16.5%
-12°	10°	.9726	20.5%	.9704	25.5%	1.034	25.5%
-18°	0°	.9638	28%	.9611	33.5%	1.044	33.5%
-23°	-10°	.9560	34.5%	.9511	40.5%	1.051	39%
-29°	-20°	.9493	39%	.9392	47.5%	1.058	44%
-34°	-30°	.9421	44%	.9244	54.5%	1.062	47.5%
-40°	-40°	.9358	47.5%	.9068	63%	1.064	51.5%

Fig. 16. Anti-freeze Solution Chart

derneath the fuel pump. If the glass filter bowl on the fuel pump shows any amount of water and dirt, it should be removed, cleaned, and replaced, making sure that the edges of the bowl fit evenly and tightly against the cork gasket.

(3) Grease the water pump by turning down the grease cup.

c. Additional Checks before Starting in Cold Weather.

If the power unit is to be operated in temperatures of 32 degrees Fahrenheit or lower, observe the following precautions:

(1) Use only high-test winter-grade gasoline and keep the supply tightly covered so that the more volatile portion does not evaporate.

(2) At the end of each day's run, fill the gasoline tank to prevent moisture from collecting in the tank.

(3) Use the correct grade of lubricant in the crankcase and air cleaner. (See paragraph 39).

(4) Drain the cooling system of water at the end of each run, or use one of the recommended antifreeze solutions shown in Fig. 17. To drain the cooling system, open the drain cocks in the lower radiator connection, manifold, and cylinder block (located beneath the carburetor). See that drains are not plugged and that the water drains completely.

(5) During freezing weather, cover the entire radiator, fill with cooling solution, and start engine.

(6) If starting the engine is difficult in cold weather, it may be necessary to pour a small quantity of gasoline into each cylinder through the spark plug holes. Wait a few minutes, in order to vaporize the gasoline before turning on the switch which starts the engine.

6. Starting the Power Unit.

a. See that the mechanism of the circuit breaker on the generator control panel operates freely by manually throwing the handle up and down a few times before starting the engine. The breaker is closed when the handle is inclined toward the ON marking. Throwing it toward the OFF marking will cause the operating mechanism to snap the contacts open. The engine should not be started under load. The circuit breaker must therefore be thrown to the OFF position before starting the engine.

b. Open the valve to the 15-gallon gasoline tank. Close the valve to the external drum.

c. Move the shaft lever on the carburetor to the RUN position.

d. Pull out the choke knob on the engine instrument panel.

e. Push the STARTER button on the safety control box until the engine fires. If the engine does not start immediately, push in the choke control and continue turning over

the engine with the starter until it fires. Do not operate the starter continuously for longer than thirty seconds without allowing the cranking motor to cool.

f. As the engine warms up, push the choke rod gradually in.

Caution. If the choke control rod is left out, an excess of raw fuel will be drawn into the cylinders, resulting in dilution of the crankcase oil, or possible stopping of the engine, owing to an over-rich mixture.

If the engine has been standing idle for some time, it may be necessary to push the control rod on the governor toward the radiator in order to hold the governor throttle partly open. The governor control rod will be found on the left side of the engine.

g. When the engine has started and is running at rated speed, observe all the engine instruments and general operating conditions to make sure that each element is performing its required function. (As soon as the oil from the engine builds up enough pressure to operate the governor, the governor regulates itself and maintains correct engine speed.)

h. After the engine warms up, switch from the 15-gallon tank to the external drum for fuel supply.

i. When the engine has warmed up sufficiently, throw the circuit breaker on the generator control panel to the ON position. This connects the generator to the external load and the ammeter will read the load current, as load is applied.

To read the current in each phase, the ammeter transfer switch can be turned to each of its three positions. This switch should be left in the position reading the highest current. The generator should not be made to deliver more than the rated current on one phase, even though the other phases are not fully loaded. The voltage from any phase to neutral may be read by turning the voltmeter switch to its three position. (A reading of 120 volts from phase to neutral indicates 208 volts from phase to phase.)

The breaker will trip automatically on overload or short circuit. When it opens, the handle moves to the midposition between OFF and ON. The breaker may be reset by moving the handle to the OFF position in order to reset the latch, and then moving it to the ON position in order to close the contacts. Overload tripping is initiated through a bimetallic thermal strip which deflects and actuates the trip mechanism when the strip is heated by the overcurrent. The breaker, also, has an instantaneous magnetic trip mechanism for rapid operation on short circuits.

j. After throwing the breaker ON, the voltage regulator should be adjusted for stability and operation.

k. In order to transfer the generator from the automatic voltage control supplied by the regulator to hand control of voltage, proceed as follows: With the generator running, turn the exciter field rheostat slowly, until the voltage begins to fall. The voltage-adjusting rheostat should then be turned to increase the resistance. The regulator is then out of the circuit and the voltage may be controlled by the exciter-field rheostat alone. To return to regulator control, turn the voltage-adjusting rheostat back to its normal position slowly, and slowly turn the exciter rheostat back to its normal setting. The regulator will again operate automatically.

7. Stopping the Power Unit.

a. Turn OFF the circuit breaker switch on the control panel.

b. Move the shaft lever on the carburetor to the STOP position. This cuts off the fuel supply to the carburetor and grounds the magneto.

c. If the power unit is to be left shut down for any length of time, shut off the fuel supply and drain the carburetor bowl. When the unit is to be moved to a new position, however, it is best to allow the fuel to remain in the carburetor.

SECTION III. MAINTENANCE

8. General.

a. Daily (After 24 Hours' Service).

(1) See that only clean fuel is put into the tank from a clean container.
(2) Keep the radiator full of clean cooling liquid.
(3) Turn the water-pump grease cup down until it is snug. When it is empty, refill it with high-temperature ball-bearing grease.
(4) See that the oil is up to the FULL mark on the dip stick. Use oil as recommended.
(5) Keep the cylinder head and crankcase breathers free from dirt. When necessary, remove, wash in gasoline, and dry thoroughly and then replace.
(6) Check the air cleaner, and maintain the oil level to bead.

b. Weekly (After 150 Hours' Service).

(1) Check the spark plug and magneto point gaps. (See paragraph 26.)
(2) Lubricate all the accessories: battery charging generator, starting motor, etc.
(3) When the lubricating oil becomes badly discolored or diluted, it is an indication that the oil requires changing; the interval between oil changes depends entirely upon operating conditions and the quality of oil used. Renew oil-filter element.
(4) Valve adjustment should be checked to guard against low compression, which means loss of power. The clearance between the valve stems and the push-rod adjusting screws should be 0.015 inch when hot, and 0.018 inch when cold. Do not set too close, as this causes burned and warped valves.
(5) Check adjustment of the fan belt. The fan belt should be kept tight enough at all times to prevent slippage. (See paragraph 9.)
(6) Inspect and tighten any nuts that may have worked loose on the cylinder head and cylinder block.

c. Monthly (After 600 Hours' Service).

(1) Test the compression by cranking the engine over slowly on each compression stroke.
(2) Should the engine turn over easily on all cylinders, showing poor compression, the cylinder head should be removed and the valves reground. If one or two cylinders only lack compression, carefully inspect the valve and tappet clearances on these cylinders before removing the head. Insufficient valve clearance will cause burned valves and lack of compression.
(3) If valves are pitted, regrind them. (See paragraph 22.)
(4) The oil pan or sump should be thoroughly cleaned, removing all traces of sludge.
(5) Remove the oil-strainer screen from the oil pan and wash in gasoline.
(6) Remove coupling guard, check the coupling, and tighten nuts if necessary.

d. Semiannually (After 3,000 Hours' Service).

The entire engine should receive a thorough general inspection by a competent mechanic.

9. Cooling System.

Capacity—U. S. Gal.	9
Type	Flat Tube
Thermostat Opens	160° F.
Water Pump Drive	V Belt
Water Pump Fan Belt. Tension Adjustment	Turn one flange of pump pulley

a. Operation.

Positive centrifugal pump circulates water in closed system between engine block, cylinder

head and radiator. Temperature is controlled by thermostat, by-pass type, located in engine outlet hose connection. Path of water circulation when engine is cold is from radiator bottom up through pump, through engine block, up to cylinder head and out into thermostat, through thermostat and by-passed back into pump. Any water escaping into radiator is made up from supply at bottom of radiator. This circulation during warm up period prevents formation of steam pockets. The thermostat opens at 160° and when open, the by-pass is closed and water is circulated thru the radiator. Temperature controls the opening of thermostat which controls amount of water recirculated through pump and also amount of cooler water added from radiator.

b. Cleaning out Dirt and Sludge.

(1) Drain the cooling system by opening the drain cocks in the lower radiator connection, in the cylinder block, and in the manifold. Allow the system to drain and close the cocks.
(2) Fill the cooling system with a solution of two and one half pounds of ordinary washing soda mixed with nine U. S. gallons of water (cooling system capacity).
(3) Leave the radiator filler cap off and run the engine until the water is hot; then drain and flush the system with clean water.
(4) Refill with clean water.

c. Radiator Core.

Overheating is often caused by bent or clogged radiator fins. If the spaces between the fins become clogged, clean them with an air hose. When straightening bent fins, be careful not to injure the tubes or break the bond between the fins and tubes.

d. Adjusting Fan Belts.

Adjust the tension of the fan belt by changing the width of the groove in the fan pulley. To decrease the width of the pulley grooves loosen the lock nut and screw the pulley flanges together; to increase the width, screw the flanges apart. Retighten the lock nut after correct tension is obtained. Use special spanner wrench No. 88-252 to turn flanges. To adjust the generator drive belt, loosen bracket, and move generator outward, away from the engine, until proper tension is secured.

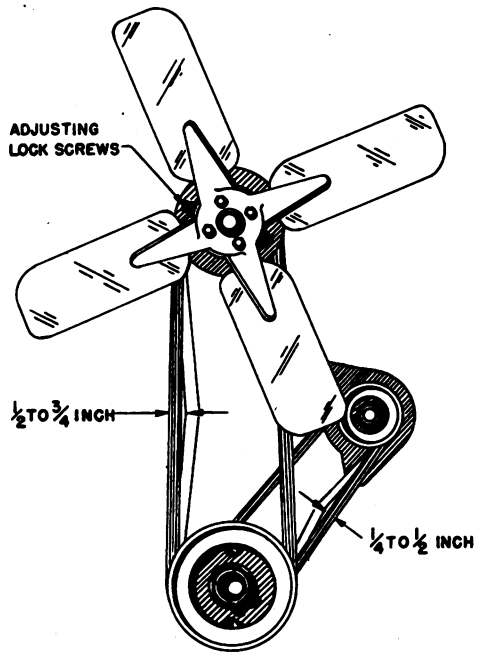


Fig. 17. Correct "V" Belt Tension

After adjustment is obtained tighten the bracket securely.

When properly adjusted, belts must be slack enough to permit deflection by amount shown in Fig. 17 without appreciable pressure. Do not adjust belts too tightly.

e. Removing the Generator Belt.

To remove the generator belt, loosen the bracket and move the generator inward to engine until the belt can be slipped off the pulley. The fan belt must be removed before the generator belt can be removed.

f. Removing the Fan Belt.

To remove a fan belt, loosen the lock screws in the fan pulley hub and move the flange out as far as possible. Start the belt over the outer flange of the lower pulley and pry it out with a light bar or rod. Slowly crank the engine at the same time and the belt will work off the pulley.

g. Replacing Fan Belt.

The fan belt should be replaced with a new

one when it becomes soaked with grease, or when it becomes so badly worn that it does not drive the fan at the proper speed. When replacing the belt, reverse the procedure outlined under paragraph 9f, above. The belt can be started on the lower pulley by hand, and will find its correct position if the engine is cranked slowly. Adjust to proper tension.

10. Water Pump

a. Description.

Fan blade is secured to fan pulley by four cap screws. Fan pulley is secured to water pump shaft by means of a pin. Impellor is pressed onto water pump shaft. Water pump shaft is mounted in bronze bushings. Sealing is accomplished by means of a carbon sealing washer held in contact with a shoulder and a rubber bellows and spring which automatically takes up normal wear preventing leakage. Due to wear after considerable service the pump may leak and when this occurs the pump must be removed and dismantled and carbon sealing washer and bellows replaced.

b. Removal.

To remove water pump the following steps should be followed:

(1) Drain radiator and cooling system.
(2) Release tension on fan belt and remove.
(3) Remove hose connections at water pump.
(4) Remove cap screws holding water pump to water pump bracket and remove pump.

c. Disassembly. Refer to Fig. 18.

(1) Remove fan.
(2) Drive pin (481) out of hub or pulley.
(3) With gear puller pull fan hub or pulley (480) off of shaft.
(4) Draw impellor (478) with shaft (475) out of pump.
(5) Press pump shaft (475) out of impellor (478).
(6) Upon reassembling make certain that driving lugs of carbon seal are engaged in slots in impellor before pressing impellor on shaft.
(7) Upon reassembling shaft with impellor into pump body it will be necessary to align thrust ring (472) with bushing and flat surface of shaft. (Note No. 5A13-360-1 water pump does not have thrust ring.)

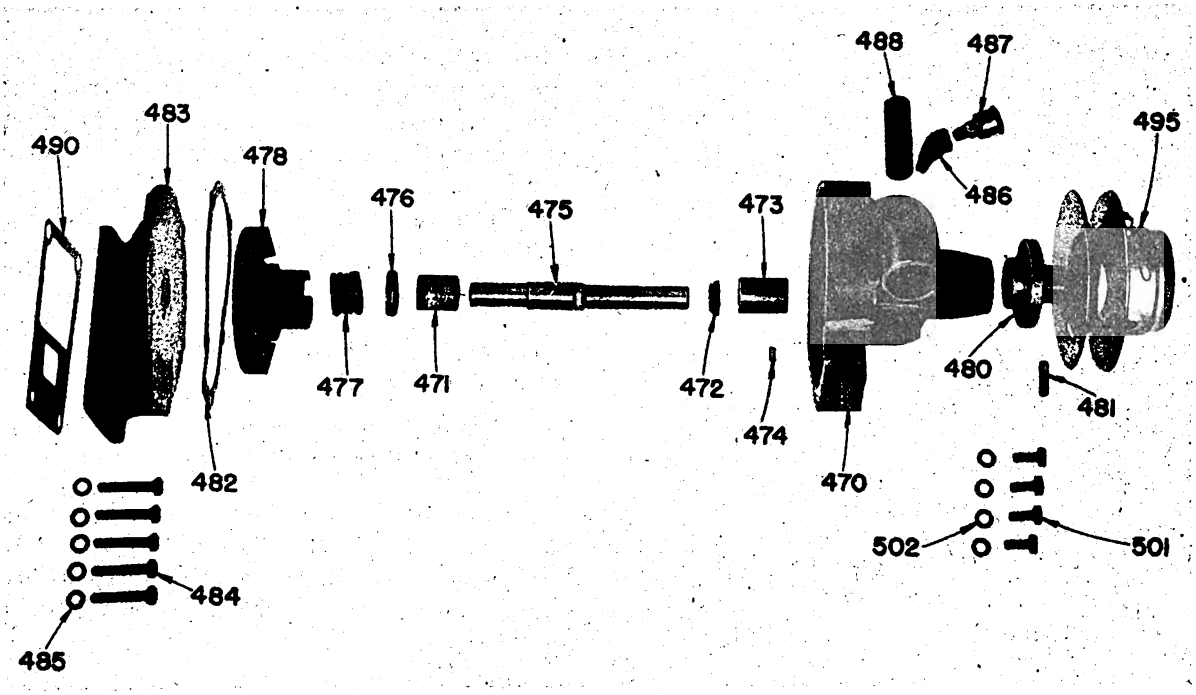


Fig. 18. Component Parts of 1A13-360-1 Water Pump

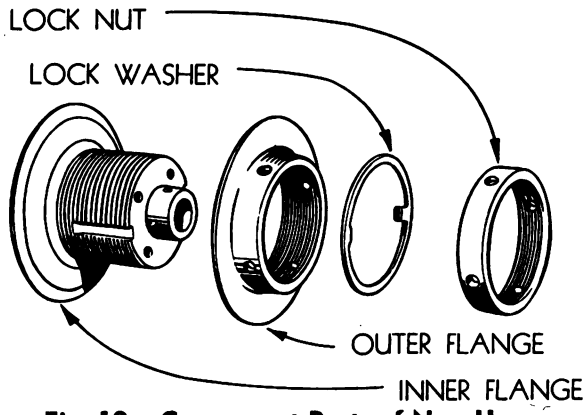


Fig. 19. Component Parts of New Heavy Duty Water Pump Pulley

(8) Service bushings are reamed to size. However, the bores should be checked after bushings are installed. In No. 1A13-360-1 Water Pump, diameter should be .753" for front bushing. .875" for rear bushing. Running clearance for both is .0015" to .0035". In No. 4A13-360-1 Water Pump, bushing diameter should be .8765" both front and rear, with running clearance of .0015" to .002".

(9) Gasket between pump and bracket should be replaced whenever pump is dismantled.

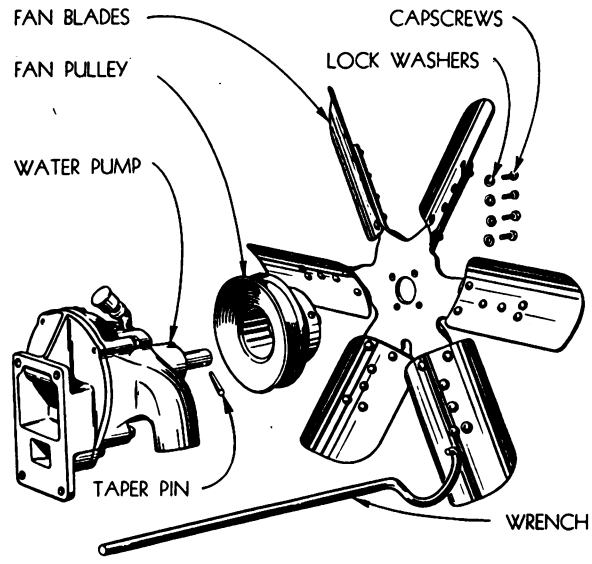


Fig. 20. Water Pump with New Pulley and Fan

11. Air Cleaner.

The air cleaner is attached to the side of the cylinder block by means of a cast-iron connection. Air passes through the intake opening down into the bowl of the cleaner through a bath of oil and then passes through the filter element, where the oil is removed and returned into the oil bowl, allowing clean air to pass on into the engine. The oil drained back from the screen washes the dirt away.

The oil bowl should be removed daily and checked for dirt accumulation. Cleaning is accomplished by removing the oil bowl and dumping out the dirty oil. Rinse the bowl in fuel oil or gasoline, dry thoroughly, refill with clean oil to level of bead, and reassemble. It is important that the oil level be maintained at all times.

Periodically, depending upon operating conditions, the entire filter unit should be dismantled and cleaned thoroughly.

12. Manifolds.

Make certain that all connections and holddown studs are tight at all times to prevent water leakage.

13. Oil Filter.

The oil filter is located on the left side of engine. A quantity of oil is bypassed from the main circulatory system through the filter element to the crankcase. Filter elements cannot be cleaned and should be replaced every time the oil begins to get black and dirty. Filter service operations are as follows:

a. Stop the engine.

b. Remove the drain plug and allow the filter to drain.

c. Remove the top cover assembly by unscrewing the bar handle capscrew.

d. Remove and discard the used refill cartridge. Inspect the bottom support plate and top of case. Clean thoroughly to insure complete seal when a new refill cartridge is inserted.

e. Flush the filter, using regular motor flushing oil or kerosene.

f. Replace the drain plug.

g. Place the new refill cartridge in the case.

h. Clean the hold-down plate and the gasket in top cover thoroughly. If the gasket has become hard, replace with a new gasket or place in hot water (200 degrees Fahrenheit) for ten minutes to restore resilience.

i. Replace the top cover assembly by placing the cover on the clarifier, and screw the bar-handle capscrew down tightly.

j. Check the oil level in engine crankcase.

k. Run the motor for at least ten minutes; then check all fittings and cover for leaks.

l. Add oil, if necessary, to bring crankcase up to the proper level.

14. Oil Pump.

a. Description.

The oil pump is See fig. 21 located between fuel pump and bellhousing on Magneto side of engine. It is a single stage gear driven type operating off camshaft and is attached to crankcase by cap screws. Oil travels through the screen (144) which strains out the large particles, up through pump body (130) to opening between pump body and crankcase where it enters drilled passages in the crankcase. Both drive pinion (134) and idler gear (141) are keyed to their shafts (132), (139). Upper drive gear (137) (which meshes with camshaft is also keyed to shaft.) Oil Pump screen should be cleaned of sludge and foreign particles whenever oil pan is removed.

b. Disassembly.

Remove five cap screws holding cover (147) to crankcase and withdraw oil pump assembly out thru hole in crankcase. Drive gear (137) is pressed onto shaft (132) and may be removed by driving out pin (138). Remove wire (145) and screen (144) to service lower portion of pump. Remove cap screws holding cover (143) to pump body (130). Drive shaft with gear (134) may now be removed from pump body. To remove gear from shaft, remove lock ring (135) with screwdriver and push shaft out of gear. **Note:** Driven shaft (139) and gear (141) are removed and dismantled in a like manner. **Caution:** All gears are keyed to shafts—be

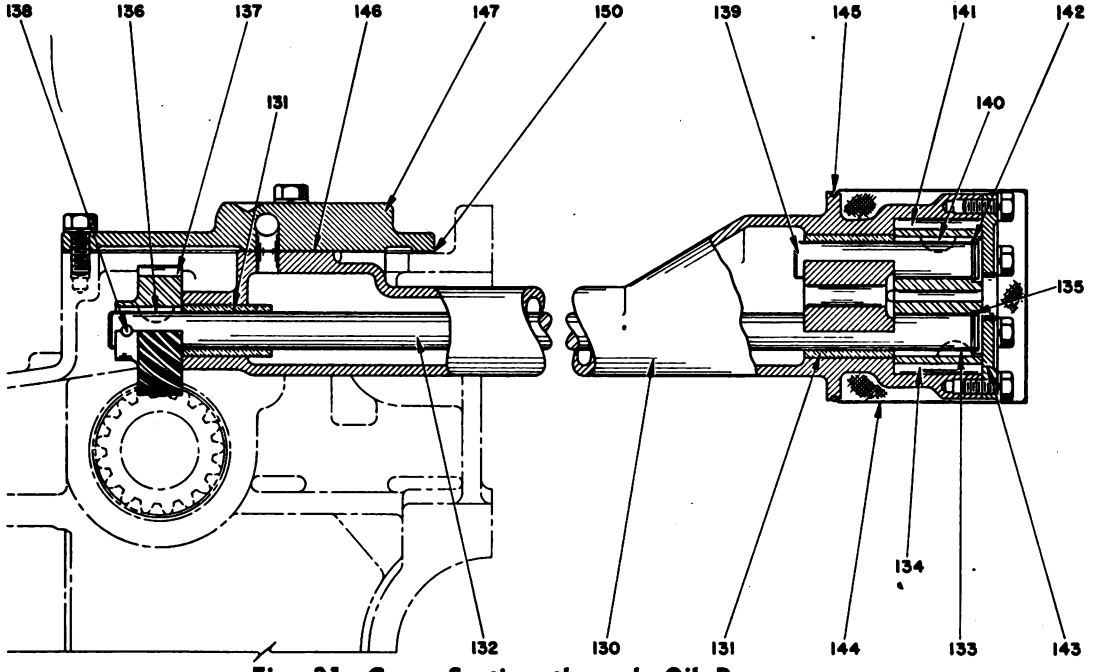


Fig. 21. Cross Section through Oil Pump

sure not to damage keyways in dismantling; also make certain keys are in place when reassembling.

c. **Reassembly.**

Special Note: If either gears (134) or (141) are to be serviced they must be replaced in pairs. Install gear (141) onto shaft (139) and lock in place—install shaft assembly into pump body. Install gear (134) onto shaft (132), lock in place and install in pump body. Replace cover (143) and invert pump body to install drive gear (137) making certain pin (138) is in place. Replace screen over lower end of pump and wire in place. **Note:** If screen (144) is damaged, it should be replaced.

Insert pump assembly thru crankcase opening and install capscrews holding oil pump in place.

15. Timing Gears.

For correct timing of the engine the three timing gears must be in their proper places. The timing gear is accessible with the front cover removed. The camshaft gear operates directly off the crankshaft gear and drives the accessory shaft drive gear. Before installing the camshaft gear, make certain that the timing marks are aligned as illustrated in Fig. 22.

Before meshing the accessory shaft drive gear it is necessary to turn the crankshaft until the impulse mark on the flywheel is aligned with the dead center mark on bell housing when the No. 1 cylinder is in firing position. To get the No. 1 cylinder into firing position turn the engine over until the No. 4 exhaust valve just closes, which will bring the flywheel markings (Fig. 23) into position. After the crankshaft is in position as described, move the accessory shaft-drive gear until No. 1 impulse fires; then move the gear back approximately one quarter turn and mesh the gears without further movement. After installation is made, it is best to check position by removing the No. 1 spark plug and reconnecting the wire. Ground the plug but do not install it in the cylinder head. Rotate the flywheel toward impulse position. The spark plug should fire as the flywheel is moved in the direction of rotation as impulse mark is reached. If the plug does not fire in this position, the magneto will have to be rotated on its flange mountings. Make certain that the magneto flange capscrews are tightened securely after the proper setting is reached. If the proper setting cannot be obtained by flange adjustment, accessory shaft-gear position will have to be reset.

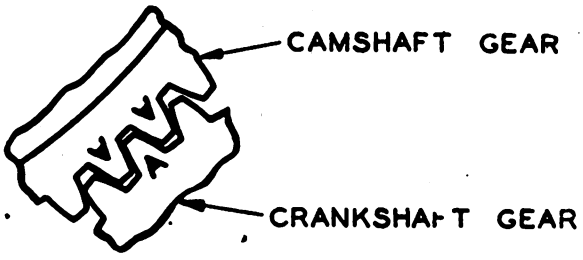


Fig. 22. Timing Gear Marks

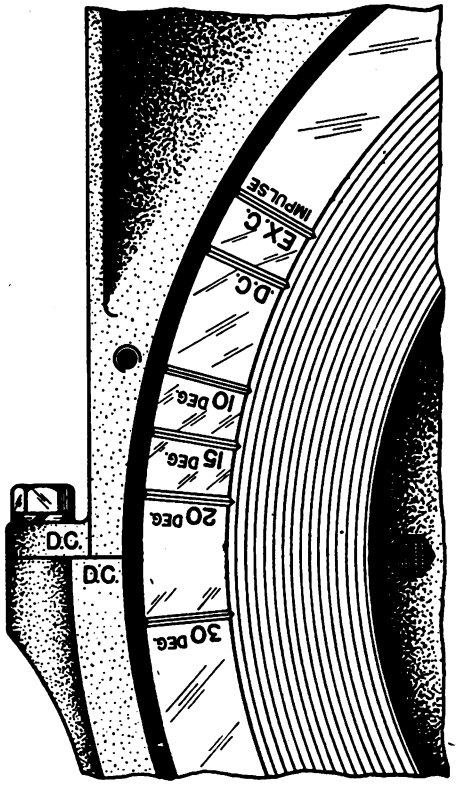


Fig. 23. Flywheel Timing Marks

The engine front gear cover can be removed, after taking off the cranking jaw and fan drive pulley. Care should be taken not

to damage the oil seal when the cover is removed. In replacing the engine front cover make certain that the oil seal and gaskets are in good condition. If damaged in any way, replace. (See paragraph 20 b.)

16. Cylinder Sleeves.

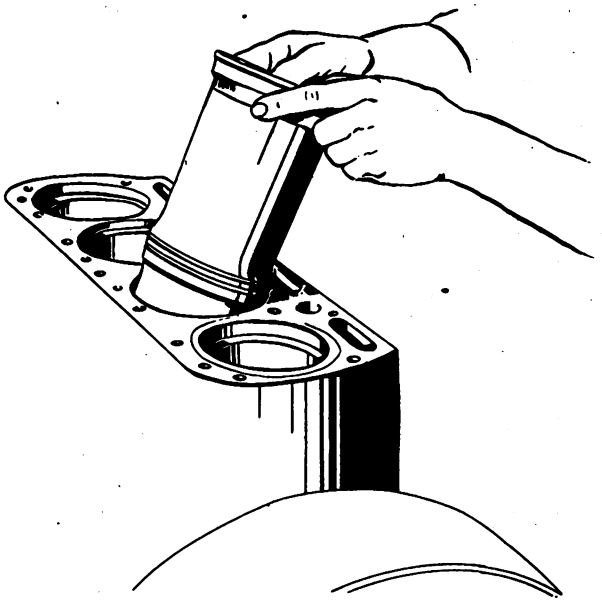


Fig. 24. Installing Cylinder Sleeves

Wet-type cylinder sleeves do not fit as tightly as dry-type sleeves, and can be driven out by using a block of hard wood and a hammer. The lower ends of the sleeves fit into rubber sealing rings. The cylinder block should be cleaned thoroughly at this point and the upper contact point before the sleeves are inserted. Clean the sleeves thoroughly at the contact points and place the rubber rings in position in the cylinder block, covering them with a thin coat of soft soap. Set the sleeve in the bore of the cylinder block with seal ring grooves down and drive the sleeve into position with a hard wooden block. To avoid damage to the rubber sealing rings, care should be taken to drive the sleeve down straight into the block. Carelessness might result in a water leak in the crankcase. When the cylinder sleeve is in place the top will project approximately 0.005 inch above the top surface of the cylinder block. This permits the cylinder head to clamp the cylinder-head gasket tightly against the top of the sleeve, holding it in place and sealing it at the upper end. Because of the removable sleeve construction of this engine, oversize pistons and rings are not necessary. When appreciable wear occurs, new standard-size parts should be installed.

17. Cylinder Head.

a. Removal.

Remove the water connections, manifold, cylinder head cover, oil lines, and rocker-arm mechanism. Disconnect spark-plug wires, carburetor and accessories. Withdraw the push rods and remove the cylinder head stud nuts and lift off the cylinder head. Valve seat inserts are standard for exhaust valve ports and minimize valve regrinding.

b. Replacing.

Before replacing the cylinder head make certain that the surfaces of the cylinder block and head where the gasket rests are absolutely clean. It is important to tighten the cylinder head securely whenever it is replaced. This must be done carefully to prevent damage to the copper-asbestos gasket

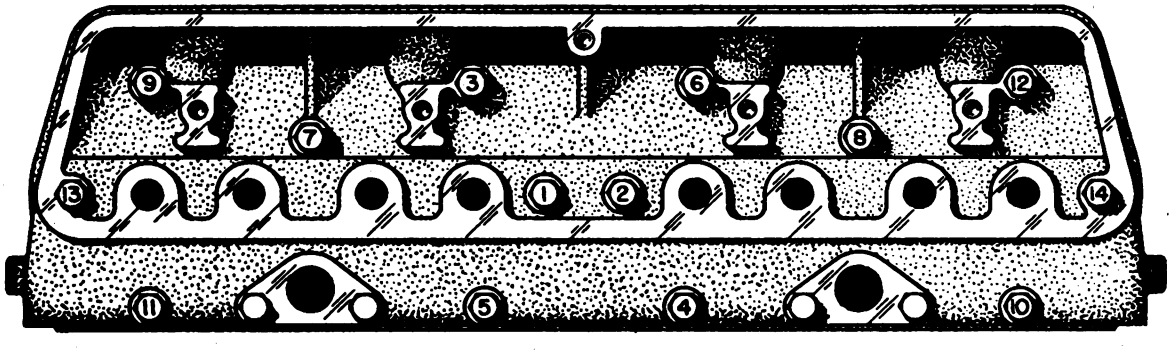


Fig. 25. Cylinder Head Stud Nut Tightening Sequence

between the cylinder head and the cylinder block. When installing the cylinder-head gasket place it on the cylinder block with the beaded side up. For correct sequence in tightening cylinder head stud nuts, refer to Fig. 25. The cylinder-head stud nuts which are tightened when the engine is cold must be retightened when the engine is hot.

18. Piston Assemblies.

Piston Rings:	
Total required	4
Compression	3
Oil control	1
Width, compression	5/32"
Width, oil control	3/16"
Gap, compression	0.010" to 0.020"
Gap, oil control	0.010" to 0.018"
Piston clearance	0.005" to 0.007"
Piston Pin:	
Length	4 3/8"
Diameter	1.500"
Clearance in bushing	0.0007" to 0.0012"

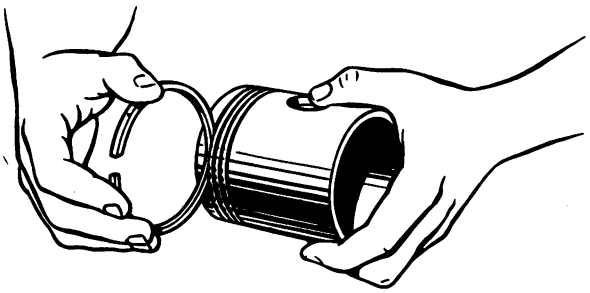


Fig. 26. Checking Piston Ring Fit to Piston

To fit the piston to the connecting rod, place the rod in the piston and slide the piston pin through the bushings. Tighten the clamp bolt in the connecting rod securely and lock in place. Fit the piston rings in the bore and assemble to the piston, making certain that the rings are free in the grooves and that the gaps are staggered. Oil the piston before replacing in engine. Pistons are numbered and should be reassembled into correct cylinders. (No. 1 starts at the front of the engine.)

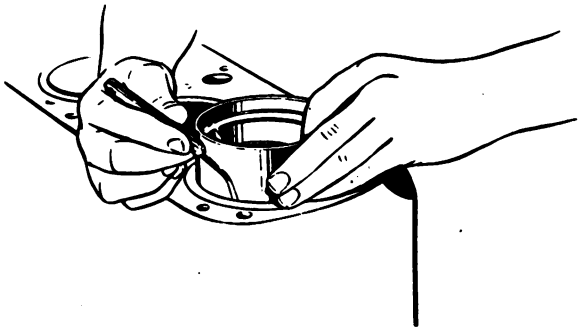


Fig. 27. Checking Piston Clearance in Cylinder

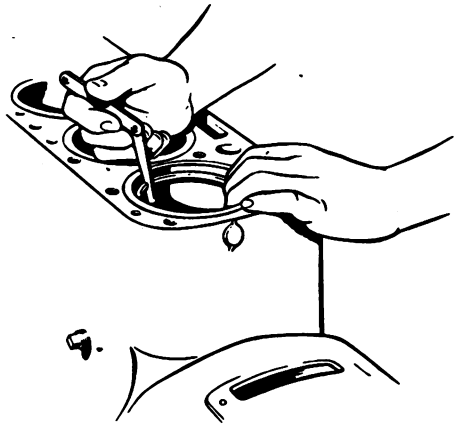


Fig. 28. Checking Piston Ring Clearance in Cylinder

19. Connecting Rods.

Connecting rod length, center to center	12 1/2"
Crank pin diameter	2.875"
Bearing length, total	2.075"
Bearing running clearance	0.002" to 0.003"
Bearing end clearance	0.012" to 0.020"
Bolts, size (special)	7/16" x 3 1/16"

The connecting rod bearings are of the babbitt-lined, steel-backed, precision type. They are not adjustable, and when clearance becomes excessive replacement is necessary. The connecting rods should be free from twist and parallel with the pistons. The connecting rods and caps are numbered with the number of the cylinder bore. Make certain that the proper cap is fitted to each rod and also that numbers correspond. No. 1 starts at the front of the engine. Place the numbered side away from the camshaft. When installing bearings be sure that the bearing backs and rod surfaces are absolutely clean, smooth, and free from oil. The bearings have a nib engaging a milled notch in rod and cap. Do not scrape the shell bearings and do not file the connecting rod nor the connecting rod cap-parting faces. Install the cap and turn the nuts down tightly, turning the engine over by hand to make sure that cap does not bind on the crank pin. Adjustment is correct when the nuts are tight

and when the crankshaft may be rotated by hand with the starting crank. Replace all cotter pins and locking wires.

20. Crankshaft.

The crankshaft is drilled for pressure lubrication of the connecting rod and main bearings. Each bearing cap bears a number, which corresponds to a number stamped on the side of the crankcase.

a. Removal.

To remove crankshaft from engine it is necessary to remove entire crankcase assembly from base. The shaft is then easily removed. Remove bolts from flywheel and remove flywheel and bell housing. Remove engine front gear cover. Remove rear oil retainer assembly and disconnect connecting rods. Remove main bearing caps. The crankshaft can now be lifted out of the crankcase.

b. Replacing.

Before replacing the crankshaft be sure that the bearing caps, bearings, crankshaft journals and crankcase are all clean and absolutely dry, and oil the bearing surfaces.

(1) The front oil seal is located in the engine front gear cover with lip pointing inward, toward engine. Installation should be made by aid of a thin metal sleeve inserted inside of the seal. Slip the seal and sleeve over the crankshaft and remove the sleeve, making certain that the seal is not scratched or marred. The sleeve can be made of shim stock that can be bent into position. The rear oil seal is of the split type. To replace this the rear main bearing cap and rear oil retainer must be removed. If oil leaks behind the flywheel, check the fit of the welch plug at the rear of camshaft, replace the felt oil seal, and check the rear main bearing for excessive wear.

(2) The bearings are not adjustable. When clearance becomes excessive, replacement is necessary. The end thrust of the crankshaft is taken up by thrust washers on either side of the rear main bearing. The correct end clearance should be maintained from 0.002 inch to 0.012 inch. Bearings may be replaced without removing the crankshaft. To remove the upper half of the bearing shell, insert in the crankshaft-journal oil hole a cotter pin, or its equivalent, which has had its rounded head flattened to form a T. Then rotate the crankshaft to push out the bearing liner. The cap and bore are milled to receive a projection on the back of the bearing liner. The projection end is removed first. When replacing, rotate the shaft, and see that the projection end enters last. The bearing backs, crankcase bore, and cap bore should be absolutely clean and dry before the shells are replaced.

21. Camshaft.

Bearings, number	3
Bearing material	Bronze
Bearing journal diameter, front and center	2.250"
Bearing journal diameter, rear	2.250"
Running clearance	0.002" to 0.004"
Bearing length, front and center	3"
Bearing length, rear	2"
Thrust plate material	Bronze
End clearance	0.005" to 0.009"
Service bushings	Reamed to size
Camshaft drive	Helical gear
Number of teeth in gear	72

The camshaft rests in three bearings, reamed to size. To replace it, press these bearings into position. Make certain that oil holes are lined up with the holes in the crankcase. For sizes and running clearance, refer to the table above.

In order to complete the assembly of the camshaft, put the thrust plate onto the shaft, put the key into the shaft, and press the gear (72 teeth) on the shaft. Put on the lockwasher and the nut. The camshaft assembly is attached to the motor block with two capscrews ($\frac{5}{16}$ inch by $\frac{3}{4}$ inch) with lockwashers accessible through holes in the flange of the gear. After assembly, the camshaft is put into place in the engine. To install the capscrew, it is necessary to rotate the gear slightly, either forward or backward.

The drilled holes in the camshaft center bearing journal supply metered oil to the valve rocker mechanism. Valve tappets may be removed and replaced when camshaft is removed.

When installing the camshaft make certain that the marked teeth on the gear mesh with the marked teeth on the crankshaft gear. (See Fig. 22.)

22. Valves.

Valve seat, width	3/32"
Valve seat, angle	45°
Valve seat, insert	Exhaust only
Valve stem guides (replaceable)	Grey iron
Valve stem, diameter	0.434"
Valve stem clearance in guide (intake)	0.0025" to 0.004"
Valve stem clearance in guide (exhaust)	0.0045" to 0.006"
Valve clearance, hot	0.015"
Valve clearance, cold	0.018"
Rocker arm shaft, diameter	0.998" to 0.999"
Rocker arm bushing, diameter	1.001" to 1.0015"

a. Intake Valves.

Head diameter	1 7/8"
Port diameter	1 11/16"
Valve opens	5° after top dead center
Valve closes	41° after bottom dead center

b. Exhaust Valves.

Head diameter	1 3/4"
Port diameter	1 11/16"
Valve opens	42.5° before bottom dead center
Valve closes	8.5° after top dead center

Valve stem guides are furnished as service parts but are not reamed to size. It is

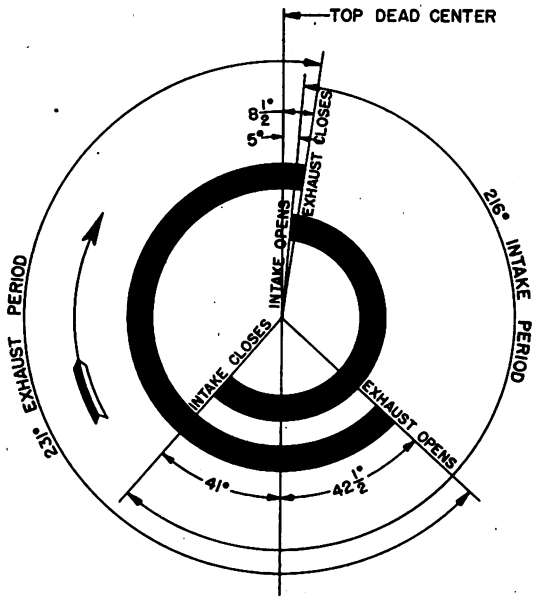


Fig. 29. Valve Timing Diagram

necessary to press them into place and ream them. After new valve guides are installed it is necessary to recut the valve seats.

When service inserts are to be installed, it is necessary in most cases to use oversize

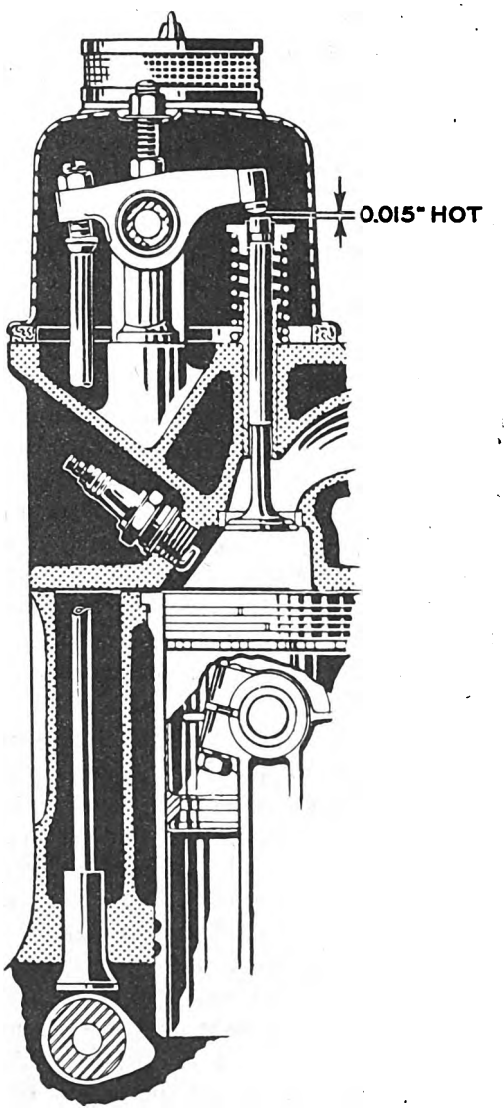


Fig. 30. Valve Operating Mechanism

inserts and to remachine the insert seat for a true fit. Allow approximately from 0.004 to 0.005 inch for press fit of insert. Do not drive the insert into place, as this will invariably cause trouble. A recommended practice is to pack the inserts in dry ice for approximately ten minutes before dropping them into position. Pliers should be used for handling. After the inserts reach atmospheric temperature, make certain that they are seated squarely. If a furling tool is available, it should be used. It is unnecessary to peen the head, since this does not insure a tight fit. Extreme care should be given in making this replacement. Rocker arms can

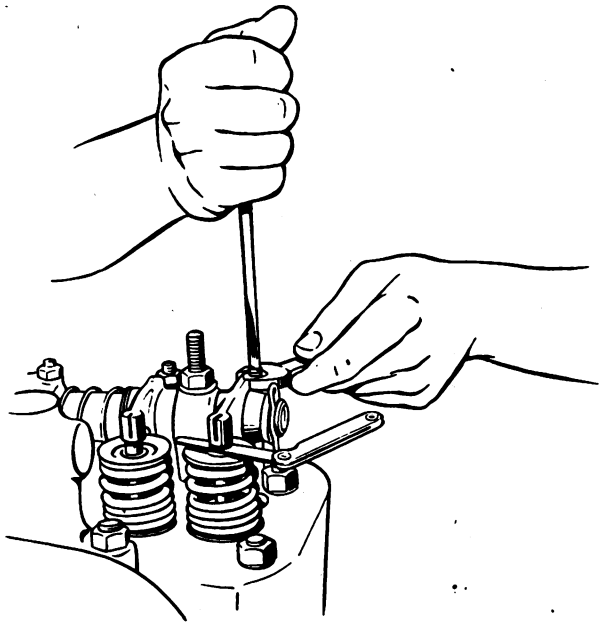


Fig. 31. Adjusting Valve Clearance

be removed, as outlined for the cylinder head. Recheck valve tappet settings, after removing the rocker mechanism or head. Push rods are of tubular steel. Tappets are fitted into the crankcase, and are removable from the bottom after removing the camshaft. Lubrication to tappets is by splash and by returning oil from the rocker mechanism.

c. Valve Adjustment.

Before adjusting valve clearance, the engine should be thoroughly warmed up to operating temperature to normalize the expansion of the various operating parts. This is very important because, during the warm up period, the valve clearance may vary considerably. After normal operating temperatures are obtained proceed as follows. (Engine should be idling slowly during this operation.)

(1) Remove cylinder head cover, being careful not to damage gasket between cover and cylinder head.

(2) Loosen rocker arm lock nut and insert a 0.015 in. feeler gauge between rocker arm and valve. Turn rocker arm screw until proper clearance is obtained.

(3) Without further movement of screw tighten lock nut securely.

(4) Recheck clearance with feeler gauge.

23. Engine and Alternator Alignment.

The engine and alternator are aligned accurately on the bedplate by means of shims under the alternator. When the alternator is removed, the shims must be marked so that they can be replaced in the original manner. Alignment is maintained by dowels in the engine base and the alternator feet. These dowels must be removed before attempting to remove the engine or the alternator, and they must be replaced upon reassembly.

The engine and alternator are connected by full metallic coupling. In aligning, the alternator shaft is brought within 0.003 inch of concentricity with the inner bore of the engine flywheel, with the sub-base level and free of strains. When installing the completely assembled unit in a truck or on a floor, shims must be placed around each foundation bolt so that when the foundation bolts are tightened the bedplate will not be distorted.

24. Power Take Off.

The only field service required for the coupling is that involving the occasional replacement of disks. If the alignment is maintained and the nuts on the coupling bolts kept tight, there will be practically no service replacement of these items. The method of removal of disks for service is obvious upon examination of the coupling.

25. Trouble and Possible Causes.

a. Engine Hard to Start.

(1) Battery:
- (a) Battery not fully charged.
- (b) Loose battery terminals.
- (c) Electrolyte low.

(2) Magneto:
- (a) Worn brushes.
- (b) Oil or water soaked.
- (c) Coil damaged.
- (d) Brushes sticking.
- (e) Magnets weak.
- (f) Condenser faulty.
- (g) Points worn or pitted.

(h) Points sticking.
(3) Fuel system:
(a) No fuel in tank.
(b) Fuel flow obstructed.
(c) Air vent in fuel tank filler cap clogged.
(d) Fuel pump filter clogged.
(e) Too much fuel. Carburetor flooded.
(f) Water in fuel supply.
(g) Improper fuel mixture.
(h) Valves and jets clogged with gum from fuel.
(4) Miscellaneous:
(a) Loose or defective wiring.
(b) Spark plugs cracked or shorted by external dirt.
(c) Spark plugs fouled.
(d) Cables connected to wrong plugs or coated with paint.
(e) Throttle or governor valves loose on shafts.
(f) Intake manifolds or gaskets leaking.
(g) Valves not seating properly.
(h) Improper timing of ignition or valves.
(i) Improper tappet clearance.
(j) Muffler clogged.

b. Faulty Carburetion.
See paragraph 32.

c. Excessive Smoke from Exhaust.
(1) Too much oil in crankcase.
(2) Carburetor needle valve open too far.
(3) Carburetor float sticking or leaking.
(4) Lubricating oil too thin to seal piston rings.
(5) Worn bearings, rings, cylinders and valve guides.

d. Explosion in Muffler.
(1) Spark retarded.
(2) Weak spark.
(3) Valves not seating or out of time.
(4) Exhaust valves warped.
(5) Missing on one or more cylinders.

e. Engine Overheating.
(1) Lack of water.
(2) Fan belt slipping.
(3) Water hose obstructed.
(4) Water hose collapsing.
(5) Carburetor choke control partially pulled out.
(6) Improper fuel mixture.
(7) Radiator clogged.
(8) Cylinders limed.
(9) Improper ignition timing.
(10) Valves leaking.
(11) Oil badly diluted.
(12) Lack of oil.

f. Engine Lacks Power.
(1) Valves warped or sticking.
(2) Valve seats worn.
(3) Cylinders or pistons badly worn or scored.
(4) Piston rings weak or worn.
(5) Piston rings sticking.
(6) Improper fuel mixture.
(7) Improper timing of ignition or valves.
(8) Muffler clogged.
(9) Governor or throttle levers loose on shafts.
(10) Oil badly diluted.
(11) Air cleaner requires cleaning.
(12) Fuel not suited to engine. Octane rating too low.

g. Engine Knocks.
(1) Excessive carbon deposits in combustion chambers.
(2) Loose main bearing.
(3) Loose connecting rod bearing.
(4) Valve tappet clearances too great.
(5) Valve not free in guides.
(6) Worn pistons, piston pins or cylinders.
(7) Engine overheated.
(8) Tight pistons or pins.
(9) Loose flywheel.
(10) Lack of oil or water.
(11) Worn timing gears.
(12) Spark advanced too much.
(13) Fuel not suited to engine. Octane rating too low.

h. Engine Missing.
(1) Spark plugs fouled.
(2) Spark plugs cracked or shorted by external dirt, or moisture.
(3) Improper spark plug gap.
(4) Defective wiring.
(5) Ignition breaker points sticking.
(6) Improper breaker point gap.
(7) Faulty condenser.
(8) Cylinder-head gasket leaking.
(9) Intake manifold or gaskets leaking.
(10) Valves warped or broken.
(11) Valves or tappets sticking.

(12) Valve tappets improperly adjusted.
(13) Valve springs weak or broken.
(14) Dirt or water in fuel system.

i. Explosion in Carburetor or Intake Manifold.

(1) Fuel mixture too lean. See carburetor instructions herein.
(2) Valves or tappets sticking.
(3) Intake valve springs weak or broken.
(4) Intake valves warped or broken.
(5) Intake tappets set too close.
(6) Incorrect timing of ignition or valves.
(7) Intake manifold or gaskets leaking.
(8) Cylinder head gasket leaking.

j. Poor Compression.

(1) Valves not seating properly.
(2) Valves or tappets sticking.
(3) Valve tappets set too close.
(4) Valves incorrectly timed.
(5) Weak valve springs.
(6) Piston rings sticking, weak or worn.
(7) Loose or cracked spark plugs.
(8) Cylinder head gasket leaking.
(9) Oil too thin to seal piston rings.
(10) Scored or worn pistons or cylinders.

26. Magneto.

ROTATION ..... Clockwise
SPARK ..... Fixed
COUPLING 1CA2A2
SETTING ..... 33°

The magneto, which produces an ignition spark only at certain definite points in the rotation of the magnet rotor ⑦ (see Figs. 32 and 33), must be connected to the engine in such a manner that the spark is available always at the instant when required in the cylinder, i.e., about top dead center of compression stroke, with magneto set in retard position. The proper operating results are obtained by timing the engine and the magneto as follows (see Figs. 32 and 33). It is unnecessary to remove the distributor plate for this purpose.

a. How to Time the Magneto.

Remove the cap ⑳ from radio shield cover ⑬ (refer to Figs. 32 and 33). To prevent the engagement of coupling weights, rotate the impulse coupling ⑥ in the opposite direction to which magneto is to be driven, passing through the "contacts open" point to a position slightly beyond the point where the contacts ㉘ close. Then rotate coupling ⑥ in correct direction of rotation, until contacts ㉘ are just separating. With piston of No. 1 cylinder in firing position of compression stroke, both the engine and the magneto are in their correct relation for firing. Connect magneto drive to engine. The arrow visible through the observation cover ⑱ of the radio shield ⑬ and window ⑰ of the distributor plate ⑫ points to the cable outlet which is to be connected to No. 1 cylinder (that nearest the radiator). Complete the installation by connecting the remaining cables of the magneto to the spark plugs in the proper firing order (1-2-4-3). The firing sequence of the distributor, or high-tension end of the magneto, follows the opposite direction of rotation from that indicated by the arrow on the magneto nameplate, and must be taken into consideration when cables are connected to spark plugs. Replace the cap.

b. Trouble Shooting.

In case of defective ignition, it must first be determined whether the fault is in the magneto, or, as is more probable, elsewhere. Generally, when only one cylinder misfires, the fault is in the spark plug.

c. Plug Gap.

The distance between the electrodes of the spark plug varies according to the individuality of the engine, but, normally, this distance should not be less than 0.025 inch. On the other hand, too wide a gap increases the electrical resistance and interferes with the operation of the engine at low speed. Difficulty in starting an engine, and missing at low speed, are very often caused by the spark plug gaps being too wide, and as the spark will have a tendency to burn the electrodes and thereby gradually increase the gap, it is especially important that the plugs be examined occasionally to see that the gap is not too great; any difficulty of this nature may be overcome readily by readjusting the electrodes.

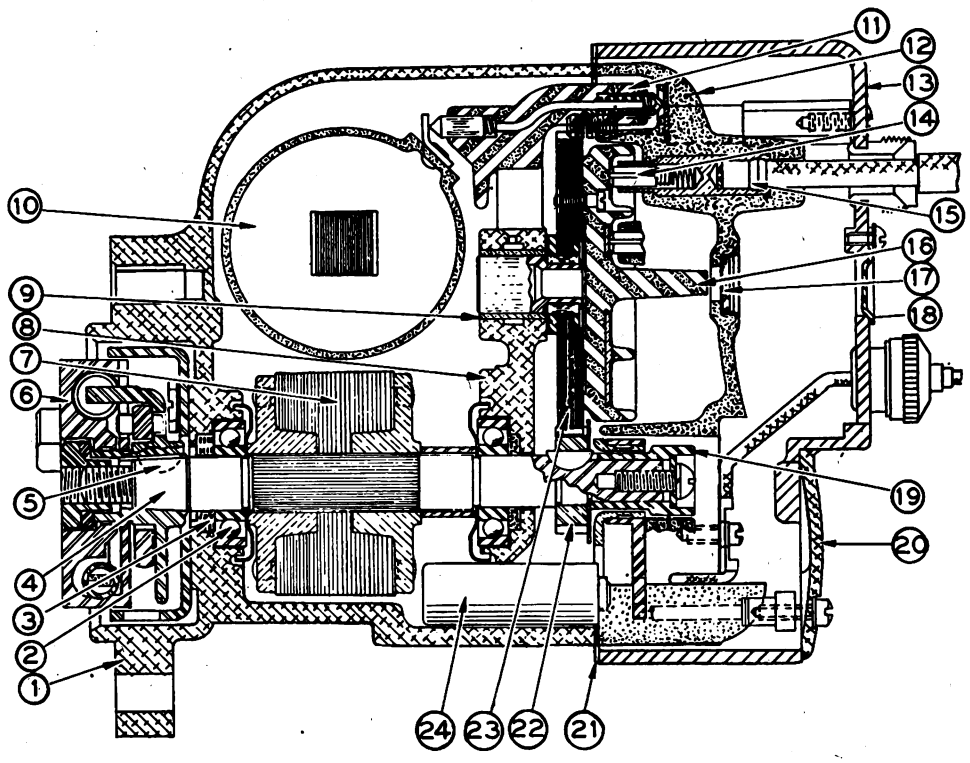


Fig. 32. Longitudinal Section through Magneto

d. Plug Short-circuited.
This is usually caused by a cracked or porous insulator, or by fouling of the electrodes or insulator. Any of these conditions cause misfiring by permitting the current to stray from its intended path.

e. Cables.
Misfiring of one cylinder, either continuous or intermittent, may be caused by a chafed or broken cable or a loose cable connection. The metal terminals of the cables must not come into contact with any metal parts of the engine or the magneto, except those designated in the instructions.

f. Irregular Firing.
If the cables and plugs are in good condition and yet the ignition is irregular, the trouble is probably with the magneto, and the interrupter assembly ㉗ (see Fig. 33) should be carefully examined. It should be seen that the interrupter lever ㉚ moves freely and contacts ㉘ are clean and in correct alignment. (See paragraph 26h)

g. Damaged Insulating Parts.
As it sometimes happens that distributor plate and control arm cap parts of the magneto are damaged through accident or carelessness, these parts should also be carefully examined for possible disarrangement or damage which might permit leakage of current.

h. Interrupter.
The interrupter contacts ㉘ should be adjusted to an opening of from 0.014 inch to 0.016 inch when the interrupter lever ㉚ fiber bumper rests on the top of the cam ⑲. This is done by means of the adjustable contact bracket ㉙ which can be shifted by an eccentric screw until the correct opening has been reached. After adjustment, the bracket ㉙ must be secured by means of its fastening screws. Contact points ㉘ must be free from oil or grease and be in proper alignment, so that the full surfaces of both contacts meet squarely. Pitted contacts ㉘ can be either filed flat or cleaned on a suitable stone. When point renewal be-

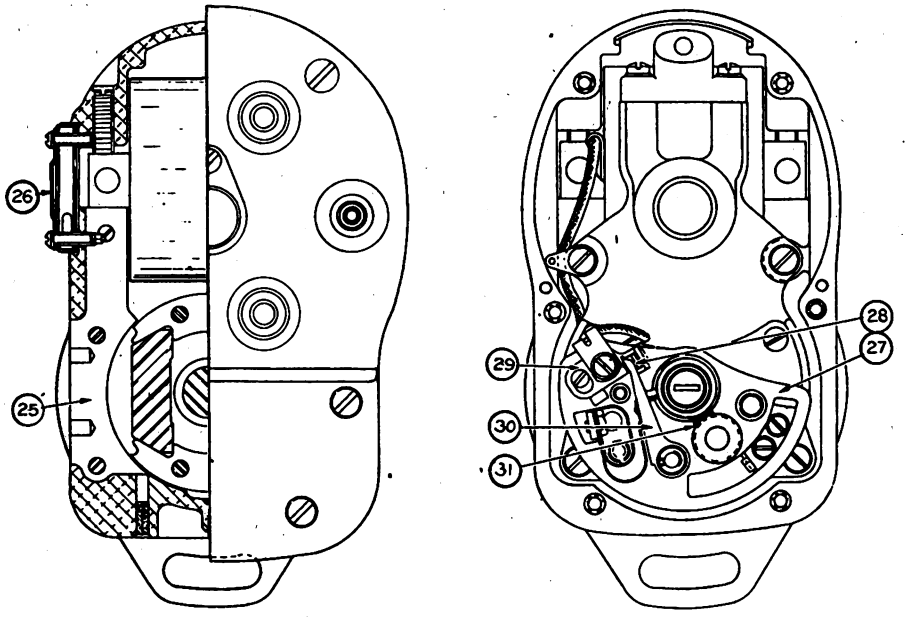


Fig. 33. Cross Sections through Magneto

comes necessary, always replace both interrupter lever and contact bracket at the same time.

i. Impulse Coupling

(1) General

The ICA series of impulse coupling employs sliding L shaped weights and a coil type spring which absorbs the shock after impulsing. The cushioned action of the coupling minimizes the wear to both coupling and magneto parts and reduces the metallic click produced with previous designs. Therefore, the absence of this pronounced clicking noise at each impulse, common with previous designs, does not indicate a weak spring or improper coupling operation. The vertical movement of the sliding L shaped weights is guided by the ears of the impulse member hub which engages the housing into which are assembled the spiral spring and cam. The coupling is released by the arrester plate mounted at the shaft end of the magneto frame.

(2) Removing the Coupling

When disassembling the coupling to check parts for wear or damage, puller ST 413 is recommended to remove the coupling hub from the magneto shaft—see Fig. 34. Damaged or worn parts must be replaced.

(3) Reassembling the coupling (see Figure 35).

Reassemble pins ③ and spiral spring with felt wick ② to coupling housing ①. Pins ③ must rest against groove ④ in housing channel.

With ear ⑥ of coupling hub facing you, locate weights ⑦ in elongated hub slots.

IMPORTANT: When the coupling is be-

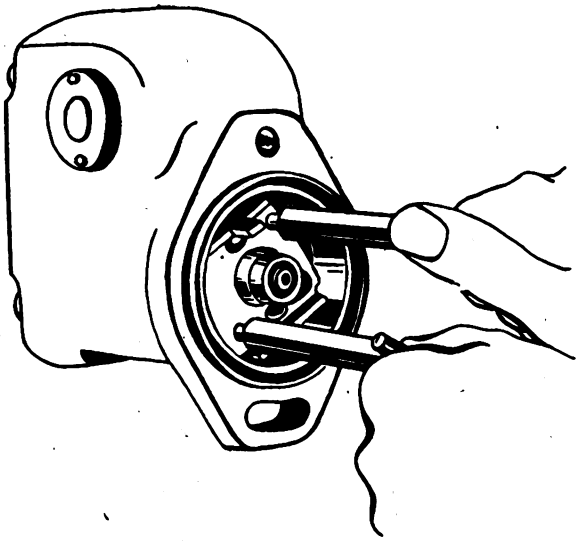


Fig. 34. Removing Impulse Coupling

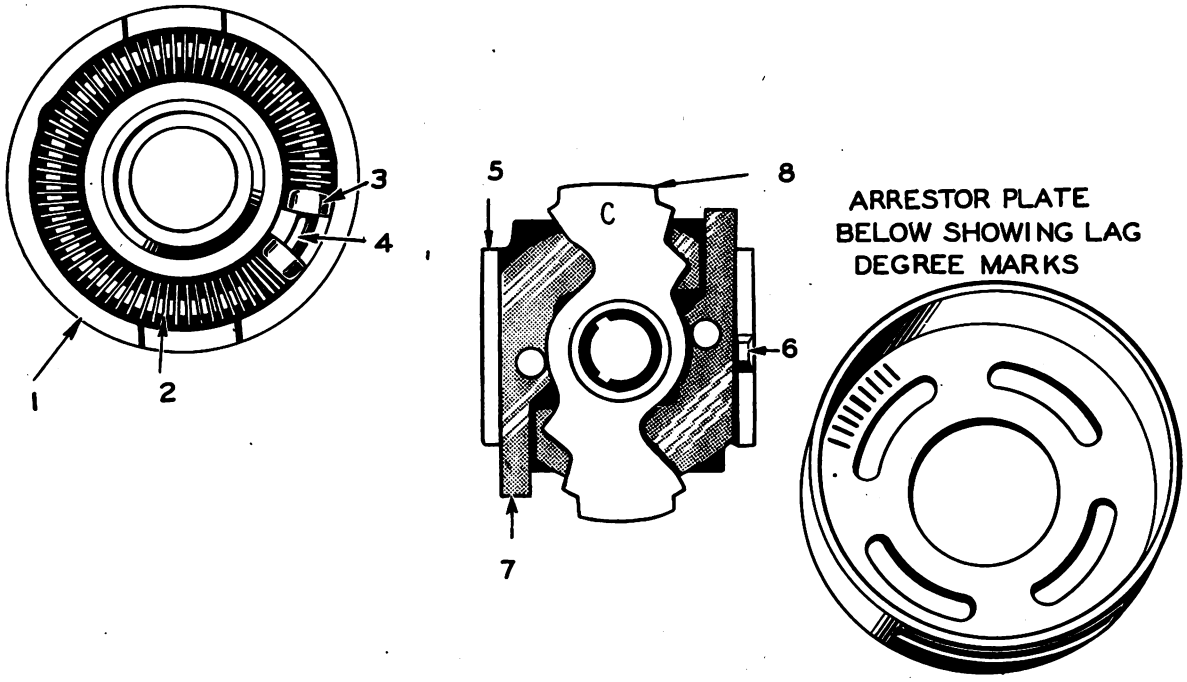


Fig. 35. Component Parts of Impulse Coupling

ing assembled, letter "C" stamped on weights ⑦ must be face up.

Place cam ⑧ on coupling hub with letter "C" facing upward. Engage ear ⑥ of coupling hub ⑤ between pins ③ in housing ① and mesh the two assemblies.

(4) Installing the Coupling on a Magneto

NOTE: To provide accurate setting of the coupling retard, marks spaced 5° apart have been placed adjacent to the upper left-hand slot of arrester plate.

When heavy center mark lines up with fastening hole in magneto housing automatic retard or lag angle of coupling is approximately 30°.

Turning the arrester plate in a clockwise direction increases the automatic retard or lag angle and turning it in a counter-clockwise direction decreases the automatic retard or lag angle.

Retards of from 10° to 50° are obtained by moving the arrester plate as outlined above.

Fasten the arrester plate to the magneto frame. Adjust plate to required retard and securely fasten in place.

Locate impulse member assembly on magneto drive shaft and fasten in place with rotor shaft nut and lock washer. NOTE: Hub ⑤ of the impulse member assembly is provided with two keyways—one for clockwise rotation marked "C," the other for anti-clockwise rotation marked "A." Be sure to use keyway marked "C."

j. Spark Plugs.

Remove the spark plugs every 200 to 300 working hours, or oftener if necessary, for cleaning and checking the gaps between electrodes. A gap of from 0.025 inch to 0.030 inch

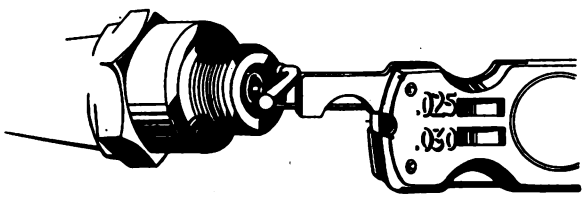


Fig. 36. Adjusting Spark Plug Gap

should be maintained at all times. When making this adjustment, always bend the outer electrode. Never bend the center electrode, as this will damage the insulator. If the gap between electrodes is too great, because of improper setting or burning off of the ends, the engine will misfire and be hard to start,

and may produce radio interference.

The recommended method of cleaning spark plugs is by sand-blasting. Never scrape or clean the insulator with anything that will scratch the porcelain, because scratched porcelain allows carbon and dirt to accumulate much faster.

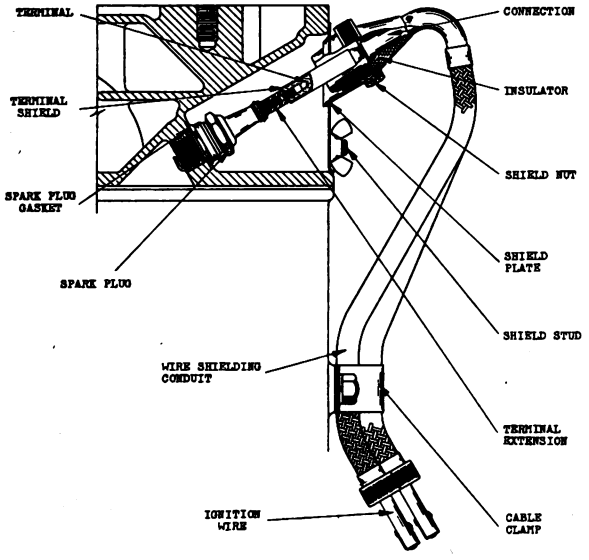


Fig. 37. Ignition Radio Shielding

k. Spark Plug Cables.

If the spark plug cables are removed for any reason, mark or tag the number of each cable with reference to the magneto distributor cap. The wiring diagram in the appendix shows correct wiring.

27. Cranking Motor.

a. General

The cranking motor is a six brush, six pole unit with the armature supported by a cast bronze bushing at the drive end, and at the commutator end, and a middle bearing assembly with cast bronze bushing.

b. Detailed Description

The cranking motor consists of a commutator end frame assembly, field frame assembly, armature, Bendix drive component parts and drive housing.

(1) Commutator End Frame Assembly

The commutator end frame assembly consists of an end frame brush holders, brush springs, and brushes. The brushes are placed 60° apart. Three of the brushes are grounded, the other three brushes are insulated and are connected by leads to the field

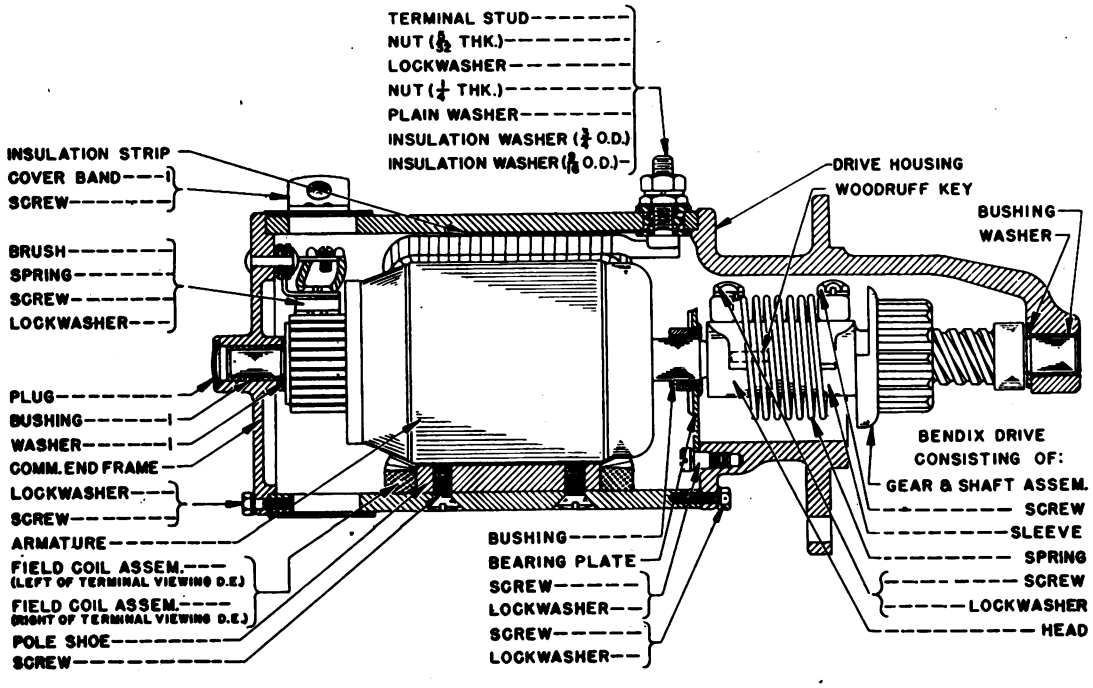


Fig. 38. Longitudinal Section through Cranking Motor

coils. Current from the battery enters the terminal passes through the field coils and brushes into the armature, from the armature through other brushes, then through ground back to the battery. Springs hold the brushes against the armature commutator with the proper tension to provide good contact. A cover band on the field frame assembly covers windows in the frame and can be removed so that the condition of the brushes and commutator may be noted.

(2) Field Frame Assembly

The field frame assembly consists of six field coils, assembled to the field by pole shoes and pole shoe screws. The terminal is mounted on the frame and is connected to the field coils.

(3) Armature

The armature consists of a shaft on which lamination is pressed. The lamination is laterally slotted and into the slots are assembled the armature windings. The windings are connected to the commutator segments so that current from the brushes can be fed into the winding and back out again.

c. Specifications

Clockwise rotation viewing drive end.
Brush spring tension—36-40 ounces.
No load—80 amperes at 11.2 volts at 4500 r.p.m.
Lock test—32 lb. ft. at 670 amperes at 5.35 volts.

d. Operational Maintenance Checks

Operational maintenance checks may be defined as the checks which may be made during the operation of the equipment. These checks give the operator some idea as to the condition of the cranking motor so that if some abnormal condition of operation is noted, corrections may be made before complete failure of the unit takes place, with a consequent failure to start the engine. During starting, the action of the cranking motor should be noted. The cranking motor should take hold promptly and spin the engine at normal cranking speeds. After the engine starts and the cranking motor switch is opened, the cranking motor should stop operating. If the cranking motor cranks the engine slowly or not at all, the equipment should be checked. Failure to crank normally can be due to a low battery, defective battery cables, poor connections in the cranking motor to battery circuit (including switch) defective cranking motor, low temperatures, or various conditions in the engine.

CAUTION: The cranking motor must never be used for more than 30 seconds at any one time without a pause of several minutes to wait until the cranking motor cools off. Failure to observe this rule may result in complete failure of the cranking motor.

e. Inspection Checks

Inspection checks include a periodic investigation every 100 hours of operation, of the condition of the battery, battery cables and connections, cranking motor switch, commutator, brushes, lead connections and mounting. Place a few drops of OE 10 (light engine oil) in the hinge cap oilers.

(1) Battery

The condition of charge of the battery should be noted as outlined in **paragraph 30.**

(2) Commutator

The armature commutator may be observed by removing the cranking motor cover band. It should be clean, not out of round or excessively worn, without high mica or burned bars. Armature leads must be properly connected to the commutator riser bars. Failure to meet these specifications requires that the armature be removed and the commutator serviced as outlined in **paragraph 26k.**

(3) Brushes

The brushes must be making good contact with the commutator and must not be worn any shorter than 5/16 inch (from an original length of 1/2 inch). If worn down to, or almost to, this length, replace.

(4) Lead Connections

Lead connections must be tight and in good condition.

(5) Mounting

Mounting bolts must be tight.

(6) Drive Assembly

The drive assembly cannot be observed with the cranking motor mounted on the engine, but its action can be noted by observing the operation of the cranking motor as outlined in **paragraph d.**

f. Periodic Disassembly

At periodic intervals of 600 hours of operation, the cranking motor should be removed from the engine, disassembled and all parts cleaned and inspected as outlined in **paragraphs 27g to 27k.** This guards against failure of the equipment at some critical instant and must be considered as an important part of the preventive maintenance routine.

g. Disassembly Into Main Sub-Assemblies

(1) Detach Commutator End Frame

Detach commutator end frame by removing cover band, removing three brush screws and lock washers so field coil leads may be detached and then removing six commutator end frame attaching screws and lock washers. It may be necessary to tap the commutator end frame lightly with a soft hammer to loosen it. Remove thrust washer from armature shaft.

(2) Detach Drive Housing

Remove six attaching screws and lock washers. Tap drive housing and armature away from field frame with a soft hammer. Remove the two screws and lock washers holding the middle bearing in place. The drive housing is now free to be removed. Note space washer at end of shaft.

(3) Disassemble Bendix Drive

Bendix drive may be removed from armature shaft by bending down tang of lock washer and unscrewing Bendix drive head attaching screw. Bendix drive assembly will slip off shaft. Remove woodruff key from shaft. Slip middle bearing assembly off shaft. Bendix drive may be further disassembled by removing other drive spring attaching screw after bending down tang of lock washer.

h. Disassembly of Commutator End Frame

(1) Detach Brushes

Remove three brush attaching screws and lock washers so the six brushes may be detached. Three screws were removed when the field leads were disconnected to remove commutator end frame.

(2) Detach Brush Springs

Detach brush springs by catching straight section of springs with pliers and lifting off.

(3) Remove Bushing

The end plug may be pressed out and the bushing replaced if necessary.

i. Disassembled Field Frame Assembly

(1) Unsolder Field Coils from Terminal Stud

(2) Remove Field Coils from Frame

Remove field coils from field frame by removing 12 pole shoe screws, six pole shoes and coils. Be careful with coils to avoid bending lead connections or damaging insulation. Take off insulating strip under coil connections.

(3) Remove Terminal Stud

From terminal stud, remove nut, lock washer, nut, lock washer, washer, and insulating washer. Remove terminal stud from field frame and slip three bushings and insulating washer off stud.

j. Disassemble Magnetic Switch

The only serviceable part of the magnetic switch is one each nut and lock washer, on each of the three terminals. The magnetic switch is the base mounted type and acts to close the cranking motor circuit when its windings are energized.

k. Inspection and Repair of Parts

(1) General

After disassembly, all parts should be cleaned, examined, and defective parts replaced. The procedure of cleaning, inspecting, and repairing of parts is given in the following paragraphs.

(2) Armature

Do not clean the armature by any degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth slightly dampened with carbon tetrachloride or similar solvent. If the commutator is worn, dirty, rough, out of

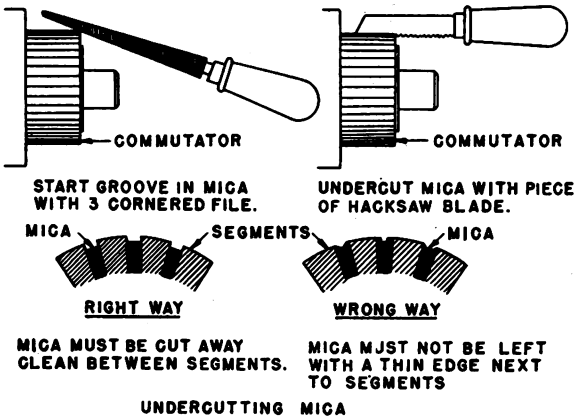


Fig. 39. Undercutting Mica

round, has high mica, filled slots, burned spots, place the armature in a lathe and turn down the commutator. Make cut no deeper than necessary. Minimum diameter of commutator should be 1.5625 in. (original 1-11/16 in.). If it is necessary to turn commutator down below this diameter, discard armature. Undercut mica 1/32 inch (Fig. 39). Armature may be checked for ground, open, or short circuit as follows:

(a) Ground

Check with test lamp and test points from the commutator to the armature shaft or lamination. If the lamp lights, indicating ground, and if the ground is not readily apparent and repairable, the armature must be replaced.

(b) Open

An open circuited armature is often easy to detect, since this condition produces badly

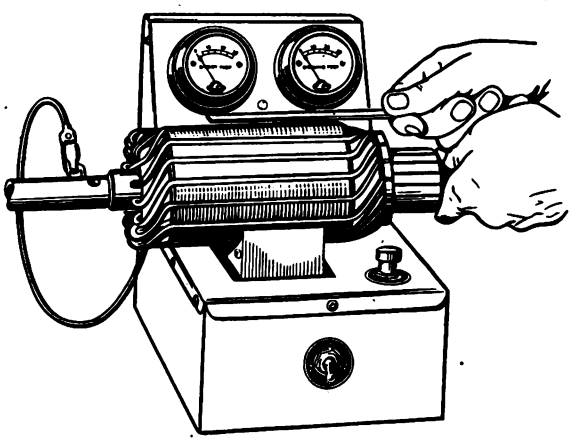


Fig. 40. Checking Armature on Growler

burned commutator bars. The open will usually be found at the commutator riser bars and is often a result of excessively long cranking periods which overheat the units and cause the connections to become bad. Thrown solder is evidence of this condition. Repair is made by resoldering leads in riser bars (rosin flux) and turning down commutator.

(c) Short

A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature testing shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

(3) Fields

The fields should not be cleaned by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the windings to avoid breaking or weakening the connecting straps between windings. If the field insulation is

charred or chaffed so that the windings are exposed, it is sometimes possible to rewrap them with insulating tape and paint them

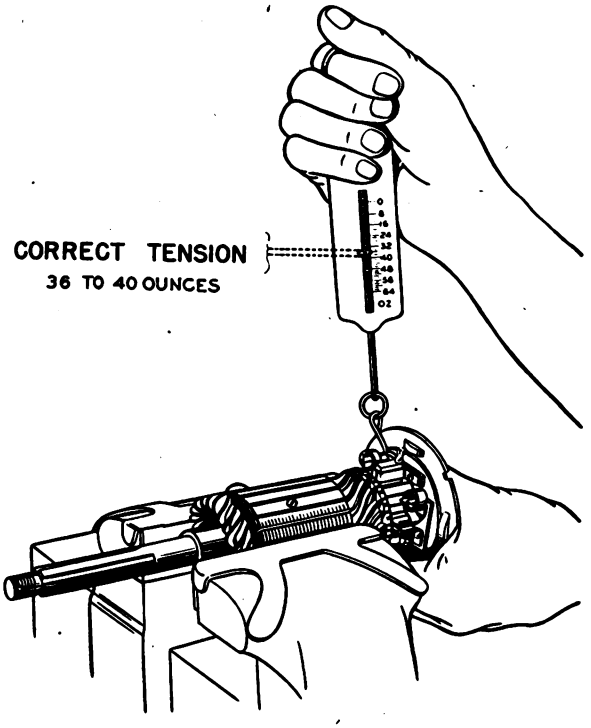


Fig. 41. Checking Brush Spring Tension

with insulating compound. It must be remembered that if the wrapping is done carelessly so the insulation bulks up too large, it will be impossible to reassemble the coils under the pole shoes. All soldered connections should be made with rosin flux solder.

(4) Brushes

If the brushes are worn down to 5/16 inch (original length 1/2 in.), replace. Make sure that the pigtail leads are tight in the brushes and that the clips are fastened well to the leads.

(5) Brush Springs

The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by placing the armature and commutator and frame together in their normal operating position and then placing the brushes in their holders with the springs in place so that the tension of the brushes against the commutator can be measured with a spring gauge. Replace springs if the tension is not correct.

(6) Bushings

If the bushings are worn, they should be replaced. Wear will not be even, but on the side which sustains the greatest thrust during cranking.

(7) Brush Holders

If the brush holders, spring pins, insulators, washers, etc., are warped, cracked, burned or otherwise damaged, replace commutator end frame. This is a riveted construction and individual parts cannot be replaced in the field.

1. Assembly Procedure

(1) Assemble Field Frame Assembly

(a) Place field coils in position in frame with pole shoes with insulating strip to protect connections. Insert pole shoe spreader, tighten, and with pole shoe screw-driver, tighten pole shoe screws.

(b) Place insulating washer and three bushings on terminal stud, insert stud through hole in field frame. Place in order on stud, insulating washer, flat washer, lock washer, nut, lock washer and nut.

(c) Solder coil leads to terminal stud.

(2) Assemble Commutator End Frame Assembly

(a) Install new bushing if necessary and ream to size. Install end plug.

(b) Install brush springs and put six brushes in holders and attach three grounded brush leads with screws and lock washers to brush holders. Other three brush leads will be attached during final assembly of unit.

(3) Assemble Cranking Motor

(a) Slip middle bearing assembly on armature shaft. Put woodruff key in place on armature shaft, install drive head of Bendix drive. Slip drive spring and remainder of Bendix assembly on shaft and secure by run-

ning down the Bendix drive spring screws. Use new lockwashers and place with bent lip in gap in drive spring eye. Bend tangs up against a flat side of screw head.

(b) Install space washer and drive housing and attach to middle bearing assembly by two screws and lock washers. Attach the field frame assembly to the drive housing with the six screws and lock washers.

(c) Attach commutator end frame. Place thrust washer on armature shaft, cock brushes in their holders and slip commutator end assembly into place on field frame. Secure with six attaching screws and lock washers. Attach three field coil leads to brush holders (attaching brush lead clips at same time) with three screws and lock washers. Put cover band in position and secure with cover band screw and nut.

m. Cranking Motor Checks

(1) No Load Test

Connect the cranking motor in series with a battery of the specified voltage and an ammeter capable of reading several hundred amperes. If an r.p.m. indicator is available, read the armature r.p.m. as well as the current draw with the unit running free speed or no load.

(2) Torque Test

Torque testing equipment is required for conducting a stall torque test of the cranking motor. The torque developed, current draw, and voltage are checked together.

(3) Interpretation of No Load and Torque Tests

(a) Rated torque, current draw, and no load speed indicates normal condition of the cranking motor.

(b) Low free speed and high current draw with low developed torque may result from:

Tight, dirty, worn bearings, loose field poles which cause armature to drag.

Grounded armature or field. Check by raising brushes from armature commutator and testing with test lamp and points from cranking motor terminal to frame and from commutator to frame. If the lamp lights, a ground exists.

Shorted armature. Check armature on growler.

(c) Failure to operate with high current draw:

Direct ground in switch, at terminal or brushes.

Frozen shaft bearings which prevent armature from turning.

(d) Failure to operate with no current draw:

Open field circuit. Trace with test lamp and points.

Open armature coils.

Broken or weakened brush springs, worn brushes, high commutator mica, or other conditions which would prevent good contact between brushes and commutator.

(e) Low no-load speed with low torque and low current draw indicates:

Open field. Trace circuit with test lamp and points.

High internal resistance due to worn brushes, dirty commutator, weak or worn springs, and other causes of poor contact between brushes and commutator.

Defective leads and connections.

(f) High free speed with low developed torque and high current draw indicates shorted fields. It is difficult to detect shorted fields with ordinary testing instruments, since the field resistance is originally low. If shorted fields are suspected, install new fields and check for improvement in performance.

28. Magnetic Switch.

a. Description

The magnetic switch consists of a winding, plunger, contact terminal and contact disk. When the winding is energized (connected to

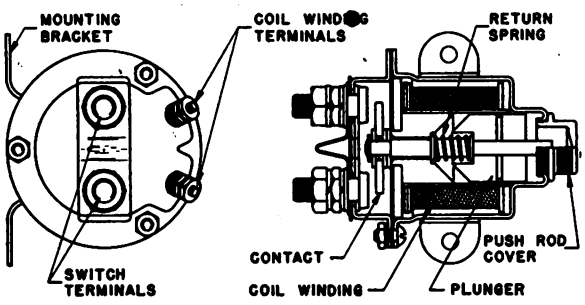


Fig. 42. Cross Section through Magnetic Switch

battery) by the closing of the cranking motor switch, the resulting magnetic field pulls in the solenoid plunger, forcing the contact disk against the contact terminals, and connecting the cranking motor to the battery. Opening of the cranking motor switch disconnects the magnetic switch winding from the battery, so that the magnetic switch spring can separate the contact disk from the terminals, opening the circuit between the cranking motor and battery.

b. Tabulated Data

The magnetic switch specifications are:

Force necessary to make contact 4 lb. minimum.

Maximum voltage to close switch 7.0 volts.

Current draw at rated voltage 12.0-13.0 amperes.

c. Disassembly

Remove 3 screws, lock washers, and nuts holding cover and case together. Case, push rod pin, plunger, spring, plunger stop and base, push rod and contact assembly may be removed from the winding. By taking coil lead studs off, the cover and terminal assembly may be separated from winding assembly. Studs are removed by taking off nut, lock washer, nut, lock washer, plain washer, insulating bushing, insulating washer, and plain washer. Terminal assembly may be disassembled by removing from each terminal, nut, lock washer, nut, lock washer, flat washer, bent insulating strip, flat insulating strip, cover and cover insulators.

d. Assembly

Assemble terminal assembly by placing on the two terminal studs cover insulator, cover, flat insulating strip, bent insulating strip, flat washer, lock washer, nut, lock washer, and nut. Connect coil leads to coil lead studs and assemble studs in cover with plain washer,

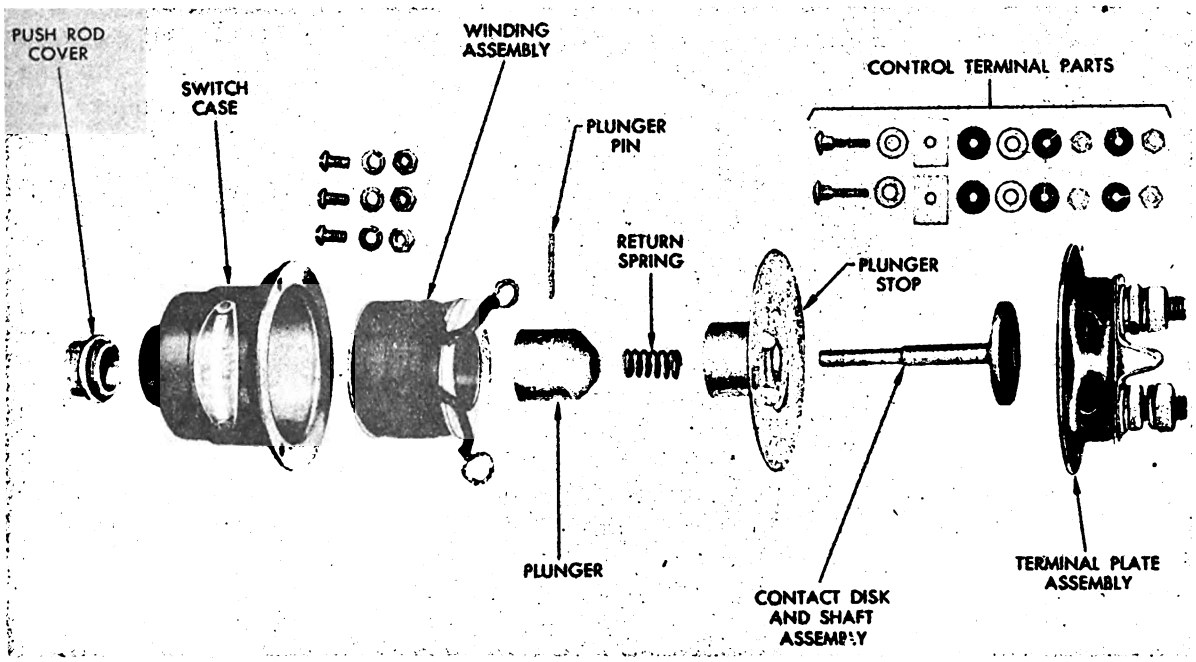


Fig. 43. Component Parts of Magnetic Switch

insulating washer, insulating bushing, plain washer, lock washer, nut, lock washer, and nut. Complete assembly by putting push rod and contact assembly, plunger stop and base, spring, plunger, push rod pin, and case into position and secure with 3 screws, lock washers and nuts.

29. Generator.

a. Function of Generator

The generator has two functions, it restores to the battery the current withdrawn during cranking and carries the connected electrical load, up to the capacity of the generator, when the generator is operating at speeds sufficient to produce rated output.

b. Tabulated Data

Generator specifications are:

Clockwise rotation viewing drive end.

Field current draw 1.5-1.67 amperes at 12 volts.

Brush spring tension 16 ounces.

Cold output 8-10 amperes at 14.4-14.9 volts at 2200 r.p.m.

Hot output 6-8 amperes at 14.1-14.5 volts at 2400 r.p.m.

Step-voltage control unit specifications are:

Cutout relay.

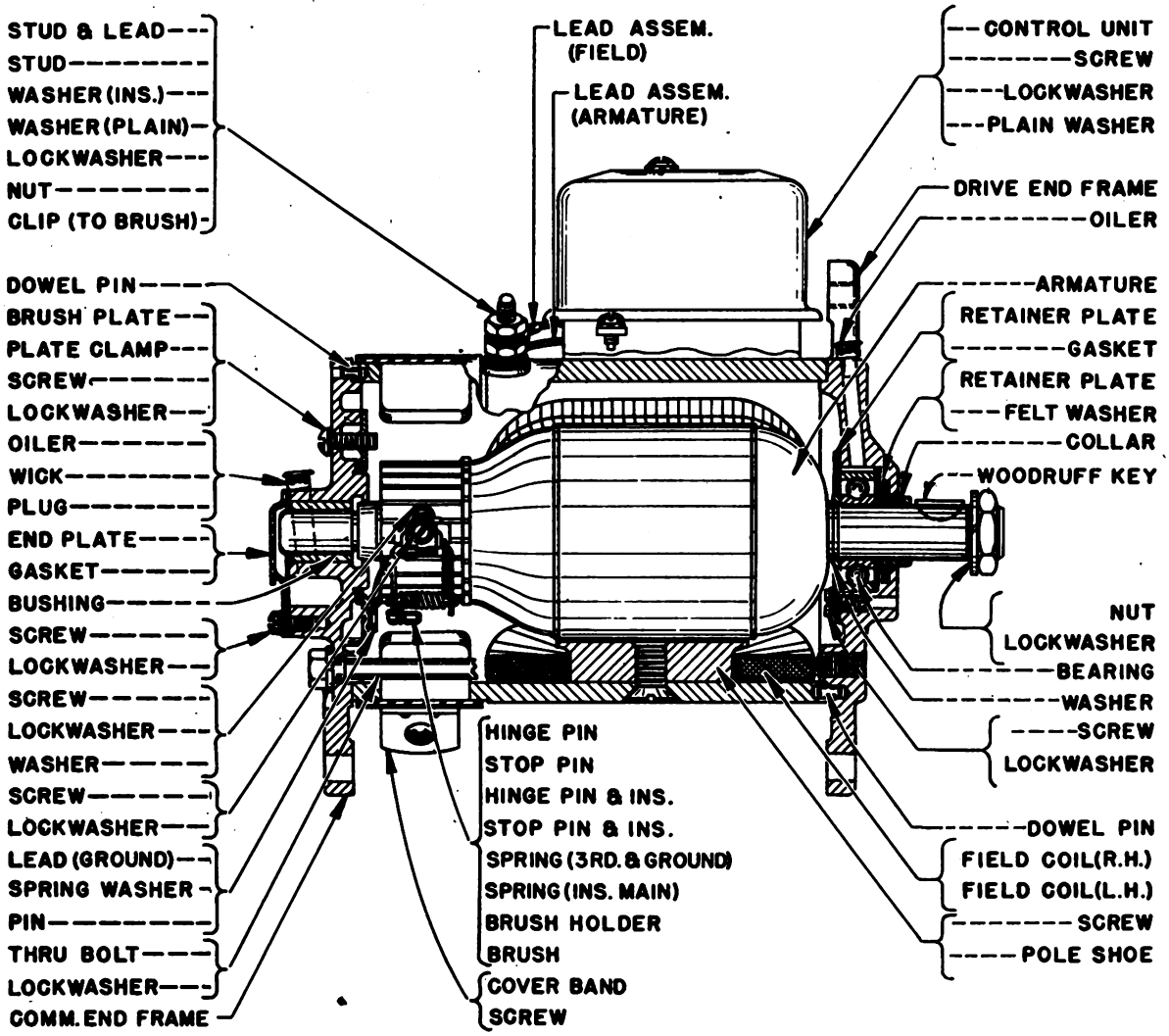


Fig. 44. Longitudinal Section through Generator

Closing voltage—12.9-13.9 volts.

Air gap—.015 inch.

Point opening—.020 inch.

Voltage control.

Points open—14.1-14.7 volts (150° F.)

Points close—12.0 volts max.

Air gap—0.045 inch.

Point opening—0.015 inch.

Contact spring tension—.7-1.4 oz

Armature travel—0.045 inch.

c. Inspection Checks

Inspection checks include a periodic investigation of the generator brushes, commutator and leads. These checks should be made every 100 hours of service.

(1) Generator Brushes

If the brushes are shorter than 7/16 in. (original length 3/4 in.), they should be replaced. Brush spring tension should be sufficient to give good clean contact of the brushes on the commutator and the leads should be tight.

(2) Commutator

The commutator must be smooth, round, without excessive roughness, dirt, gum, or burned areas. The slots between the segments must be open and not filled with brush or copper dust. Otherwise, the unit must be disassembled and the commutator serviced as outlined in **paragraph i.**

d. Periodic Disassembly

Every 600 hours of service the generator should be removed from the power unit, disassembled, all parts cleaned and inspected as outlined in **paragraphs f, g and h.** Generally speaking, disassembly should be carried only so far as is necessary to adequately inspect and clean the parts. For example, it will not be necessary to disassemble the commutator end assembly except as required to replace defective parts. Likewise, the field windings need not be removed from the field frame unless their repair or replacement is required. Needless disassembly of such parts may cause damage to them, weakening insulation, stressing leads, etc.

e. Trouble Shooting

(1) No Generator Output

If no output can be obtained from the generator with the generator "F" terminal grounded, remove the cover band and check for sticking brushes, gummed or burned commutator or other causes of poor contact between commutator and brushes. Sticking brushes are corrected by cleaning brush holders or springs, and replacing brushes as required. A gummed or burned commutator may be corrected as explained in **paragraph i.** If the trouble is not readily apparent, use test lamp and test points and check further. The test lamp and test points are connected in series with the test lamp and a source of electricity (110 volt circuit for example). When the test points are held together, the lamp lights. Thus a short in an electrical circuit is indicated by lighting of the test lamp when the points are placed across the circuit. Likewise, an open circuit is indicated by failure of the lamp to light when the points are placed across the circuit. With generator disconnected, check as follows:

(a) Test for Ground

Raise the grounded brush from the commutator and insulate it with a piece of paper or cardboard. Check with test lamp from "A" terminal to frame of generator. If lamp lights, the generator is grounded. Raise other brushes, and check the "F" terminal, commutator and "A" terminal separately to locate ground.

(b) Test for Open Field

Check for open field circuit with test points from the "F" terminal to the third brush. If lamp does not light, field is open. Leads which have broken or connections which have come loose may be resoldered, but if the open is inside a winding, the winding must be replaced.

(c) Test for Shorted Field

Connect a 6-volt battery and an ammeter in series with the generator field ("F" terminal

to third brush) and note current draw. Normal field current draw would be 1.5-1.67 amperes at 12 volts. Proceed with care on this test, since a shorted field will draw a high current.

(d) Open Circuited Armature

An open circuited armature is usually readily apparent, since this condition causes burned bars. Further details of this condition are found in **paragraph 29h.**

(e) Check Armature for Short Circuits

Check the armature on a growler for short circuits. See **paragraph h** for details of this check.

(2) Excessive Generator Output

Excessive generator output normally results from an improper third brush setting. See **paragraph j** for procedure of checking and adjusting generator output.

f. Disassembly Procedure

(1) Disassembly Into Main Sub-assemblies

(a) Remove the step-voltage control unit by unscrewing the attaching screws, lock washers and plain washers and disconnecting the leads from the armature and field terminals.

(b) Unscrew coverband screw and detach coverband.

(c) To detach commutator end frame, disconnect the field lead from the third brush by removing screw and lock washer. Disconnect "A" terminal lead from main brush in the same manner. Unscrewing these two screws detaches brush washers and two brushes. Remove two thru bolts and lock washers and detach commutator end frame by tapping lightly with soft hammer.

(d) To remove armature, place armature in soft jaws of vise, unscrew nut and remove lock washer. Remove pulley and then pull woodruff key from shaft If armature does not slip out of drive end frame easily, take armature from vise and press out in arbor press. Remove collar and space washer from drive end frame.

(2) Disassembly of Drive End Frame

(a) Remove bearing retainer plate by removing three screws and lock washers. Remove gasket. Remove ball bearing (with arbor press if necessary) and take out retainer and felt washer.

(3) Disassembly of Commutator End Frame

(a) Remove end cover plate by detaching three screws and lock washers. Remove gasket. Bushing may be pressed out in an arbor press, if necessary.

(b) Remove ground brush lead attaching screw and lock washer, connecting ground lead to brush holder. Brush and brush washer will also come off.

(c) To lift off brush springs and arms, take pliers, catch hooked end of spring and lift up over stop pin. Arm and brush spring will slide off pin.

(d) Detach third brush plate. Unscrew third brush locking screw from outside of frame. Remove clamp. With 1/8 punch, push third brush plate spring attaching pin out so spring, ground lead, and third brush plate may be detached from frame. Press out brush arm stop and hinge pins from frame, if necessary to replace them.

(4) Disassembly of Field Frame

(a) Detach terminal studs. From each terminal stud remove in the following order: one nut, lock washer, another nut, lock washer, plain washer, and insulating washer.

(b) Remove fields and pole shoes. With a pole shoe screw-driver, remove two pole shoe screws, pole shoes, and windings. Stud and clip on field windings may be unsoldered and replaced, if required. Use care in handling field coils to avoid damaging leads or insulation.

g. Inspection of Parts

(1) General

After disassembly, all parts should be cleaned, examined, and defective parts replaced. The procedure of cleaning and inspecting parts is given in following paragraphs.

(2) Armature

Do not clean the armature by any degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth slightly dampened with carbon tetrachloride or similar solvent. If commutator is rough, out of round, worn, has high mica, filled slots, or is burned, it must be turned down in a lathe and the mica undercut. Armature may be checked for ground, open or short circuit as follows:

(a) Ground

Check with test lamp and test points from the commutator to the armature shaft or lamination. If the lamp lights, indicating ground, and if the ground is not readily apparent and repairable, the armature must be replaced.

(b) Open

An open circuited armature is easily detectable, since this condition produces badly burned commutator bars. The bars connected to the open coils in the armature soon burn since every time they pass under the brushes they interrupt a flow of current so that heavy arcing occurs. If the bars are not too badly burned, the armature may often be saved.

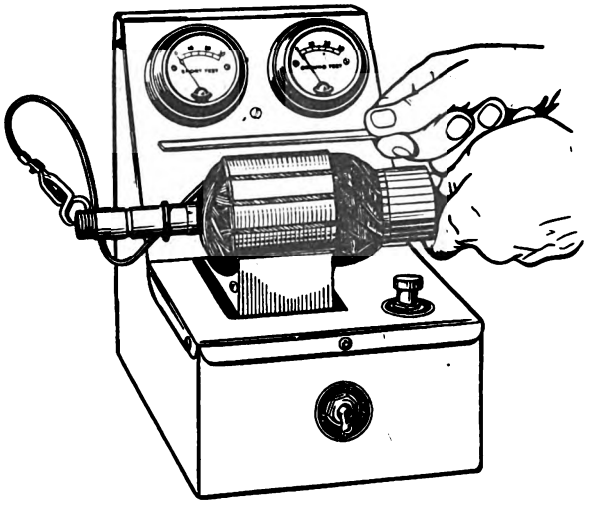


Fig. 45. Checking Armature on Growler

(c) Short

A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When shorted armature is placed on the growler, and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature testing shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

(3) Fields

The fields should not be cleaned by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the winding assembly to avoid breaking or weakening the connecting lead between the two windings. Test the field current draw by connecting a 6-volt battery and an ammeter in series with the two field leads. The current draw should be 3.5 to 4.5 amperes at 6 volts. Replace windings if they do not meet specifications. The field insulation should be in good condition. If it is charred or worn away so that the wire is exposed, it is sometimes possible to rewrap the windings with insulating tape and paint them with insulating compound. All soldered connections should be made with rosin flux solder. If the terminal stud or clip is damaged, replace.

(4) Brushes

If the brushes are worn down to 7/16 in. (original length 3/4 in.), replace. New brushes may be seated with a brush seating stone. The brush seating stone is an abrasive material which held against a revolving commutator, disintegrates, carried under the brushes and seats them in a second or two.

(5) Brush Springs

The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by assembling the brushes, brush springs, and arms to the commutator end frame paragraph j placing the commutator in position in the

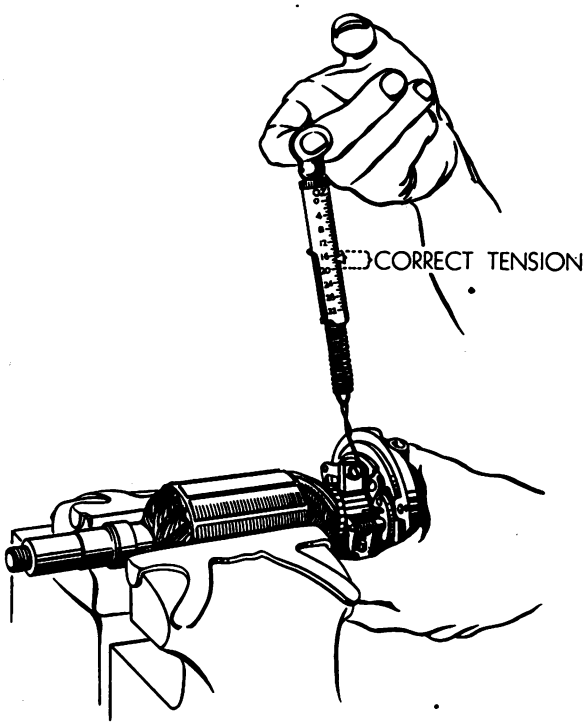


Fig. 46. Checking Brush Spring Tension

end frame and then checking with a spring gauge the amount of pull required to raise the brush arms from the brushes. Replace springs if tension is not correct.

(6) Bearing

If the bearing appears to roll roughly, or sloppily, replace it. Otherwise, the bearing may be cleaned by rotating it in carbon tetrachloride, drying it with air, and immediately relubricating with WB-2 (ball bearing grease).

(7) Brush Ring

If the brush ring, brush arm pins, brush holders, spring stop pins are damaged (bent, warped, cracked, insulation burned, etc.) replace. The ring is of a riveted construction so that it must be serviced as a unit.

(8) Miscellaneous

Any defective insulator, screw, washer, lead, stud, retainer, plate, etc., should be replaced. Cracked, bent, battered, worn, burned insulators and washers are defective. Screws or studs which are bent, battered, broken, or which have crossed or damaged threads, are defective. Leads which have broken strands, badly frayed insulation, are defective.

h. Overhaul Procedure

(1) Armature

Conditions in the armature requiring repair are:

(a) Commutator Worn, Dirty, etc.

If the commutator is rough, worn, out of round, has high mica, filled slots, burned spots, place the armature in a lathe and turn down the commutator. Make cut no deeper than necessary. If it is necessary to turn down the commutator below this diameter, discard the armature. Undercut mica 1/32 inch.

(b) Armature Open

Some bars badly burned, with other bars fairly clean, indicates an open circuited armature. The open will usually be found at the commutator riser bars and is often a result of generator overload — the consequence of an excessively high generator output resulting from a too advanced third brush adjustment. If the bars are not too badly burned, the armature may sometimes be saved by resoldering the leads in the riser bars with rosin flux, turning the commutator down and undercutting the mica. Make sure the third brush is adjusted according to specifications, see paragraph (g5).

(2) Fields

Conditions in the field windings requiring repair are:

(a) Field Insulation Defective

If the field insulation is defective, charred or worn away, so the field circuit is, or could become, grounded, it may sometimes be repaired by rewrapping the field windings with insulating paint. This operation must be executed with care and neatness, since excessive bulkiness of the tape will prevent reassembling the windings under the pole shoes in the proper manner. All soldered connections should be made with rosin flux solder.

i. Servicing of Step-Voltage Control

IMPORTANT: As a rule, the step-voltage control should **not** be disassembled. The only exception is where some part such as the cut-

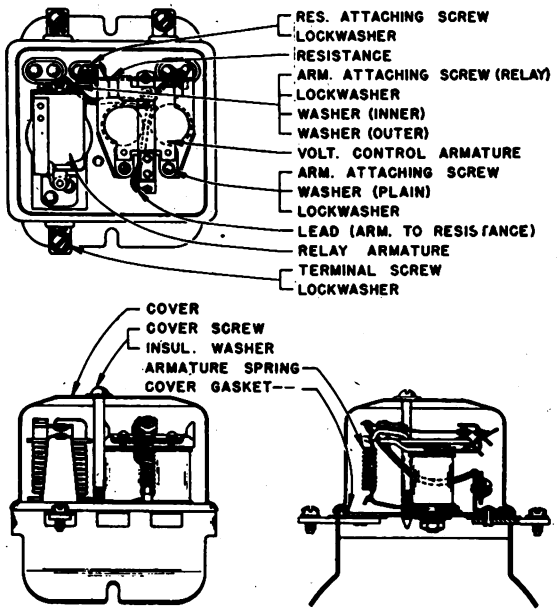


Fig. 47. Cross Section through Voltage Regulator

out relay or step-voltage control armature requires replacement. The adjustments of the unit are delicate and must be made with great precision in order to obtain normal operation of the unit. Actually, only a few parts can be removed from the unit. It is recommended that, if service is required on any of the parts, the entire control unit be replaced as an assembly.

(1) Disassembly Procedure

(a) Remove Cover

Remove cover by removing screw and washer.

b) Remove Resistance

Remove resistance by unscrewing two screws and lock washers. This also disconnects lead soldered to voltage control armature.

(c) Detach Voltage Control Armature

Detach voltage control armature by removing spring, two screws, lock washers and washers. Lead may be unsoldered from armature.

(d) Detach Cutout Relay Armature

Remove two screws and lock washers and remove cutout relay armature and flat two hole washer. It is not necessary to unsolder lead from two hole clip washer.

(2) Inspection of Parts

All parts should be examined, with particular emphasis on the contact points in both the cutout relay and the voltage control unit. Points which are dirty, burned, or oxidized should be cleaned. The point and fiber bumper on the flat spring on the voltage control armature, and the point on the cutout relay armature should be assembled tightly. Leads, windings, insulators, screws, washers, must all be in good condition. If the windings,

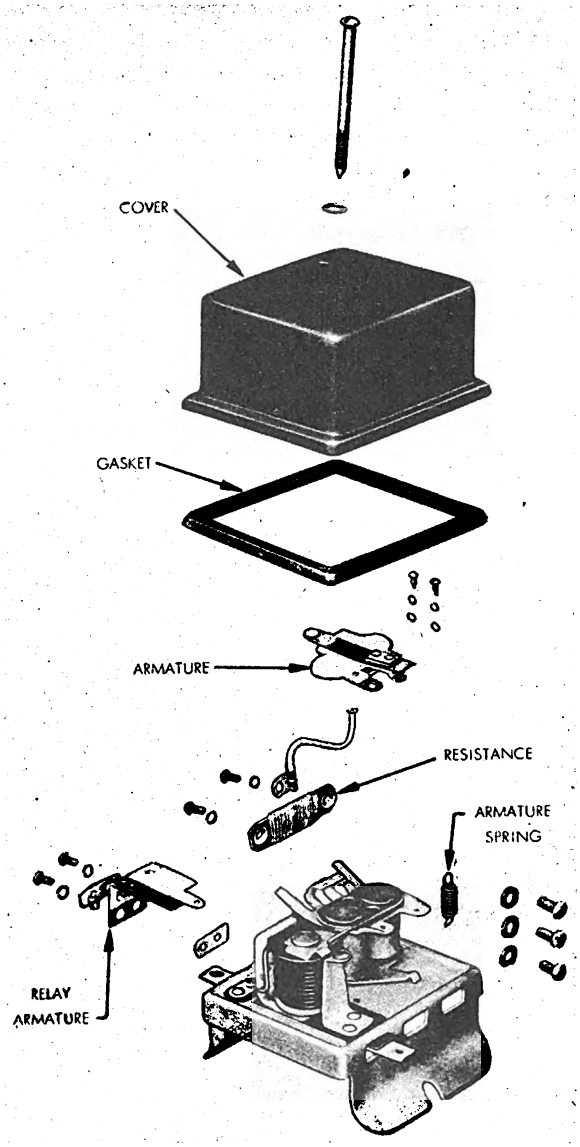


Fig. 48. Component Parts of Voltage Regulator

stationary cutout relay contact point, insulators, are burned or otherwise defective, replace the complete voltage control. The voltage control is a riveted construction and only the parts shown disassembled in Figure 48 are serviceable items.

(3) Contact Points

Contact points which are pitted, rough, dirty, or burned may be cleaned with a stroke or two of a clean, fine-cut contact file. Blow out all dust. Be careful in cleaning the voltage control unit contact points to avoid bending or distorting the flat armature spring. The spring should hold the two points in contact with the proper spring tension. Never use emery cloth or sandpaper to clean the points, since small particles of emery or sand might embed in the point surfaces and prevent good contact. Do not touch the point surfaces after cleaning them, since any trace of oil or grease may cause the points to burn.

(4) Assembly of Voltage Control

(a) Attach Cutout Relay Armature

Attach cutout relay armature with two screws and lock washers. Thick two hole washer goes under relay armature, while thin two hole clip washer goes over armature.

(b) Attach Voltage Control Armature

Attach voltage control armature with two screws, lock washers and washers. Solder lead to armature if it has been unsoldered and hook spiral spring between armature and lower spring support.

(c) Attach Resistance

Attach resistance with two screws and lock washers. This also attaches other end of lead from voltage control armature. Lead should be attached under screw and lock washer nearest voltage control unit.

(d) Attach Cover with Screw and Washer

(5) Adjustment Procedure

The cutout relay and voltage control unit are checked and adjusted as follows:

(a) Cutout Relay Adjustments

Air Gap (.015 in.) — With the contact points held closed, check the air gap between the armature and the center of the core (figure 49). To adjust, loosen the two screws at

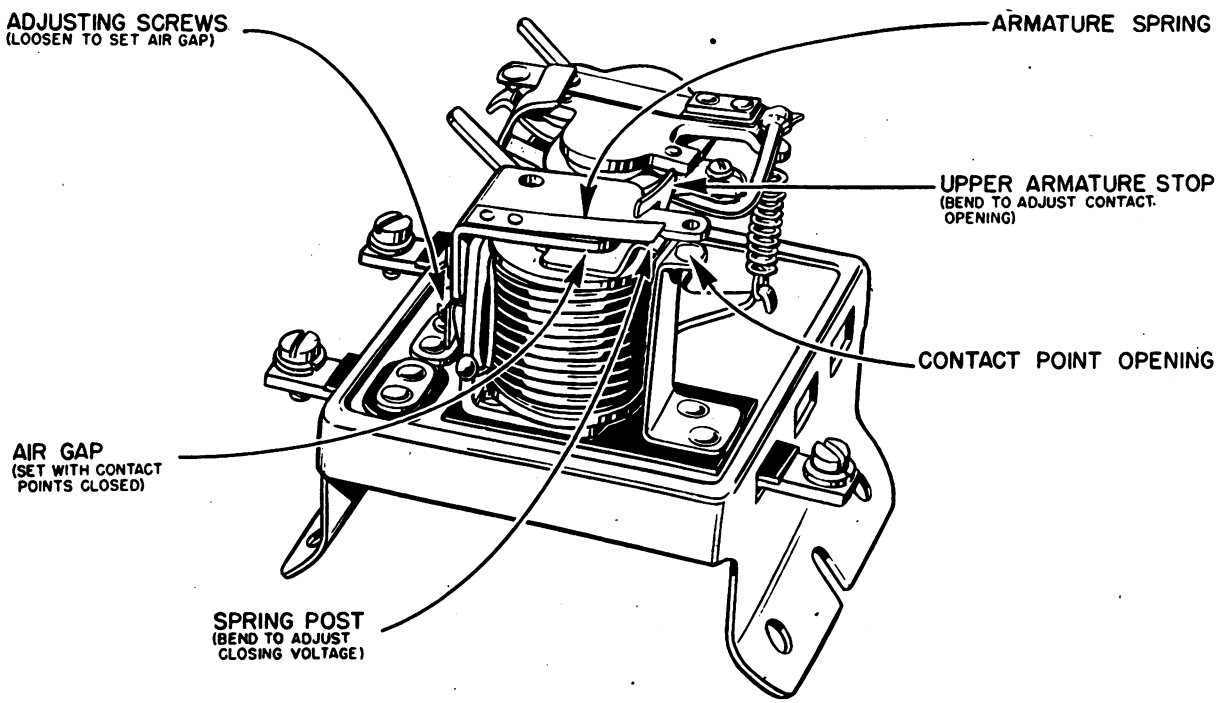


Fig. 49. Cut-Out Relay Adjustments

the back of the relay and raise or lower the armature as required. Tighten screws securely after adjustment.

Point Opening (.020 in.)—Measure point opening with points open. Adjust by bending the upper armature stop (Figure 49).

Closing Voltage (Figure 51)—Connect voltage control to generator and battery to check relay closing voltage. Connect voltmeter from "GEN" terminal to voltage control base. It is not necessary to connect ammeter into circuit unless it is desired to measure generator output. Gradually increase generator speed and note voltage at which relay points close. Adjust by bending up on the spring post to increase the spring tension and raise the closing voltage. Bend down to lower closing voltage.

(b) Voltage Control Adjustments (Fig. 50).

Contact Spring Tension (0.7-1.[illegible]oz.)—The flat contact spring tension is measured at the contacts with the armature up. The pull required to separate the points should be carefully measured. Adjust by slightly bending the flat spring.

Air Gap (0.045 in.)—The air gap is measured with the armature held down against the lower armature stop, between the center of the core and the armature. Bend the lower armature stop to adjust.

Armature Travel (0.045 in.)—Release the armature and gauge the travel between the armature and the lower armature stop. Adjust by bending the upper armature stop.

Point Opening (0.015 in.)—With the armature held down against the lower armature stop, measure the contact point opening. Adjust by bending the contact spring post.

Voltage Setting (Figure 52)—The opening voltage (14.1-14.7 with unit hot—150° F.) of the contact points is checked by connecting the meters and 1/4 ohm variable resistance as illustrated (in Figure 52) to the voltage control, generator and battery. Increase generator speed slowly and note the voltage at which the contact points of the voltage control unit open. VOLTAGE CONTROL MUST BE AT OPERATING TEMPERATURE AND COVER MUST BE IN PLACE. If the battery is low, the voltage control may not operate. To obtain sufficient voltage to cause the voltage control points to open, operate the generator at medium speed and slowly cut in re-

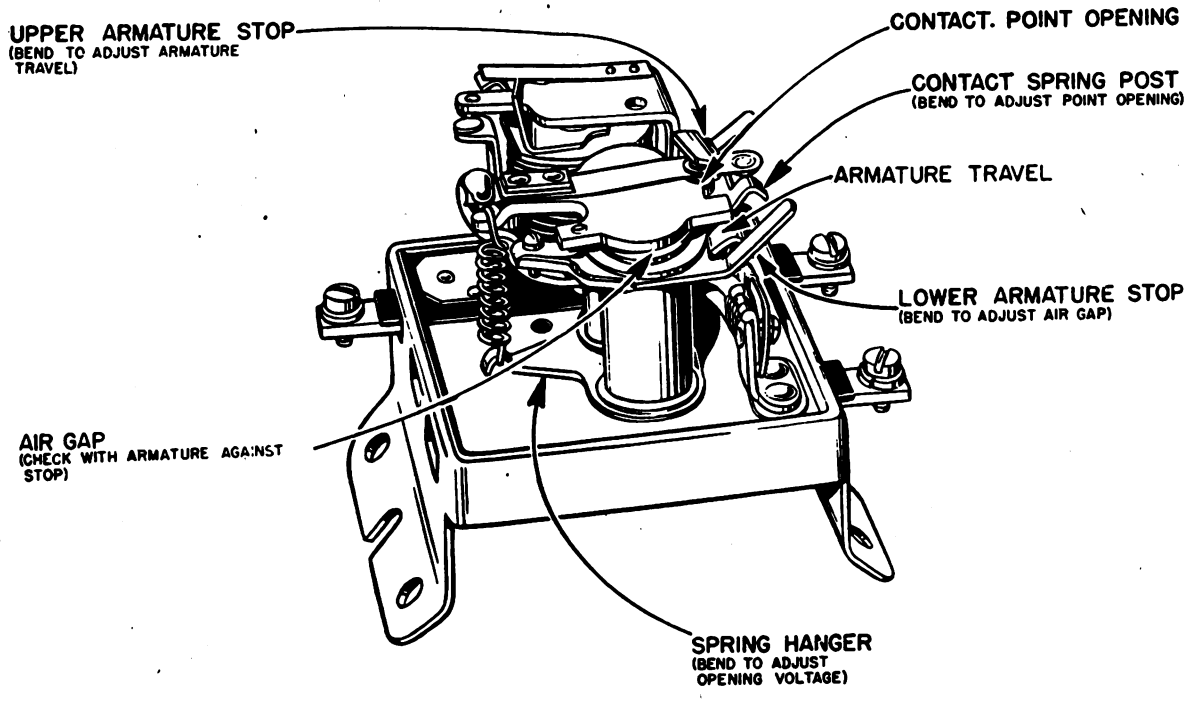


Fig. 50. Step Voltage Control Adjustments

sistance until the voltage control points open. Note voltage. To adjust, bend the spiral spring hanger down to increase the opening voltage setting. Bend up to lower the setting. The closing voltage (12.0 max. volts) is checked by reducing the generator speed or cutting out resistance so the voltage drops to the value at which the points close. Adjust by adjusting the air gap as above. Increase the air gap to raise the closing voltage, or decrease the air gap to lower the closing voltage. After readjusting the air gap, readjustment of the contact point opening may be required.

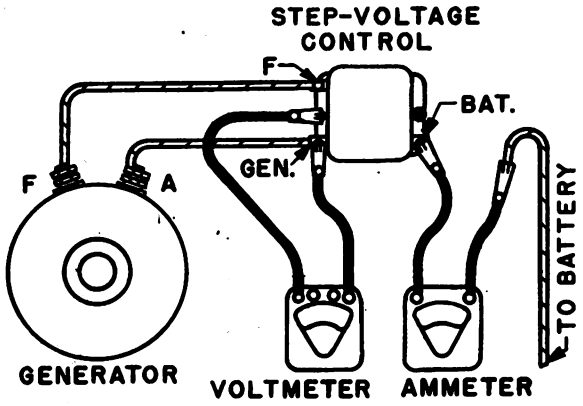


Fig. 51. Meter Connections to Check Cut-Out Relay

j. Assembly Procedure

(1) Field Frame Assembly

(a) Assemble Field Windings

Place field winding assembly, with pole shoes in field frame. Insert pole shoe spreader and tighten shoes against frame. Install and tighten pole shoe screws with pole shoe screwdriver. Winding with lead with stud most be placed so stud will thread through proper hole in frame.

(b) Attach Terminal Studs

Attach terminal studs to frame with one each insulator, flat washer, lock washer, and nut. Attach leads with lock washers and nuts.

(2) Commutator End Frame

(a) Install Bushing, Brush Arm and Stop Pins

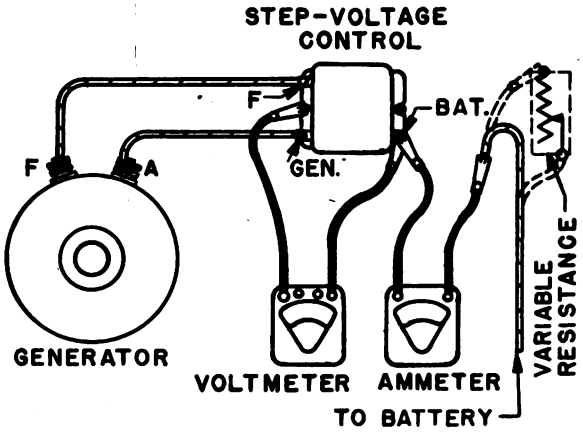
Install new bushing, brush arm and stop pins, if required. Finish bushing to size.

(b) Mount Third Brush Plate

Note relationship of third brush plate and frame and attach third brush plate with clamp, screw, and lock washer. Fasten third brush spring and ground lead to frame with attaching pin.

(c) Assemble Brush Springs and Arms

Assemble brush spring and arms to hinge pins. Straight end of spring rests on back of brush arm, while bent end of spring should be caught with pliers and hooked over stop pin. Fasten brush and ground lead to grounded holder with screw lock washer and brush washer.



NOTE: AMMETER NOT NECESSARY EXCEPT TO CHECK GENERATOR OUTPUT

Fig. 52. Meter Connections to Check Step-Voltage Control and Generator Output

(d) Attach End Cover Plate

Attach end cover plate and gasket with 3 screws and lock washers.

(3) Drive End Frame

(a) Procedure—Install Ball Bearing

Install felt washer, retainer, and bearing in frame. Cupped side of retainer is away from bearing so it does not touch inner race of bearing. If ball bearing does not slip into frame easily, it may be pressed in with an arbor press. Secure bearing in place with

gasket, retainer plate, three lock washers and screws.

(4) Assembly to Generator

(a) Install Armature in Drive End Frame

Place space washer on armature shaft. Insert shaft through bearing in drive end frame. It may have to be pressed in with an arbor press. Place collar on shaft.

(b) Install Pulley on Shaft

Place key in keyway and press pulley on shaft in arbor press. Fasten with lock washer and nut.

(c) Attach Field Frame

Align dowel and holes and place field frame in position on drive end frame.

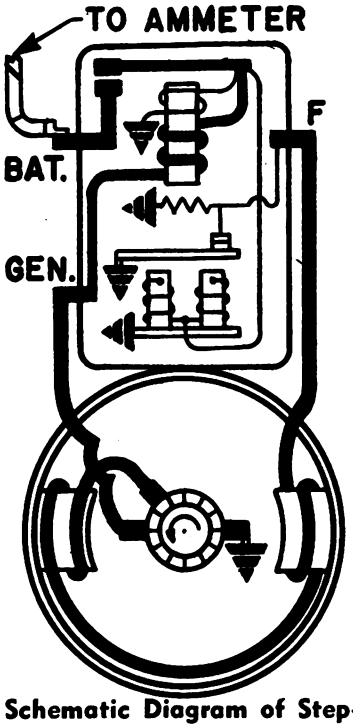


Fig. 53. Schematic Diagram of Step-Voltage Control Unit

(d) Attach Commutator End Frame

Align dowel and holes and place commutator end frame in position on field frame. The three brushes may be lifted so they will be out of the way of the commutator during this assembly procedure. Secure commutator end frame to field frame with two thru bolts and lock washers.

(e) Attach Insulated and Third Brush Leads

Attach insulated and third brush leads and brushes to insulated and third brush holders with one each screw and brush washer. Clips go UNDER lock washers. Drop brushes down on commutator in operating position.

(f) Install Cover Band

Install cover band and secure with screw.

(g) Attach Step-Voltage Control Unit

Attach unit to frame with two screws and lock washers. Attach lead from generator "A" terminal to "GEN" terminal and from generator "F" to field terminal of control unit.

(5) Testing and Adjusting Generator

(a) Procedure

Mount generator on test stand, connect to test stand ammeter and voltmeter in accordance with test stand instruction pamphlet. Connect ammeter lead to "GEN" terminal and ground "F" terminal with a jumper lead. Operate generator at speed at which maximum output is obtained. If output exceeds 11-13 amperes with generator cold, immediately remove cover band, loosen third brush ring locking screw in commutator end frame and move third brush away from main brush to obtain 11-13 amperes. Generator output at specified voltage must be checked. If specified voltage cannot be attained, 1/4 ohm variable resistance of sufficient current carrying capacity should be inserted into the charging circuit and resistance cut in until the specified voltage is attained. Operate until generator reaches operating temperature (about 30 minutes). At operating temperatures, the generator should produce 6-8 amperes at 14.1-14.5 volts, at 2400 r.p.m. (read speed if an indicator is available). Adjust by moving third brush toward the main brush to increase output, or move third brush away from main brush to lower output. After adjustment is complete, tighten the locking screw and replace cover band.

Always check the generator output at the specified voltage. Never set the output beyond the specified value. Failure to observe these rules may cause a high setting which will damage the generator.

k. Installation

After the generator is installed on the Power Unit and reconnected, always connect momentarily with a jumper lead between the generator and battery terminals "GEN" and "BAT" BEFORE STARTING THE ENGINE. This allows a momentary surge of battery current to flow into the generator which correctly polarizes it with respect to the battery it is to charge. This should ALWAYS be done after any check, adjustment, repair, or installation of the generator or step-voltage control.

CAUTION: Never operate the generator with the field circuit connected and the charging circuit open (open circuit operation) which since this will allow a high voltage to build up within the generator which will damage the field and armature.

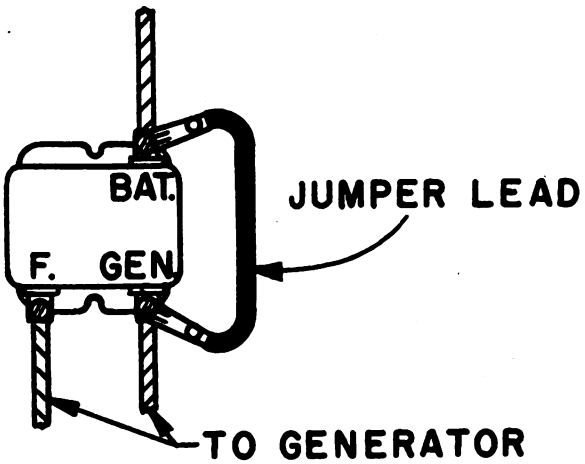


Fig. 54. Jumper Lead to Polarize Generator

30. Storage Battery.

a. Electrolyte.

To prevent failure of battery it is important that the electrolyte be kept at the proper level at all times.

b. Care of Battery.

Keep the vent hole in the battery filler caps open.

Inspect the battery once a week or oftener to keep the water at the correct level and to maintain the correct specific gravity. The specific gravity reading of about 1.250, corrected to 80 degrees Fahrenheit, should be maintained. (See Battery Testing Chart following.) **Caution: If water is added to the battery when the temperature is near the freezing point (32 degrees Fahrenheit) always run the engine long enough to mix the water and the electrolyte so that the water will not freeze.**

Acid or electrolyte should never be added except by a skilled battery man. Under no circumstances should any special "dopes," solutions, or powders be added.

The electrolyte in each cell should be approximately one-half inch above the plates. When the electrolyte is below this level, pure distilled water should be added. Never use hydrant water, or any water which has been in a metal receptacle. Keep on hand a glass jar of pure distilled water for battery use only. Use a clean syringe to put water in a cell.

The battery cable terminals must be clean and tight. Use hot water to remove any terminal corrosion, and also for cleaning the top of the battery. Brighten the terminal contact surfaces with wire wool, apply a light coat of vaseline and reassemble. Be sure that the terminals are clamped tightly and that the battery is clamped securely in place.

c. Battery Testing Chart.

Condition	*Cause*	*Procedure*	*Remedy*
1. Hydrometer test shows all cells over 1.250 specific gravity and readings practically equal (within 10 or 15 points).	Battery is probably in good condition.	Battery does not require a recharge in summer months, but may require a boosting charge in cold weather.	Examine battery terminals to see that they are tight and clean; ascertain charging rate of generator.

c. Battery Testing Chart (continued)

Condition	*Cause*	*Procedure*	*Remedy*
2. Hydrometer test shows all cells reading 1.250 or less and readings practically equal (within 10 or 15 points).	Demand from battery greater than input from generator.	Recharge battery.	Make a thorough check on electrical system for short circuits, loose connections, and charging rate of generator. Recommend an increase in charging rate to suit.
3. Cells unequal (20 or more points variation) and highest reading over 1.225 specific gravity.	a. Short circuit in low cell or cells. b. Evaporation caused by overcharging. c. Unnecessary addition of acid. d. Loss of electrolyte by leakage.	Make momentary high rate test on each cell.	If high rate test shows that all cells are within from 1 to 10 volts of each other, recharge battery until gravity of electrolyte remains constant for 4 hours. Adjust gravity of all cells by adding water or small amount of acid (1.400 specific gravity or less).
4. Cells unequal (20 or more points variation) and highest cell reading 1.225 or less.	a. Short circuit in low cell or cells. b. Evaporation caused by overcharging. c. Unnecessary addition of acid. d. Loss of electrolyte by leakage.	Recharge battery if possible, and then make momentary high rate discharge test on each cell.	If battery takes a recharge and high rate test shows all cells within from 1 to 10 volts, adjust gravity of all cells by adding water or small amount of acid (1.400 specific gravity or less).
5. Hydrometer tests show cells with gravity readings over 1,300 at 80 degrees Fahrenheit.	a. Unnecessary addition of acid to cells.	a. If battery has not been operated for a long period or at an excessively high gravity, this condition may be remedied by careful treatment.	a. Drain out all solution from cells. Refill with dilute (1.000 specific gravity) electrolyte and charge at a low rate of current until gravity of electrolyte remains constant for 4 hours. Then drain cells again and refill with 1.285 specific gravity electrolyte and after 3 hours charging adjust gravity to 1.285. Continue charge until the gravity of all cells is constant for a period of 2 hours.
	b. Addition of battery compounds commonly known as battery "dope" solutions.	b. No positive assurance can be given that conditions arising from the use of battery compounds can be remedied. A number of battery manufacturers construe the use of battery "dope" solutions as grounds for cancelling their warranty.	b. Treat as in preceding paragraph (a). Under no circumstances should battery compound be introduced into a battery.

c. Battery Testing Chart (concluded)

Condition	*Cause*	*Procedure*	*Remedy*
6. Battery is fully charged but hydrometer tests show gravity to be 1.265 or less at 80 degrees Fahrenheit.	Excessive evaporation usually caused by overcharging.	Adjust gravity of electrolyte to proper limits by adding small amounts of acid (1.400 specific gravity or less).	Ascertain charging rate of generator and reduce the rate if necessary.
7. Frequent additions of water to all cells of battery.	Excessive overcharging.		Reduce charging rate of generator.
8. Container cracked, causing frequent additions of water to one cell of battery.	a. Loose installation. b. Stone bruise c. Frozen battery.		Replace with new container.
9. Bulge in battery container.	Excessive temperature, probably caused by overcharging.	Same as for condition 3 or 4.	If high rate test indicates any weak cells, the battery probably is beyond repair. In all cases, ascertain charging rate and reduce the rate if necessary.
10. Corrosion on battery terminals.	a. Excessive charging rate causing spray of acid on terminals. b. Lead coating destroyed on terminals.	Remove terminals from posts. Clean posts and terminals thoroughly. Replace terminal cable if corroded excessively.	Grease terminals and posts thoroughly to prevent access of acid to terminals, bolts and nuts. Ascertain charging rate and reduce rate if necessary.
11. Broken terminal posts.	a. Loose battery installation. b. Terminal cable too short.	Remove battery and build up new terminal post.	Replace terminal cable with one of proper length; tighten battery in carrier and also battery terminals on posts.

d. Tools.

To diagnose the conditions stated in the foregoing paragraphs the battery station must have the following tools:

(1) A good, accurate hydrometer graduated to read from 1.100 to 1.325 with divisions to indicate differences in gravities within ten points.

(2) A good, accurate thermometer graduated to read as high as 115 degrees Fahrenheit. Many batteries are damaged because of high temperatures; this condition can be determined only by means of a thermometer.

(3) A good, single-cell-type voltmeter, having a three-volt scale with division showing one tenth of a volt (possibly an additional scale reading 15 volts to read total battery voltage).

(4) A good, high-rate discharge tester; this instrument may be either a single-cell tester or a more elaborate type adapted to test the complete battery.

e. Charging Instructions.

Regular starting and lighting batteries should be charged at a current rate not exceeding one ampere per positive plate. A rate of four or five amperes is usually suitable for the majority of batteries. During the charge, a thermometer should be used to check the temperature of the electrolyte in the cells. If the temperature exceeds 110 degrees Fahrenheit, reduce the charging rate immediately, or else discontinue the charge until the battery temperature is less than 90 degrees Fahrenheit. Charge the battery until all cells gas freely and the specific gravity of electrolyte remains constant for four hours. Ad-

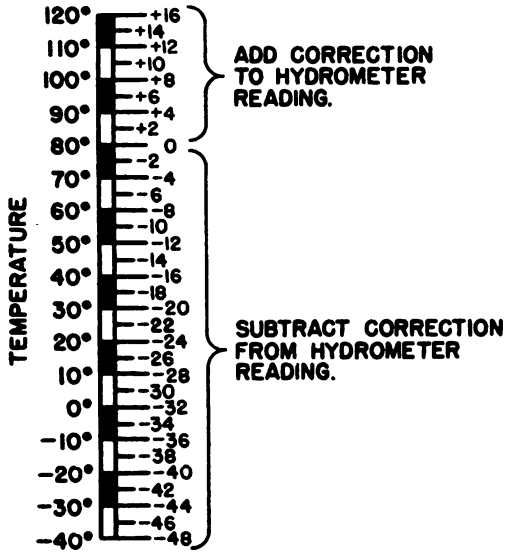


Fig. 55. Hydrometer Reading Correction Chart

just the gravity of cells at end of charge to proper limits if necessary. The specific gravity of a fully charged battery should be between 1.275 and 1.295 at a temperature of 80 degrees Fahrenheit.

f. Conditions Within the Battery.

No battery should be returned to the manufacturer, nor should it be opened for inspection before its condition is diagnosed in accordance with the procedure given in this chart. When readings obtained with the high-rate test differ considerably more than one tenth of a volt, it is proper to open the battery. The separators may be found to be worn thin in places, or broken, or split. If the plates are in good condition, however, the separators may be replaced and the battery recharged. If the positive plates are badly buckled or the positive grids are broken, the battery is not in condition for further service. Such a battery either was badly overcharged or else may have been in service for a long period of time.

Example: A battery cell has a hydrometer reading of 1.245 at ten degrees Fahrenheit. What is specific gravity at 80 degrees Fahrenheit?

From the correction scale, illustrated in Fig. 55, we find that the correction is minus 28 points in gravity. Subtracting 28 points from hydrometer reading gives the correct specific gravity of the battery, 1.217 at 80 degrees Fahrenheit.

31. Control Switch Box.

a. General.

The purpose of these controls is to shut down the engine when the oil pressure drops below five pounds per square inch, or when the water temperature rises above 195 degrees Fahrenheit, while the engine is running.

The sequence of operation is as follows: If the water-temperature pilot is lighted, the thermostat-reset button should be pressed, and, if necessary, held down while starting. Pressing the start button will drop out the relay and turn out the oil-pressure pilot light if it is on. The start button must be held in until the oil pressure builds up. There is no danger of holding the start button in too long, since once engine is running the Bendix drive automatically disconnects the starter when the engine is started.

Caution: If the engine fails to start do not hold starting button in for more than 30 seconds without allowing the cranking motor to cool.

If the oil pressure pilot lights when the start button is released, the oil level should be checked. This light could be caused, however, by the oil being so cold that the pump cannot build up pressure, or by the oil in the pipe leading to the oil-pressure switch having been solidified by the cold so that it will not transmit the pressure. This condition will correct itself after the engine reaches operating temperature.

After the engine is running, if the oil pressure drops until the oil-pressure switch closes, the relay coil is connected across the generator and the relay closes. When the relay is closed, the coil is connected directly across the battery and remains closed until the start button is touched. This opens the coil circuit so that the relay drops out and the circuit cannot be closed again until oil pressure fails while the engine is running. Closing of the relay also makes a connection from the magneto to ground, shorting the magneto and stopping the engine.

Some power units are equipped with oil pressure safety control only in which case,

instructions pertaining to thermostatic control are to be disregarded.

b. Water Temperature Control.

The thermostat has a two-circuit single-throw switch which connects both of the terminals to the grounded side of the battery whenever the temperature of the water in the engine exceeds 195 degrees Fahrenheit. One of these terminals is connected to the magneto so that the magneto is shorted when the thermostat switch closes. The other terminal is connected to one side of the pilot light, which indicates when shutdown is caused by high water temperature. The other side of this pilot light is connected to the live side of the battery so that it will light when the thermostat switch closes. After the switch has closed, it will not reopen automatically, no matter how cool the water in the engine. The reset button on the top of the thermostat cabinet must be pressed before it will open, turning out the pilot light and removing the short from the magneto so that the engine can be restarted. When it is necessary to start the engine immediately after it has been shut down because of too high water temperature, the radiator should be filled and the reset button held down while the start button is pushed. The reset button should be held down until the cooler water has been circulated to reach the thermostat bulb. It may then be released and the engine will continue to run.

c. Oil Pressure Control.

The oil pressure switch closes whenever the oil pressure drops to less than five pounds per square inch, and opens when the oil pressure rises above nine pounds per square inch. Whenever the engine stops, the oil pressure will drop to zero; the oil pressure switch therefore cannot be used to light the indicating pilot as with the thermostat since oil failure would then be indicated whenever the engine was not running. Hence it is necessary to add a relay which will close whenever the oil pressure drops too low while the engine is running, but will not close when the drop in oil pressure is caused by the engine slowing down. This selective action is accomplished by connecting the relay coil across the generator which charges the storage battery. Whenever the engine is running at nearly normal speed, the generator will be charging the battery and its voltage will be enough to close the relay whenever low oil pressure causes the switch to close. However, when the engine slows down (stopped manually) the generator voltage drops until the automatic cutout opens, disconnecting it from the battery, and the generator voltage continues to drop as the speed decreases. The oil pressure drops more slowly so that when the oil pressure switch finally closes, the generator voltage is not sufficient to close the relay and therefore oil failure will not be indicated.

In case of generator failure, the engine can still be run, but the low-oil-pressure safety feature will not be working. If it is important to retain the low-oil-pressure safety feature, it will be necessary, whenever the engine is run, to connect terminal 1 of the pressure switch directly to the battery for as long as the generator is not working. With this connection, oil failure will be indicated each time the engine stops, but the engine will be stopped whenever the oil pressure fails. The start button can be touched to turn out the oil-failure pilot light when the engine is stopped.

d. Audible Alarm with Controls.

On some of the later models of this power unit, an audible alarm and a flasher light was added to the safety control circuit. This type of installation differs slightly from the former type in that in case of oil pressure failure or excessive water temperature rise, adequate warning is given, but the power unit is not shut down.

In case either abnormal condition arises, and the warning is given, it is possible to disconnect the horn and flasher light from the circuit, until the abnormal condition can be corrected, by depressing the "RESET" button. The corresponding pilot light will remain lighted as a constant reminder until the condition is corrected and the control reset.

The manual reset button for the water temperature control is on top of the thermostat switch cabinet and must be depressed before the thermostat switch will open, turning out the pilot light, and restoring the alarm system to the circuit.

Manual resetting for the oil pressure warning circuit is accomplished by pressing the "START" button slightly, turning the pilot light out and, restoring alarm system to circuit.

Water temperature of engine can be checked with thermometer located in exhaust manifold. Oil pressure can be checked with gage located in fuel tank support.

If it is desirable to have the flasher light in operation after it has been disconnected with the horn from the circuit, remove convenience plug of light cord from its receptacle and insert it in the receptacle on the main control panel.

32. Carburetor.

In servicing the carburetor, refer to Figs. 56 and 57.

a. Main Jet System.

The main or high-speed jet (2) exerts its principal influence at the higher engine speeds. Fuel from the bowl is metered through the main jet and discharged into the air stream at the point of greatest suction, in the secondary venturi (3) through the main discharge jet (4).

The main jet determines the maximum amount of fuel to be obtained for high-speed operations. The main-jet adjustment (8) reduces this amount if it is turned toward its seat. Ordinarily the main-jet adjustment has no effect after it is two turns open.

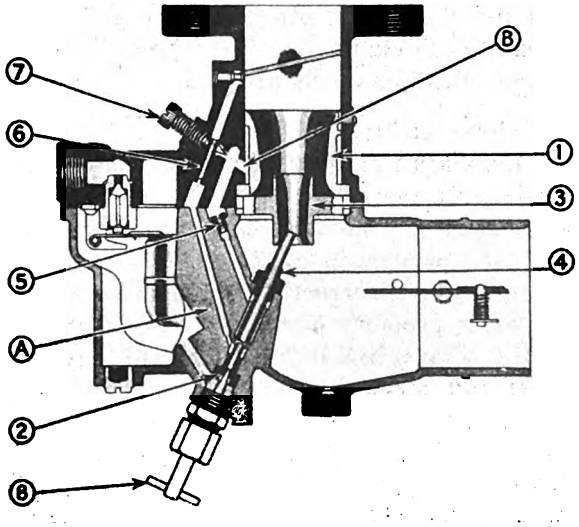


Fig. 56. Cross Section through Carburetor

To set this adjustment, retard the spark and move the throttle to approximately one-quarter open. Turn the adjustment clockwise, shutting off the fuel until the engine speed is decreased by the lean mixture. Open the adjustment until the engine speed is decreased by excess fuel. The adjustment should be set at a position halfway between these two extremes.

b. Compensating System.

The compensating system consists of the main discharge jet and the well vent (5). The flow of fuel from the main jet is controlled by the size of the well vent and the size of the main discharge jet. The mixture delivered through the main discharge jet may be made richer either by increasing the size of main discharge jet or by decreasing the size of the well vent. Conversely, the mixture may be made leaner by reversing this procedure.

c. Idling System.

The idling system consists of the idling jet (6) and the idle adjusting needle (7). The idling jet receives its fuel from the main jet through channel (A). The fuel is metered through the idling jet and is mixed with air which is admitted from behind the venturi (1) through channel (b). The idle-adjusting needle controls the amount of air which is admitted to the idling system, which functions only at idling and low speeds. At these speeds, the throttle plate is almost closed and there is a very strong suction past the edge of the throttle plate. This suction draws the mixture of fuel and air from the idling jet which discharges into the air stream through the priming plug.

d. Removal.

Removal of the carburetor may be accomplished in the following manner.

(1) Disconnect the air cleaner and connection from the carburetor.

(2) Disconnect the choke wire and remove the lever from the end of the governor operating cross shaft.

(3) Disconnect the fuel inlet line.

(4) Take out the carburetor-to-manifold cap-screws and remove the carburetor by pulling away from the engine, using caution not to damage cross shaft or bushings.

e. Replacement.

The carburetor may be replaced by reversing the order of removal. Make certain that the gasket is in good condition and that the connections are tight.

f. Disassembly.

To repair the carburetor properly, follow the routine below.

(1) Loosen the clamp screw and remove the throttle lever.

(2) Remove idling adjusting screw (7) and spring.

(3) Remove assembly screws, using a screwdriver or a 5/16-inch wrench.

(4) Raise the throttle body slightly and loosen the gasket from the bowl assembly.

(5) Lift the throttle body and gasket clear of the bowl without damaging the float.

(6) Turn the throttle body upside down on the bench.

(7) Remove the body-to-bowl gasket.

(8) Remove the float axle, pushing it from the slotted end of the float-hinge bracket with a small screwdriver, and using the fingers to remove it the rest of the way.

(9) Remove the float and the fuel valve needle.

(10) Remove the fuel valve seat and gasket, using C161-85 service tool.

(11) Remove the secondary venturi (3) and the main venturi (1) as a unit.

(12) Remove the idling jet (6), using a small screwdriver with 3/16-inch blade.

(13) Remove the economizer jet and gasket, using a screwdriver. (This jet is located in the lower face of the throttle body, directly under one of the throttle shaft bearings.)

(14) **Before removing the throttle plate, refer to paragraph 32h.** Then proceed as directed and remove throttle-plate screws, plate and shaft.

(15) Remove the throttle stop-lever taper pin, using a small punch and a light hammer.

(16) Drive the throttle shaft out of the stop-lever hub, using a small drift and a light hammer.

(17) Remove throttle-shaft packing retainers and packings, using a screwdriver to pry out the retainers. (See paragraph 32r.)

NOTE: Do not remove the identification disk which is riveted to the bowl cover, the throttle stop, the venturi locating pin, the priming plug, the float hinge bracket, nor the channel plugs.

(18) Remove the well vent (5), using a small screwdriver.

(19) Remove the main discharge jet (4) and gasket, using C-161-9 service tool.

(20) Remove lower plug (or main-jet adjustment (8), using a one-half-inch open end wrench.

(21) Remove the main jet (2) and gasket, using C161-1 service tool (or suitable screwdriver).

(22) Remove air-shutter lever retainer nut, using a 5/16-inch wrench.

(23) Remove air-shutter lever.

(24) Remove air-shutter bracket retainer screw and bracket, using a one-half-inch wrench.

(25) Remove air-shutter screws and lockwashers.

(26) Remove air-shutter and shaft.

(27) Remove air-shutter shaft hole plug, using a one-half-inch wrench.

(28) Remove air-shutter shaft packing retainers and packings.

NOTE: Do not remove air-shutter stop pin, bowl-vent channel plug, or drip plug.

(29) Clean the bowl and throttle body castings in gasoline or other solvent and blow through each channel with compressed air to make sure all channels are clean.

g. Reassembly.

(1) Install air-shutter shaft packings and packing retainers.

(2) Install air-shutter shaft and air shutter. (See paragraph 32j.) Be sure the air-shutter valve is correctly located and that air shutter is properly centered before tightening the screws and lockwashers securely.

(3) Install air-shutter shaft-hole plug and gasket, using a one-half-inch wrench.

(4) Hold air-shutter bracket in position and install retainer screw, using a one-half-inch wrench.

(5) Install air-shutter lever with retainer

nut and lockwasher, using a 5/16-inch wrench.
(6) Check for complete closing and full opening of air shutter and change position of the lever on the shaft, if necessary, to obtain correct operation.
(7) Replace main jet (2) and new gasket, using C161-1 service tool.
(8) Install lower plug (or main-jet adjustment) and new gasket, using a one-half-inch open-end wrench.
(9) Replace main discharge jet (4) and new gasket, using C161-9 service tool.
(10) Replace well vent (5), using a small screwdriver (no gasket required).
(11) Place new throttle shaft packings in retainers.
(12) Install throttle-shaft packing retainers (with packings), using a light hammer.
(13) Install new throttle shaft and throttle plate as described in paragraph (32)h. Be sure the shaft is installed so that the economizer valve milling on the shaft coincides with economizer channels in the casting. Use new throttle-plate screws.
(14) Set throttle stop-screw to hold throttle slightly open, as a preliminary adjustment.
(15) Install stop-lever assembly on the shaft so that the stop lever is resting against the stop pin when the throttle plate is wide open (straight up and down in the barrel).
(16) Drill and pin stop-lever hub to shaft, using a No. 45 drill and CT63-2 taper pin.
(17) Replace economizer jet and new gasket, using a small screwdriver (one-quarter-inch blade).
(18) Replace idling jet (6), using small screwdriver (3/16-inch blade). No gasket is required.
(19) Place main venturi (1) in position with locating groove on the locating pin.
(20) Place secondary venturi (3) in slots provided in main venturi.
(21) Replace fuel valve seat and new gasket, using C161-85 service tool.
(22) Replace fuel valve needle.
(23) Replace float assembly and float axle, using the handle end of a screwdriver to drive the float axle into the slotted end of the float-hinge bracket.
(24) Check position of float assembly for correct fuel level. As shown in Figure 57, the A dimension should be $1^{39}/_{64}$ inches plus or minus 3/64 inch. Float should move freely on its axle.
(25) Place a new bowl-to-body gasket in position on the throttle body. Be sure that the economizer channel in throttle body coincides with hole in gasket.
(26) Place bowl assembly in position on the throttle body, being careful to avoid damaging the float.

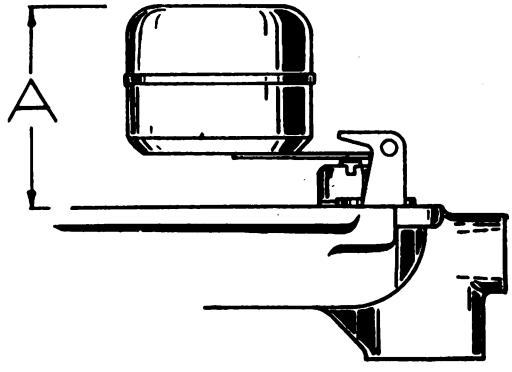


Fig. 57. Carburetor Float Adjustment

(27) Install assembly screws and lockwashers. Be sure to tighten screws evenly and securely, using a screwdriver or a 5/16-inch wrench.
(28) Install idling adjusting screw (7) and spring. Adjust to one full turn open as a preliminary adjustment.
(29) Install throttle lever and tighten clamp screw.

h. Throttle Replacements.
The location of the priming-hole plug in relation to the throttle plate is extremely important for uniform idling and part-throttle operation. To maintain a uniform relation between the priming-hole plug and the throttle plate, the throttle shaft and plate are assembled in the throttle body before drilling the body for the priming-hole plug, locating the hole in a definite relation to the throttle plate in each case. It is readily apparent from the foregoing that throttle plates and throttle bodies cannot be interchanged indiscriminately. When it becomes necessary to replace the throttle shaft or throttle plate, follow the routine below:
(1) Unscrew the throttle stop screw to permit closing of the throttle plate.
(2) Hold throttle in tightly closed position

and mark the inside of the throttle body close to the throttle plate with a steel scriber. (3) Using this scribed line as a guide, replace the throttle shaft or plate. If new plate used shows a noticeable variation from old one, select another new plate that fits very close to the scribed line when installed. (4) If throttle body has to be replaced, it is advisable to obtain a complete throttle body assembly, including shaft, plate, and priming-hole plug, built to the outline number which appears on the identification tag on the bowl cover.

i. Ordering Special Parts.
A round identification tag riveted to the carburetor bowl cover specifies the assembly outline number to which the carburetor was originally built. When ordering special parts, such as the throttle bodies, throttle lever and stop lever assemblies, throttle plates or throttle shafts, be sure to specify outline number of the carburetor to prevent errors in selecting parts required.

j. Bracket and Lever Assemblies.
The air-shutter bracket and lever assemblies can be installed on either side of the air inlet. Be sure to assemble on same side and in same position as when received for overhaul.

k. Rebushing Throttle Shaft Bearings.
This operation should not be attempted unless the shop is properly equipped for such work. Bushings must be lined reamed after installation. If facilities for this are not available, replace entire throttle body assembly.

l. Tool List.
The following tools are recommended for servicing the carburetor:

Main Jet Wrench C161-1
Main Discharge Jet Wrench C161-9
Fuel Valve Seat Wrench C161-85

33. Fuel Pump.

a. Operation. (Refer to Fig. 58)
The rotation of the camshaft eccentric ① actuates the rocker arm ②, which pulls the link, diaphragm ⑨, and pull rod assembly ③ downward against the diaphragm spring ④ pressure, creating a vacuum in the pump chamber ⑤.

On the suction stroke of the pump, fuel from the tank enters through the inlet into

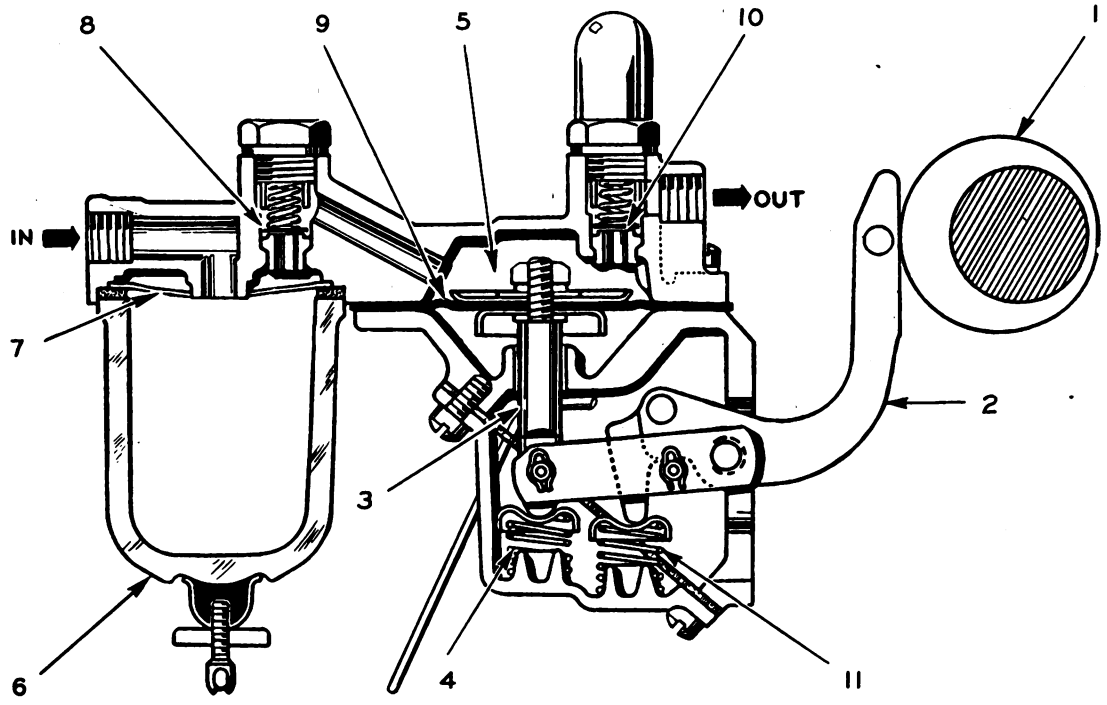


Fig. 58. Cross Section through Fuel Pump

the sediment bowl ⑥, passes through the screen ⑦ and on through the inlet valve ⑧ into the pump chamber ⑤.

On the return stroke, the diaphragm-spring ④ pressure pushes the diaphragm ⑨ upward, forcing fuel from the pump chamber through the outlet valve ⑩ and out through the outlet to the carburetor.

When the carburetor bowl is filled, the float in the carburetor will shut off the needle valve, thus creating a pressure in the pump chamber. This pressure will hold the diaphragm ⑨ downward against the spring pressure, where it will remain inoperative in the downward position until the carburetor requires further fuel and the needle valve opens. The rocker-arm spring ⑪ is merely for the purpose of keeping the rocker arm ② in constant contact with the camshaft.

b. Minor Adjustments.

If there is evidence of a lack of fuel in the carburetor or if the carburetor is flooding, check the float and needle valve for proper functioning. Examine the gas line for leaks, kinks, or obstructions.

NOTE: Check to see whether leak occurs at pipe fittings, allowing fuel to run down pump to flange, where it appears to originate. Do not use shellac or any other adhesive on diaphragm.

c. Maintenance.

IMPORTANT: Mark the top cover and body before disassembling so that in reassembling they are placed back in the same relative position.

(1) Body, Rocker Arm, and Link Assembly.

The links used with the rocker arm are assembled together by a link pin in the hole nearest the larger rocker-arm pin hole. The movement of the linkage and pull rod is procured by the rocker arm striking this link pin.

(a) Assemble the two side pieces making up the linkage, using the link pin and clips.

(b) Attach the linkage to the pull rod, using link pin and clips. Make certain that

Lack of Fuel at the Carburetor

Check as follows:

CAUSE	REMEDY
Gasoline tank empty.	Refill.
Leaky tubing or connections.	Replace tubing and tighten all pipe connections at the fuel pump and gasoline tank.
Loose valve plug.	Tighten valve plug securely, replacing valve plug gasket if necessary.
Bent or kinked tubing.	Replace tubing.
Dirty screen.	Clean the screen. Make certain that cork gasket is properly seated when reassembling.
Dirty or warped valves.	Remove valve plugs and valves. If valves are damaged or warped, replace them. Examine valve seats to make certain that there are no irregularities which prevent proper seating of valves. Place valves in valve chambers. Reassemble valve plugs and spring, making certain that springs are around the lower stems of the valve plugs properly. Use new gaskets under valve plugs if necessary.

Fuel Leakage at Edge of Diaphragm

Check as follows:

CAUSE	REMEDY
Loose cover screws.	Tighten cover screws alternately and securely, also check inlet and outlet pipe connections.

the sheared corners of the two side-pieces are assembled upward.

(c) Insert the rocker-arm pin through the holes of the pump body, linkage and rocker arm. Place washer over counter-bored end of pin and then swedge pin over against washer.

(d) Check assembly to see that rocker arm and linkage move freely on rocker arm pin.

(2) Diaphragm Assembly.

(a) With fuel-pump body held in a bench vise, place the pull-rod gasket over threaded end of pull rod, seating the gasket against the shoulder of the pull rod.

(b) Place lower diaphragm washer over threaded end of pull rod, cup-side down.

(c) Place diaphragm over threaded end of pull rod.

(d) Line up holes in diaphragm with screw holes in body diaphragm flange.

(e) Place upper diaphragm protector washer over threaded end of pull rod, cup-side up.

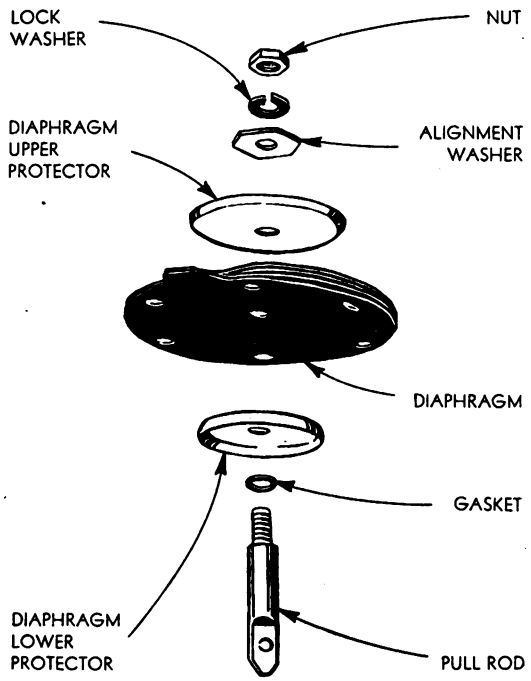


Fig. 59. Component Parts of Fuel Pump Diaphragm

(f) Place hexagon-shaped diaphragm alignment washer over end of pull rod. Assemble lockwasher and pull-rod nut, using special wrench to hold diaphragm alignment washer stationary and prevent diaphragm from twisting or turning. Tighten pull-rod nut securely.

NOTE: It is extremely important that the diaphragm be held exactly in alignment while the pull-rod nut is being tightened. If it is allowed to twist or become distorted, unsatisfactory operation of the pump will result.

(3) Valve Assembly.

(a) Blow out each valve chamber and make certain that no foreign particles are present which might prevent valves from seating properly. Also make certain that no burrs or irregularities exist in the valve seats and that the valve seats are securely held in place in the upper cover.

(b) Place valves in proper position in valve chambers. Make certain that valves lie flat against the valve seats and are not standing on edge or tipped.

(c) Insert valve spring on top of valves.

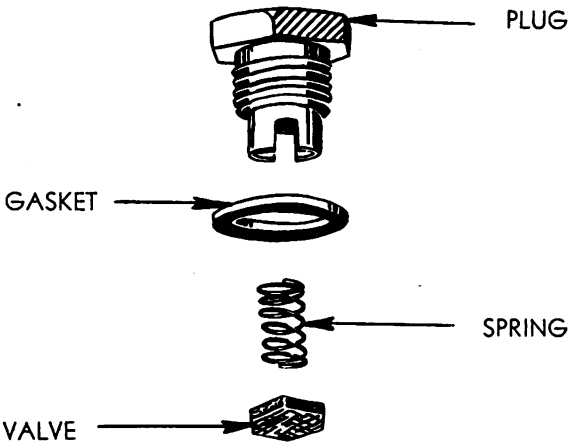


Fig. 60. Component Parts of Fuel Pump Valves

(d) Place fiber gaskets on valve plugs and then place stems of valve plugs into the valve springs and tighten plugs securely. Be certain that the stems of the valve plugs do not distort the valve spring but fit properly inside of them.

(4) Cover Assembly. The position of the diaphragm when the fuel pump cover is assembled is the most important single item to be observed in repairing and assembling fuel pumps. If the diaphragm is not in the proper position when the top cover screws are tightened, the pump will not function correctly

when replaced on the engine. Follow instructions carefully.

(a) Lay the cover on the pump in proper position, determined by marks made before pump was disassembled.

(b) Insert screws from top through lockwashers, upper cover and diaphragm.

(c) Tighten screws until they barely engage lockwashers.

(d) Pull priming lever up as far as possible, forcing diaphragm to its extreme high position; while it is held in this position, the cover screws should be tightened alternately and securely.

(5) Bottom Cover Assembly.

(a) Holding pump upside down, place rocker-arm spring cap and diaphragm-spring cap over the end of the pull rod and the projection on the rocker arm in their proper positions.

(b) Place gasket between pump body and lower cover.

(c) Locate springs for the diaphragm and rocker arm in their proper position on bosses in lower cover, then carefully fit lower cover to the pump body, making certain that the spring caps and spring remain in their proper positions.

(d) Tighten screws securely.

(6) Final Assembly.

(a) Assemble screen in pump cover. Make certain that it fits snugly around the gasoline inlet and edges of the casting.

(b) Place bowl gasket next to screen, then complete the assembly of the bowl and bail and screw assembly.

(7) Service Hints.

Never stretch or in any way change the tension of the valve spring, as this will change its pressure against the valve and reduce the capacity of the pump, particularly under extreme conditions. Always use new valve springs if in doubt as to the condition of the old springs.

(8) Valves.

Do not replace the fiber valves with makeshift valves, such as steel balls or metal disks. The fiber valve has proved superior to all other types of valves under all conditions.

(9) Gum in Gasoline and Sticking Valves.

Field reports sometimes ascribe faulty operation of the fuel pump to the formation of a gum-like substance on the valves. When this trouble is encountered, clean and polish the pump valves, valve seats, and gas strainer parts thoroughly.

Fuel Pump Trouble Chart

Trouble	*Cause*	*Remedy*
Broken rocker arm.	Visible.	Replace rocker arm.
Broken rocker arm spring.	Visible.	Replace rocker arm spring.
Defective or worn links.	Pump does not supply sufficient fuel.	Replace links. Also check for air leaks.
Broken diaphragm return spring.	Does not supply fuel to carburetor.	Replace spring.
Punctured or worn-out fuel pump diaphragm.	Fuel leaking through vent hole in body.	Replace complete diaphragm. Do not attempt to replace just one or two layers.
Leakage around pull rod.	Fuel leaking through vent hole in body.	Replace pull rod gasket, tightening pull-rod nut securely.

34. Governor.

a. General.

The governor acts, through oil pressure, to increase fuel supply. It has a useful work capacity of about six-inch-pounds over the full terminal-shaft range of 30 degrees. A spring, acting to cut off the fuel supply, has been incorporated in the fuel control linkage. This spring should oppose the action of the governor with a total resistance of 12-inch-pounds work for full terminal-shaft travel.

When the governor is installed, particular care should be taken to see that it is mounted squarely, and that the splined drive shaft of the ballhead is in exact alignment with the coupling sleeve on the drive from the engine. The hold-down bolts should be securely tightened and pulled down evenly.

The oil line between the engine-lubricating oil-pressure system and the governor should be installed. The proper linkage connections to the speed-adjusting shaft should also be made.

When making up the linkage connections between the TERMINAL SHAFT and fuel system, care should be taken to insure that when the TERMINAL SHAFT of the governor is in the fuel-off position, the fuel system will also be shut off.

After checking the foregoing carefully, so far as the governor is concerned, the engine may be started. After the governor begins to receive engine-lubricating oil, it will start to open the fuel, and continue in this direction until the engine fires. After the engine is running, it will control the speed at that value for which the governor speed adjustment is set.

The hydraulic feature of the governor is brought about by the admission of oil from the engine lubricating system, under pressure, to a gear pump in the governor base. The gear pump raises the oil pressure to a value determined by the relief valve spring opposing relief valve plunger. The oil under pressure is maintained, when the governor is operating, in the annular space between the reduced diameter on the pilot valve plunger, and the bore in the ballhead.

For any given speed-adjustment setting, the speeder spring has a definite compression, which must be opposed by the centrifugal force of the flyballs. When these two forces are in equilibrium, the land on the pilot valve plunger exactly covers the lower holes, or ports, in the ballhead. Under a steady load condition, speed will then remain constant and the pilot valve will pass only that amount of oil required to replace leakage, and maintain the required power piston position.

Assume that a certain amount of load is applied to the engine. The speed will drop below that corresponding to the speed adjustment setting on the speeder spring, the flyballs will be forced inward, and will lower the pilot valve plunger. This will admit oil pressure underneath the power piston, which will rise. The movement of the power piston is transmitted to the terminal shaft by the terminal lever. Rotation of the terminal shaft causes the fuel setting on the engine to be increased.

Simultaneously with the upward movement of the power piston, the droop rivet on the droop-adjusting bracket moves upward and raises the floating lever which pivots about the spring fork pin in the speed-adjusting lever.

When the load is applied, the engine speed drops slightly; as a consequence, the centrifugal force of the flyballs decrease. As the floating lever rises, the compression load on the speeder spring is reduced and this enables the flyballs to assume again their normal vertical position.

The land on the pilot valve plunger then again exactly covers the ports in the ballhead, and the power piston stops moving at a position corresponding to an increased fuel setting on the engine. The engine now carries the increased load at a slightly reduced speed because of the slight decrease in speeder-spring compression.

If the load is decreased, the engine speed rises and the flyballs move outward, lifting the pilot valve plunger. This opens the area under the power piston to the longitudinal drain hole in the ballhead, and allows the spring opposing the governor, which acts to decrease fuel, to force the power piston downward, and decreases the fuel setting on the engine. As this happens, the floating lever is depressed and increases the compression load on the speeder spring. The centrifugal force of the flyballs increases as the engine

speed is increased, and the increased compression on the speeder spring now forces the flyballs to return to their normal vertical position. The pilot valve ports are then closed, and the power piston movement ceases under the influence of the return spring.

If the governor is to be used for constant speed service, speed adjustment may be made by proper setting of the low limit adjustment screws. A wing nut is provided to lock the speed-adjusting screw in position.

The engine speed is then again steady at a reduced load and has increased slightly because of the increased compression load on the speeder spring.

b. Speed-Droop Adjustment.

That operation may be stable (without hunting), speed droop is introduced into the gov-

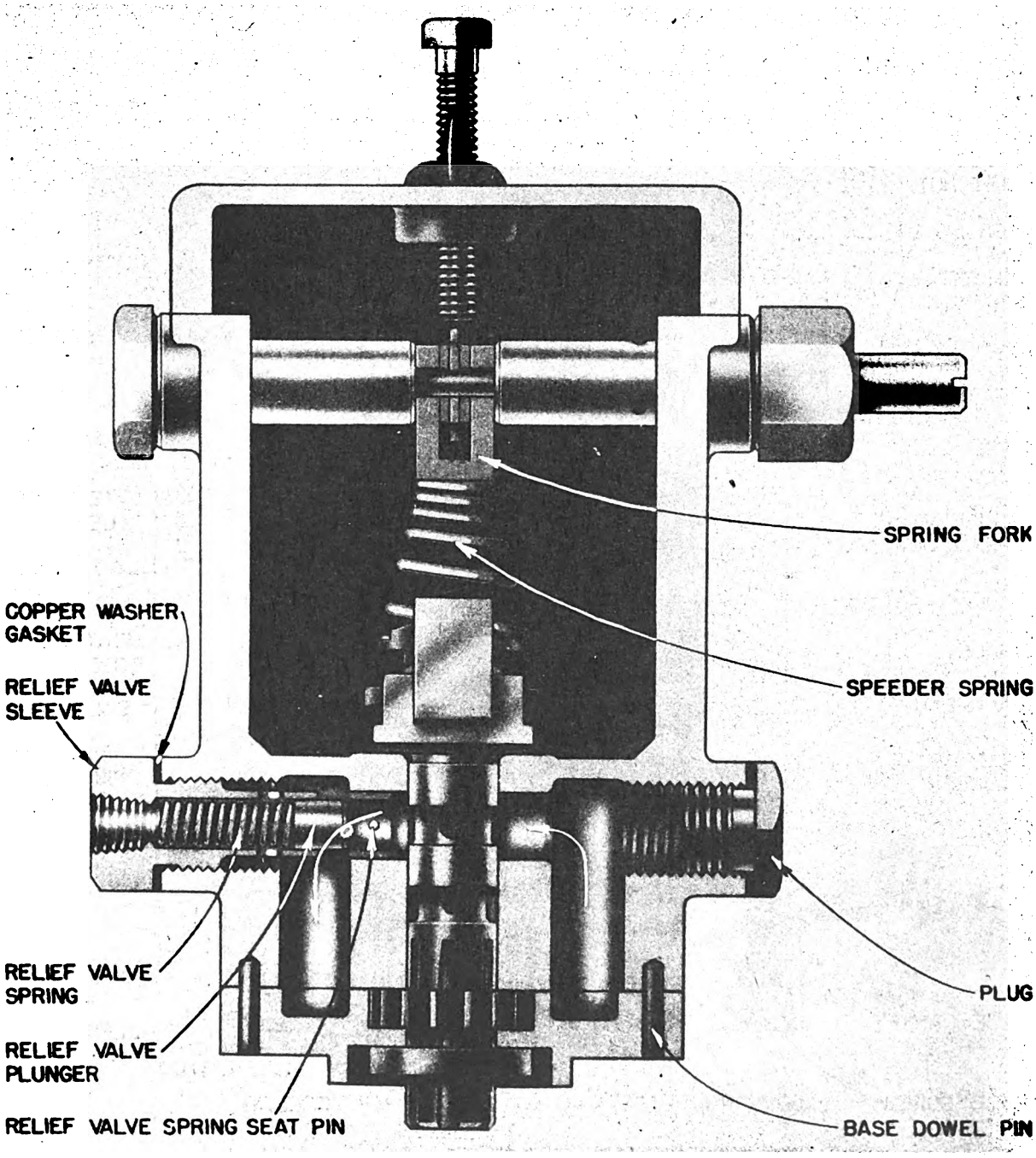


Fig. 61. Governor Cut-away Section—Front

erning system. By speed droop is meant the characteristic of decreasing speed with increasing load. The required magnitude of this speed droop varies with engine applications and may easily be adjusted to suit conditions.

The speed droop is adjusted internally. The cover must be removed to make this adjustment. A range may be covered of from approximately one-half of one percent to seven percent.

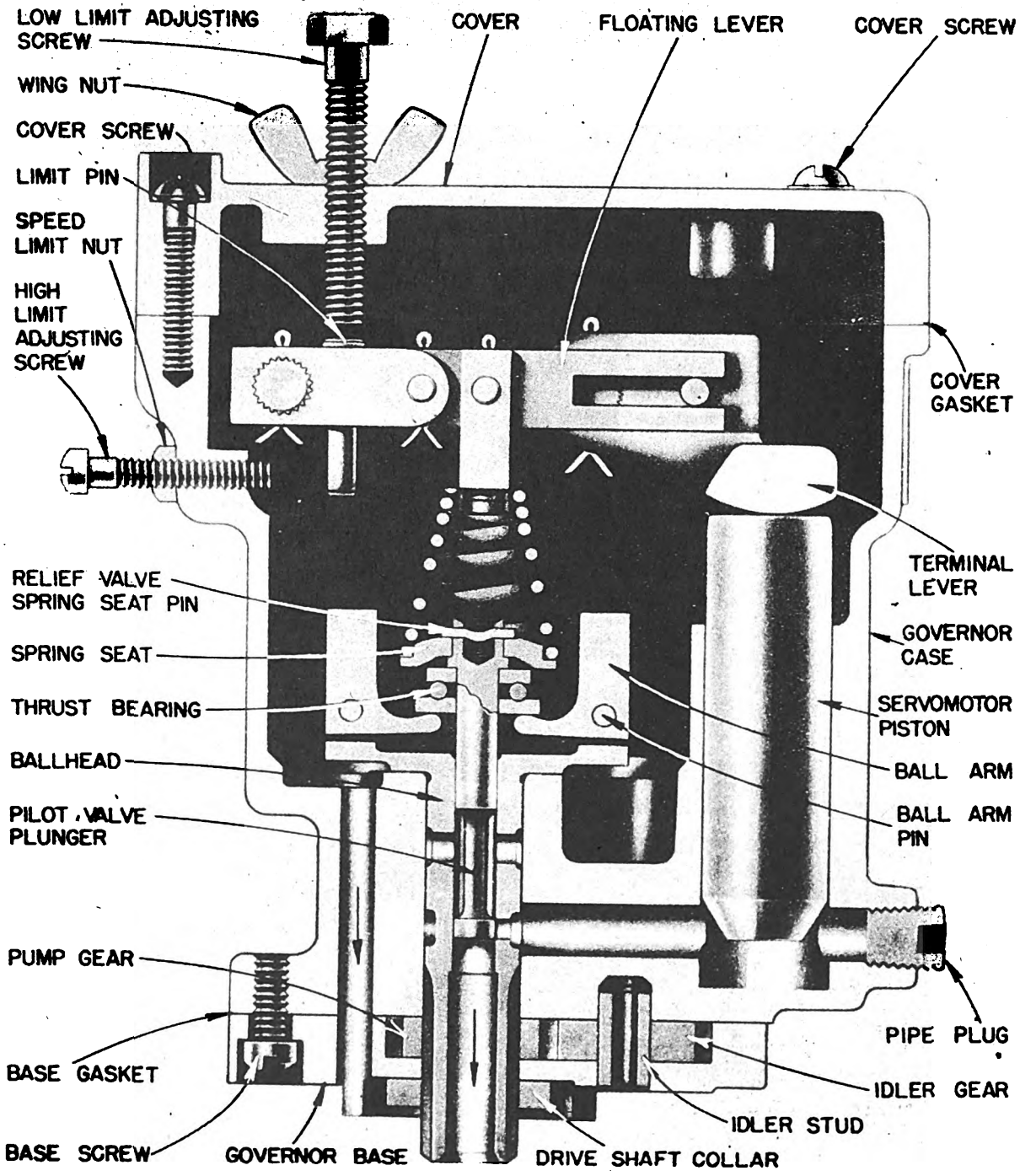


Fig. 62. Governor Cut-away Section—Side

If the governor allows the engine to hunt, shut down the engine and remove the cover. Loosen the droop-adjustment screw which holds the droop-adjusting bracket and move the droop-adjusting bracket away from the center of the governor about one-eighth inch. This increases the speed-droop setting. Tighten the droop-adjustment screw and replace the cover. Start the engine and observe whether the engine is still hunting. If it is, repeat the procedure outlined above until hunting stops.

As the droop-adjusting bracket is moved away from the center of the governor, the droop rivet moves away from the axis of the terminal shaft, and movement of the power piston, through the floating lever, causes a greater change of loading on the speeder spring, or increases droop.

It will be noted that when the droop-adjusting bracket is pushed toward the center of the governor as far as it will go, the droop rivet is near the axis of the terminal lever. Consequently, as the power piston moves,

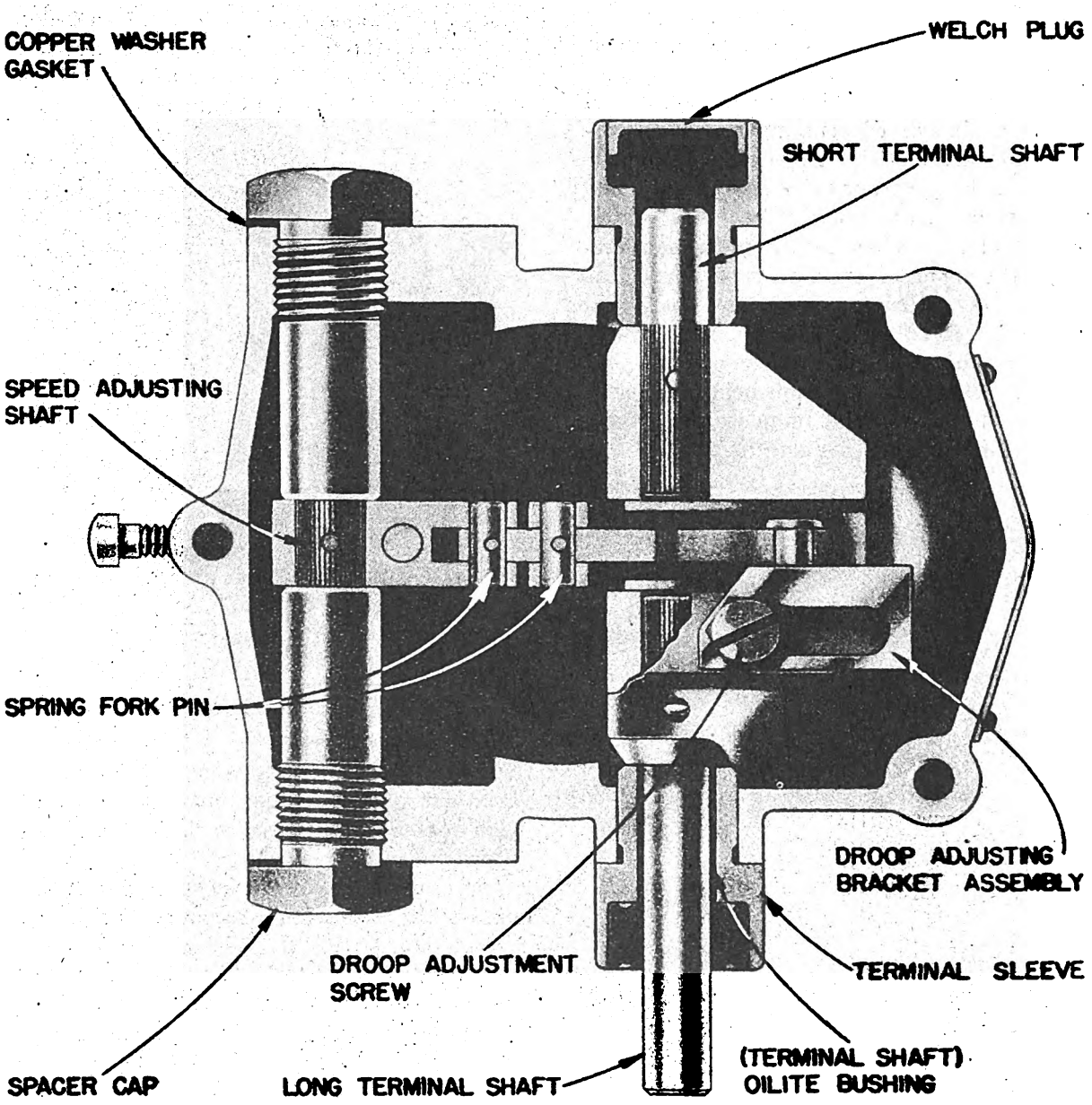


Fig. 63. Governor Cut-away Section—Top

there will be but a slight up-and-down movement of the floating lever. This, in turn, results in a minimum change of loading on the speeder spring, or minimum speed droop.

In general, the engine can be run with the least speed droop that will give the desired stabilization (without hunting) over the operating range. In special cases, as when two units are to be paralleled, greater speed droop may be required in order to match units and secure the proper division of load.

c. Application.

(See Figs. 66 and 67.) The governor has been mounted vertically on the engine with a gasket between its base and the adapter pad. A 9/16-inch six-splined coupling has been provided for driving the governor. This part should fit the governor drive shaft freely, but not so freely that excessive backlash exists.

Particular care has been used in manufacturing the governor drive parts to insure that these parts will run smoothly and not transmit speed irregularities, such as may be caused by shaft run-out or uneven gear teeth. The ballhead in the governor, being very sensitive, will pick up these impulses and governor performance will be erratic.

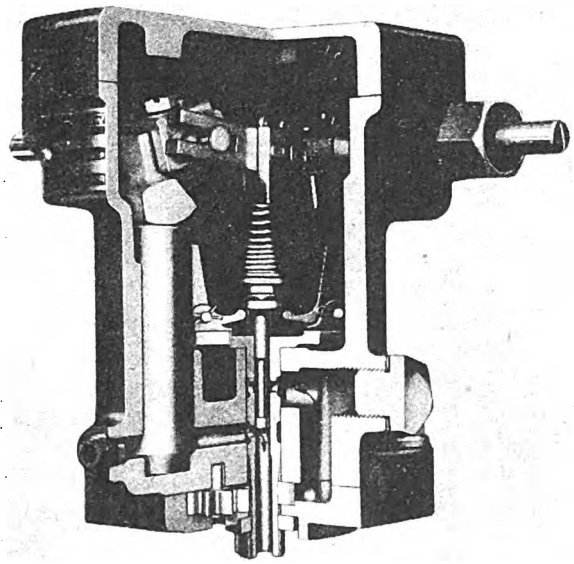


Fig. 64. Governor—Operating Speed Position

d. Speed Level Adjustment.

Rotation of the speed adjusting shaft causes the speed adjusting lever to raise or lower the floating lever. Since the terminal lever is stationary when the load is steady, the floating lever pivots on the droop rivet and increases or decreases the compression on the speeder spring.

Increasing this compression causes the speed to rise; decreasing it causes the speed to drop.

Rotation of the speed-adjusting shaft sufficiently far in the decrease-speed direction (see Figs. 66 and 67), causes the floating lever to pick up the speeder spring and lift the pilot valve plunger. This opens the area under the power piston to drain and enables the fuel-return spring to shut off the fuel completely, thus shutting down the engine.

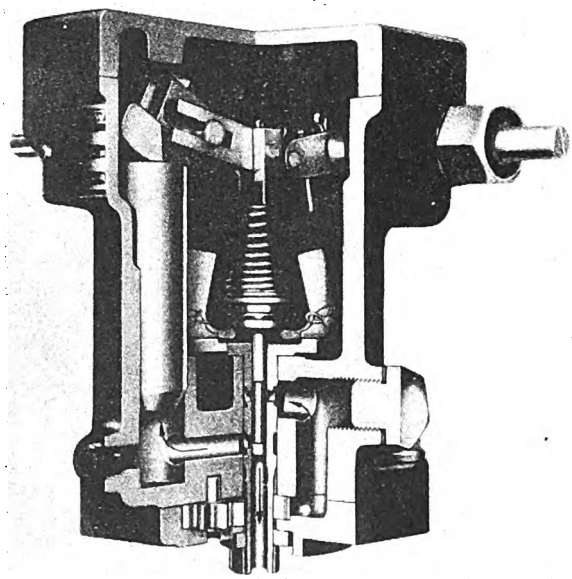


Fig. 65. Governor—Start Position

e. Governor Service.

Governor faults usually show up in speed variations of the engine, but this does not mean that all such speed variations indicate governor faults.

Therefore, when improper speed variations appear, the following procedure should be carried out.

(1) Check the load to be sure that the speed changes observed are not the result of load fluctuations.

(2) If the load is uniform check the engine carefully to be sure that all cylinders are firing properly.

(3) See that the governor is installed so that

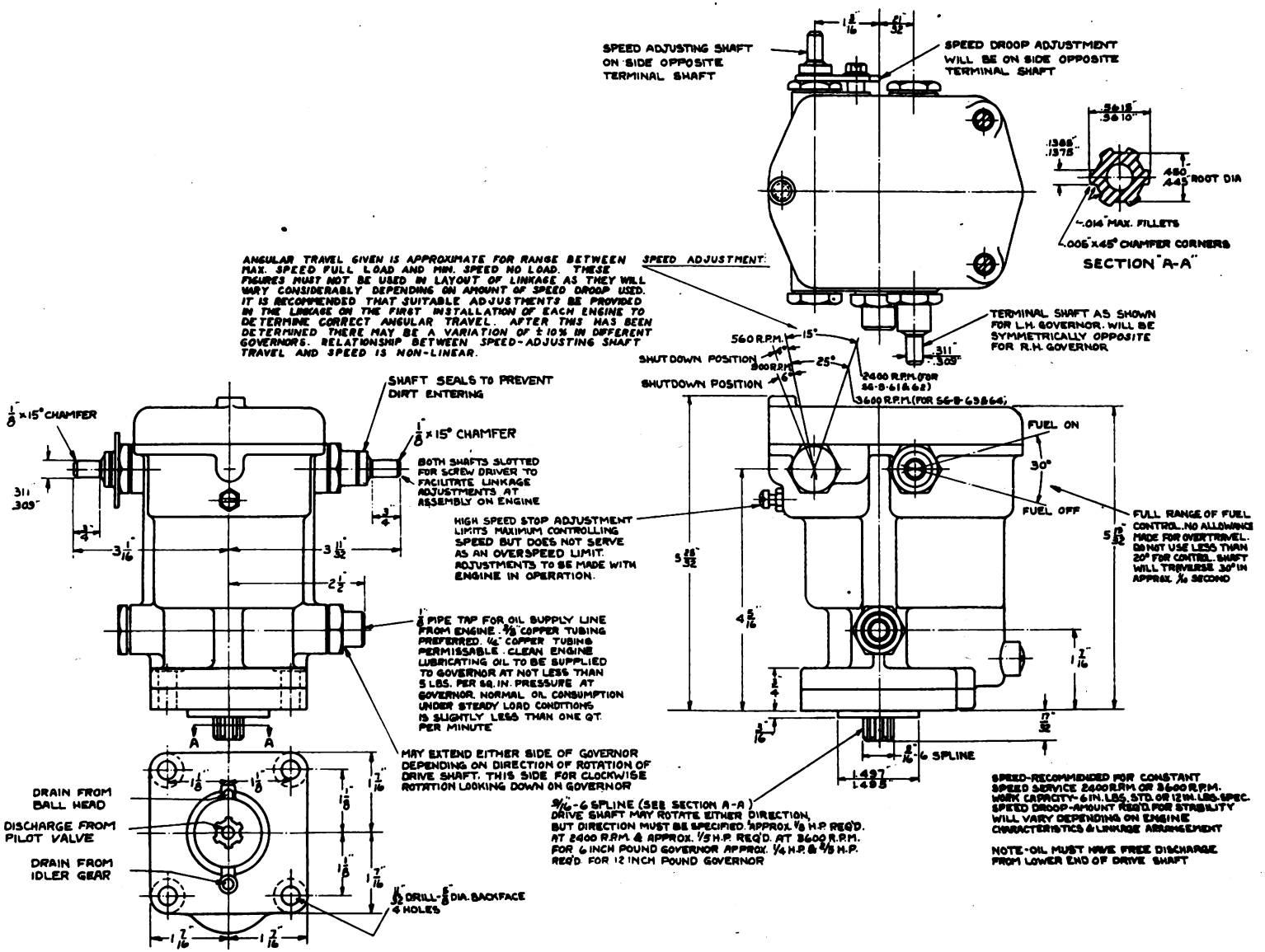


Fig. 66. Governor installation and Operational Drawing (up to Serial No. 155895)

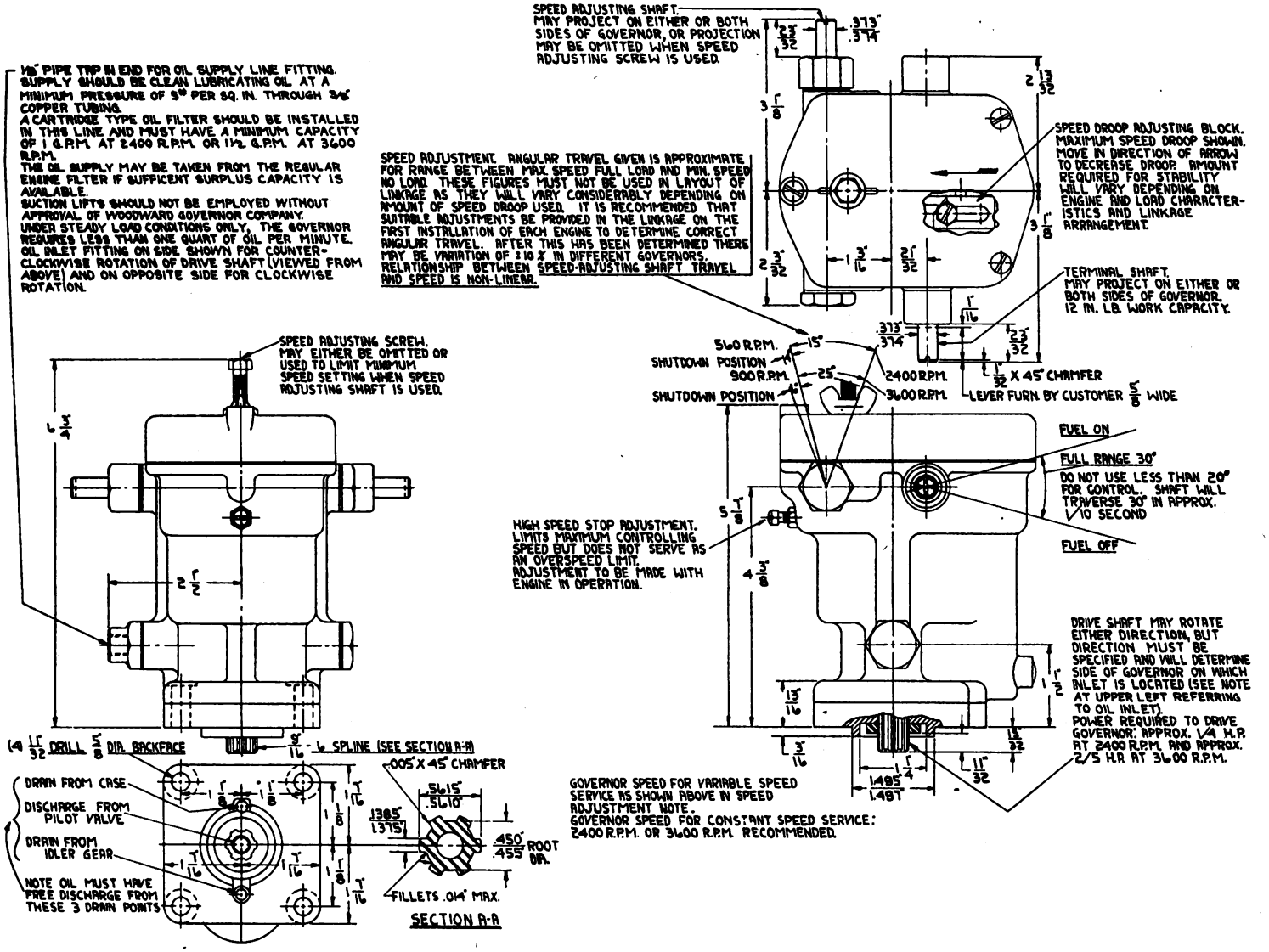


Fig. 67. Governor Installation and Operational Drawing (Serial No. 155896 up)

no bind exists in any of the governor control mechanism nor in the operating linkage between governor and engine; also, that no bind exists in the fuel mechanism on the engine.

If the speed variations are large and erratic, and unaffected (except, perhaps, in magnitude) by change of speed-droop adjustment, or if the governor simply fails to control at all, it is probably defective.

If the speed variations are erratic but small in magnitude, the fault may lie in the governor drive. Excessive backlash in the coupling or the drive gears, or too tight meshing of the latter, may cause this trouble. No amount of adjustment or other work on the governor can correct this fault.

35. Maintenance of Generator.

a. Protection.

The machine should be protected carefully against moisture both before and after erection. It is particularly important to keep the windings dry since the moisture lowers the insulation resistance and increases the likelihood of a breakdown.

Care should be taken in transporting and handling the machine to see that the windings are not damaged. A blow upon any part of the windings is liable to injure the insulation and result in a burnout of a coil.

The generator is connected 3-phase star with the neutral lead brought out.

b. Single Phase Operation.

The ability of a generator to operate single phase, depends largely on the design of the amortisseur or damper windings. Single phase operation produces heavy currents in the damper winding, which may cause overheating in a machine not designed for such operation. If there is no damper winding, the field current required for a given load is increased to such an extent that the output is seriously limited.

c. Collector Rings and Brushes.

(1) Sparking.

If sparking between the brushes and the collector rings occur, the following points should be checked:

Brush pressure—It may be that the pressure on the brushes is insufficient to make them follow the ring surface.

Brush holder vibration.

Brush chatter.

Oil vapor

Collector ring rough.

Spotted rings—This has been cured in certain cases by the use of a more abrasive brush.

(2) Selective Action Between Brushes.

This is generally aggravated by any of the causes of sparking at the brushes and if the same remedies are applied, it can generally be improved.

(3) Rings

Should be maintained smooth and true. Grind or turn them if necessary to restore a smooth and true surface.

Occasionally ring trouble will arise from a ring not being of uniform hardness, so that it wears unevenly. Such a ring should be replaced.

Collector ring trouble is seldom due to high-current density as the maximum current density, 40 amperes per square inch or less, is well below the maximum density specified for the brushes.

The brushes used should be light in weight, with a fairly high current capacity, and should contain a slight amount of abrasive material. A suitable grade is furnished with the machine, and for the best results this grade should always be used.

(4) Brushes.

Should make good contact with the slip rings along the whole face of the brush. If necessary grind the new brushes in with fine sandpaper. Maintain a free sliding fit between the brushes and the brush holder by cleaning both thoroughly when necessary.

There are two collector rings made of bronze alloy. Brushes supplied on these machines are metal graphite and should have a brush pressure of approximately 3 pounds per square inch. There are two brushes per ring.

(5) Operation and Care of Ball Bearings

Quietness and life of ball bearings depend largely on cleanliness and proper lubrication.

d. Inspection.

(1) When the generator is installed, make certain that the rotor turns easily, particularly if the generator is not installed until some months after being shipped.

(2) Never open the bearing housing under conditions which would permit entrance of dirt.
(3) External inspection of the generator at the time of the first greasing soon after it is put into operation will determine whether the bearings are operating quietly and without undue heating. Further inspection will not be necessary except at infrequent intervals, probably at greasing periods.
(4) If practicable, it is desirable for the most satisfactory service to open the bearing housings once a year, or after every 5,000 hours operation, to check the condition of the bearings and grease. If difficult to inspect the pulley or pinion end bearing, the condition of the bearing of the opposite end will usually be representative of both.
(5) If grease deterioration has occurred or if dirt has gained entrance to the housing, the bearing and housing parts should be thoroughly cleaned out and new grease added.

e. Cleanliness.
Since ball bearings are sensitive to small amounts of dirt, they must be protected at all times. If necessary to disassemble the bearing housing, first thoroughly remove all dirt from adjacent parts, so no dirt will fall upon the bearing or interior of the housing. Cover the bearing and interior of the housing with clean wrapping material if they are to be left dismantled and exposed.

If dirt or deteriorated grease is found in the housing or bearing, the parts should be thoroughly cleaned with carbon tetrachloride (avoid allowing this liquid to remain on adjacent generator windings). In some cases, it may be necessary to entirely remove the bearing from the shaft in order to clean it properly.

f. Mechanical Damage.
In mounting or removing bearings, pressure should be applied only against the inner race, always using a sleeve or other intermediate piece if mounting or removal is accomplished by hammer blows. Cover bearing carefully during these operations if there is danger of flying particles getting in amongst the balls. Never attempt to remove a ball bearing by exerting pressure against the outer race, as the bearing may be seriously damaged.

In mounting or removing pulleys, couplings or pinions, the bearing must not be subjected to axial pressure, especially hammer blows as when these accessories are driven on the shaft with a mallet. Any pressure of this kind should be taken by supporting the opposite end of the shaft against a stop of some kind.

g. Spare Parts.
The electrical spare parts on this set consist of exciter and generator brushes and exciter and generator brush holders. When brushes have worn to the place where correct spring pressure cannot be obtained, new brushes should be installed. When new brushes are installed, follow instructions listed under "Brushes."

h. Flashing Exciter Field.
If the exciter field loses residual magnetism due to vibration or other causes, this may be restored by passing a d-c current through the field. The 12-volt battery may be used for this purpose. First, raise the brushes in the brush holders and place a piece of heavy dry paper between each brush and the commutator. The field leads are marked F1 and F2. The positive terminal of the battery should be connected to F1 and the negative to F2.

If either battery terminal is grounded it is not necessary to remove the ground, but the corresponding field lead should be grounded and the other field lead and battery terminal connected. This application of d-c current should be made for 30 seconds and repeated three or four times. Tapping the exciter frame with a hammer during the application will help to restore the residual magnetism.

36. Maintenance of Voltage Regulator.

a. Detailed Description of Operation.
The voltage of the alternator is connected across the regulator coil circuit. An iron magnetic circuit in the shape of a square "C" passes through and mounts the regulator coil. The movable arm of the element is mounted so that the iron armature attached to its lower end can move, against the pull of a spring, in the air gap of the magnetic circuit. Thus any change in the value of the voltage being regulated correspondingly

changes the magnetizing effect of the coil on the iron magnetic circuit. This in turn causes a change in the flux in the air gap and changes the attractive force on the iron armature of the moving arm, causing it to change its position.

The movement of the upper end of the movable arm directly controls, depending on the direction of its motion, the closing or opening, in succession, of a series of silver buttons. Each of these silver buttons is mounted at the free end of an individual leaf spring of conducting material. The other end of the leaf spring is fixed and the assembly holding the fixed ends is arranged so that each one is individually insulated from the others. Each silver button is connected electrically, by means of a wire from the fixed end of its leaf spring, to a tap on the stationary regulating resistance. The silver buttons, in this manner are connected in sequence to consecutive taps or steps of the regulating resistance.

The regulating resistance is connected directly in the field circuit (exciter shunt field). At one end of the travel of the moving arm, all of the silver buttons are apart from each other, thus, placing maximum resistance in the field circuit. At the other end of the arm's travel all of the silver buttons are closed thus shorting out the resistance in the field circuit through a silver path, which reduces the resistance to a negligible value. Thus, as the moving arm operates through its travel, depending on the direction of its motion, it successively opens or closes the silver buttons, to increase or decrease the resistance in the field circuit. Since the moving arm has a short travel all resistance can be inserted or cut out quickly or it can be varied gradually, depending on the change in excitation required.

An important operating feature of the Silverstat design is the smooth control of excitation made possible by the use of the silver buttons. Although the operation of these buttons in sequence apparently cuts small steps of resistance in or out in a definite, step by step manner, this is not actually the case. When the moving arm operates the silver buttons in sequence, there is a progressive change in pressure between the faces of the buttons, due to the action of the moving arm in deflecting the leaf springs that mount the buttons. Since the effective resistance between silver surfaces is dependent upon the pressure, this effect combined with the small value of resistance per step, acts to produce an infinite number of steps from practically zero to the maximum. In this manner the Silverstat design inherently provides for smooth variation of the stationary regulating resistance.

The regulating action of the regulator is that of a semi-static device which operates only when a correction in voltage is necessary. For a given value of regulated voltage and load on the machine being regulated there is a corresponding value of regulating resistance required in the field circuit; and a corresponding position of the moving arm and silver buttons which will give this value of resistance. Under such conditions the magnetic pull on the moving arm is balanced against the spring pull, at that position of its travel. A change in load on the machine being regulated causes a corresponding change in the voltage. To restore the voltage to its correct regulated value, the moving arm and the silver buttons take a new position corresponding to the changed value of load.

Should additional load be placed on the machine whose voltage is being regulated, the voltage will drop and an increase in field current is required to bring the voltage back to normal. The drop in voltage decreases the magnetizing effect of the regulator coil and reduces the flux in the air gap of its magnetic circuit. This in turn decreases the magnetic pull on the iron armature attached to the moving arm and allows the coil spring to move the arm in a direction to begin closing in sequence the silver buttons. This action shorts out in small steps additional portions of the regulating resistance, which being connected in the field circuit, causes the field current to be increased and the voltage raised back to its normal value. When the voltage is restored to its normal value the moving arm of the regulator is again in a balanced state. However, the moving arm has changed its position to correspond to the change in load on the machine.

In case some load is taken off the machine and the voltage rises, the sequence as de-

scribed in the foregoing paragraph is reversed. The rise in voltage increases the current and magnetizing effect of the regulator coil. This increases the pull on the armature and moves it in opposition to the pull of the coil spring, to start opening in sequence, the silver buttons. This action inserts additional steps of the regulating resistance in the field circuit, thereby decreasing the field current and reducing the voltage to its normal value. With normal voltage restored the moving arm is again in a balanced state in its new position.

From the foregoing description of operation it becomes apparent that the Silverstat regulator can increase the excitation to its ceiling value (ceiling voltage of exciter) where necessary. Also, the excitation can be quickly reduced to the lowest value required. The maximum travel of the moving arm being only a fraction of an inch permits the regulating resistance to be very quickly varied from maximum to practically zero when operating conditions require such control.

b. Damping Transformer.

To stabilize the regulated voltage and prevent excessive swinging under various conditions of excitation change, a damping effect is introduced into the regulator coil circuit by means of a damping transformer. See illustrations. The use of this device eliminates the need for dashpots or similar mechanical anti-hunting devices, which require adjustment and maintenance.

The damping transformer is of a special type having a small air gap in the laminated iron magnetic circuit. One winding is connected across the field of the generator whose voltage is being regulated. (See illustrations, for a-c applications.) The other winding is connected in series with the regulator coil. When there is a change in excitation voltage as a result of the regulating action of the regulator, there is an induced transfer of energy from one winding to the other of the damping transformer. The energy thus introduced into the circuit of the regulator coil acts by reason of its direction, magnitude and time to electrically damp excessive action of the moving arm, thus preventing the moving arm from carrying the change in regulating resistance and consequent change in excitation, too far. Since the damping transformer operates only when the excitation of the generator is changing, it being remembered that the excitation circuit is d-c, the damping transformer has no effect when the regulated voltage is steady and the regulator is in a balanced condition. The damping transformer is arranged for mounting separate from the regulator as outlined under "Accessories."

c. Voltage Adjusting Rheostat.

A small voltage adjusting rheostat is included in the regulator assembly and provided a convenient means of setting the voltage at the value at which it is to be regulated. The rheostat knob is located outside the regulator cover where it is always accessible. The rheostat has a range which makes it possible to change the value of the regulated voltage approximately 10 per cent above or below normal on the type SRA a-c regulators.

d. Assembly and Mounting.

The main control element with its moving arm and the required number of silver button assemblies, together with the voltage adjusting rheostat are mounted on the front of a metal plate which serves as a base. A second metal plate is attached to the rear of the base and held a short distance behind it by means of a post at each corner. The regulating resistance is mounted in the space between the base and the rear metal plate. The top and sides of this space are enclosed by a perforated removable cover. Each of the projection mounting type regulators is provided with a protective removable cover, held in place by thumbnuts, which fits on and encloses the front of the regulator. A gasket of long life, flexible material, around the end of the cover provides a dust-tight fit which protects against dust and dirt collecting in the main assembly. This gives adequate protection in case a regulator is installed where the air is dust laden or contains foreign materials due to manufacturing processes, etc.

e. Installation.

The method of mounting the regulator and the fact that only four to six wires are con-

nected to it makes it easy to install. Since all internal adjustments are made in the factory it is also easy to place into operation. The usual field rheostat (exciter field rheostat) is normally left in the circuit in series with the regulating resistance of the regulator. Setting the field rheostat in the proper position to permit the regulator to take control places the regulator in service.

f. Sensitivity.

The rated sensitivity of the type SRA regulator is as follows: SRA-1 X1 2½%.

Only sensitivity, as listed, is specified in connection with the performance of generator voltage regulator. Sensitivity represents the band or zone of voltage, expressed in terms of percentage of the normal value of regulated voltage, within which the regulator will normally hold the voltage under steady load conditions. This does not mean that the regulated voltage will not vary outside of the sensitivity zone. It does mean, however, that when the regulated voltage varies more than the percentage sensitivity from the regulator setting, due to sudden changes in load or other conditions, the regulator will immediately apply corrective action to restore the voltage to the sensitivity zone.

Regulator sensitivity must not be confused with overall regulation, which involves not only regulator sensitivity, but also the time constants of the machines, and the character and magnitude of load changes. A regulator cannot get more from a machine than it is inherently capable of delivering and cannot change machine characteristics. The magnitude and rate of load change determines how far the voltage will vary outside of the regulator sensitivity zone and the time constants of the machines chiefly determines the time required to restore the voltage to the sensitivity zone of the regulator. For these reasons only sensitivity can be specified insofar as the regulator is concerned and not overall regulation which involves factors over which a regulator has no control.

The design of the Silverstat regulator has been coordinated so that any change of regulated voltage with respect to temperature of the regulator parts is very small, over the range of ambient temperatures usually encountered in normal operating practice. The standard design of Silverstat regulator will maintain its rated sensitivity, when operated in ambient temperatures between +15° and +40° Centigrade (+59° and +104° Fahrenheit). This means that the regulator will hold practically the same voltage whether it is cold or warm. Special designs are available where it is desired to maintain rated sensitivity over wider ranges of ambient temperature than listed.

g. Accessories.

(1) Rectox Rectifier—Damping Transformer Unit.

On the type SRA a-c regulator a full wave Rectox rectifier is used. The function of the Rectox unit is to rectify the single phase a-c supply to the regulator to a proportional value of d-c energy, the regulator element being a d-c operated device. The rectified d-c energy is to all practical purposes independent of frequency changes, and the a-c regulator is correspondingly free from frequency error due to small changes in speed of the a-c machine. The Rectox unit is completely dry and requires no maintenance.

A damping transformer is supplied with each regulator. This transformer functions to stabilize the regulated voltage by acting as an electrical anti-hunting device. This device does not require any adjustment or maintenance.

The Rectox rectifier and damping transformer are mounted on a steel plate to form a single unit as shown. This unit is arranged for mounting separate from the regulator and is designed so that it can be readily mounted at the rear of a switchboard panel or in any convenient location. The sides of the steel plate are bent to form flanges and mounting holes in both the base and flanges facilitates mounting. The damping transformer and Rectox rectifier are wired to a terminal block mounted at the bottom of the steel plate.

37. Maintenance of Type WL Field Rheostat.

a. Construction.

In the manufacture of type WL rheostats a pressed steel plate forms a rigid base, durable but light in weight. After the entire surface is sand blasted to remove foreign particles the thoroughly cleaned plate is cov-

CLASS 3	COMPLETE REWINDING MATERIAL PLUS MECHANICAL DETAILS AND MOULDED MICA PARTS	3		
CLASS 2	COMPLETE REWINDING MATERIAL‡	2		
CLASS 1	CUT WINDING INSULATION	1		
SUB CLASSIFICATIONS	MATERIAL INCLUDED*		MATERIAL INCLUDED*	MATERIAL INCLUDED*
A CUT CORE INSULATION	All cut insulating material used to prepare the ends of the core for winding, such as treated cloth caps, coil support moulded paper rings, fibre rings and canvas caps.		Cut winding insulation (Class 1) plus all bulk materials such as tapes, twines, varnishes, solder, soldering flux and banding wire. Note: This bulk material is placed in a separate class since the larger motor users generally find it more satisfactory to purchase in bulk from the Company.	Complete rewinding material (Class 2) plus all necessary cleats, bolts, tie rings, formed copper connectors, and brace or support arms. All moulded mica rings and parts. The following parts are supplied, when used: Temperature indicating coil wiring details. Wood forming blocks for closing the open end of shove through type of coils.
B SLOT AND END INSULATION	All cut insulating material used when winding, such as cells, fillers, wedges, spacing blocks, wood bracing blocks, micarta tubes, etc.			
C CONNECTING MATERIAL FOR A-C STATORS OR ROTORS or CROSS CONNECTING MATERIAL FOR D-C ARMATURES	All cut material used when winding, such as cable for leads and for star or parallel rings and jumpers, figure 8 or sleeve connectors, wood wedge blocks for soldering, canvas caps, etc. All cut material used for cross-connections, such as cable, wood supporting or spacing blocks, micarta tubs, mica washers, etc.			
D CUT BANDING MATERIAL†	All cut insulating material necessary to install the bands, and segmental bands with keys and wedges, wood wedge blocks for soldering riser neck commutators and tin clips. (For banding wire, see Class 2.)			

Cut Insulating Material means any item that is cut to a definite size or shape. It does not include bulk material.

‡Complete Rewinding Material, Class 2, corresponds to the Rewinding Material listed in the various Parts Sections of this Manual.

*Any desired combination may be obtained by combining the Class Number and Sub Letter. For example 1-B includes the slot and end Insulation only, or 2-B includes 1-B plus the bulk material pertaining to 1-B. Similarly, 3-A includes the cut core insulation (1-A) plus the necessary material of Classes 2 and 3 for installing it.

Part set orders for any class will include only the items necessary to install the number of coils involved except:

†Cut Banding Material (3-D) will be supplied in whole sets only.

Banding tools will be supplied only when specially ordered.

IMPORTANT: ALWAYS GIVE THE COMPLETE NAMEPLATE READING AND STATE DEFINITELY THE CLASSIFICATION OR SUB CLASSIFICATION DESIRED.

ered with a ground coat which protects the surface of the plate and forms an electrical insulating, heat conducting surface upon which to mount the resistance elements of approximately zero temperature coefficient wire. To these wires the heavy contacts are fastened by a patented process which gives a mechanically and electrically perfect joint. Vitrohm insulation is applied over the resistance wire. It holds the wire and contacts securely and protects them against corrosion and mechanical injury. A porcelain terminal block, movable contact arm with its bearing together with back cover and handwheel form a complete plate.

When looking at the handwheel side the all out or high capacity step is reached by turning the handwheel counter-clockwise. Clockwise rotation cuts resistance into the circuit.

b. Adjustable Stop.

Each rheostat is provided with an adjustable arm stop, which consists of a movable angle piece clamped in a slot on the rear cover. To limit the maximum voltage of a generator set clamp to limit the clockwise rotation. To limit the speed of a motor set clamp to limit clockwise rotation. After clamp has been adjusted it should be held in position by tightening set screw securely.

c. Rating.

The ampere rating stamped on the name plate is calculated on the basis that the hottest spot temperature on the enamel does not exceed 250° C. rise, which is the NEMA standard for imbedded resistors. It is permissible to use a rheostat on voltages lower than the name plate rating provided the maximum current is not exceeded.

38. Total Hour Meter.

a. Operation.

The total hour meter type NH-35 consists essentially of a synchronous motor, gear train, and six indicating numbered wheels. The meter is connected in parallel with the alternator whose total hours of operation are to be measured. When the unit is started the self-starting synchronous driving motor starts and runs continuously as long as the unit runs.

The synchronous motor drives the gear train which in turn drives the six number wheels. The meter will indicate accurately as long as the frequency of the supply circuit is well regulated.

b. Construction.

The motor is a true high torque synchronous motor having 12 poles and operating at 600 rpm. on 60 cycles. An oil storage reservoir is provided for the motor bearings which provides freedom from frequent service. When the oil supply is exhausted it is only necessary to clean the motor bearings and replenish the oil supply.

The precision gears are machine cut and then gold plated for protection from corrosive action. The bearings are of the highest grade to insure frictionless operation over long periods of service.

A zero reset has been provided for use when required. The resetting is accomplished by removing the case and disengaging the number wheel shaft which allows the number wheels to be set to any desired reading.

39. Lubrication of Power Unit.

The following chart gives the grade of oil which should be used in this engine. Care must be exercised to replenish the supply daily if necessary, and to drain it as advised in the paragraphs that follow.

High-grade, highly refined oils, corresponding in body to the SAE (Society of Automotive Engineers) viscosity numbers listed below will prove economical and assure long engine life. SAE viscosity numbers classify oils in terms of body only, without consideration of quality or character. Only lubricating oil of the best quality should be used.

a. Oil Recommendations.

The recommendations that follow are for new or well-maintained engines:

Temperature	*Engine Crankcase*	*Air Cleaner*
Below 32° F.	OE SAE 10	OE SAE 10
Above 32° F.	OE SAE 30	OE SAE 30

NOTE: Follow summer recommendations if engine is housed in a warm building.

b. Force-Feed System.

The oil supply is contained in the oil pan and

oil is fed to the moving parts of the engine by a gear-type pump. This pump draws oil out of the oil pan, through a screen of small mesh which prevents foreign material from being drawn into the lubricating system.

An oil-pressure relief valve is provided to prevent the oil pressure from building up to an excessive degree. Normal oil pressure for the engine is from 20 to 30 pounds under average working conditions. Extreme temperatures, load conditions, or the use of improper grades of oil may cause these pressures to vary.

c. Filling.

The oil in the engine should be replenished daily, if necessary, in order to maintain the level to the FULL mark on the dipstick. The capacity of the crankcase is 28 quarts, U. S.

Overfilling should also be avoided as this may permit the connecting rods to dip into the oil supply, thus splashing an excessive quantity of oil on the cylinder walls, causing smoking, oil pumping, waste of oil, excessive carbon deposit, fouled spark plugs, and sticky valves.

Be sure the filler cap is replaced after each refilling to prevent dirt from entering the engine.

d. Draining.

It is essential that the oil pan be drained and refilled with new oil regularly, since the oil gradually accumulates small particles of dust, grit, and metal, which will cause wear, and is also diluted by unburned fuel which passes by the piston rings.

Draining the oil while hot will aid in the removal of sediment. Refill the oil pan to the proper level with new oil and replace filler cap.

e. Cleaning the Oil Pan.

The practice of removing the crankcase handhole covers for inspection at monthly intervals or after 600 hours of service, is recommended. At that time the oil pan should be washed thoroughly with gasoline and a stiff brush. **Do not use cotton or wool waste,** as fibers from it may stick to rough surfaces, ultimately causing stoppage of the screen and oil lines in the lubricating system.

f. Sludge.

The formation of sludge in the oil pan is due to oil contamination caused by exhaust gases which pass the pistons and come in contact with the oil and condense to form an acid. This condition will be found more often and to a greater extent when an engine is operated at too low a temperature. Sludge is very detrimental, and if the oil, when drained, appears to be thick and congealed, the oil pan should be thoroughly cleaned of all sludge. See paragraph 38e above.

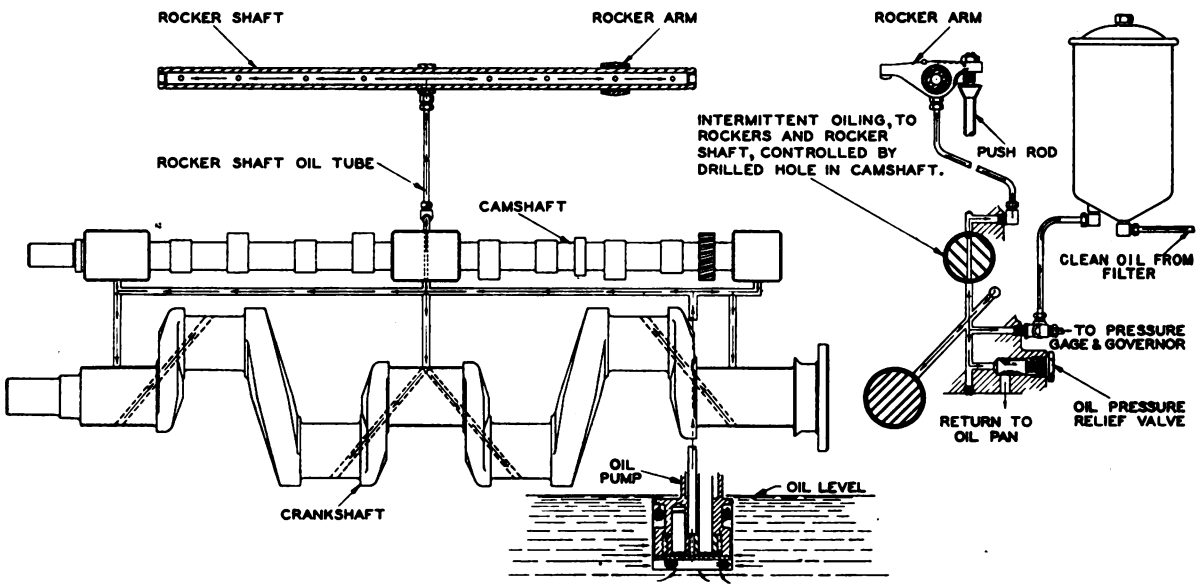


Fig. 68. Oil Circulation Diagram

g. Lubrication of the Water Pump.
Turn down grease cup snugly after every eight hours of service and replenish lubricant when necessary. Use WB-2.

h. Lubrication of Fan.
The fan is mounted on the water-pump shaft and requires no lubrication.

i. Lubrication of the Governor.
The governor is lubricated by oil introduced into the governor housing past the power piston and pilot-valve plunger. The oil is broken up into a fine mist by the rotation of the governor flyballs. It collects in the bottom of the governor case, and is discharged through the base by a drain hole. No additional lubrication is required.

j. Lubrication of the Magneto.
The cam-lubricating felt wick (31) (see Fig. 13) is saturated with grease at the factory and should be relubricated periodically with a small quantity of SAE 50 or 60 oil. The magnet-rotor ball bearings (2), packed with high temperature American Bosch U. S. 508 grease, and the distributor gear oil-less composition bearing (9) require no additional lubrication between overhauls. Extreme care must be exercised that the contact points remain free from oil and grease.

k. Lubrication of the Air Cleaner.
After every eight hours of service unscrew the wing nut and remove assembly to open the entire air cleaner for inspection. Dispose of accumulated dust in sump, refill to lower bead with the same grade of OE as used in crankcase, and replace top. Should filter element need cleaning, swish up and down and sidewise in fuel oil or gasoline. When gasoline is used, allow to dry thoroughly before reassembling.

l. Lubrication of the Starting Motor.
No lubrication is required, since all three bushings are of the oil-less type. However, at any time that the cranking motor is disassembled for cleaning, put a few drops of light OE in each bushing.

m. Lubrication of the Generator (12-Volt)
Add from eight to ten drops of OE SAE-10 to each hinge-cap oiler after every 128 hours of operation.

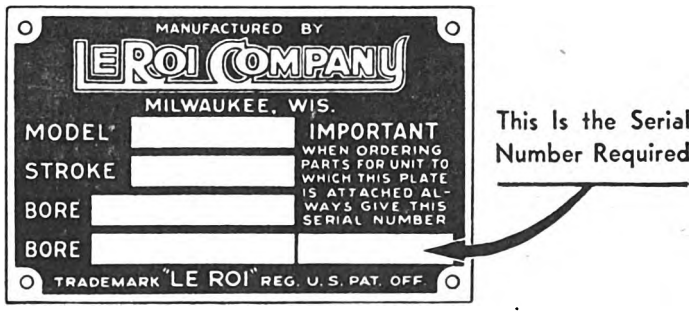
n. Lubrication of the Alternator.
After every 1,024 hours of service add WB-3 to ball bearings. The following procedure should be observed.
(1) Stop engine.
(2) Remove drain plugs located beneath ball-bearing retainers.
(3) Remove any hardened grease in the drain-plug holes.
(4) Turn down grease cups until lubricant is expelled through drain holes.
(5) With drain plugs removed, start the engine and run for several minutes, or until all excess lubricant is expelled through drain holes.
(6) Stop the engine.
(7) Replace the drain plugs and carefully wipe away any excess lubricant from surrounding parts.

Lubrication to crankcase bearings, camshaft bearings, connecting rod bearings, valve mechanism, timing gears, and governor is full-force feed. Pistons and piston pins are splash-lubricated.

IMPORTANT

40. Special Instructions When Ordering Spare Parts

Delay and confusion can be avoided when full and correct serial number of engine is specified on parts orders and correspondence. The illustration shows the serial number name plate, attached to the engine, and number that is required. When ordering spare or replacement parts for this Engine or when corresponding with the factory regarding it, it is necessary this serial number be indicated.

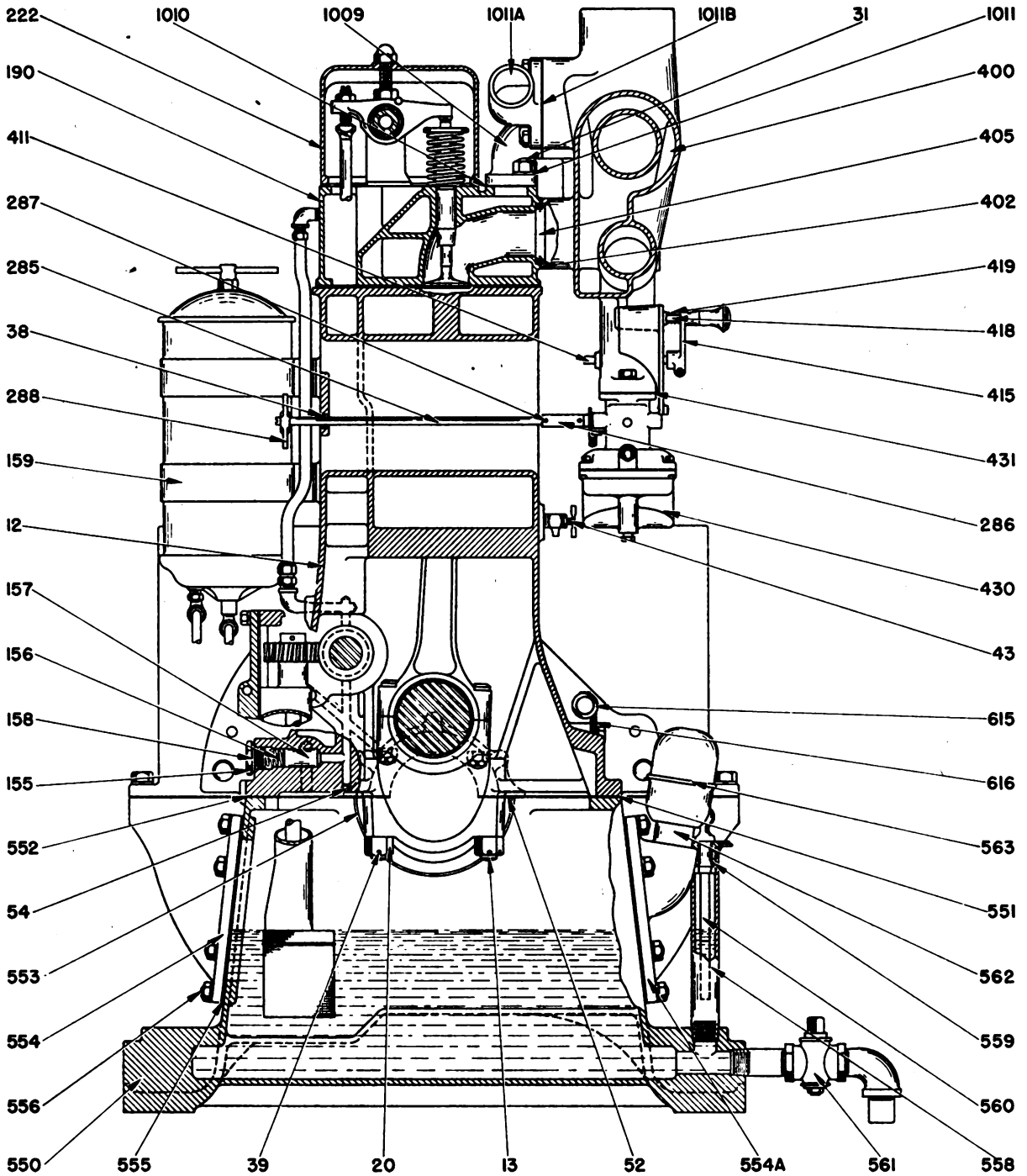


SECTION IV. PARTS LIST

INDEX TO PARTS LISTS FOR POWER UNIT

MANUFACTURER'S CODE INDEX

Code	*Name and Address*
A	Le Roi Company Milwaukee, Wis.
B	Air-Maze Corporation Cleveland, Ohio
C	Zenith Carburetor Division Bendix Aviation Corp. Detroit, Mich.
D	Allen-Bradley Company Milwaukee, Wis.
E	Thomas Flexible Coupling Company Warren, Pa.
F	Delco-Remy Division General Motors Corporation Anderson, Ind.
G	A-C Spark Plug Division General Motors Corporation Flint, Mich.
H	Woodward Governor Company Rockford, Ill.
I	American Bosch Corporation Springfield, Mass.
J	Westinghouse Electric and Manufacturing Company East Pittsburgh, Pa.
K	Briggs Clarifier Company Washington, D. C.



CROSS SECTION THRU ENGINE

PLATE D471-26

Fig. 69. Cross Section through Engine

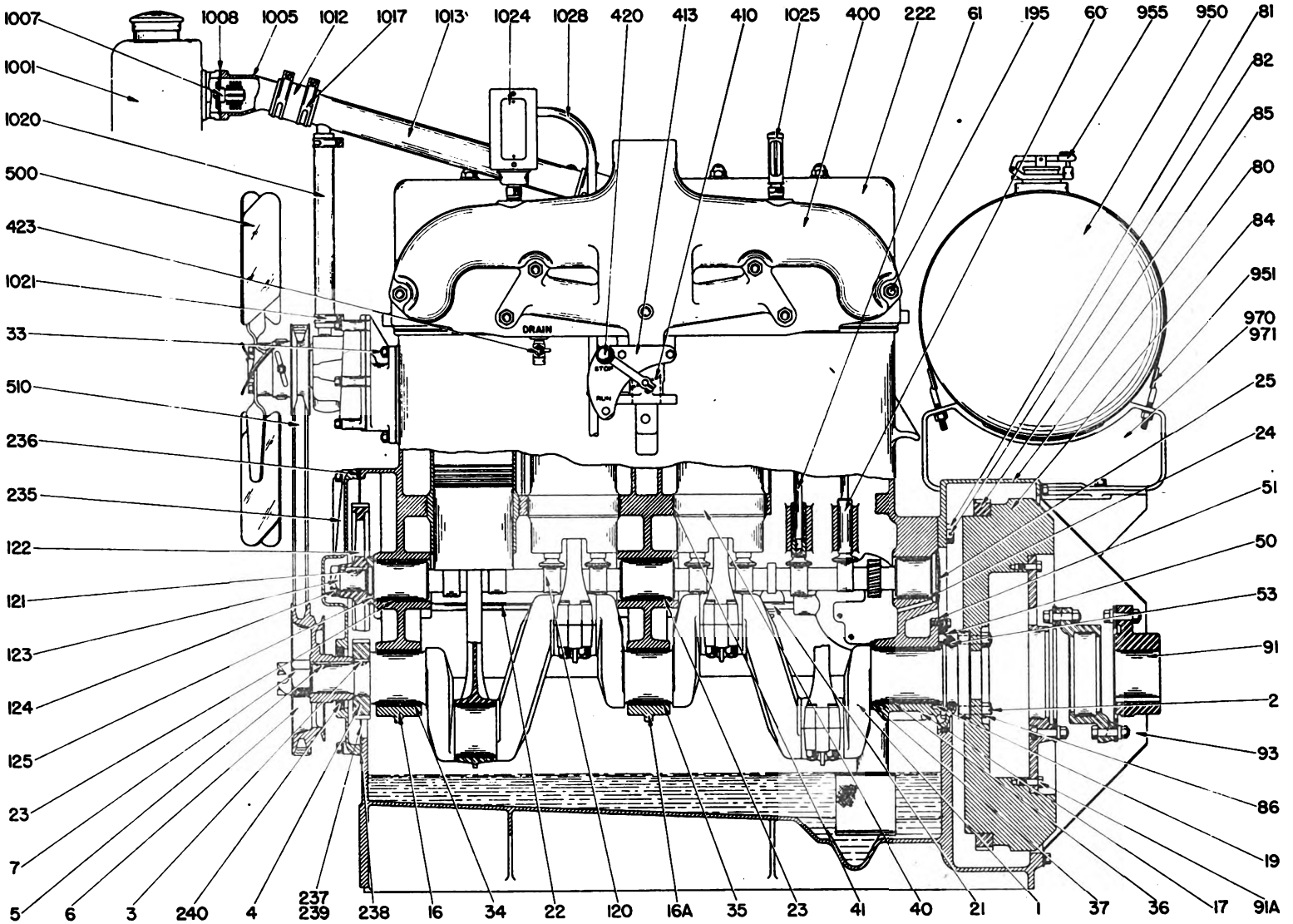


Fig. 70. Longitudinal Section through Engine

41. Crankshaft

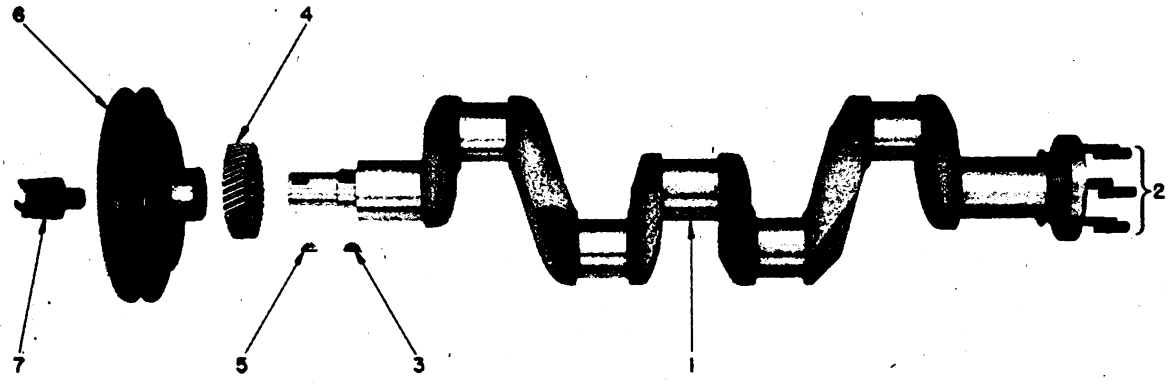


Fig. 71. Crankshaft and Component Parts

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
1		1	Crankshaft Assembly, Includes next 3 items	A5-372	A
2	3H4584A/S58	6	Stud—Crankshaft flange	105-338	A
3	3H4574/K5	1	Key—Crankshaft gear, Woodruff #A	09-15	A
4		1	Crankshaft gear	26-325	A
5	3H4574/K5	1	Key—Crankshaft pulley, Woodruff #A	09-15	A
6	3H4574/P21	1	Pulley—Crankshaft	36-517	A
7		1	Cranking jaw	96-27	A

42. Crankcase

12		1	Crankcase assembly (A to D Incl.)	A100-149-5	A
12		1	Crankcase assembly (A to E Incl.)	1A100-149-5	A
12		1	Crankcase assembly (A to F Incl.)	2A100-149-5	A
13		12	Capscrew—Main bearing (Serial No. 164990 up) A	34-217	A
13		12	Stud—Main bearing (up to Serial 164989)	B105-43	A
16	3H4584A/C31	1	Bearing cap—Front main	4-177	A
16A	3H4584A/C13	1	Bearing cap—Center main	4-181	A
..		2	Dowel pin, for rear bearing cap	17-400	A
17	3H4574/P7	1	Bearing cap—Rear main, Includes part #17-299	A4-178	A
19		2	Thrust washer pin	17-299	A
20		12	Nut—Main bearing stud, (up to Serial 164989)	B53-26	A
21	3H4574/T16	1	Rear oil tube	55-397	A
22	3H4574/T17	1	Front oil tube	55-398	A
23	3H4574/B19	2	Bushing, Front and center camshaft	11-134	A
24	3H4574/B18	1	Bushing, Rear camshaft	11-133	A
25		1	Welch plug, 3" D	019-40	A
..	3H4574/S18	4	Screw—Parker Kalon #2 x 5/16", Type U	03-2001	A
..	3H4574/P21	1	Name Plate—LeRoi Serial Number	62-48	A
..	3H4574/S25	14	Stud—Cylinder head 1/2 x 5 1/4" lg	105-232	A
31	3H4574/S26	4	Stud—Cylinder head 1/2 x 5 3/4" lg	B105-31	A
32		4	Stud—Oil cleaner, 5/16 x 1" lg	B105-39	A
33		4	Stud—Water pump brkt. 3/8 x 1 5/16" lg	105-245	A
..		1	Stud—Ignition wire brkt., 5/16 x 1" lg	B105-39	A
34		2	Bearing shell—Front main, 1/2	21-348	A
35		2	Bearing shell—Center main, 1/2	21-347	A
36		2	Bearing shell—Rear main, 1/2	21-349	A
37	3H4584A/W5	4	Thrust washer—Rear main bearing	20-370	A
38	3H4574/B20	1	Bushing—Governor cross shaft	21-324	A
39	3H4574/W10	6	Locking wire—main bearing E	61-44	A
40	3H4574/S15	4	Cylinder sleeve	175-5-1	A
41	3H4574/P1	8	Packing—Cylinder sleeve F	74-41	A
43	3H4574/C28	1	Drain cock, 1/4" M. and F. M. P. thrd	15-338	A

42. Crankcase (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
..	3H4574/D7	1	Decalcomania—Water drain	62-109	A
50	3H4584D/R7	1	Oil retainer	31-325-1	A
51	3H4574/G27	1	Gasket—Oil retainer	16-777	A
52	3H4574/G38	2	Gasket—Oil retainer parting	16-907	A
..		3	Capscrew, 5/16—18 x 7/8" hex	02-19	A
..		3	Lockwasher, 5/16"	05-50	A
53	3H4584A/S57	2	Oil seal—felt	125-67	A
54		3	Pipe plug—1/8" slotted	19-13	A
55		5	Pipe plug, 1/8"	011-1	A
59	3H4574/P13	1	Pipe plug, 3/8" ctrsk, special	011-103	A
60	3H4574/T1	8	Valve tappet	23-12	A
61	3H4574/R25	8	Push rod	99-72	A
..		1	Stud, oil line clamp, 5/16 x 1"	B105-39	A

43. Bell Housing, Flywheel and Coupling

80	3H4574/H20	1	Bell housing—upper half	37-221	A
81		3	Capscrew, 3/4—16 x 1 1/2" hex	34-37	A
82	3H4574/W10	1	Locking wire	61-44	A
..		2	Capscrew, 1/2—13 x 1 1/4" hex	02-70	A
..		2	Lockwasher, 1/2"	05-53	A
84		1	Flywheel assembly, Includes ring gear	A9-486-1	A
85	3H4574/G36	1	Ring gear, 8/10 pitch	26-270	A
86	3H4574/N3	6	Nut, 1/2"—20 hex. slotted	B53-25	A
..	3H4584A/P33	6	Cotter pin, 3/32 x 1" lg	07-23	A
91A		8	Capscrew, 3/8—16 x 1 1/4" hex. hd	34-209	A
..		8	Lockwasher, 3/8"	05-51	A
92	3H4574/K6	1	Key (Furnished with Alternator)	09-213	A
93	3H4584A/G10	2	Coupling guard	156-116	A
..		6	Capscrew, 3/8—16 x 5/8" hex	02-33	A
..		6	Lockwasher, 3/8"	05-51	A
91		1	Coupling—Thomas flexible No. 312, Includes next 7 items	A28-256	A
..	3H4584A/F7	1	Flywheel adapter plate	30702	E
..	3H4584A/R36	1	Center ring	20752	E
..	3H4584A/H25	1	Hub—rear flange, 2 5/8" Bore, special	21188	E
..	3H4584A/R38	2	Laminated rings—Flexible (20 pieces)	10957	E
..	3H4584A/B40	16	Bolt, 1/2 x 2" lg. special	10966	E
..	3H4584A/W5	16	Washer—Beveled, 1/2	10965	E
..	3H4584A/N50	16	Nut, 1/2"—20, "Stay-on"	11118-6	E

44. Connecting Rod

100	3H4584A/R6	4	Connecting rod assembly, Includes parts A to B	1A7-74	A
101	3H4584A/B25	16	Bolt—Connecting rod A	34-201	A
103		16	Nut—Connecting rod bolt, 7/16" x 20 hex. special	53-31	A
104		8	Bearing shell—Connecting rod, 1/2	21-350	A
105	3H4574/W54	4	Capscrew—Piston pin clamp	B35-8	A
106		4	Lock wire	61-5-3	A
...	3H4584A/P33	16	Cotter pin, 3/32 x 1" lg B	07-23	A

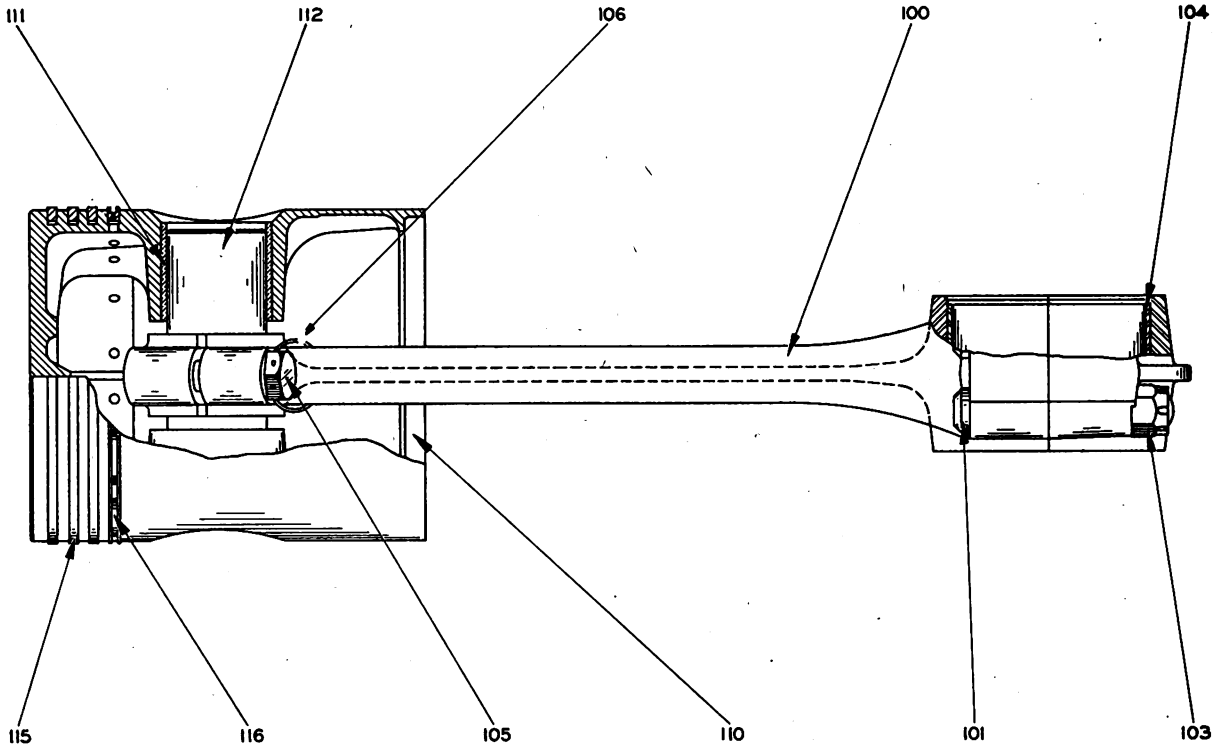


Fig. 72. Cross Section through Connecting Rod and Piston

45. Piston

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
110	3H4574/P20	4	Piston assembly, Includes pin and bushings	1A8-199-3	A
111	3H4574/B21	8	Bushing—Piston pin	11-166	A
112		4	Piston pin	17-298	A
115	3H4574/R12	12	Compression ring—P. C. 5 x 5/32"	18-235	A
116	3H4574/R16	4	Oil ring—P. C. 5 x 3/16"	18-236	A

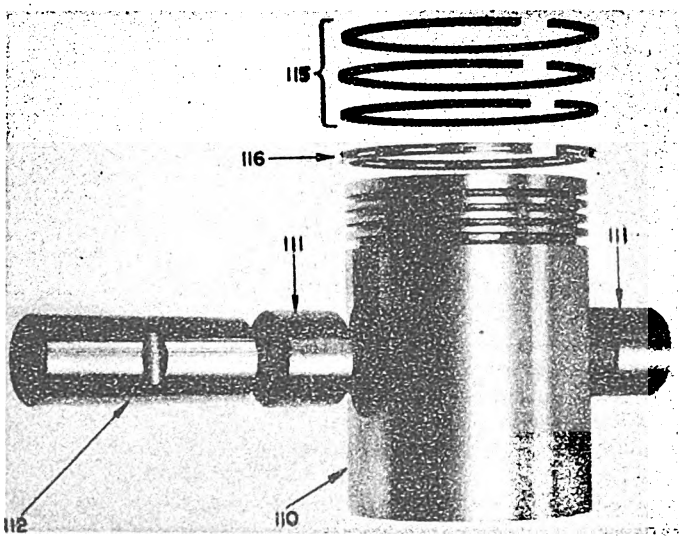


Fig. 73. Piston and Component Parts

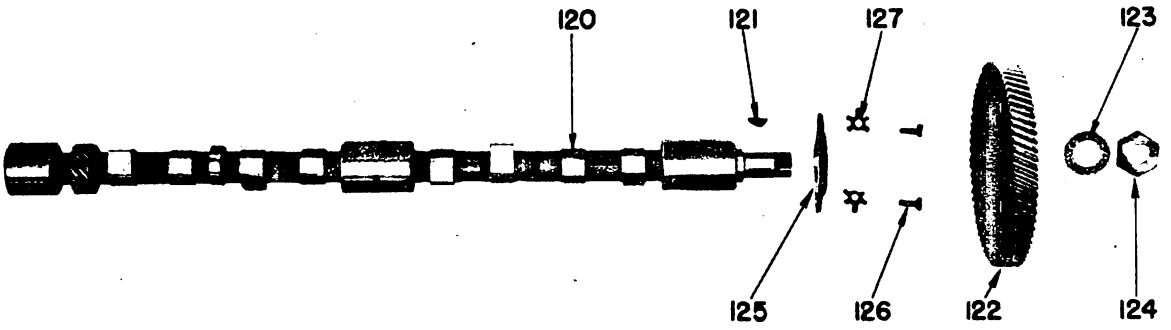


Fig. 74. Camshaft and Component Parts

46. Camshaft

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
120	3H4574/C8	1	Camshaft	6-132	A
121	3H4574/K4	1	Key—Camshaft gear, Woodruff #13	09-17	A
122	3H4574/G35	1	Camshaft gear	26-326	A
123	3H4574/W5	1	Lockwasher—Camshaft gear, special	20-276	A
124	3H4574/N11	1	Nut—Camshaft gear, 1⅛"—12 special	53-171	A
125	3H4574/R5	1	Camshaft retainer	31-327	A
126	3H4574/S52	2	Capscrew, 5/16—18 x ¾" hex	02-18	A
127		2	Lockwasher, 5/16", special	20-274	A

47. Lubrication, Oil Pump, Lines and Filter

130		1	Oil pump assembly, Includes 1A13-260-2 plus parts A to B	2A13-260-2	A
130		1	Oil pump assembly, Includes bushings	1A13-260-2	A
131		3	Bushing—Oil pump body	21-370	A
132		1	Shaft—Oil pump A	27-850	A
136		1	Key—Pump drive gear, Woodruff #6	09-6	A
137	3H4574/D3	1	Pump drive gear	26-327	A
138		1	Taper pin—Pump drive gear, #2 x 1" lg	010-29	A
139		1	Shaft—Oil pump idler gear	27-1337	A
133		2	Key—Oil pump gear, Woodruff #6	09-6	A
140		2	Key—Oil pump gear, Woodruff #6	09-6	A
134		2	Oil pump gear	26-519	A
141		2	Oil pump gear	26-519	A
135		1	Lock wire—Oil pump gear	64-29	A
142		1	Lock wire—Oil pump gear	64-29	A
143		1	Cover—Oil pump	14-538	A
148		6	Capscrew, ¼—20 x 5/8" hex	02-3	A
149		6	Lockwasher, ¼"	05-49	A
144	3H4584A/526	1	Screen—Oil pump	43-70	A
145		1	Wire—Oil pump screen	61-5-2	A
146	3H4574/G39	1	Gasket—Oil pump body to cover	16-636	A
151		2	Capscrew, 5/16—18 x 1¼" hex	02-21	A
152	3H4574/S52	1	Capscrew, 5/16—18 x ¾" hex	02-18	A
153		3	Lockwasher, 5/16"	05-50	A
147		1	Cover—Oil pump	14-536-1	A
...		1	Pipe plug, ⅛" slotted B	19-13	A
150	3H4574/G24	1	Gasket—Oil pump cover flange	16-635	A
154	3H4574/S52	5	Capscrew, 5/16—18 x ¾" hex	02-18	A
154A		5	Lockwasher, 5/16"	05-50	A
148	3H4574/P47	1	Pipe plug, ¼" ctrsk	011-102	A

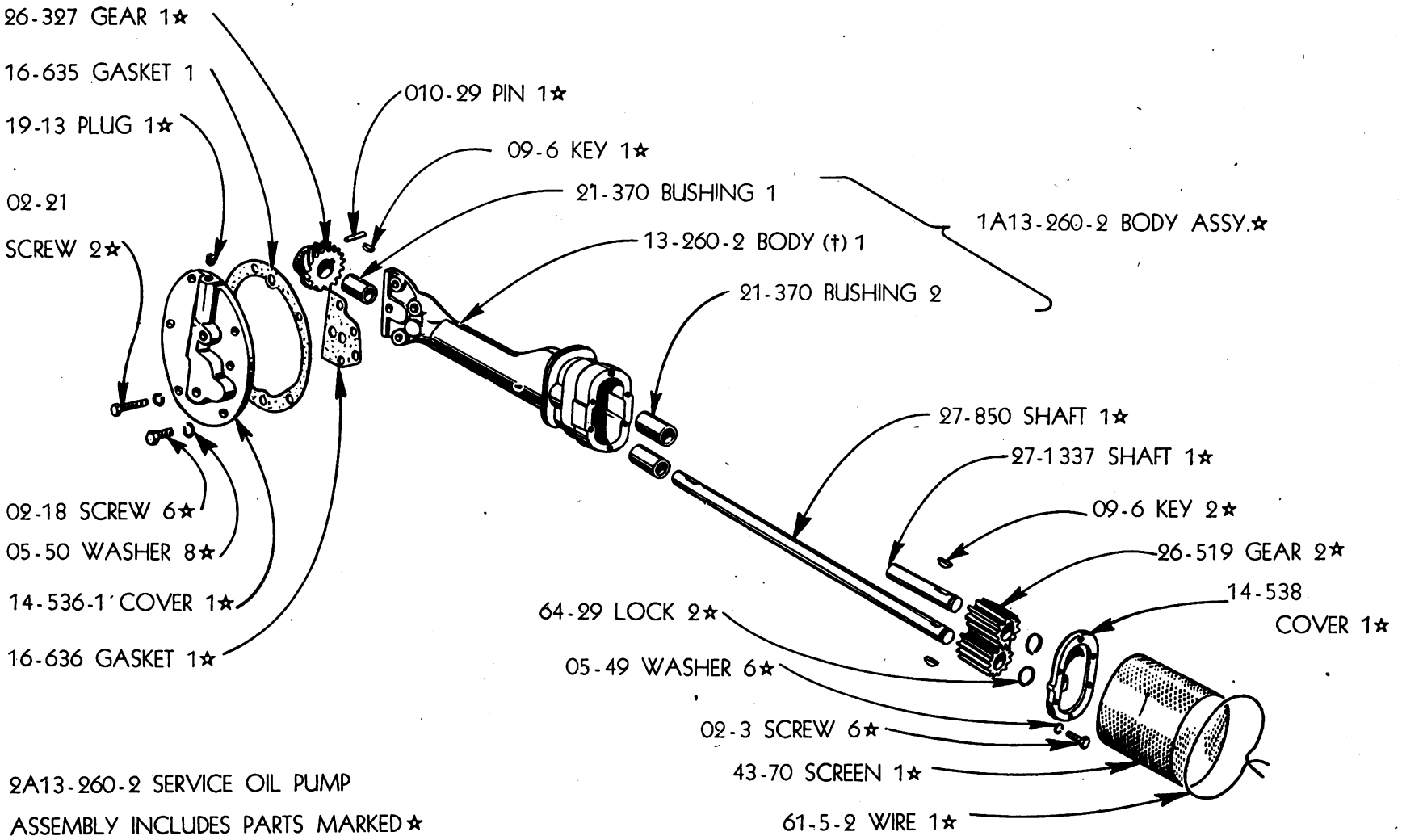


Fig. 75. Component Parts of Oil Pump

47. Lubrication, Oil Pump, Lines and Filter (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
155		1	Plug—Oil relief	53-150	A
156	3H4574/41	1	Spring—Oil relief plunger	24-236	A
157	3H4574/P17	1	Plunger—Oil relief	25-54	A
158	3H4574/G23	1	Gasket—Oil relief plug	B16-117	A
159	3H4574/F10	1	Oil filter assembly—Briggs Model G400, Includes parts marked*	A77-176	A
160	3H4584D/32	1	*Element—For oil filter, Briggs Model G-41 Cel	A77-180-1	A

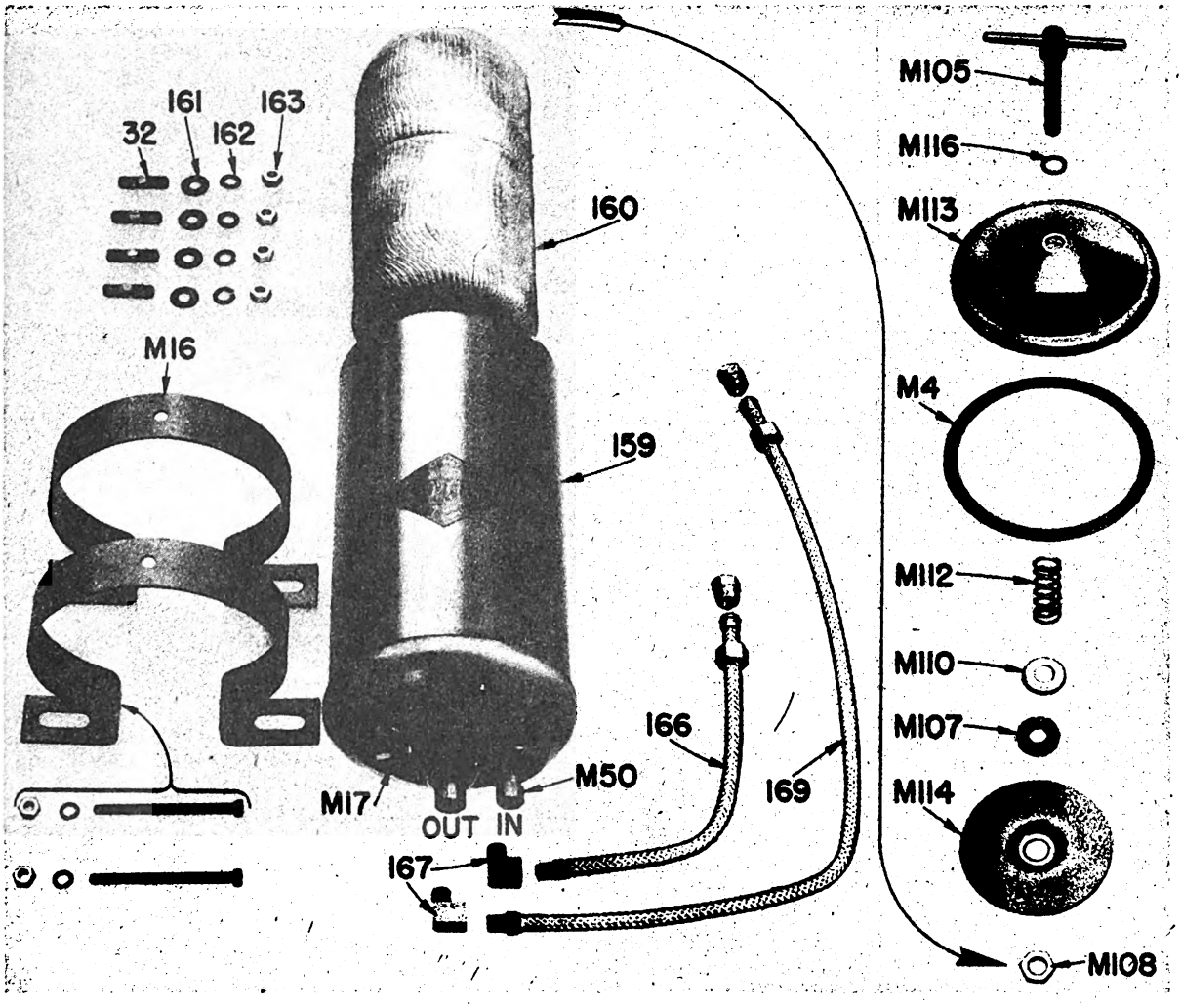


Fig. 76. Oil Filter and Component Parts

M-4	3H4574/G76	1	*Gasket—For top cover, Vellum	M-4	K
M-16	3H4574/M16	2	*Strap—Mounting	M-16	K
M-17	3H4574/P77	1	*Drain plug—Sump	M-17	K
M-50	3H4574/F17	1	*Restrictor fitting—Brass	M-50	K
M-105	3H4574/S142	1	*Capscrew—Bar handle	M-105	K
M-107	3H4574/A86	1	*Cork washer	M-107	K
M-108	3H4574/N35	1	*Check nut	M-108	K
M-110	3H4574/W84	1	*Steel washer	M-110	K

47. Lubrication, Oil Pump, Lines and Filter (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
M-112	3H4574/S140	1	*Hold down spring	M-112	K
M-113	3H4574/C121	1	*Top cover	M-113	K
M-114	3H4574/P77	1	*Plate—Top hold down	M-114	K
M-116	3H4574/W85	1	*Copper washer	M-116	K
32		4	Stud—Oil filter support, 5/16 x 1" lg. (also listed in Group 42)	B105-39	A
161		4	Plain washer, 5/16"	06-3	A
162		4	Lockwasher, 5/16"	05-50	A
163	3H4574/N4	4	Nut, 5/16"—24 hex. for #B105-39	04-602	A
166	3H4574/L8	1	Oil line—Filter inlet, Titeflex metal, 10¼" lg	A55-642-5	A
167	3H4574/E18	4	Connection, ⅛" x 90° brass str. ell	33-542	A
169	3H4574/L34	1	Oil line—Filter outlet, Titeflex metal, 21½"	A55-642-7	A
171	3H4574/C48	2	Connection—Filter lines, ⅛" brass nipple	33-544	A
172	3H4574/L9	1	Oil line—To cyl. hd., Titeflex metal hose, 16¼" lg	A55-642-4	A
173	3H4574/E18	2	Connection—Cyl. hd. oil line, ⅛" 90° brass str. ell	33-542	A
174	3H4574/C48	1	Connection—Cyl. hd. oil line, ⅛" brass close nipple	33-544	A
175	3H4574/C48	1	Connection—Oil line crankcase, ⅛" brass close nipple	33-544	A
176		1	Connection—Oil line, ⅛" cross	54-101	A
164		1	Gauge—Oil pressure	60-80	A
177	3H4574/L11	1	Oil line—To oil gauge, Titeflex metal hose, 29¾" lg	A55-642-8	A
178	3H4574/C48	1	Connection—Oil line to oil gauge, ⅛" brass close nipple	33-544	A
179	3H4574/L10	1	Oil line—To governor, Titeflex metal hose, 22½" lg	A55-642-6	A
...	3H4574/E18	1	Connection—Oil line to gov., ⅛" 90° brass str. ell	33-542	A
180	3H4574/C48	1	Connection—Oil line to gov., ⅛" close nipple	33-544	A
181		2	Clamp—Oil line	83-49	A
...		1	Lockwasher, 5/16"	05-50	A
...	3H4574/N4	1	Nut, 5/16"—24 hex	04-602	A
...	3H4584A/T5	1	Brass tee, ⅛ x ⅛ x ⅛"	33-554	A
...	3H4574/E16	1	Brass elbow, ¼ x ⅛", special reducing	33-547	A
...	3H4574/L14	1	Oil line—Pressure switch to gauge, Titeflex metal hose, 11⅝" lg	A55-642-13	A
...	3H4574/C48	2	Brass close nipple, ⅛"	33-544	A

48. Cylinder Head

190		1	Cylinder head assembly optional, Includes parts A to C Incl.	1A2-149-3	A
190	3H4574/H1	1	Cylinder head assembly optional, Includes parts A to D Incl.	2A2-149-3	A
190	3H4574/H7	1	Cylinder head comp. assembly optional, Includes parts A to L Incl.	3A2-149-3	A
191		4	Seat insert—Exhaust valve A	64-33	A
192	3H4584A/G2/1	4	Guide—Intake valve	58-26	A
193	3H4584A/G2/2	4	Guide—Exhaust valve	58-27	A
194		4	Stud—Rocker arm bracket	105-216	A
195		6	Stud—Manifold	105-191	A
...		16	Stud—Spark plug shield (not illustrated) C	105-315	A
196	3H4574/V2	4	Intake valve	15-200	A
197	3H4574/V8	4	Exhaust valve	15-201-1	A
198	3H4574/S17	8	Valve spring	B24-26	A
199	3H4584A/R4	8	Washer—Valve spring	20-278	A
200	3H4574/W6	16	Lockwasher—Valve stem, special D	20-279	A
201	3H4574/L36	1	Oil line—Rocker arm to cylinder head 3/16 x 8"	A55-51-24	A
205	3H4574/S22	1	Rocker arm shaft assembly, Includes sleeve and plugs	1A27-839	A
205		1	Rocker arm shaft assembly, Includes 1A27-839 plus parts E to L, Incl.	4A27-839	A
206	3H4574/S114	1	Sleeve—Rocker arm shaft	63-41	A
207		2	Plug—Rocker arm shaft	19-87	A
210	3H4584A/A7	4	Rocker arm assembly—Intake includes bushing and parts G and H E	A98-19-2	A

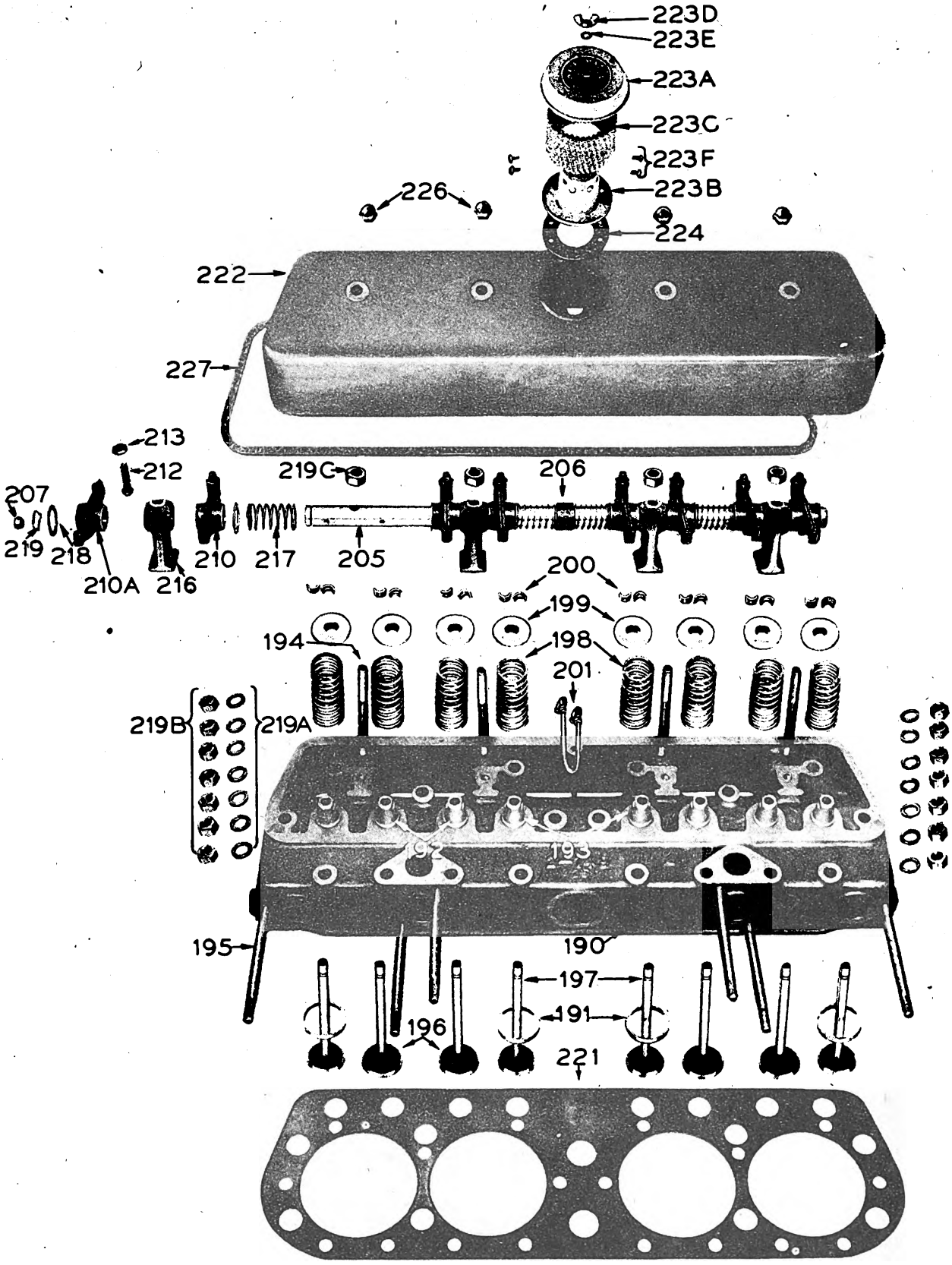


Fig. 77. Cylinder Head and Component Parts

48. Cylinder Head (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
212	3H4574/B27	4	Bolt—Valve adjusting.....G	B34-25	A
213	3H4574/N31	4	Lock nut—Valve adjusting bolt.....H	B53-8	A
210A	3H4584A/A1	4	Rocker arm assembly—Exhaust includes bushing and parts J and K.....	A98-19-3	A
212	3H4574/B27	4	Bolt—Valve adjusting.....J	B34-25	A
213	3H4574/N31	4	Lock nut—Valve adjusting bolt.....K	B53-8	A
216		4	Bracket—Rocker arm shaft.....	40-795-2	A
217		4	Spring—Rocker arm shaft.....	24-86	A
218		8	Washer—Rocker arm shaft.....	20-74	A
219		2	Lock wire.....L	61-59	A
219A	3H4574/W7	14	Washer—Cylinder head stud, ½".....	B20-1	A
219B	3H4574/N8	14	Nut—Cylinder head stud, ½"—20 hex.....	04-605	A
219C	3H4574/N27	4	Nut—Rocker arm bracket.....	04-604	A
...		4	Washer—Rocker arm bracket stud, 7/16" plain.....	06-70	A
221	3H4574/G22	1	Cylinder head gasket.....	16-629	A
...	3H4574/G59	1	Cylinder head cover assembly, Includes parts M to N Incl...	A14-535	A
222		1	Cover—Cylinder head.....M	14-535	A
223	3H4574/B9	1	Breather—Air Maze ZOH, Includes parts marked †.....	A77-137	A
223A		1	†Breather top, Includes name plate #Z0-3.....	Z0-001	B
223B		1	†Breather base.....	Z0-003	B
223C		1	†Breather element.....	Z0-18	B
223D		1	†Wing nut, ⅜" std.....	04-1002	A
223E		1	Lockwasher, ⅜".....	05-51	A
223F	3H4574/S63	4	Screw—Breather, Parker Kalon, Type Z Stove head #10 x ⅜".....	03-1538	A
224	3H4574/G21	1	Breather gasket.....N	16-643	A
226	3H4574/N7	4	Nut—Cylinder head cover, 7/16"—20 Acorn.....	04-1129	A
227		1	Gasket—Cylinder head cover.....	16-634-2	A
		4	Spacer—Cylinder head cover stud (Serial 181801 up).....	22-229	A

49. Gear Cover

235		1	Gear cover.....	14-540-2	A
236	3H4574/G19	1	Gasket—Gear cover (upper).....	16-650	A
237	3H4574/G18	1	Gasket—Gear cover (manifold side).....	16-651	A
238	3H4574/G17	1	Gasket—Gear cover (lower).....	16-652	A
239	3H4574/G16	1	Gasket—Gear cover (magneto side).....	16-653	A
240		1	Oil retainer, 2½" I.D.....	125-58-1	A
243		11	Capscrew, ⅜—16 x 1¾" hex.....	02-39	A
244		2	Capscrew, ⅜—16 x 1½".....	02-38	A
245		14	Lockwasher, ⅜".....	05-51	A
241		2	Taper pin, #7 x 2" lg.....	010-315	A
242		2	Nut, ⅜"—24 hex.....	04-603	A

50. Governor Drive Assembly

260	3H4574/D20	1	Governor drive assy., Optional, Includes parts A to F.....	2A116-51	A
260		1	Governor drive assy., Optional, Includes parts A to E.....	1A116-51	A
260		1	Governor drive assy., Optional, Includes parts A to B.....	A116-51	A
260		1	Body—Governor drive.....A	116-51	A
261	3H4574/S71	1	Bushing—Governor shaft, front.....	21-339	A
262	3H4584A/B21	1	Bushing—Governor shaft, rear.....	21-354	A
263	3H4584A/S64	1	Oil slinger.....	202-1	A

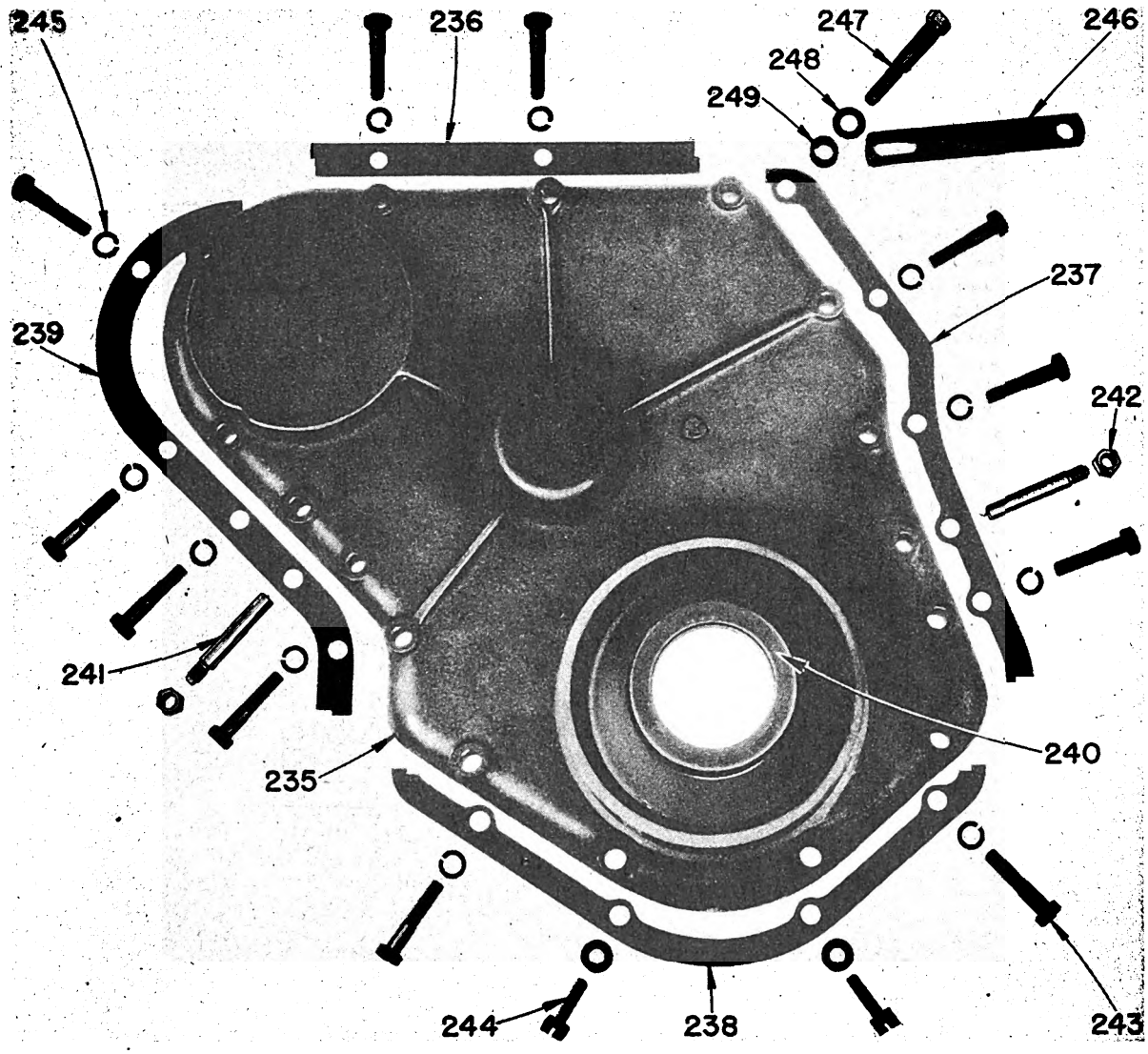


Fig. 78. Gear Cover and Component Parts

50. Governor Drive Assembly (Cont'd)

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
263A	3H4584A/S53	1	Spring	24-310	A
264	3H4584A/S56	1	Oil seal.....B	125-56-1	A
265		1	Bearing cap assy., Includes bushing	A4-167	A
266	3H4574/B64	1	Bushing—Governor drive pinion	21-327	A
267	3H4574/G15	1	Gasket—for bearing cap.....E	16-873	A
268		1	Bevel pinion—Governor drive	26-504	A
269		1	Bevel gear—Governor drive shaft	26-503	A
270		1	Taper pin, for bevel gear, #3—1¼" lg	010-42	A
271	3H4574/S14	1	Shaft—Accessory drive	27-1325	A
272		1	Gear—Accessory drive shaft	26-334-2	A
273		1	Taper pin—Governor drive gear, #3—1¼" lg	010-42	A
274		1	Key—Magneto coupling, Woodruff #6	09-6	A
275		1	Magneto coupling.....F	28-159	A
...	3H4574/S2	4	Capscrew, for drive shaft bracket, ⅜—16 x 1" hex	02-36	A
...		4	Lockwasher, for #02-36, ⅜"	05-51	A
280	3H4574/G14	1	Gasket—Drive shaft bracket	16-669	A

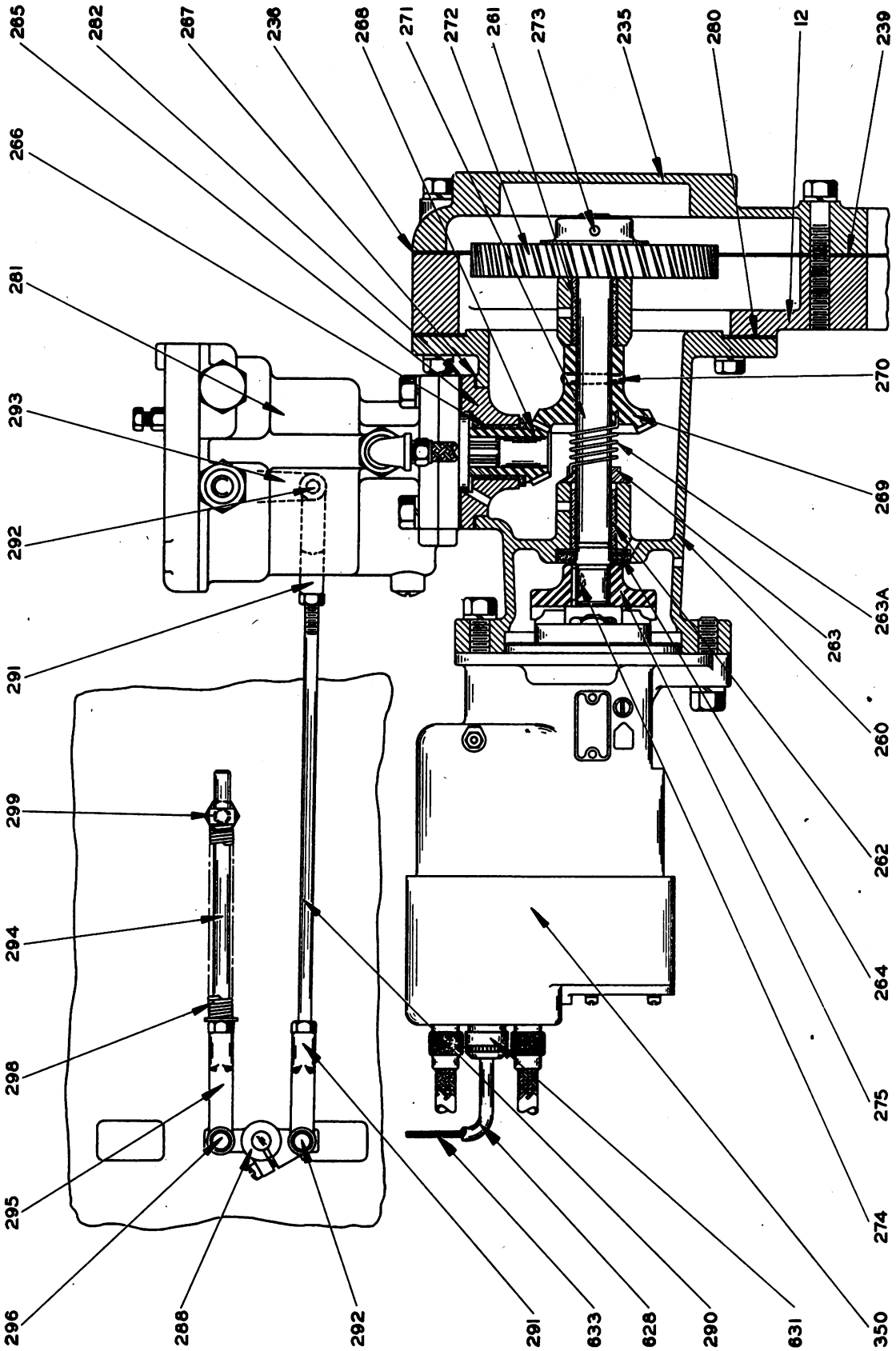


Fig. 79. Cross Section through Governor Drive

51. Governor Controls

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
285	3H4574/S13	1	Cross shaft assy., Governor operating, Includes next 5 items..	A27-1152	A
285		1	Cross shaft	27-1152	A
286	3H4584A/C11	1	Coupling—Cross shaft	28-232	A
287		1	Taper pin, for coupling #000 x ½"	010-201	A
...		1	Screw, for #48-493, #10-24 x ½"	03-92	A
288	3H4574/L3	1	Lever—Governor operating cross shaft	48-493	A
290	3H4574/R28	1	Rod—Governor operating	47-264	A
291	3H4574/C52	2	Clevis end—Governor rod	031-2	A
...		2	Nut, for #031-2, ¼"—28 hex	04-601	
292	3H4574/P8	2	Clevis pin	031-62	A
...	3H4574/P9	2	Cotter pin, 1/16 x 7/16"	07-2	A
294		1	Rod—Governor control spring	47-524	A
295	3H4574/C52	1	Clevis end—Spring rod	031-2	A
...		1	Nut, for #031-2, ¼"—28 hex	04-601	A
296	3H4574/P8	1	Clevis pin	031-62	A
...		1	Cotter pin, 1/16 x 7/16"	07-2	A
298	3H4574/P9	1	Spring—Governor control	24-300	A
299	3H4574/G58	1	Guide assy.—Governor spring rod, Includes bushing	A58-38	A
300	3H4574/N5	1	Bushing, for guide	21-345	A
...		1	Nut, for guide, 5/16"—18	04-102	A

52. Manifold

400		1	Manifold assembly (Includes Welch plugs)	A10-355	A
...	3H4574/P29	4	Welch plug, 1¼" dia	019-19	A
...	3H4574/G13	2	Gasket—Intake	16-630	A
402	3H4574/G28	1	Gasket—Exhaust center	16-885	A
...	3H4574/G29	2	Gasket—Exhaust end	16-632	A
...	3H4574/W7	6	Plain washer, ½"	B20-1	A
405	3H4574/C42	1	Collar—Manifold center outlet	63-94	A
...	3H4574/N8	6	Nut, ½"—20 hex	04-605	A
410		1	Butterfly valve	15-329	A
411		1	Shaft for butterfly valve	27-1327	A
...		2	Screw, ⅛"—40 flat head	34-187	A
413		1	Bracket assembly, Includes stop pin for start and stop control.	A116-52	A
...		2	Capscrew for control bracket, ¼—20 x 2" hex	02-10	A
...		2	Lockwasher, ¼" dia	05-49	A
415		1	Control lever	48-489	A
...	3H4574/S3	1	Screw for control lever, #10—24 x ½" lg. fil. hd.	03-92	A
418	3H4574/R27	1	Rod for control lever	47-542	A
419	3H4574/S48	1	Spring for control lever rod	24-308	A
420		1	Handle for control lever	50-88	A
...		1	Pipe plug, ⅛" slotted	19-13	A
423	3H4574/C28	1	Drain cock, ¼" male x ¼" female	15-338	A
1025		1	Thermometer, engine temperature gauge	60-146	A

53. Muffler

800		1	Muffler assy	78-73	A
802		1	Exhaust pipe	33-178-23	A
803		1	Retainer muffler packing	31-426	A
804	3H4574/P4	1	Muffler packing, ⅜ x 24" lg	16-886	A

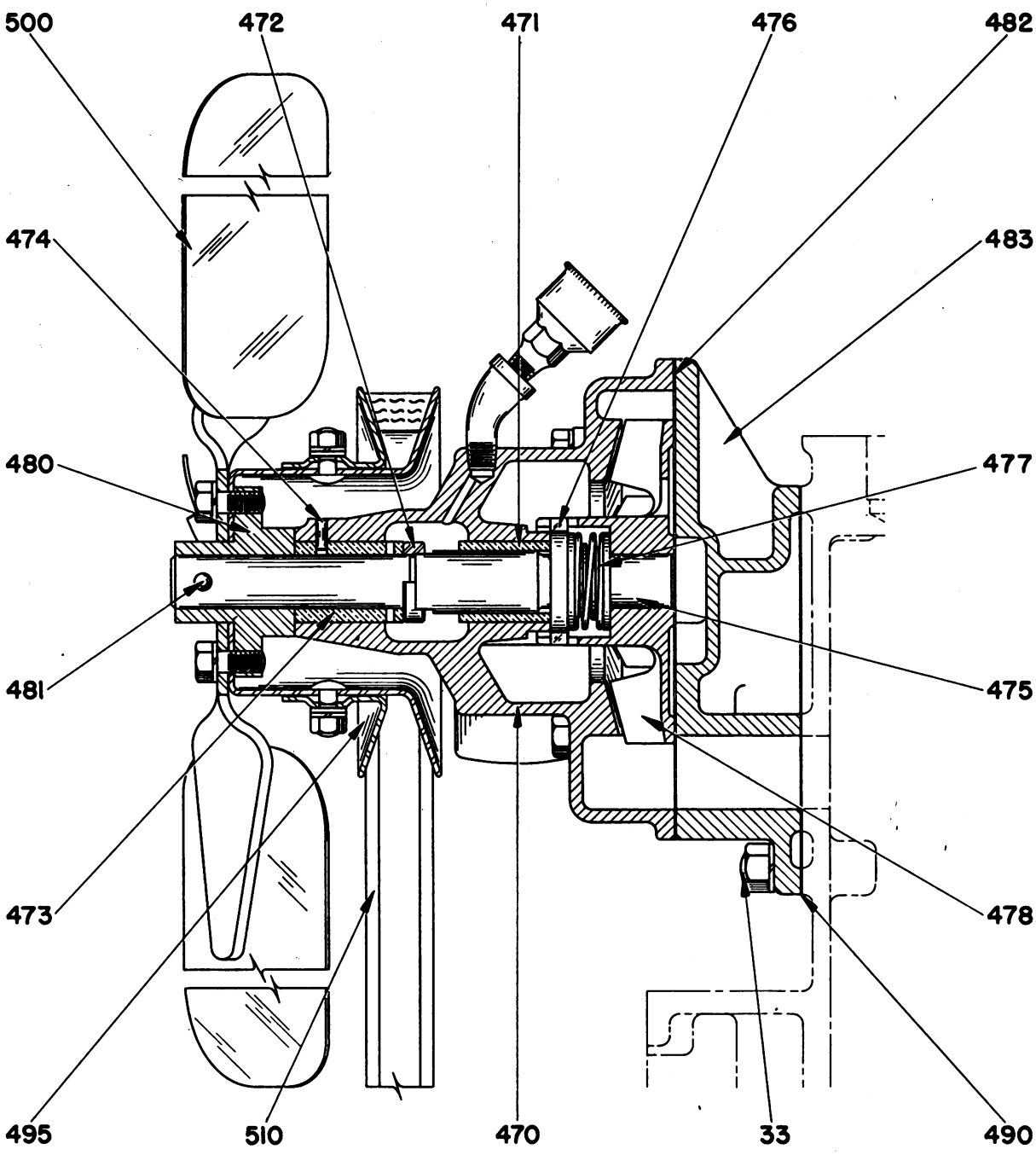


Fig. 80. Cross Section through Water Pump (up to Serial No. 166321 except Nos. 164990 to 164997 incl.)

54. Water Pump and Fan (Up to Serial No. 166321 except Nos. 164990 to 164997 incl.)

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
...		1	Water pump assembly, Includes A13-360-1 plus items marked †	1A13-360-1	A
470	3H4574/B58	1	Body—Water pump, Includes next 4 items	A13-360-1	A
471		1	Bushing	21-368	A
472	3H4574/W76	1	Thrust washer	20-378	A
473		1	Bushing	21-367	A

54. Water Pump and Fan (Up to Serial No. 166321 except Nos. 164990 to 164997 incl.)-(Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
474	3H4574/P75	1	Bushing pin	17-418	A
475	3H4574/S133	1	†Shaft—Water pump	27-1381	A
476	3H4574/W77	1	†Seal washer	20-379	A
477	3H4574/B3	1	†Bellows seal assembly	125-68	A
478		1	†Impeller—Water pump	101-28	A
480		1	†Fan hub	132-73	A
481	3H4574/P74	1	†Taper pin—Fan hub, #4 x 1"	010-53	A
482	3H4574/G9	1	†Gasket—Pump body	16-754	A
483		1	†Bracket—Pump body	40-1075	A
...	3H4574/S55	5	†Capscrew, 5/16—18 x 1¾"	02-23	A
...		5	†Lockwasher, 5/16"	05-50	A
...		1	†Street ell, ⅛" P. T. x 45°	013-531	A
...	3H4574/C117	1	†Grease cup, ⅛" MPT	017-11	A
...	3H4574/N32	1	Nipple, ½ x 2½" thread one end	33-114-21	A
490	3H4574/G8	1	Gasket—Water pump bracket to cylinder	16-638	A
...		4	Hex. nut, ⅜"—24	04-603	A
...		4	Lockwasher, ⅜"	05-51	A
495		1	Fan pulley assembly	1A36-249	A
510		1	Fan belt	41-235	A
500	3H4574/B63	1	Fan blade assy	42-107	A
...	3H4574/S52	4	Capscrew—Fan blade, 5/16"—18 hex	02-18	A
...		4	Lockwasher, for #02—18, 5/16"	05-50	A
...	3H4584A/P2	1	†Pin, Taper, Impeller hub, #4 x 1½"	010-55	A

55. Water Pump and Fan (Serial No. 166322 up, also 164990 to 164997 incl.)

...		1	Water pump assembly, Includes parts marked †	5A13-360-1	A
470		1	†Body—Water pump (Not sold for service, Order 5A13-360-1)	13-360-1	A
471		1	†Bushing—Water pump shaft, Rear	21-380	A
473		1	†Bushing—Water pump shaft, Front	21-381	A
474	3H4574/P75	1	†Pin—Rear bushing retainer	17-418	A
475		1	†Shaft—Water pump and fan	27-1397	A
476	3H4574/W77	1	†Washer—Water pump seal, Carton	20-379	A
477	3H4574/B3	1	†Bellows seal assembly	125-68	A
478		1	†Impeller—Water pump	101-28	A
479		1	†Pin—Impeller hub retainer, #4 taper x 1½" lg	010-55	A
...		1	†Steel ell—⅛" P. T.—45°	013-531	A
...		1	†Pulley assembly—Includes next 4 items	A36-529	A
480		1	Pulley—Inner half	36-529	A
480A		1	Pulley—Outer half	36-528	A
480B		1	Lockwasher—Special	20-386	A
480C		1	Locknut—Special	53-231	A
481		1	†Pin—Fan pulley retainer, #4 taper x 1¼" lg	010-54	A
...		1	Grease cup—⅛" M. P. T	017-12	A
484		1	Nipple—Water by-pass, thread one end, ½" x 2½" lg	33-114-21	A
482	3H4574/G9	1	Gasket—Water pump body to cover	16-754	A
483		1	Bracket—Water pump body	40-1075	A
...	3H4574/S55	5	Capscrew—5/16—18 x 1¾" lg	02-23	A
...		5	Lockwasher—5/16"	05-50	A
490	3H4574/G8	1	Gasket—Water pump bracket to cylinder	16-638	A
...		4	Nut—⅜"—24, hex	04-603	A
...		4	Lockwasher—⅜"	05-51	A
510		1	Belt—Fan and water pump drive	41-225	A
500		1	Fan blade assembly, suction type	42-107-1	A
500	3H4574/S52	1	Fan blade assembly, blower type, used on Serial Nos. 181832 to 181955	42-113	A

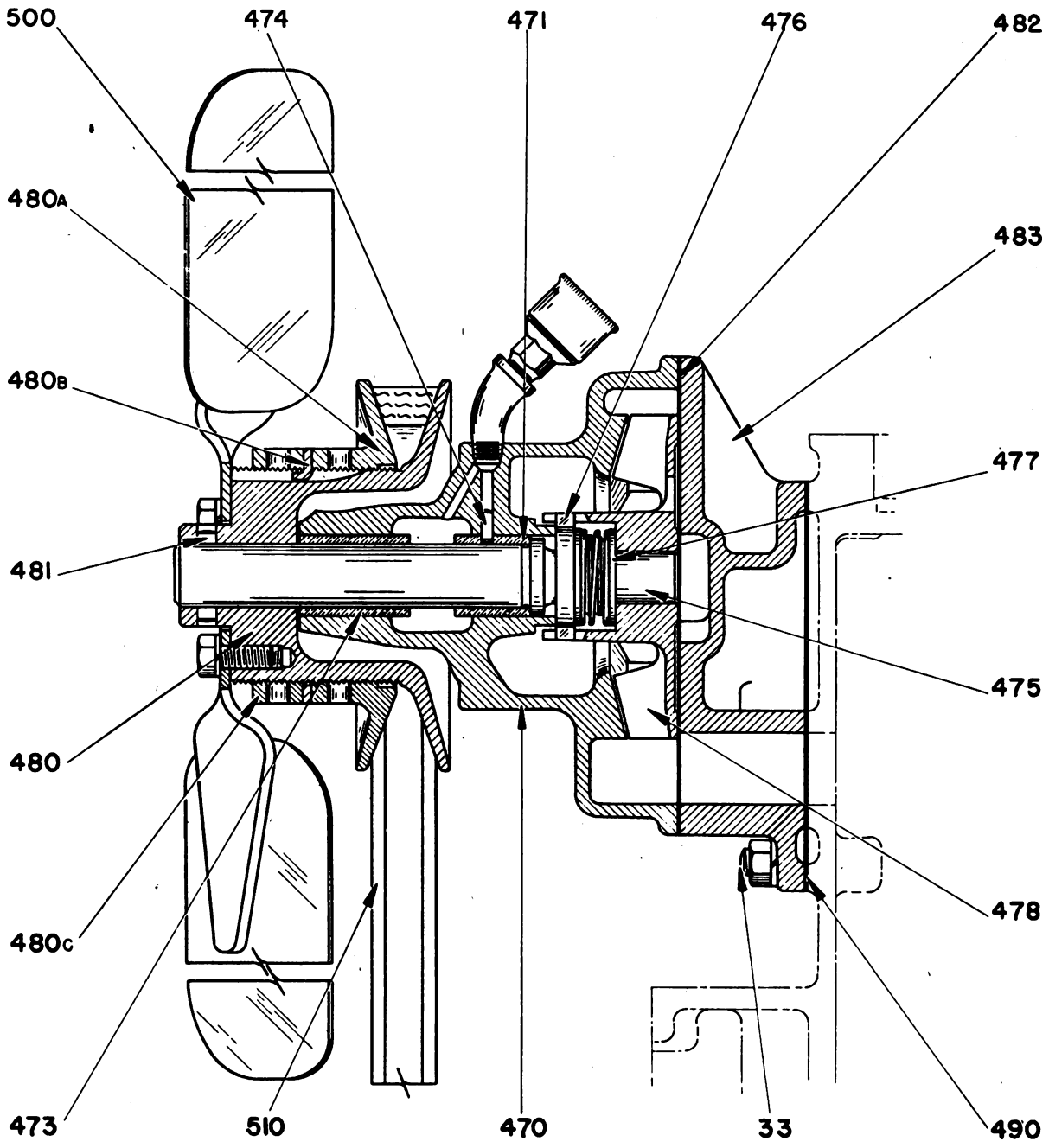


Fig. 81. Cross Section through Water Pump (Serial No. 166322 up, also Nos. 164990 to 164997 incl.)

55. Water Pump and Fan (Serial No. 166322 up, also 164990 to 164997 incl.) (Cont'd)

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
...		4	Capscrew—Fan blade, 5/16"—18 hex.....	02-18	A
...		4	Lockwasher—For #02-18, 5/16".....	05-50	A

56. Cooling Group

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
1001	3H4574/B3	1	Radiator assembly	A71-243-10	A
1002	3H4574/P3	2	Packing, radiator	B74-4	A
....		2	Capscrew—For radiator, 5/8—11 x 1½"	02-10	A
....		2	Plain washer, 5/8"	06-73	A
....		2	Lockwasher, 5/8"	05-55	A
1003	3H4584A/G11	1	Fan guard	156-170	A
1003A	3H4584A/G12	1	Radiator guard	156-169	A
....		6	#10 x 3/8" Binding head screw	03-1537	A
....	3H4584A/S22	9	Machine screws, ¼—20 x ½" lg. rd. hd.	03-619	A
....		9	Square nut, ¼"—20	04-18	A
....		9	Flat washer, ¼"	06-2	A
....		1	Street ell, ¼"—45°	013-532	A
1004	3H4574/C28	1	Drain cock, ¼ M. & F. M. PT	15-338	A
1005	3H4574/C60	1	Inlet connection—Radiator	65-626	A
1007		1	Thermostat	116-54	A
1008	3H4574/G3	1	Gasket—Inlet conn.	B16-123	A
....		2	Capscrew—Inlet conn. 7/16—14 x 1¼"	02-55	A
....		2	Lockwasher, 7/16"	05-52	A
1009	3H4574/C54	2	Connection—Cyl. hd. water	65-624	A
1010	3H4574/G2	4	Gasket—Cyl. hd. water connection	16-646	A
1011	3H4574/W7	4	Plain washer	B20-1	A
....		4	Nut, ½"—20 hex.	04-605	A
....		4	Capscrew—Cyl. hd. water conn. to mfld., ½—13 x 1¼"	02-70	A
....		4	Lockwasher, ½"	05-53	A
1011A	3H4574/655	1	Connection—Manifold water outlet	65-625	A
1011B		1	Gasket—Connection	16-146	A
....	3H4574/S2	2	Capscrew—Outlet conn. to mfld. 3/8 x 16 x 1"	02-36	A
....		2	Lockwasher, 3/8"	05-51	A
1012	3H4574/H13	2	Hose—Outlet conn. to rad., 1¾ x 2½"	73-5-20	A
1013	3H4574/668	1	Outlet conn.—to radiator	65-627	A
....	3H4584A/T9	1	Tube—Radiator to pump conn.	55-208-8	A
....	3H4574/H3	2	Hose—Radiator to pump, 1¾ x 3"	73-5-14	A
1017	3H4584A/625	8	Hose clamp assembly	83-93	A
1020	3H4574/H14	1	Hose—By-pass, ¾ x 11½"	73-29-8	A
1021	3H4574/669	2	Hose clamp assembly	83-92	A
....	3H4584A/S27	1	Bug Screen, used with suction fan only	43-131	A
....		1	Bug Screen, used with blower fan only	43-149	A
....	3H4584A/S54	8	Spring—Bug Screen, used with 43-131 Bug Screen only	24-311	A
....	3H4574/C62	1	Clamp—Tubing	83-91	A
....		1	Capscrew, 3/8 x ½" hex. hd.	02-32	A
....		1	Lockwasher, 3/8"	05-51	A
....	3H4574/D8	1	Decalcomania—Water capacity	62-113	A
....	3H4574/D7	1	Decalcomania—Water drain	62-109	A

57. Engine Base (Oil Pan Group)

550		1	Engine base (Oil Pan)	118-250-1	A
551	3H4574/G7	1	Gasket—Eng. base flange, carb. side	16-647	A
552	3H4574/G8	1	Gasket—Eng. base flange, mag. side	16-648	A
553	3H4574/G5	1	Gasket—Eng. base, rear	16-649	A
...		16	Capscrew—Eng. base flange, 3/8—16 x 1¼" hex.	02-37	A
...	3H4574/C58	16	Lockwasher, 3/8"	05-51	A
554		3	Hand hole cover	14-807	A
554A	3H4574/657	1	Hand hole cover, Includes oil filler tube	14-804	A
...		48	Lockwasher, 3/8"	05-51	A
...		48	Nut, 3/8"—24 hex.	04-603	A
555	3H4574/G1	4	Gasket, Hand hole cover	16-359	A

57. Engine Base (Oil Pan Group) (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
556		48	Stud—For hand hole cover	105-61	A
558		1	Nipple—For dipstick	33-101-2	A
559	3H4584A/B22	1	Bushing—For dipstick	21-355	A
560		1	Dipstick—Oil level gauge	A60-43-19	A
561	3H4574/V11	1	Oil drain valve, ¾" bronze	15-349	A
...		1	Oil drain line, ¾ x 2½" lg.	013-131	A
...	3H4574/E9	1	Street ell—Oil drain, ¾"—90°	013-505	A
...	3H4574/N33	1	Nipple—Oil drain, ¾ x 1½", thrd., one end	33-101-7	A
562		1	Tube—For oil breather	49-43	A
563	3H4574/B62	1	Breather—Oil pan	A49-44-1	A
...	3H4574/11	1	Decalcomania—Oil capacity	62-115	A

58. Bed Plate (Engine and Alternator)

...		1	Bedplate—Engine and alternator	118-463	A
...		6	Capscrew—Engine to base, ¾"—10 x 2" hex.	02-118	A
...		6	Lockwasher—For #02-118, ¾"	05-57	A
...		4	Capscrew—Generator to base, ¼—10 x 2¾"	02-121	A
...		4	Lockwasher—For #02-121, ¾"	05-57	A
...		4	Dowel pin, #9 x 3"	010-325	A
...		4	Shim—For generator base, .005" thick	22-190-1	A
...		8	Shim—For generator base, .015" thick	22-190	A
...		4	Shim—For generator base, .030" thick	22-190-2	A
...	3H4574/S144	1	Radiator support	39-1376	A
...		6	Capscrew—Rad. supp. ⅜—16 x ⅞" hex.	02-35	A
...		6	Lockwasher—For #02-35, ⅜"	05-51	A
...		1	Support—Starting crank	39-1225	A
...		2	Capscrew—For crank supp., ½—13 x 1½" hex.	02-71	A
...		2	Lockwasher—For #02-71, ½"	05-53	A
...		2	Nut, ½"—13 hex.	04-105	A
...		1	Front cover—For support	14-802	A
...		8	Screw—For cover, 5/16—18 x ¾" button head machine	03-628	A
...		8	Lockwasher, 5/16"	05-50	A
...	3H4574/C82	1	Cover—For battery	14-828	A
...		1	Support—For control cabinet	39-1245	A
...		4	Capscrew—For supp., ⅝—11 x 1¼" hex.	02-100	A
...		4	Lockwasher—For #02-100, ⅝"	05-55	A
...		4	Rubber mounting—For cabinet	39-1180	A
...		16	Capscrew—For rubber mountings, ¼—20 x ½" lg. hex.	02-2	A
...		16	Lockwasher—For #02-2, ¼"	05-49	A
...		2	Wire—Cabinet to ground	61-451	A
...		2	Capscrew, ¼—20 x ½" hex.	02-2	A
...		2	Plain washer, ¼"	06-67	A
...		4	Capscrew—For rubber mountings, ⅜—16 x 2¾" hex.	34-204	A
...		4	Plain washer, ⅜"	06-67	A
...	3H4584A/N42	4	Nut, ⅜"—16 castle	04-303	A
...	3H4584A/P33	4	Cotter pin, 3/32 x 1" lg.	07-23	A
...		1	Name plate, Signal Corps Unit Number	62-123-2	A
...		1	Decal.—Installation Instruction	62-148	A
...	3H4574/S18	8	Screw, Parker Kalon, #2 x 3/16", Type U	03-2001	A
...	3H4574/D7	2	Decal.—Instr. for water drain	62-109	A
...		1	Decalcomania—Weight	62-114	A
...		1	Lug—For ground	121-31	A
...		1	Capscrew, 5/16—18 x ½"	02-16	A
...		1	Lockwasher, 5/16"	05-50	A

59. Cranking Motor

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...	3H4574/M5	1	Cranking Motor—Delco-Remy Model 412, 12 volt	A107-37	A
...	3H4574/S2	3	Capscrew—Cranking motor mounting, 3/8—16 x 1" hex.	02-36	A
...		3	Lockwasher—For #02-36, 3/8"	05-51	A
...		1	Bearing plate	16199	F
...		1	Drive housing	16999	F
...		1	Insulation strip	33345	F
...		6	Brush spring	34846	F
...		1	Bushing	35048	F
...		6	Pole shoe	36497	F
...		12	Screw	37872	F
...		1	Armature	37895	F
...		1	Field coil assem. (left)	38275	F
...		1	Field coil assem. (right)	38276	F
...		1	Comm. end frame	38290	F
...		6	Brush	38367	F
...		2	Lockwasher	103319	F
...		6	Lockwasher	106496	F
...		12	Lockwasher	106497	F
...		1	Screw	107728	F
...		2	Lockwasher	110730	F
...		6	Screw	115607	F
...		1	Woodruff key	124546	F
...		1	Nut (1/4" thick)	134569	F
...		1	Nut (5/32" thick)	805258	F
...		1	Washer	805790	F
...		2	Lockwasher	806427	F
...		1	Head	808949	F
...		1	Sleeve	808950	F
...		3	Insulation washer (9/16" O.D.)	809051	F
...		1	Spring	809518	F
...		1	Head screw	810287	F
...		1	Sleeve screw	810288	F
...		1	Bushing	810620	F
...		1	Plug	810819	F
...		1	Gear and shaft	811080	F
...		1	Bendix drive	811194	F
...		1	Terminal stud	826938	F
...		2	Screw	828483	F
...		12	Screw	828675	F
...		1	Washer	833602	F
...		1	Washer	1838568	F
...		1	Bushing	1839345	F
...		2	Insulation washer (3/4" O.D.)	1861076	F
...		1	Cover band	1880355	F

60. Magnetic Switch

...	3H4574/S45	1	Magnetic switch—Delco-Remy Model 1422	A76-46	A
...		2	Capscrew—Mag. switch mounting, 1/4—20 x 1/2"	02-2	A
...		2	Lockwasher—For #02-2, 1/4"	05-49	A
...		4	Lockwasher	110730	F
...		3	Nut	120614	F
...		4	Nut (Terminal)	120622	F
...		2	Nut (Thick)	134569	F
...		3	Lockwasher	802731	F
...		2	Nut (Thin)	805258	F
...		2	Washer	805790	F

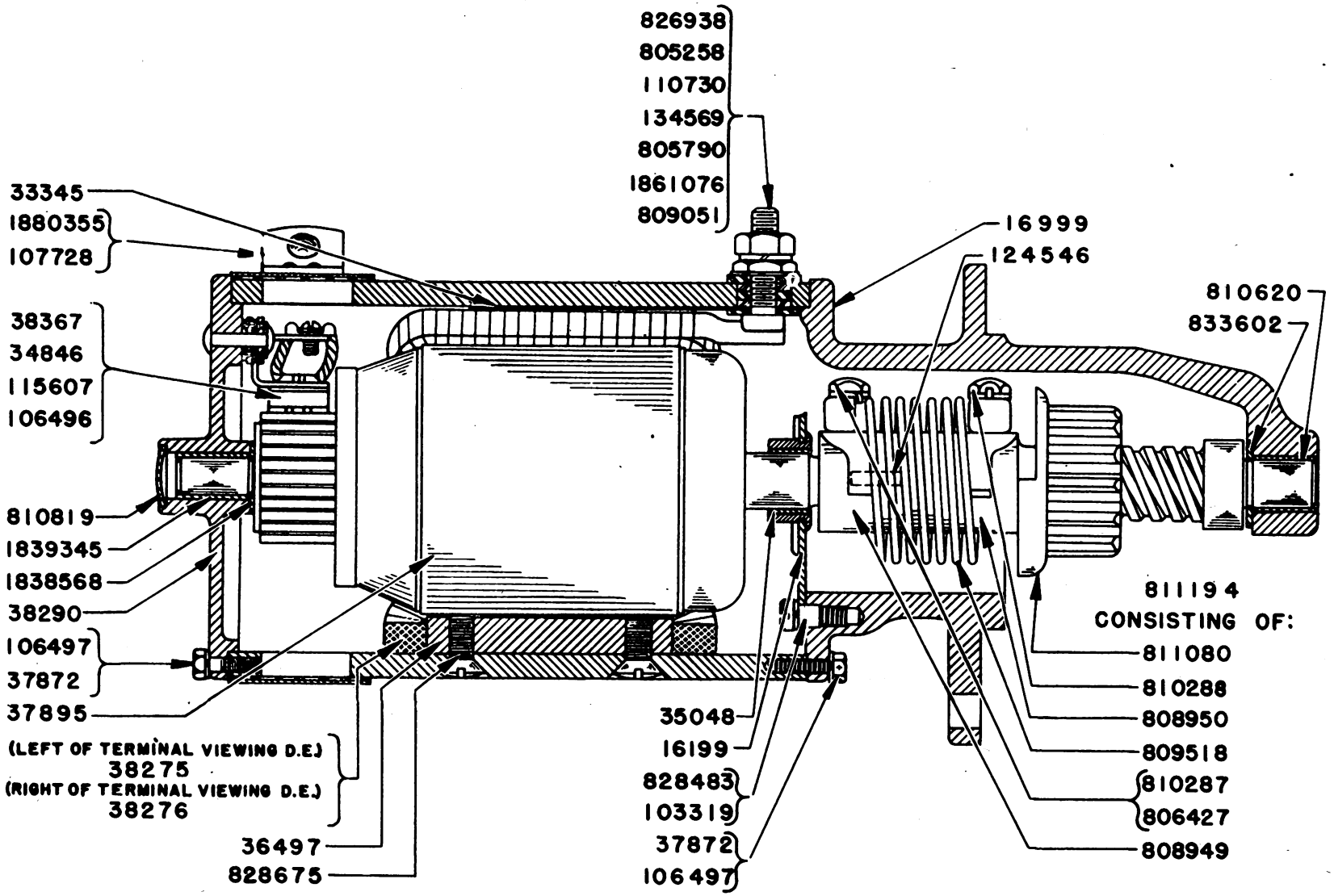


Fig. 82. Cross Section through Cranking Motor

60. Magnetic Switch (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...		1	Bent insulation	811492	F
...		2	Washer (Outside)	813731	F
...		2	Bushing (Insul.)	816863	F
...		1	Cover plug	820657	F
...		2	Stud	822205	F
...		1	Spring	825227	F
...		1	Plunger	825228	F
...		1	Pin	825229	F
...		2	Washer (Inside)	826319	F
...		4	Lockwasher	826498	F
...		2	Washer (Insul.)	1838591	F
...		1	Push rod and contact	1843456	F
...		1	Case and bracket	1843458	F
...		2	Terminal stud	1843464	F
...		1	Base insulation	1843465	F
...		1	Insulation strip	1843466	F
...		1	Coil	1862901	F
...		3	Screw	1866970	F
...		1	Stop and base	1869463	F
...		1	Base and terminal assem.	1869467	F

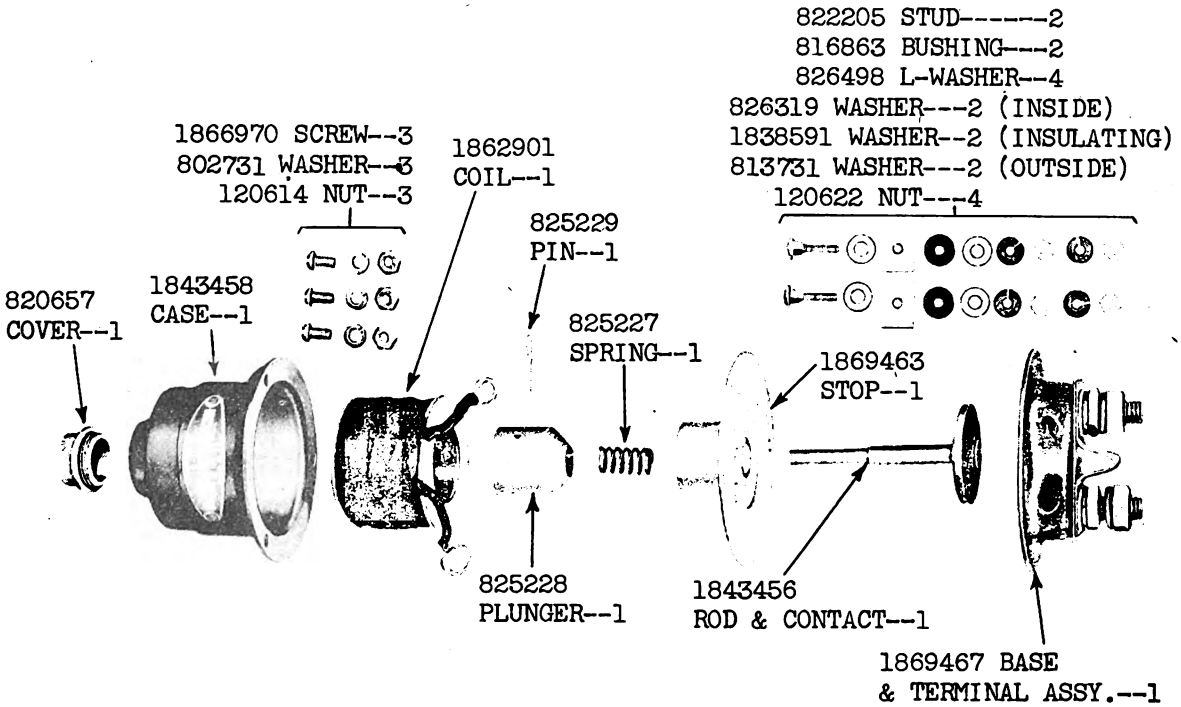


Fig. 83. Component Parts of Magnetic Switch

61. Generator

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...		1	Generator and regulator assy.—Delco-Remy Model 1101747	A108-87	A
...		1	Support—For generator	39-1353	A
...		2	Capscrew	02-34	A
...		2	Lockwasher—For #02-34, 3/8"	05-51	A
...		2	Capscrew	02-20	A

61. Generator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...		2	Lockwasher—For #02-20, 5/16"	05-50	A
...	3H4574/N5	2	Nut—For #02-20, 5/16"—18	04-102	A
...	3H4574/S137	1	Adjusting support	39-1354	A
...		1	Pulley—Generator drive	36-334-2	A
...		1	Belt—Generator drive	41-229	A
...		1	Control unit	5897	F
...		3	Lockwasher	106495	F
...		3	Lockwasher	106496	F
...		1	Lockwasher	106497	F
...		1	Screw	107728	F
...		2	Lockwasher	108579	F
...		1	Woodruff key	124545	F
...		2	Screw	132900	F
...		2	Lockwasher	138479	F
...		2	Screw	141540	F
...		1	Screw	141543	F
...		2	Lockwasher	802730	F
...		3	Lockwasher	802731	F
...		4	Lockwasher	802757	F
...		1	Lockwasher	804000	F
...		1	Wick	804076	F
...		1	Nut	806915	F
...		1	Dowel pin	809062	F
...		3	Washer	809551	F
...		1	Dowel pin	809593	F
...		1	Pin	809614	F
...		3	Brush	809637	F
...		3	Brush holder	809642	F
...		2	Spring (3rd and grd.)	809644	F
...		1	Spring (Ins. main)	809658	F
...		1	Lead (Ground)	809688	F
...		1	Brush plate	809698	F
...		1	Spring washer	809824	F
...		1	Washer	809945	F
...		1	Felt washer	809961	F
...		1	Stop pin and insul	812015	F
...		1	Hinge pin and insul	812016	F
...		1	Bushing	812823	F
...		2	Pole shoe	813496	F
...		2	Through bolt	815018	F
...		1	Plug	816315	F
...		1	Comm. end frame	817216	F
...		1	Gasket	817220	F
...		1	Drive end frame	817223	F
...		1	Collar	817224	F
...		1	Hinge pin	817313	F
...		1	Stop pin	817314	F
...		1	Plate clamp	817532	F
...		1	Retainer plate	819104	F
...		1	End plate	820524	F
...		2	Screw	828675	F
...		1	Ball bearing	903203	F
...		4	Nut	1843522	F
...		1	Armature	1855429	F
...		1	Gasket	1855701	F
...		1	Retainer plate	1855702	F
...		2	Washer	1856056	F
...		2	Clip (To brush)	1857107	F

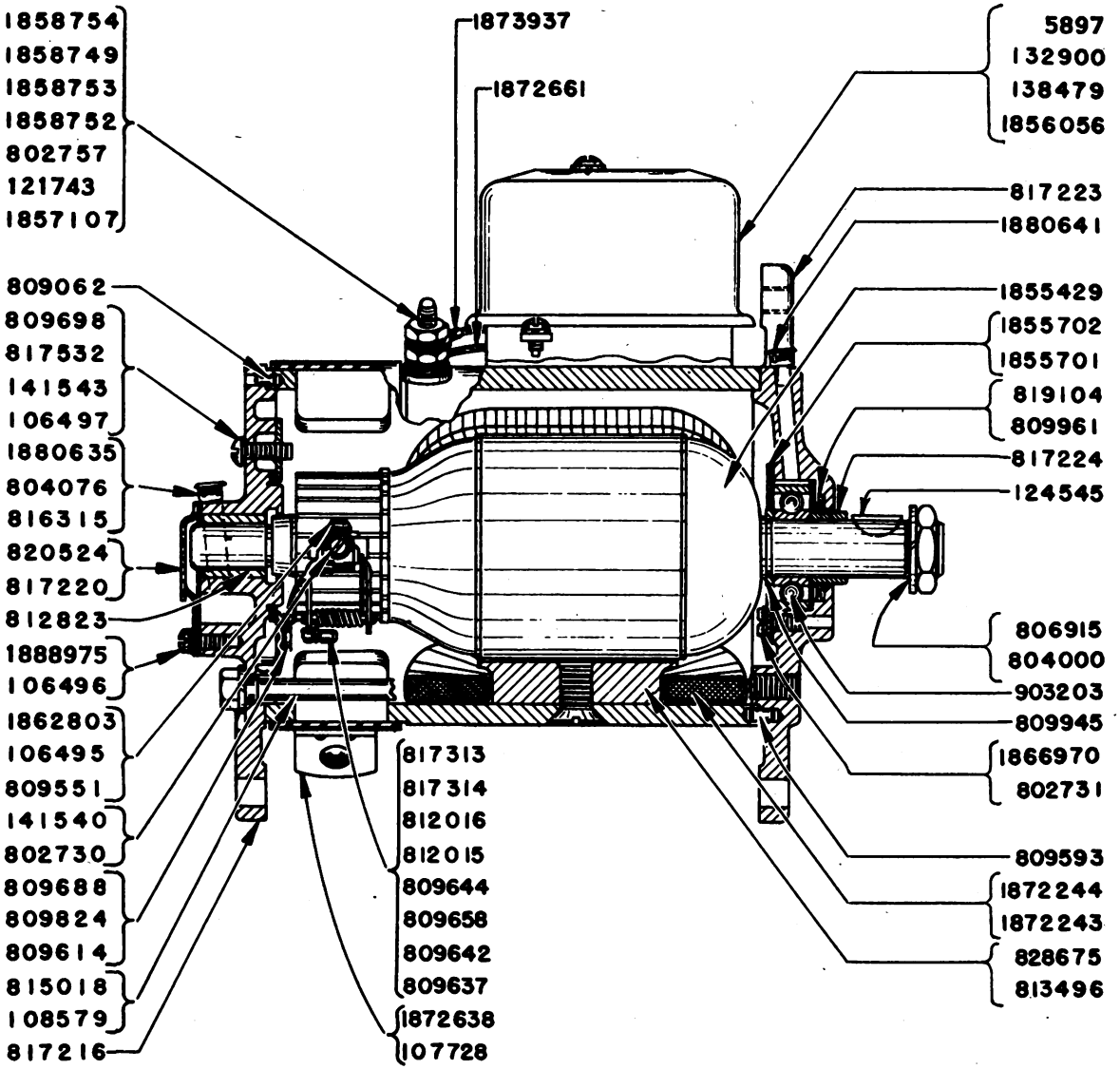


Fig. 84. Longitudinal Section through 12 Volt Generator

61. Generator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...		1	Stud (Field)	1858749	F
...		2	Washer	1858752	F
...		2	Washer (Insul.)	1858753	F
...		1	Stud and lead (Armature)	1858754	F
...		3	Screw	1862803	F
...		3	Screw	1866970	F
...		3	Screw	1868330	F
...		1	Field coil (L.H.)	1872243	F
...		1	Field coil (R.H.)	1872244	F
...		1	Cover band	1872638	F
...		1	Armature lead	1872661	F
...		1	Field lead	1873937	F
...		1	Oiler	1880635	F
...		1	Oiler	1880641	F

62. Battery

...		1	Battery—Globe-Union #133, 12 volt	A117-55	A
...	3H4574/S138	1	Battery strap	83-90	A
...		2	Lockwasher—For #83-90, 3/8"	05-51	A
...		2	Nut—For #83-90, 3/8" —16 hex	04-103	A
...		2	Spacer—For battery, rubber	22-191	A

63. Control Switch Box Assembly

a. Oil Pressure Control

640		1	Control switch box assy. Allen-Bradley No. X-84290, one pilot light	A76-175	A-D
1		1	Grommet, rubber	F-13342	D
3		1	Pilot light unit, (with lamp)	X-49323	D
		1	Bulb, 12 volt pilot	X-84317	D
4		1	Lens, pilot light, red	X-70103	D
5		1	Strap, mounting	A-22508	D
7		1	Adapter	X-67988	D
8		1	Switch, pressure	X-62153	D
9		1	Button, switch, push	X-49579	D
10		1	Cabinet, (one pilot light)	X-84562	D
11		6	Screw, (with M-1100 washer)	M-718	D
6			*See paragraph d for D. C. Relay Parts*		

b. Oil Pressure and Water Temperature Control

640	3H4584D/S46	1	Control switch box assy. Allen-Bradley No. X-84446, two pilot lights	A76-176	A-D
1		1	Grommet, rubber	F-13342	D
2		1	Strap, mounting	A-22509	D
3		2	Pilot light unit (with lamp)	X-49323	D
		2	Bulb, 12 volt, pilot	X-84317	D
4		2	Lens, pilot light, red	X-70103	D
5		1	Strap, mounting	A-22508	D
7		1	Adapter	X-67988	D
8		1	Switch, pressure	X-62153	D
9		1	Button, switch, push	X-49579	D
10		1	Cabinet (two pilot lights)	X-84561	D

63. Control Switch Box Assembly (Cont'd)

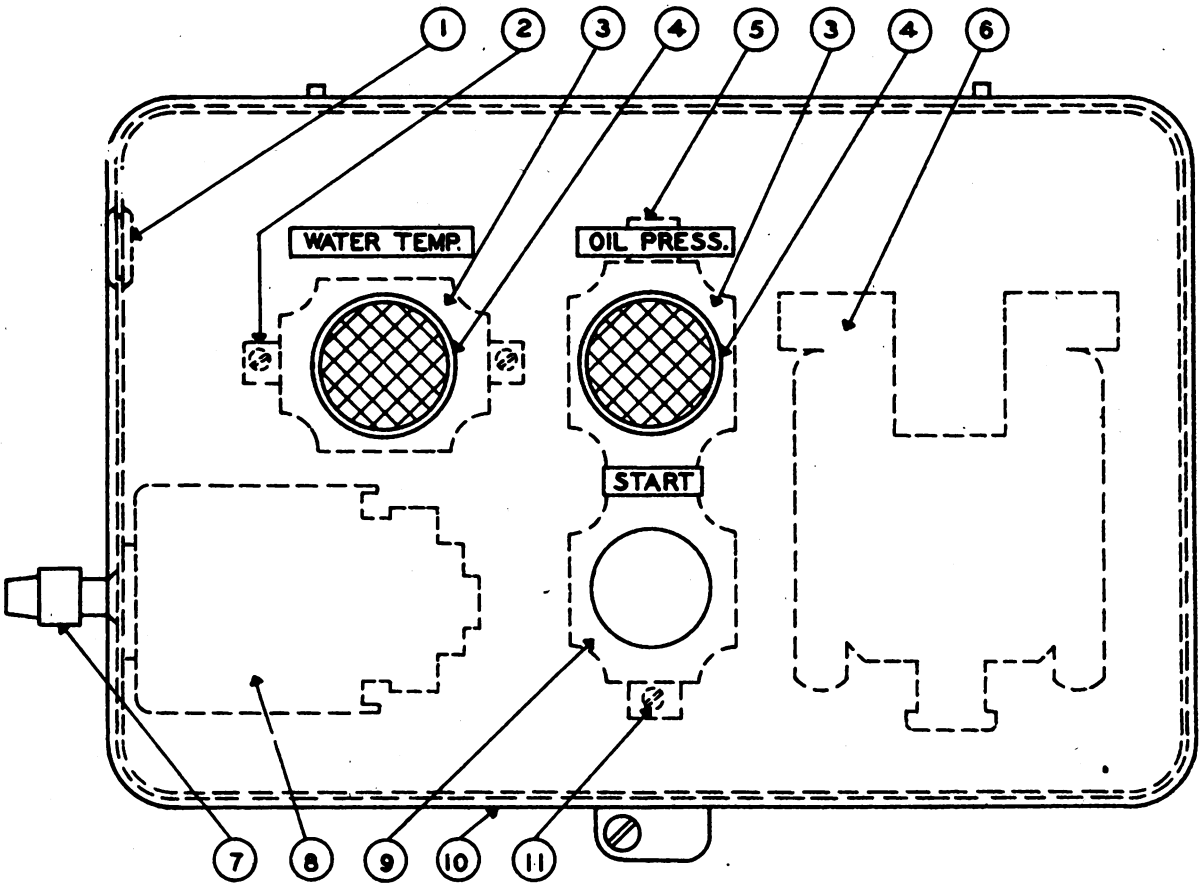


Fig. 85. Control Switch Box—Oil Pressure and Water Temperature Controls

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
11		8	Screw, (with M-1100 washer)	M718	D
6			*See paragraph d for D. C. Relay Parts*		

c. Oil Pressure and Water Temperature Control, with Audible Alarm and Flasher Light

640		1	Control switch box assy. Allen-Bradley No. X-93407	A76-193	A-D
1		1	Cabinet (two pilot lights)	X-93406	D
3		1	Switch, pressure	X-62153	D
4		1	Adapter	X-67988	D
5		1	Relay, 10 amp. A.C., N. O. & N. C.	X-39957	D
6		1	Relay, B2A, aircraft	X-89612	D
7		1	Terminal block, 4 post	X-38045	D
8		2	Bulb, 12 volt, pilot	X-84317	D
9		2	Button, switch, push	X-49579	D
10		2	Pilot light unit, (with lamp)	X-49323	D
11		2	Lens, red	X-70103	D
13		1	Strap, mounting	A-22508	D
14		1	Strap, mounting	A-22509	D
19		1	Grommet, rubber	F-13342	D

63. Control Switch Box Assembly (Cont'd)

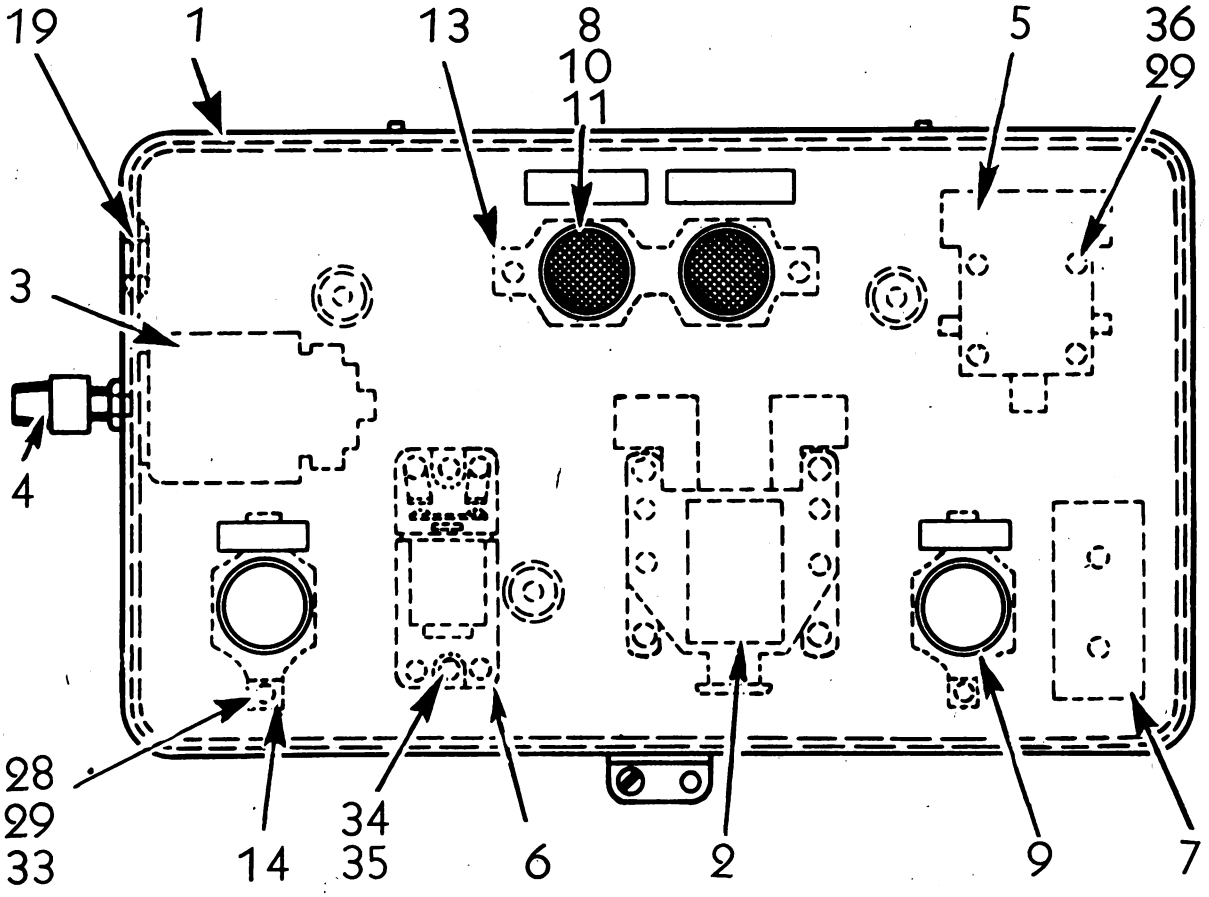


Fig. 86. Control Switch Box—Audible Alarm and Flasher Light Controls

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
28		10	Screw, (with 1100 washer)	M-718	D
29		14	Washer, spring	M-1100	D
33		6	Washer, brass	M-1426	D
34		2	Screw, #10—32 x 3/8"	M-759	D
35		2	Washer, spring	M-103	D
36		4	Screw #8—32 x 3/8"	M-148	D
2			*See paragraph d for D. C. Relay Parts List*		

d. D.C. Relay Parts

		1	Relay, D.C. 10 amp. 2 N. O. & I. N. C.	61408T	D
1		1	Left hand stationary contact	X-48686	D
2		3	Movable contact (twisted)	X-68997	D
3		1	Cup washer	M-2429	D
4		1	Spacer	E-8394	D
5		3	Contact spring	E-10113	D
6		1	Right hand stationary contact	X-48687	D
7		4	Spring	B-8590	D
8		4	Iron washer	M-1689	D
9		4	#4—40 x 1" screw	M-2066	D

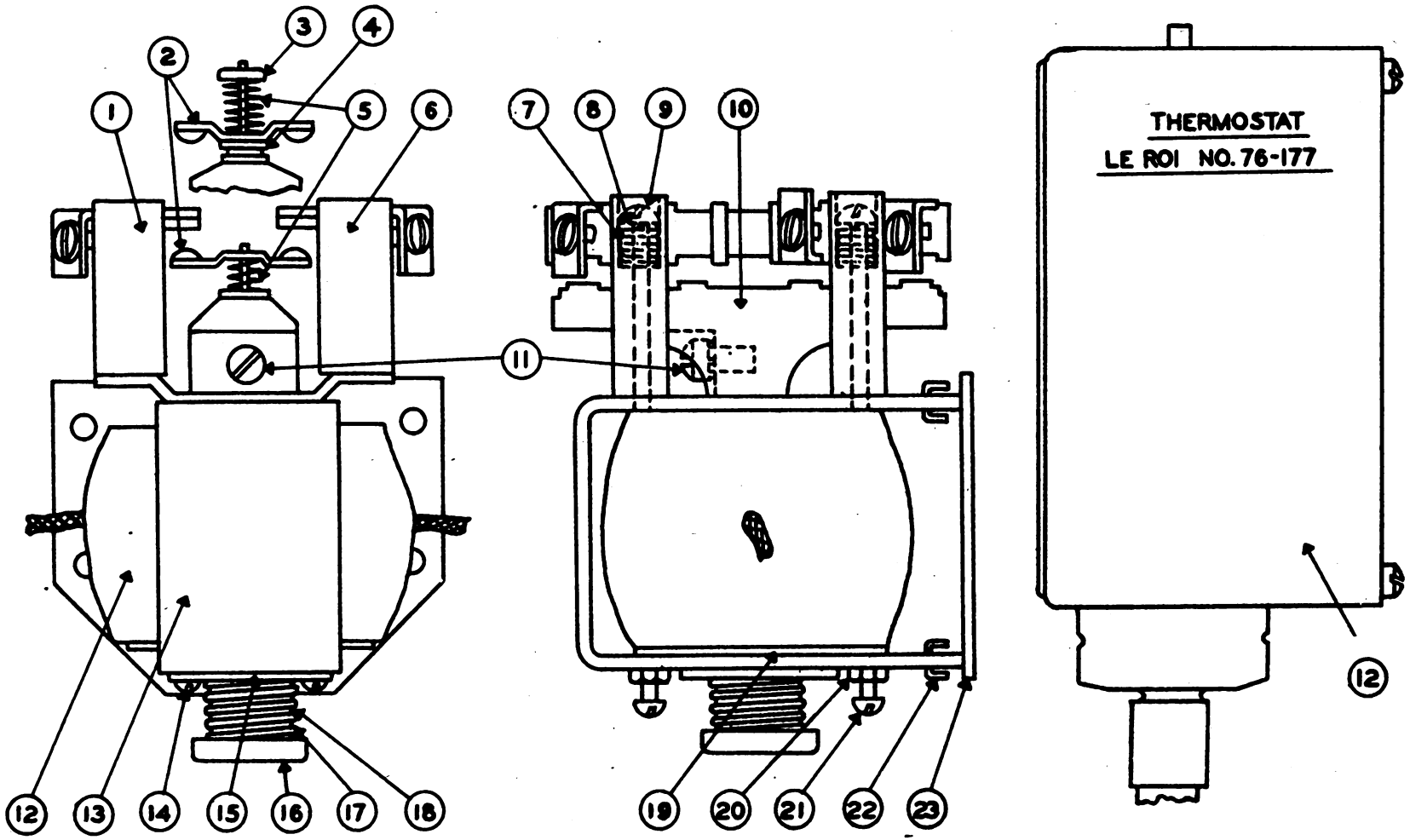


Fig. 87. D.C. Relay and Water Temperature Switch

63. Control Switch Box Assembly (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
10		1	Cross bar only	X-44849	D
11		1	Special washer	M-2240	D
...		1	Spring washer	M-1100	D
...		1	Screw	M-2355	D
12		1	Solenoid coil	RJ-4605	D
13		1	Frame assembly	X-52884	D
14		2	#6—32 x ¼" screw	M-1496	D
15		1	Washer	E-9512	D
16		1	Cup washer	M-1932	D
17		1	Spring	B-11234	D
18		1	Core and plunger assembly	X-52864	D
19		1	Washer	E-1933	D
20		2	Nut	M-990	D
21		2	#6—32 x ⅜" screw	M-256	D
22		2	Lock nut	B-8446	D
23		1	Mounting plate	A-18459	D

e. Attaching Parts for Control Boxes

		3	Mach. screw, ¼—20 x ½" lg., rd. hd	03-619	A
		3	Lockwashers, ¼"	05-49	A
12		1	Water temp. safety switch	76-177	A
...		1	Thermometer	60-146	A
...		1	Wire, temp. switch to micro switch	A61-306-37	A
...		1	Wire, temp. switch to panel	A61-306-38	A
...		1	Tube, wire cover	55-674	A
...		1	Clamp, tube	83-91	A
...		1	Capscrew, ⅜—16 x ½" hex	02-32	A
...		1	Lockwasher, ⅜"	05-51	A
...		1	Warning signal	199-6	A
...		1	Flasher button	76-194	A

64. Electrical Wires and Cables

610	3H4574/C7	1	Ground cable—Battery (Pos.) to base	A61-430	A
610A	3H4574/C1	1	Cable—Battery (Neg.) to magnetic switch	A61-75-7	A
611	3H4574/A3	1	Ammeter	A113-28	A
...	3H4574/C30	1	Clamp—For cable	83-51	A
613	3H4574/C13	1	Cable—Magnetic switch to starter	A61-75-8	A
615		1	Conduit—For wires	55-653	A
616		3	Conduit clamp	83-38	A
...		1	Conduit—For wires	55-659	A
...		3	Capscrew—For conduit clamp, ⅜—16 x ½" hex	02-32	A
...		3	Lockwasher—For #Q2-32, ⅜"	05-51	A
618		1	Condenser—5 MFD, 200 V, generator	167-6	A
619		1	Condenser—5 MFD, 200 V, ammeter	167-6	A
621	3H4584A/W19	1	Wire—Generator to ammeter, #10 x 59"	A61-416-3	A
622	3H4584A/W18	1	Wire—Ammeter to magnetic switch, #10 x 32"	A61-416-2	A
626	3H4584A/W13	1	Wire—Micro switch to ground, #14 x 2½"	A61-5-4	A
627	3H4584A/W13	1	Wire—Magnetic switch to ground, #14 x 2½"	A61-5-4	A
628		1	Tube assy.—Micro switch to magneto, Includes items marked †	1A55-29-55	A
628		1	Tube assy.—Includes ferrule	A55-29-55	A
...	3H4574/F12	1	†Ferrule—For A55-29-55	FP84832	I
...	3H4584A/B50	1	†Insulating bushing	IB84016	I
631		1	†Nut	NT571	I
...	3H4574/F11	1	†Ferrule	FP84020	I
633		1	†Wire—Micro switch to magneto, #14 ga. x 30" lg.	A61-306-33	A
635	3H4584A/W18	1	Wire—Generator to (No. 1) pressure switch	A61-306-35	A
...		1	†Terminal	121-5	A

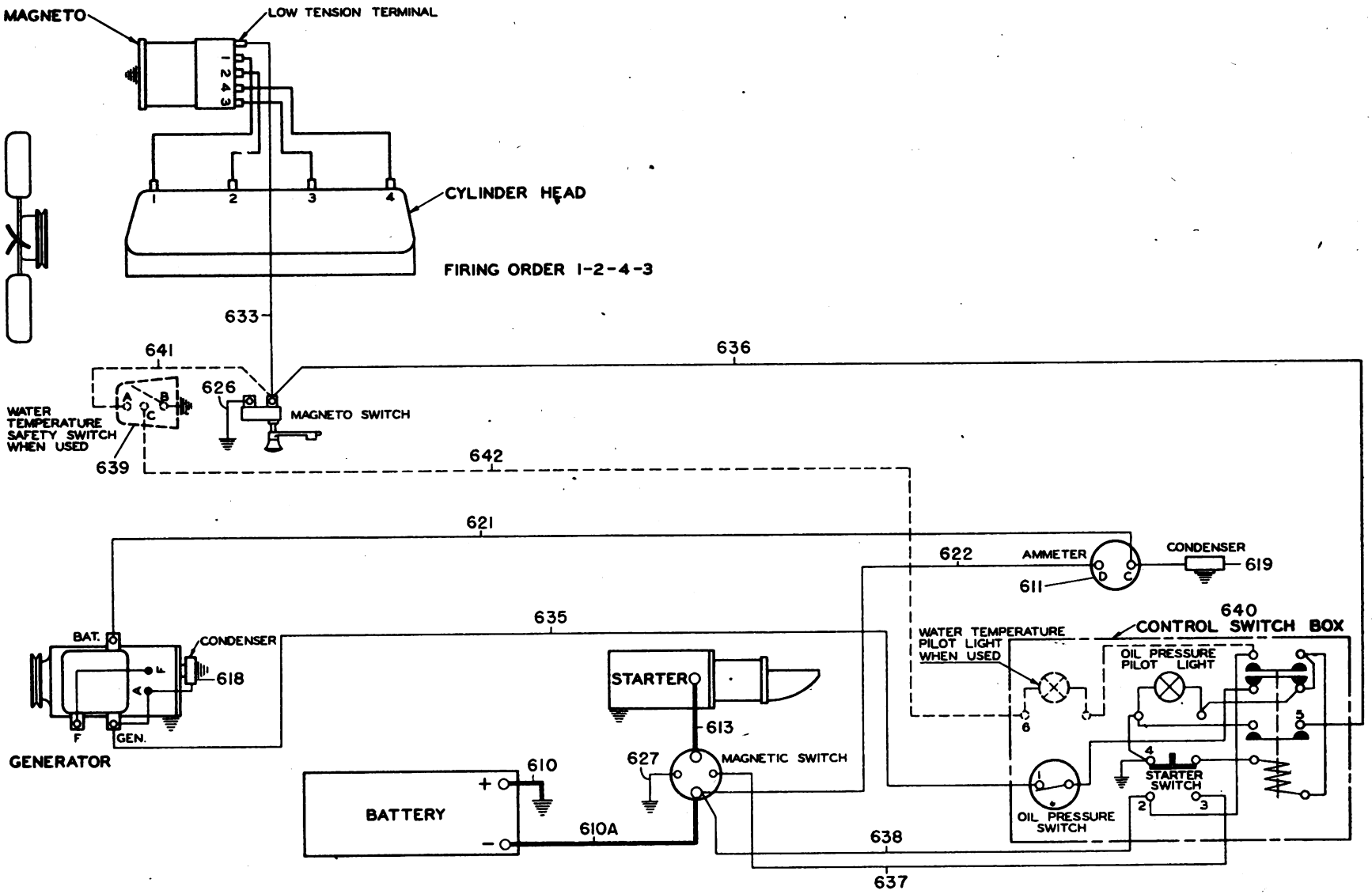


Fig. 88. Electrical Wires and Cables Diagram

64. Electrical Wires and Cables (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
636	3H4574/W79	1	Wire—Micro switch to (No. 5) relay	A61-306-39	A
637	3H4584A/W20	1	Wire—Starter switch (No. 3) to magnetic switch	A61-416-18	A
638	3H4584A/W21	1	Wire—Starter switch (No. 2) to magnetic switch	A61-416-19	A
1024		1	Safety switch, water temperature, used on Serial Nos. 160501 to 160566 and 181832 to 181955 only	76-177	A
641		1	Wire—Temp. safety switch to micro switch, for No. 76-177	A61-306-37	A
642	3H4574/W81	1	Wire—Temp. safety switch to control box, for No. 76-177	A61-306-38	A
1028	3H4574/T19	1	Tube—Wire conduit, for No. 76-177	55-674	A
...	3H4574/C62	1	Clamp for tube, for No. 76-177	83-91	A
...		1	Capscrew, 3/8 x 1/2" hex. for No. 76-177	02-32	A
...		1	Lockwasher, 3/8", for No. 76-177	05-51	A

65. Magneto

350		1	Magneto assy., American Bosch Model MJB4A-314; Includes impulse coupling 1CA2A2	A85-99-4	A
...		2	Capscrew—Magneto mounting, 3/8—16 x 1 1/4"	02-37	A
...		2	Plain washer—For #02-37, 3/8"	06-4	A
...		2	Lockwasher—For #02-37, 3/8"	05-51	A
1	3H4584A/P42	1	Distributor plate with window and grounding cable assembly	DP52328	I
2		1	Observation window	WN521	I
3		1	Ring for window	SP1001CA	I
4		1	Window gasket	GA1003	I
5		1	Clip for grounding cable (terminal block end)	EC1003	I
7		1	Clip for external grounding cable	EC1001	I
8		1	Fastening screw—Grounding cable to distributor plate	SC23-6CA	I
9		1	Lockwasher for fastening screw	WA6-5	I
10		1	Insulation under cable clip	IS5257	I
11	3H4584A/S65	2	Distributor plate fastening screw	SC1003CA	I
12	3H4584A/P41	2	Cover supporting post—Long	SD527	I
13	3H4584A/P40	2	Cover supporting post—Short	SD526	I
14		6	Lockwasher for fastening screw and cover supporting post	WA288	I
15		6	Plain washer for fastening screw and cover supporting post	WA98922	I
16	3H4584A/W45	6	Sealing washer for fastening screw and cover supporting post	WA5280	I
17		1	Distributor plate center brush and spring	SA82736	I
18		4	Distributor plate brush and spring	SA82876	I
19		1	Metal plate between frame and distributor plate	PL5232	I
20	3H4584A/C61	1	Radio shield cover	CV5224	I
21		2	Cover fastening screw—Upper	SC78-7OA	I
22		1	Round nut for low-tension terminal outlet	NT571	I
23		4	Terminal outlet ferrule—Small	FP84020	I
24		4	Terminal outlet ferrule—Large	FP84832	I
25	3H4584A/B50	1	Insulation bushing for low-tension terminal outlet	IB84016	I
26	3H4584A/B47	1	Cable outlet insulation bushing	IS524	I
27		1	Observation cover	CV5287	I
28		1	Fastening screw for observation cover	SC39-5CA	I
29		1	Lockwasher for fastening screw	WA6-4	I
30	3H4584A/C56	1	Cap for radio shield cover	CP5223	I
31		4	Cap fastening screw	SC24-7CA	I
32		4	Fastening screw lockwasher	WA5-5	I
33		1	Magneto housing	HG527	I
67	3H4584A/S74	2	Packing strip for magnet rotor ball bearing	IS504	I
68	3H4584A/W44	2	Bearing paper washer	IS222	I
69	3H4584A/T13	1	Oil thrower for ball bearing	CV522	I
70	3H4584A/S71	1	Spacer on rotor	SR1023	I
71		1	Woodruff key for gear	KY11-3	I

65. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
72	3H4584A/G14	1	Magnet rotor gear	GE5212	I
73	3H4584A/C55	1	Cam	CA522	I
74		1	Cam fastening screw	SC42-10CA	I
75		1	Fastening screw lockwasher	WA22-6	I
76		1	Cam retaining washer	WA5241	I
77	3H4584A/W46	1	Indicating washer	WA522	I
78	3H4584A/G16	1	Distributor gear and rotor assembly	GE528	I
79	3H4584A/G15	1	Distributor gear only	GE5247	I
80		1	Distributor rotor only	RT525	I
81		3	Distributor rotor fastening screw	SC521	I
82		3	Plain washer for screw	WA1005CA	I
83	3H4584A/W42	1	Distributor gear spacing washer	WA78682	I
84		1	Interrupter assembly complete with platinum point	IN5223	I
85		1	Interrupter plate with riveted parts and support plate	PL52119	I
86	3H4574/P19	1	Interrupter lever with platinum point	LE5220	I
87		1	Plain washer for lever stud	WA86678	I
88		1	Interrupter lever cotter pin	FP84791	I
89		1	Interrupter lever spring fastening screw	SC1004CA	I
90		1	Fastening screw lockwasher	WA5-4	I
91	3H4574/P18	1	Adjustable contact bracket with platinum point	BK5236	I
92		1	Contact bracket fastening screw	SC104347	I
93		1	Fastening screw lockwasher	WA6-4	I
94	3H4584A/G52	1	Interrupter grounding cable	CB5227	I
95	3H4584A/B45	1	Interrupter grounding brush and spring	BR521	I
96	3H4584A/C53	1	Cable between interrupter and clip on terminal block	CB5223	I
97		1	Stop plate	PL528	I
98		1	Stop plate fastening screw	SC21-6CA	I
34	3H4584A/S66	1	Leather oil seal—Drive end	PK521	I
35	3H4584A/W43	1	Washer under oil seal	WA1071	I
36		1	Name plate for type designation	NP521	I
37		2	Name plate fastening screw	SC121-6CA	I
38		2	Name plate on ventilator cover	NP522	I
39		2	Ventilator cover	CV52128	I
40		4	Cover fastening screw	SC1096	I
41		4	Fastening screw lockwasher	WA6-3CA	I
42	3H4584A/G13	2	Ventilator felt gasket	GA5210	I
43		2	Ventilator washer	WA5269	I
44		2	Ventilator wire screen	SN526	I
45	3H4584A/B44	1	Gear bracket with bearing	BK527	I
46	3H4584A/B43	1	Bearing only	BG521	I
47		4	Bracket fastening screw	SC25-12CA	I
48		4	Fastening screw lockwasher	WA6-6	I
49	3H4584A/T12	1	Terminal block on gear bracket	BL522	I
50		1	Terminal block fastening screw	SC21-8CA	I
51		1	Fastening screw lockwasher	WA6-4CA	I
52		1	Fastening screw plain washer	WA72613	I
53	3H4584A/C60	1	High-tension conductor	EC5212	I
54		2	Conductor fastening screw	SC21-10CA	I
55		2	Fastening screw lockwasher	WA6-4CA	I
56	3H4584A/J14	1	Conductor insulation	IS5226	I
57	3H4574/C123	1	Condenser with bracket	CW524	I
58		1	Condenser fastening screw	SC21-6CA	I
59		1	Fastening screw lockwasher	WA6-4CA	I
60		1	Condenser lead fastening screw	SC42-5CA	I
61		1	Fastening screw lockwasher	WA76919CA	I
62	3H4584A/R46	1	Magnet rotor	RT5217	I
63		1	Woodruff key—Drive end	KY11-4	I
64	3H4584A/W41	1	Felt washer for magnet rotor—Interrupter end	WA81751	I

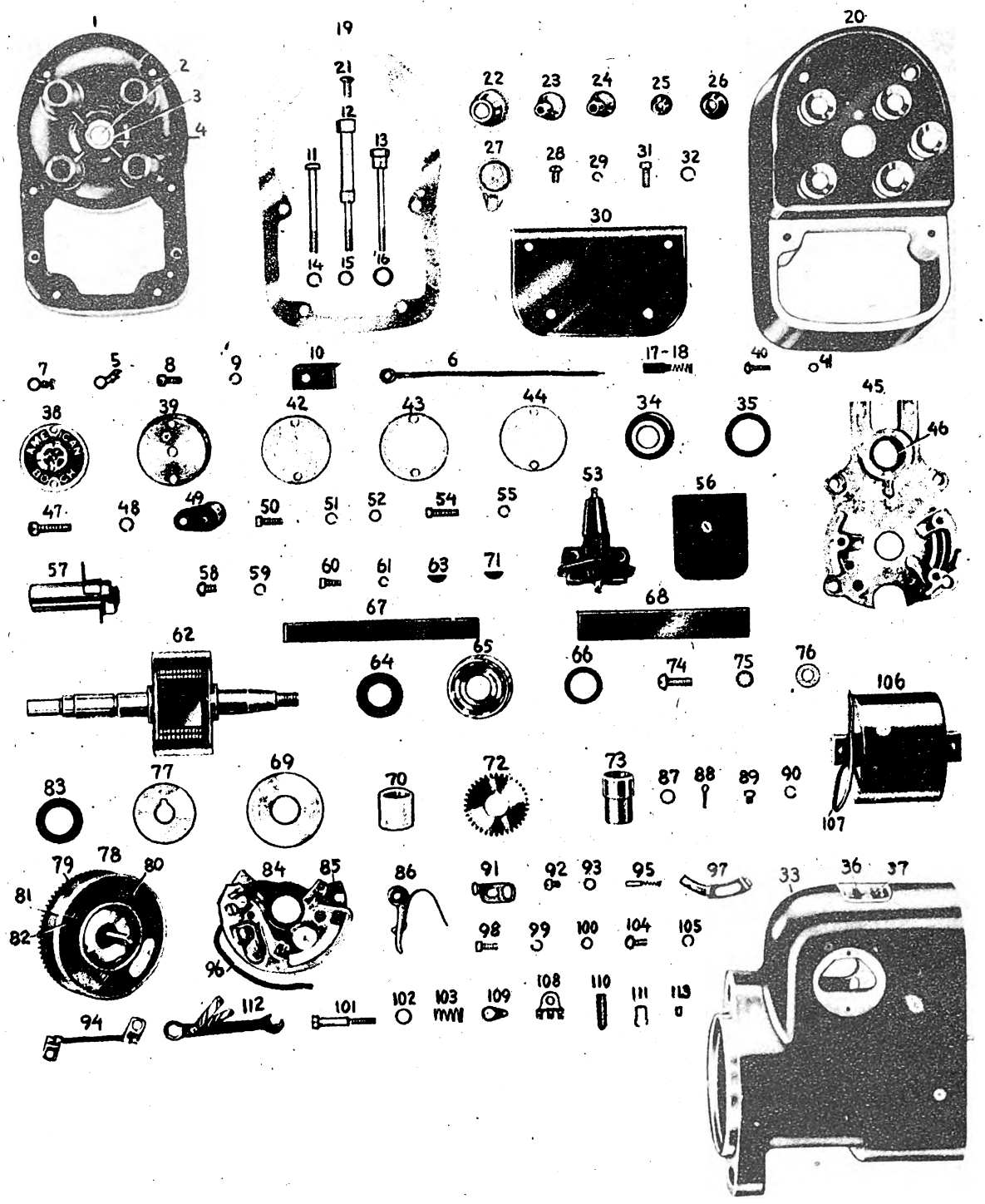


Fig. 89. Component Parts of Magneto Impulse Coupling

65. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
65		2	Ball bearing	BB60226	I
66A	3H4584A/S67	†	Bearing shim (.0126")	WA61	I
66B	3H4584A/S69	†	Bearing shim (.0071")	WA106	I
66C	3H4584A/S68	†	Bearing shim (.004")	WA107	I
66D	3H45842/S70	†	Bearing shim (.0197")	WA1009	I
99		1	Fastening screw lockwasher	WA6-4CA	I
100		1	Fastening screw plain washer	WA72613	I
101		1	Stop plate stud	D1001CA	I
102		1	Plain washer for stud	WA98904	I
103	3H4584A/S73	1	Spring for stud	SP525	I
104		1	Fastening screw for interrupter support plate	SC1029CA	I
105		1	Fastening screw lockwasher	WA6-4CA	I
106		1	High-tension coil	CL524	I
107		1	Cable for coil—Specify length	KL100657	I
108	3H4584A/C59	1	Terminal clip for interrupter and coil cables	EC5214	I
109	3H4584A/C58	1	Clip for retaining coil cable	EC1002	I
110		2	Lock screw for mounting high-tension coil	SC1060	I
111	3H4584A/C57	4	Terminal clip for distributor plate high-tension cable	FP81953	I
112		1	Magneto wrench	WR521	I
113		1	Set screw for edge distance holes	SC1040	I

† — As required.

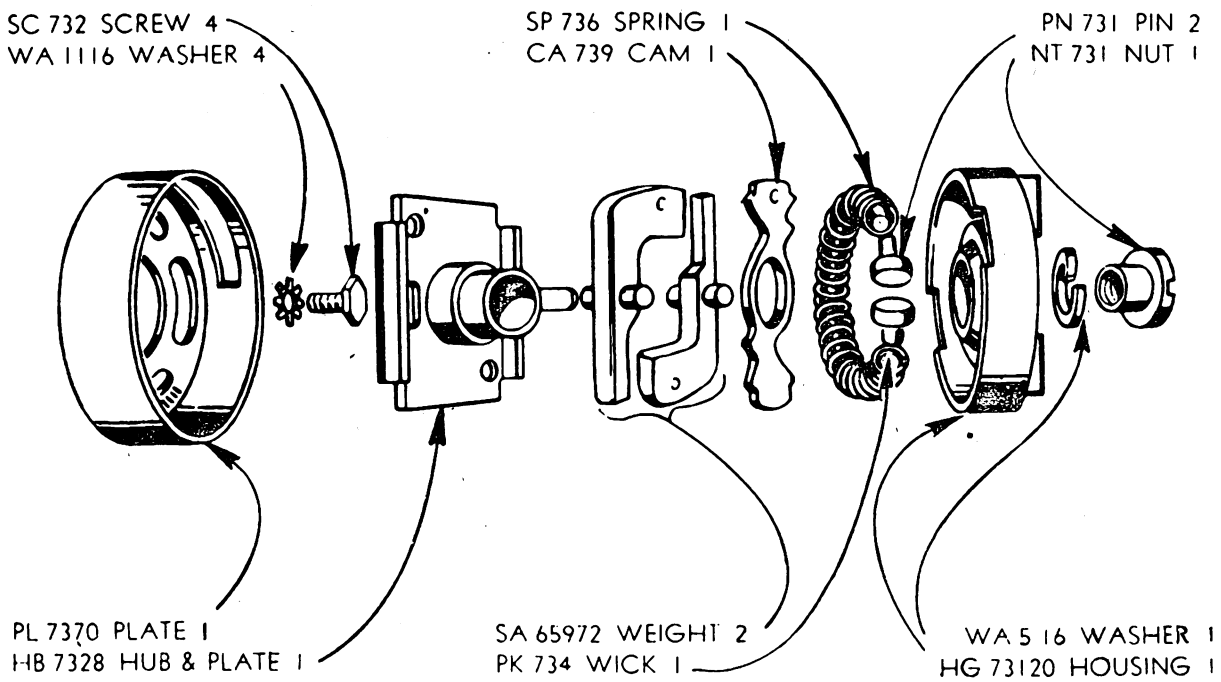


Fig. 90. Component Parts of Impulse Coupling

114		1	Impulse member assembly	HG73118	I
115		1	Arrester plate assembly	PL7365	I
116		4	Arrester plate fastening screw	SC732	I
117		4	Fastening screw lockwasher	WA1116	I
118	3H4584A/H18	1	Impulse member hub	HB7328	I
119	3H4584A/H17	1	Impulse member housing	HG73120	I
120	3H4584A/W47	2	Impulse member weight	SA65972	I

65. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
121	3H4584A/C54	1	Cam	CA739	I
122	3H4584A/S72	2	Spiral spring	SP736	I
123	3H4584A/W48	1	Felt wick for spring	PK734	I
124	3H4584A/P36	2	Pin for spring	PN731	I
125	3H4584A/C62	1	Coupling to shaft securing nut	NT731	I
126		1	Lockwasher for coupling	WA5-16	I

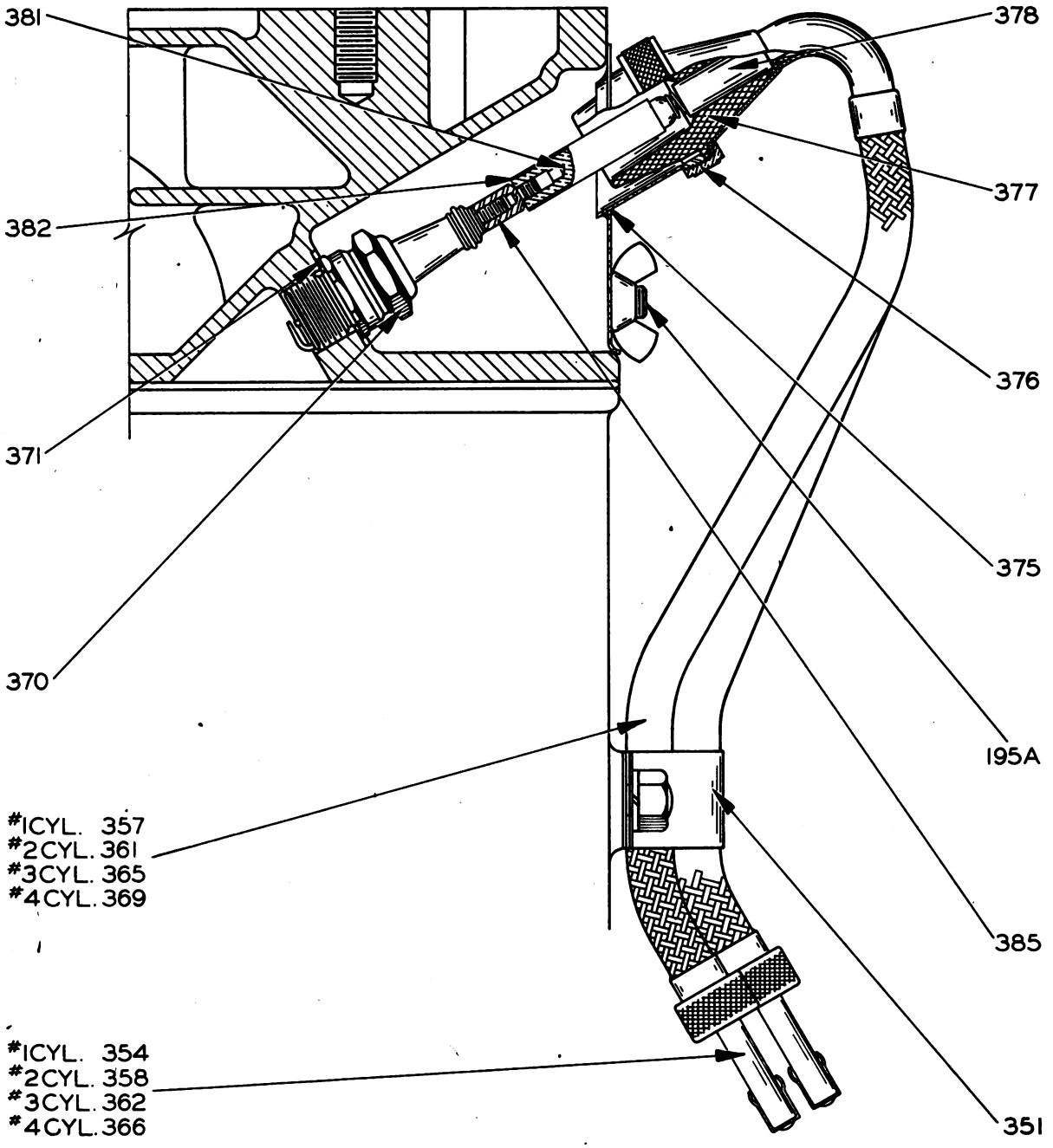


Fig. 91. Ignition and Radio Shielding Parts Diagram

66. Ignition Cables, Conduits, Etc.

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
351	3H4574/C29	1	Clamp—Ignition cable	83-40	A
...		1	Lockwasher, 5/16"	05-50	A
...	3H4574/N4	1	Nut, 5/16"—24, hex	04-602	A
354	3H4584/W8	1	Ignition cable—#1 cylinder	A61-1-51	A
357	3H4574/C44	1	Conduit assy.—#1 cylinder	A55-644-3	A
358	3H4584A/W9	1	Ignition cable—#2 cylinder	A61-1-52	A
361	3H4574/C46	1	Conduit assy.—#2 cylinder	A55-644	A
362	3H4584A/W10	1	Ignition cable—#3 cylinder	A61-1-53	A
365	3H4574/C45	1	Conduit assy.—#3 cylinder	A55-644-1	A
366	3H4584A/W11	1	Ignition cable—#4 cylinder	A61-1-54	A
369	3H4574/C47	1	Conduit assy.—#4 cylinder	A55-644-2	A
375	3H4574/P11	4	Shield plate—Spark plug	A156-130	A
...	3H4574/N20	16	Wing nut—For shield plate, 5/16"—18	04-1001	A
376	3H4574/N19	4	Knurled nut—For spark plug shield, special	53-219	A
377	3H4574/J1	4	Insulator—Spark plug shield	124-11	A
378	3H4584A/C44	4	Spark plug connection	188-17	A
381	3H4574/T11	4	Spark plug terminal	121-42	A
382	3H4574/S59	4	Terminal shield	124-15	A
370	3H4584A/P29	4	Spark plug—18 mm, AC #83, special	86-9-6	A
385	3H4584A/N40	4	Terminal connection—AC #841549	188-21	A
371	3H4574/G30	4	Gasket—Spark plug, 18 mm	16-796	A
383		1	Micro switch—Magneto	76-161	A
...		2	Screw—Switch mounting #6—32 x 1/8"	03-61	A
...		2	Lockwasher—For #03-61	05-23	A
...		1	Capscrew—Battery ground, 3/8—16 x 3/4"	02-34	A
...		1	Lockwasher—For #02-34, 3/8"	05-51	A
...		1	Nut—For #02-34, 3/8"—16, hex	04-103	A

67. Type G Synchronous Alternator

1		..	Generator complete with exciter	S. O. 2B4590	J
2		1	Field assembly complete with shaft	1287942	J
3		3	Open field coil complete with pole and damper	1239951	J
4		3	Crossed field coil complete with pole and damper	1239952	J
†		24	Bolt to connect damper segments, 1/4"—20 x 3/4" Hexagon head steel bolt	Std. Hdw.	J
†		24	Steel lock nut for bolt, 1/4"—20	Std. Hdw.	J
†		24	1/4" Lock washer for nut	Std. Hdw.	J
5		1	Laminated spider	752851	J
†		12	Key (pole dovetail to spider)	783590	J
6		1	Collector	1239819	J
7		2	Collector terminal	11040	J
8		4	Collector terminal nut, 1/4"—20 hexagon brass machine screw nut	Std. Hdw.	J
9		1	Shaft with spider key and spacing ring	1287943	J
10		1	Shaft sleeve for ball bearing	1239821	J
11		2	Blower	1239955	J
12		1	Bushing to clamp exciter armature	1106568	J
13		1	Jam nut	1168084	J
†		1	Steel cotter pin for jam nut, 1/8" x 1 1/2"	Std. Hdw.	J
14		1	Key for shaft extension	1248997	J
15			Not used		J
16		1	Frame with eye bolt and stator core	1239958	J

†Not illustrated.

Parts indented are included in the part under which they are indented.

67. Type G Synchronous Alternator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
17		1	1" Eye bolt	354807	J
18		54	Stationary armature coil	1239959	J
19		1 set	Complete winding material, class No. 3, see Par. 39.		J
20		1	Rear bracket	766707	J
21		1	Rear air shield	1082861	J
22		4	Rivet to fasten rear air shield to rear bracket, 3/16" x 5/8" round head steel	Std. Hdw.	J
†		1	1/8" Pipe plug for rear bracket	Std. Hdw.	J
23		1	1/2" Countersunk pipe plug for rear bracket	Std. Hdw.	J
24		1	Housing cover for rear bearing	766706	J
25		4	Bolt to fasten housing cover to rear bracket, 1/2"—13 x 5" hexagon head steel bolt	Std. Hdw.	J
26		1	Rear ball bearing	1173613	J
27		4	Bolt to fasten rear bracket to frame, 5/8"—11 x 2" hexagon head steel bolt	Std. Hdw.	J
28		1	Front bracket	1239960	J
†		1	3/4" Straight squeeze connector for flexible conduit	1198551	J
29		1	Front air shield	1239826	J
30		4	Rivet to fasten front air shield to front bracket, 3/16" x 5/8" round head steel	Std. Hdw.	J
†		1	1/8" Pipe plug for front bracket	Std. Hdw.	J
31		1	1/2" Countersunk pipe plug for front bracket	Std. Hdw.	J
32		1	Housing cover with brush holder rods and insulation	1239827	J
33		1	Brush holder rod—Long	1239828	J
34		1	Brush holder rod insulation tube—Long	1239829	J
35		1	Brush holder rod—short	1239830	J
36		1	Brush holder rod insulation tube—Short	1239831	J
37		4	Bolt to fasten housing cover to front bracket, 1/2"—13 x 5" hexagon head steel bolt	Std. Hdw.	J
38		1	Front ball bearing	782874	J
39		4	Bolt to fasten front bracket to frame, 5/8"—11 x 2" hexagon head steel bolt	Std. Hdw.	J
40		4	Brush for generator	777889	J
41		2	Brush holder complete for generator	884027	J
†		4	Spring	444435	J
†		4	Fillister head brass machine screw to fasten brushshunt to brush holder, No. 10—32 x 3/8"	Std. Hdw.	J
†		4	Washer for shunt screw	779354	J
†		2	Hexagon head steel bolt to clamp brush holder to rod, 1/4"—20 x 7/8"	Std. Hdw.	J
†		2	Lock nut for bolt, 1/4"—20	Std. Hdw.	J
†		2	1/4" Lock washer for nut	Std. Hdw.	J
†		2	Terminal to connect generator field leads to brush holders	229105	J
†		2	Terminal for Generator field leads (external)	229105	J
†		1	11 1/2" of 3/4" Steel flexible conduit for field leads	Standard	J
†		1	3/4"—90° Squeeze connector for conduit for field leads	752747	J
42		1	Conduit box complete	974311	J
†		1	1 1/2" straight squeeze connector for conduit for main leads	1198554	J
43		1	20 1/2" of 1 1/2" steel flexible conduit for main leads	Standard	J
†		1	1 1/2"—90° Squeeze connector for conduit for main leads	752750	J
†		4	Terminal for main leads	229120	J
44		1	Exciter support with cover	1239832	J
†		1	Band cover for exciter support	1042282	J

†Not illustrated.
Parts indented are included in the part under which they are indented.

633613 O—45——9

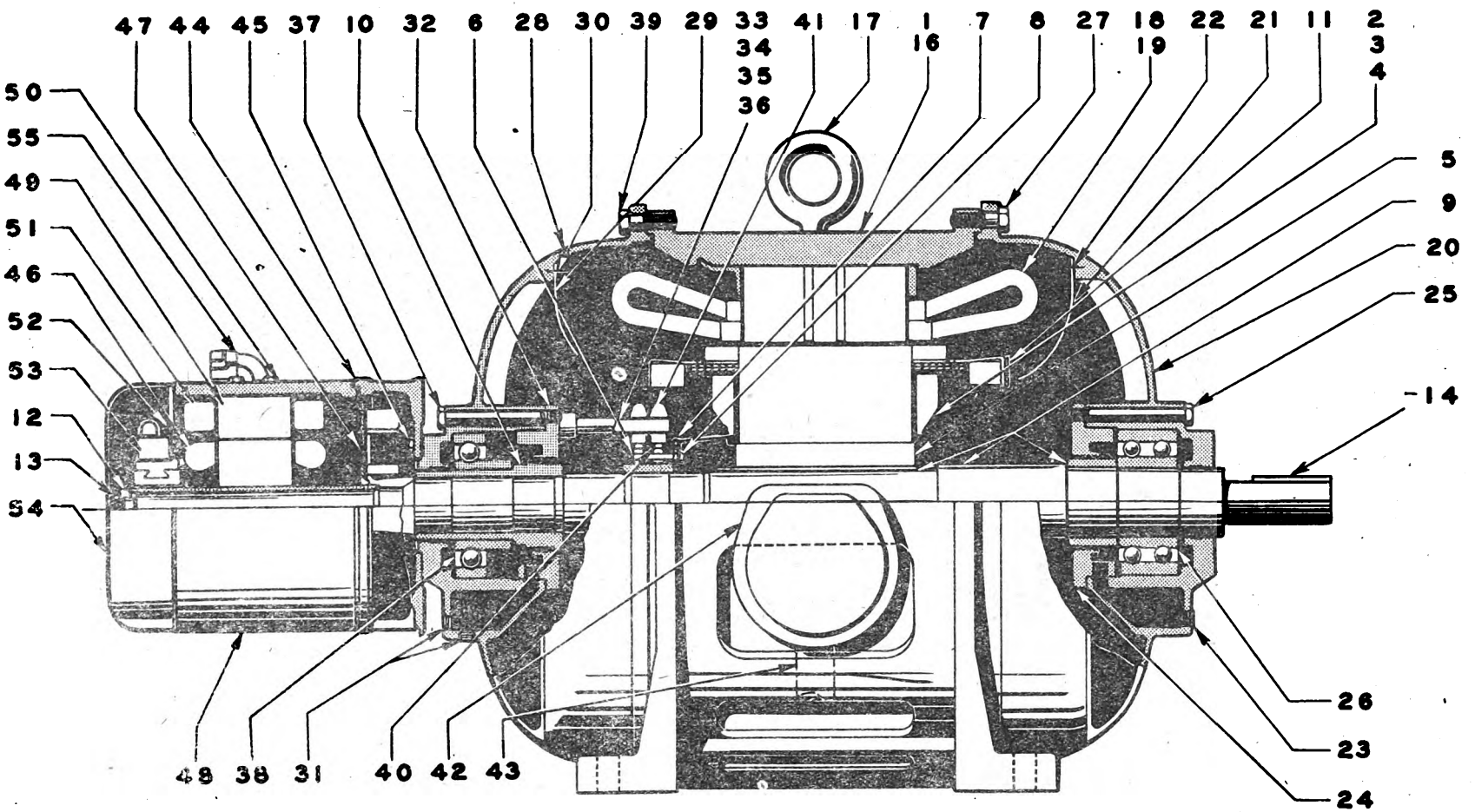


Fig. 92. Longitudinal Section through Alternator

67. Type G Synchronous Alternator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
†		2	Screw to fasten cover to exciter support, No. 10—32 x ½" fillister head steel machine screw	Std. Hdw.	J
45		6	Bolt to fasten exciter support to front bracket, ⅜"—16 x ⅞" hexagon head steel bolt	Std. Hdw.	J
†		4	Bolt to fasten exciter frame to exciter support, ⅜"—16 x 1⅜" hexagon head steel bolt	Std. Hdw.	J
†		1	Generator name plate (specify S. O. number)	NP-28788	J

68. Type SK Exciter

46		1	Exciter armature complete with quill	1239961	J
47		1	Blower	359038	J
48		1	Exciter frame	1239962	J
49		4	Exciter pole	452945	J
50		8	Hexagon head steel bolt to fasten pole to frame	359311	J
51		1	Exciter field coil set (4 coils per set)	1287944	J
†		2	Terminal for field lead (F1—F2)	229105	J
52		1	Panel complete with brushes and brush holders for exciter	1124998	J
†		4	Brush spring	281633	J
53		4	Brush (exciter)	782740	J
†		4	Stud to mount brush panel on exciter frame	559184	J
†		12	Hexagon brass machine screw nut for stud, ¼"—20	Std. Hdw.	J
†		8	Flat washer for stud	779355	J
†		4	¼" Lock washer for stud	Std. Hdw.	J
54		1	Front cover for exciter	297421	J
†		3	Fillister head brass machine screw for front cover, No. 14—24 x ⅜"	Std. Hdw.	J
†		3	¼" Lock washer for screw	Std. Hdw.	J
55		1	¾"—90° Squeeze connector for conduit for exciter leads	752747	J
†		1	16" of ¾" Steel flexible conduit for exciter leads	Standard	J
†		1	¾" Straight squeeze connector for conduit for exciter leads	1198551	J
†		4	Terminal for exciter leads	229105	J
†		1	Exciter name plate (specify S. O. number)	NP-17415	J

69. Generator Controls

..		1	Control panel assembly for all power units except serial Nos. 181832 to 181955. Includes parts marked ‡	A151-210	A-J
..		1	Control panel assembly for power units serial 181832 to 181955	A151-217	A-J
..		1	Name plate—condensed operating instructions	62-110	A
..	3H4574/S18	4	Screw—Parker Kalon No. 2 x 5/16", Type U	03-2001	A
		1	Type HA Ammeter—0-150 Ampere	CGS-1957	J
		1	Type HA Voltmeter—0-150 volt	S721721	J
		1	Type HY Frequency Meter—68-62 cycles	S721766	J
		3	Type CO current transformer—100/5 kva	651907	J
		1	Type SRA-1SP silverstat voltage regulator (page 00)	S. O. 76Y1	J
		1	Type MT potential transformer	S. O. 83Y333	J
		1	Type W voltmeter switch (page 00)	S. O. 56Y703	J
		1	Type W ammeter (page 00)	1040746	J
		1	Type AB breaker (page 00)	S 999179	J
		1	Type WL rheostat 8" plate (page 00)	874472	J
		1	Rheostat operating mechanism	883123	J
			Serial Nos. 181832 to 181955 also have following items:		
		1	Type NH-35 total hour meter		J

†Not illustrated.
Parts indented are included in the part under which they are indented.

69. Generator Controls (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
		1	Duplex convenience outlet		J
		1	Panel lamp with dimming rheostat		J
		1	Set of fuses (3 to set)		J

70. Type SRA-1 Voltage Regulator

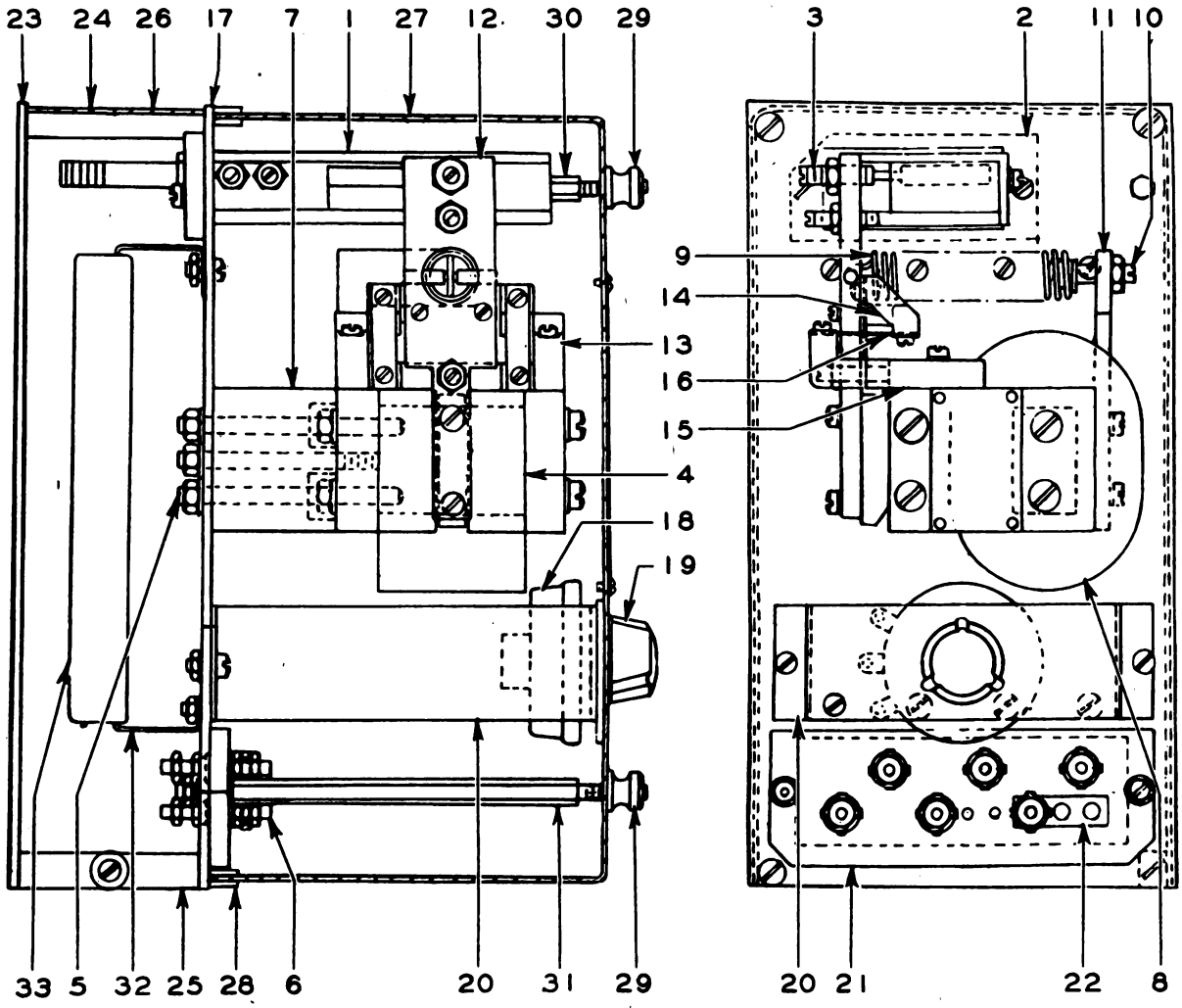


Fig. 93. Cross Section through SRA Voltage Regulator

..		1	Type SRA-1SP voltage regulator complete	S. O. 76Y1	J
..		1	Regulator without regulating resistor tubes	S. O. 76Y1	J
1		1	Contact device complete	1151948	J
2		1	Contact device plate (rear support)	1091989	J
3		1	Pusher screw	1092295	J

Parts indented are included in the part under which they are indented.

70. Type SRA-1 Voltage Regulator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
4		1	Magnet block, core and armature assembly Items 2-8-12-13-14	Dwg. 94B503	J
5		3	Stud—3" long	559185	J
6		6	Stud—1½" long	361702	J
7		1	Micarta spacer	1091992	J
8		1	Operating coil	1087327	J
9		1	Control spring	1087324	J
10		1	Control spring adjusting screw	1091987	J
11		1	Control spring bracket	1128305	J
12		1	Armature arm with spring holder Item 1	Dwg. 94B503	J
			Item 4	Dwg. 94B504	
13		1	Spring hinge complete	1087322	J
14		1	Top hinge support	1092285	J
15		1	Bottom hinge support	1092286	J
16		4	Hinge spring	1092287	J
17		1	Front plate		J
18		1	Rheostat	S. O. 76Y1	J
19		1	Rheostat knob	1087334	J
20		1	Rheostat bracket	1247175	J
21		1	Terminal board	1091994	J
22		1	Micarta hole cover Item 3	Dwg. 1B8419	J
23		1	Rear plate	1091990	J
24		2	Rear plate post—upper	1084587	J
25		2	Rear plate post—lower	1084588	J
26		1	Rear cover Item 6	Dwg. 1A8864	J
27		1	Front cover	1190739	J
28		1	Gasket for cover Item 2	Dwg. 1B6878	J
29		2	Thumb nut	196369	J
30		1	Cover stud—top	1091842	J
31		1	Cover stud—bottom	1091996	J
32		6	Resistor clip	1087230	J
33		1	Regulating resistor tube—15.0 ohms	1154226	J
33		1	Regulating resistor tube—24.8 ohms	1154227	J
33		1	Regulating resistor tube—39.6 ohms	1154228	J
33		1	Regulating resistor tube—60.7 ohms	1154229	J
*		1	Damping transformer and rectox unit	S. O. 76Y1	J
*		1	Damping transformer	1081433	J
*		4	Rectox unit	967282	J

71. Type AB-1 De-ion Circuit Breaker

..		1	Breaker complete	545397	J
1		1	Trip unit complete	545023	J
2		1	Breaker frame complete	781 969	J
3		1	Mechanism complete	894 325	J
4		3	Shunt and upper terminal complete		J
4		1	Shunt and upper terminal complete RH	894 315	J
4		1	Shunt and upper terminal complete LH	894 314	J
4		1	Shunt and upper terminal complete center	894 316	J
5		1	Handle	894 248	J
6		2	Front terminal complete with contact—RH and LH	781 974	J
6		1	Front terminal complete with contact—center	782 387	J
7		3	Arc extinguisher complete	894 321	J

*Not illustrated.

Parts indented are included in the part under which they are indented.

71. Type AB-1 De-ion Circuit Breaker (Cont'd)

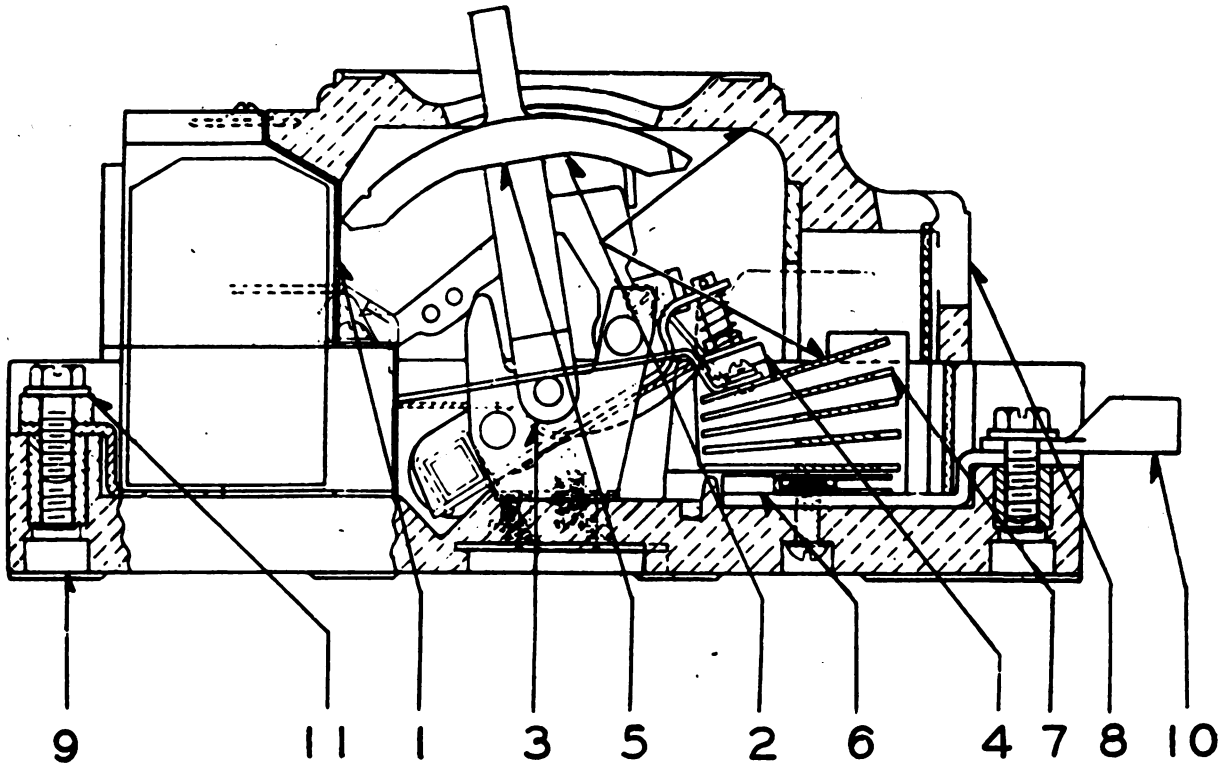


Fig. 94. Cross Section through Circuit Breaker

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
8		1	Cover complete	894 328	J
9		1	Base complete	683 389	J
10		3	Line terminal lug	513 578	J
11		3	Load terminal lug	894 213	J

72. Type W Instrument Switch

..		1	Switch complete	S. O. 56Y703	J
..		1	Drum complete	S. O. 56Y703	J
1		1	Shaft	762274	J
2		1	Micarta tube	565552	J
3		1	Micarta key	565561	J
4		1	Star wheel stop	565633	J
5		1	Star wheel stop pin	565639	J
6		4	Insulation spacer—¾" long	565542	J
6		1	Insulation spacer—$^{27}/_{32}$" long	565545	J
8		3	Moving contact segment #1-2-3	565595	J
8		1	Moving contact segment #4	692010	J
9		1	End clamp	565641	J
10		1	Base	565620	J
11		8	Stationary contact finger	519279	J

Parts indented are included in the part under which they are indented.

72. Type W Instrument Switch (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
12		8	Contact finger terminal screw	693641	J
13		2	Stop finger	519280	J
14		1	Front end plate	573696	J
15		1	Rear end plate	565602	J
16		2	Bearing	565636	J
17		1	Drum shaft spacing collar	565563	J
18		1	Top cover	565609	J
19		1	Top cover lining	565615	J
20		2	Side plate	565630	J
21		1	Dial plate	1040631	J
22		1	Name plate (handle) #28096		J
23		1	Name plate (dial) #28080		J
24		1	Indicator screw	565654	J
25		1	Handle	519286	J

73. Type WL Rheostat

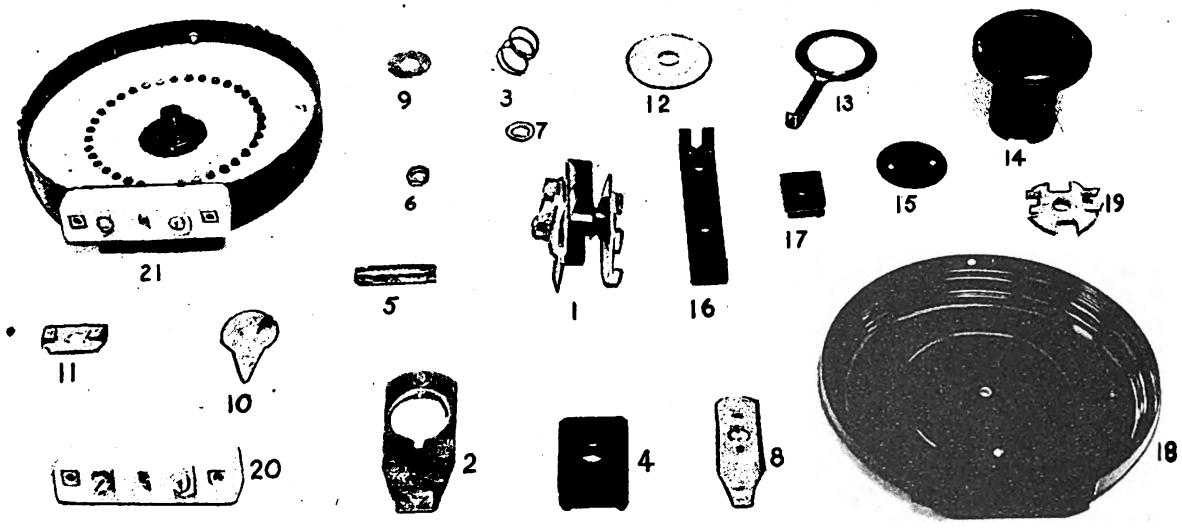


Fig. 95. Component Parts of Field Rheostat

1		1	Contact arm complete	899020	J
2		1	Contact arm	898988	J
3		1	Contact arm spring	898990	J
4		1	Insulation block	898991	J
5		1	Shaft	898992	J
6		2	Shaft nut	898993	J
7		1	Shaft washer	898994	J
8		1	Drive arm	898995	J
9		1	Thrust washer	898996	J
10		1	Pointer	896583	J
11		1	Short coupling with tapped hole	898997	J
12		1	Insulation disc	898998	J
13		1	Collector ring	899000	J

Parts indented are included in the part under which they are indented.

73. Type WL Rheostat (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
11		‡2	Short coupling	899016	J
14		1	Hand wheel	882151	J
15		1	Hand wheel name plate	899001	J
16		3	Foot for single plate	899002	J
16		3	Foot for two plate	899003	J
16		3	Foot for three plate	899004	J
16		3	Foot for four plate	899005	J
17		3	Saddle for foot	899010	J
18		1	Back pan with adjustable stop	899013	J
18		‡1	Back pan—Intermediate	1257002	J
19		‡1	Coupling disc	889015	J
20		1	Terminal block	899018	J
21		†	Plate only complete with element	†	J
		2	Hand wheel stud	970628	J
0		1	Hand wheel complete, includes 14-15 and 22	943865	J

74. Carburetor

430		1	Carburetor assy. Zenith #62AJ10	A84-546-1	A
431	3H4574/G11	1	Gasket—Carburetor flange	16-27	A
...		2	Capscrew—Carburetor mounting, 3/8—16 x 1"	02-36	A
...		2	Lockwasher—For #02-36, 3/8"	05-51	A
1	3H4584A/B23	1	Throttle body	B2-104	C
2	3H4584A/B46	1	Fuel bowl assembly	B3-37C	C
3	3H4584A/P34	1	Throttle plate	C21-79	C
4		1	Throttle shaft	C-23164	C
5	3H4584A/L5	1	Throttle lever	C24-7	C
6	3H4584A/V17	1	Main venturi (size 25)	C38-24	C
7	3H4584A/V16	1	Secondary venturi	C39-7	C
8	3H4584A/N7	1	Idle adjusting needle	C46-38	C
9		1	Economizer jet (size 21)	C52-1	C
10		1	Well vent (size 19)	C52-2	C
11		1	Main jet (size 27)	C52-6	C
12	3H4584A/J21	1	Idling jet (size 13)	C55-7	C
13	3H4584A/J20	1	Main discharge jet (size 70-1)	C66-25-1	C
14		1	Main jet adjustment	C71-21	C
15		1	Fuel valve assembly (size 45)	C81-1	C
16		1	Float assembly	C85-26	C
17	3H4584A/P42	1	Air shutter plate	C101-2	C
18	3H4584A/S75	1	Air shutter shaft	C105-18	C
19	3H4584A/L9	1	Air shutter lever	C106-2	C
20		1	Air shutter bracket	C109-2	C
21	3H4584A/S77	1	Idle adjusting needle spring	C111-17	C
22		1	Bracket locating pin	C120-9	C
23	3H4584A/A44	1	Float axle	C120-15	C
25	3H4584A/R15	1	Packing retainer	C131-3x3	C
26		2	Throttle plate screws	C136-3	C
28		1	Air shutter shaft hole plug	C138-24	C
29		1	Air shutter bracket screw	C140-7	C
30	3H4584A/B49	1	Bowl to body gasket	C142-15	C
31	3H4584A/L7	1	Throttle stop lever	CR28-28	C

‡Required number, used between plates.

†When ordering plates, give style number of Rheostat and also specify number of plates required.

Parts indented are included in part under which they are indented.

74. Carburetor (Cont'd)

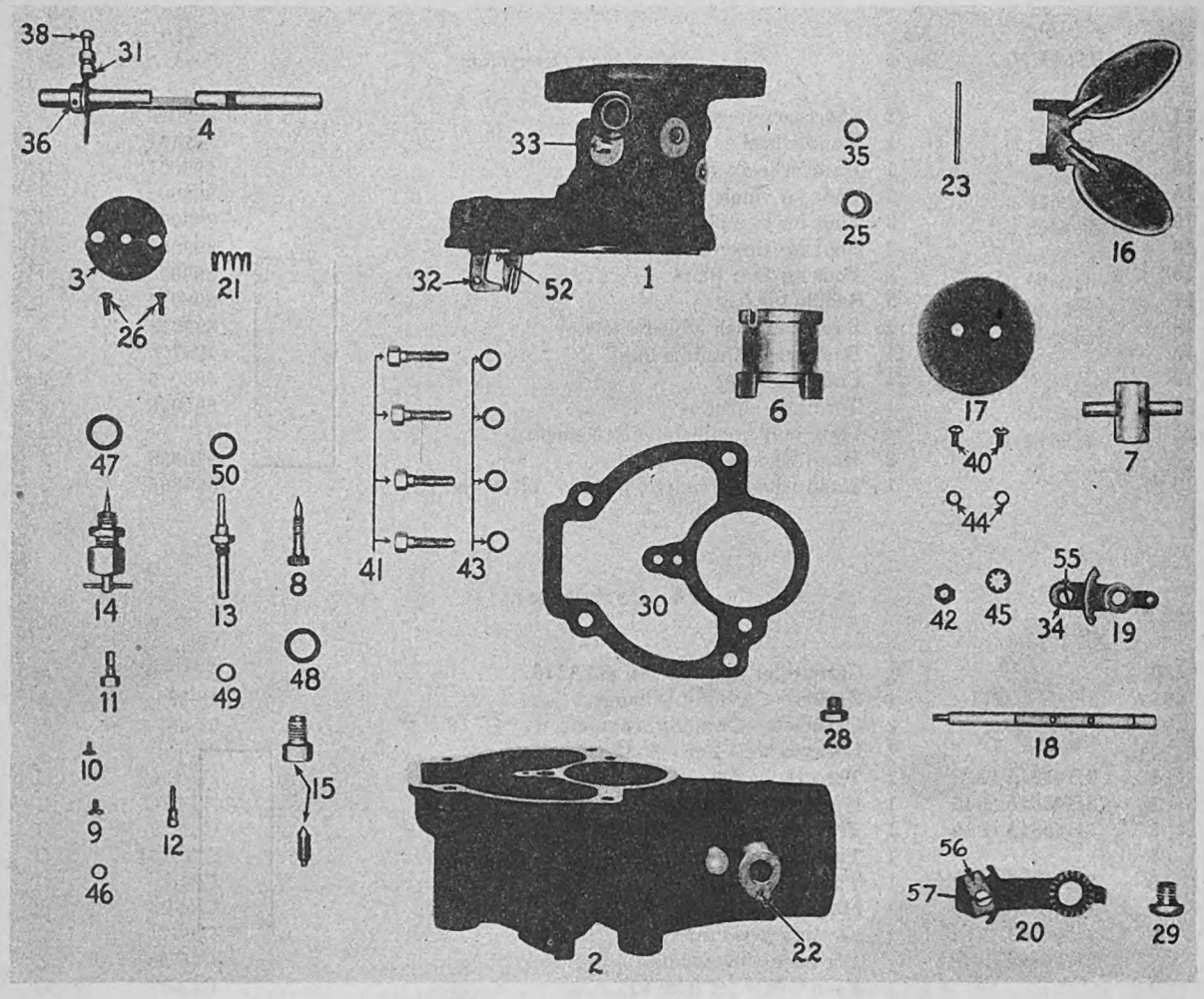


Fig. 96. Component Parts of Carburetor

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfr's. Part No.*	*Mfr's. Code*
32	3H4584A/B48	1	Float bracket	CR88-7	C
33		1	Throttle stop pin	CR121-8	C
34		1	Air shutter lever swivel	CR134-1	C
35		1	Throttle shaft packing washer	CT57-8	C
36	3H4584A/P47	1	Taper pin	CT63-2	C
37		1	Pipe plug (not illustrated)	CT91-3	C
38		1	Throttle stop screw	T1S8-10	C
40		2	Air shutter plate screw	T15B6-4	C
41		4	Bowl to body screw	T18S12-12	C
42		1	Air shutter shaft nut	T22S8	C
43		4	Bowl to body screw lockwasher	T41-12	C
44		1	Air shutter screw lockwasher	T43-6	C
45		1	Air shutter shaft nut lockwasher	T45-8	C
46		1	Economizer jet washer	T56-4	C
47		1	Main jet adjusting or lower plug washer	T56-23	C
48		1	Fuel valve washer	T56-23	C
49		1	Main jet washer	T56-24	C
50		1	Main discharge jet washer	T56-48	C
51		1	Secondary venturi locating pin	T73-8	C

74. Carburetor (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
52		1	Float bracket pin	T73-9	C
54		1	Swivel washer (not illustrated)	CT52-1	C
55		1	Swivel screw (not illustrated)	T1S8-6	C
...		1	Air shutter shaft packing (not illustrated)		C
...		1	Packing retainer (not illustrated)		C
...	3H4584A/S76	1	Filter screen (not illustrated)	C150-12	C
...		1	Filter screen washer (not illustrated)	T56-10	C

75. Fuel Pump

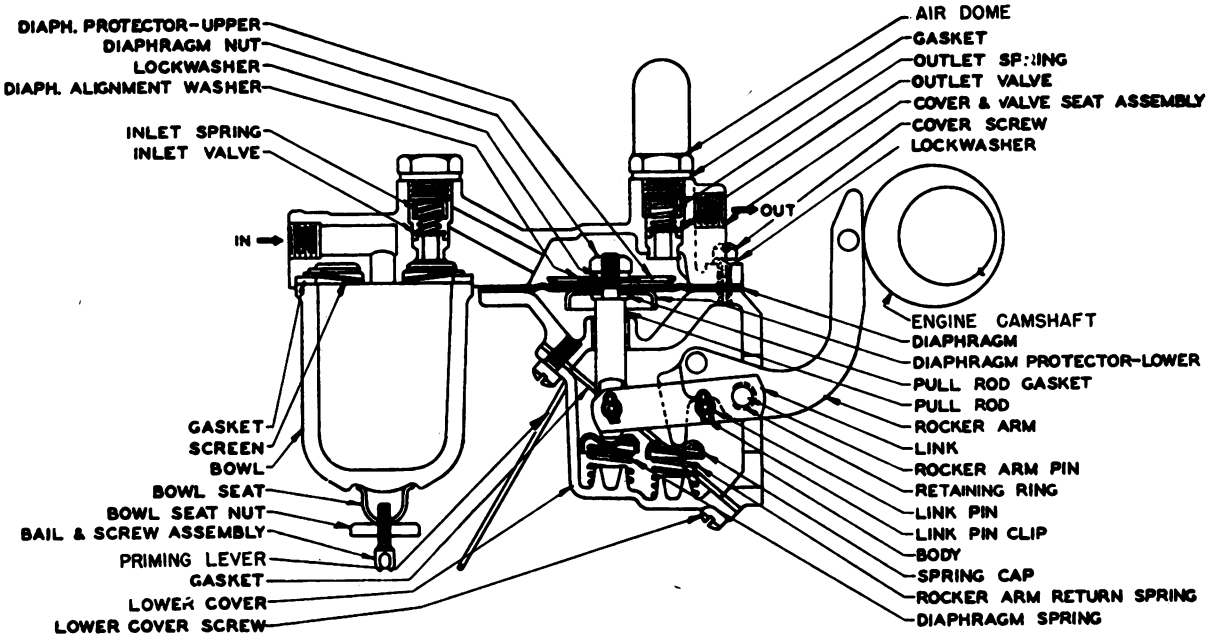


Fig. 97. Cross Section through Fuel Pump

...	3H4574/P25	1	Fuel pump assy.—A. C. #1523019	A81-99-4	A
...	3H4574/G10	1	Gasket—Fuel pump flange	16-229	A
...		2	Capscrew—Fuel pump mounting, 5/16—18 x 3/4" hex.	02-18	A
...		2	Lockwasher—For #02-18, 5/16"	05-50	A
...		1	Air dome	855918	G
...		1	Valve plug	855281	G
...		2	Gasket—Valve plug and air dome	855282	G
...		2	Spring—For valve	856270	G
...		2	Valve	855279	G
...	3H4584A/C63	1	Cover and valve seat assy.—Top	855761	G
...	3H4574B/S1	1	Screen (Le Roi No. 43-135)	1523603	G
...	3H45741/G77	1	Gasket—For bowl (Le Roi No. 16-921	854003	G
...	3H4574/B53	1	Bowl—Fuel sediment, Glass (Le Roi No. 184-2)	854004	G
...		1	Seat—For bowl	854005	G
. .		1	Bail thumb nut	855763	G
...		1	Bail and screw	854016	G
...		1	Diaphragm protector—Lower	1521720	G
...		1	Diaphragm protector—Upper	855274	G
...		1	Nut—Pull rod	855213	G
...		1	Lockwasher—For #855213	855390	G

75. Fuel Pump (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
..		1	Washer—Diaphragm alignment	855029	G
...		1	Gasket—For pull rod	855012	G
...		1	Diaphragm—5 pieces (Le Roi No. 186-9)	855389	G
...		1	Pull rod	855250	G
...		1	Rocker arm	1523020	G
...		1	Pin—Rocker arm	1521289	G
...		2	Washer—For #1521289	1521288	G
...		2	Link—Rocker arm	855574	G
...		2	Link pin	855016	G
...		4	Clip—Link pin	855017	G
...		1	Body—Fuel pump	855674	G
...		2	Spring cap	855532	G
...		1	Spring—Rocker arm	855253	G
...		1	Gasket—Bottom cover	855585	G
...		1	Bottom cover	855573	G
...		3	Screw—Bottom cover	132108	G
...		1	Spring—Diaphragm, lower	1521266	G
...		1	Priming lever	1522280	G
...		10	Screw—Top cover	855493	G
...		10	Lockwasher—For #855493	855064	G
...		1	Pipe plug	103877	G

76. Air Cleaner

453		1	Air cleaner—Oil bath, Air-Maze, Model 37U-OBF	A77-145-1	A
455		1	Connection—Air cleaner to carburetor	65-620	A
456		1	Gasket—Air cleaner connection	16-908-1	A
...		2	Capscrew connection to cyl. block, 3/8—16 x 3/4" lg	02-34	A
...		2	Lockwasher—For #02-34	05-51	A
457		1	Hose, 2" dia. x 3" lg	73-1-16	A
...		2	Hose clamp	83-94	A
459		1	Upper assembly only	AP-1128U	B
460		1	Top and skirt assembly only	AP-112U	B
461	3H4584A/E5	1	Filter element only	AP-18	B
...		1	Lower bowl only	AP-137F	B
463		1	Baffle plate only	AP-17F	B
464	3H4584A/L14	1	Felt liner and retaining spring	AP-137Z	B
465	3H4584A/C19	1	Clamp assembly only	AP-22F	B
466	3H4584A/N13	1	Wing nut only	AP-15	B
467		1	Instruction decalcomania only	AP-4	B

77. Fuel Tank, Lines, Etc.

950	3H4574/T30	1	Fuel tank assy.—15 gal. U. S. Capacity	69-186	A
951		2	Strap—Fuel tank holddown	83-37	A
...	3H4574/N24	2	Nut—For #83-37, 3/8"—16 hex	04-103	A
...		2	Lockwasher—For #04-103, 3/8"	05-51	A
955	3H4574/C102	1	Cap assy.—For fuel tank	A4-129	A
...		1	Drain plug—Brass, 1/4" square head	011-252	A
...		1	Nipple, 1/4" brass, close	33-546	A
...	3H4574/E16	1	Reducing elbow, 1/4 x 1/8"—90°	33-547	A
...	3H4574/N34	3	Nipple, 1/8" brass, close	35-544	A
...	3H4574/L30	1	Fuel line—Tank to valve, titeflex—11 3/4"	A55-643-3	A
...	3H4574/L31	1	Fuel line—Fuel pump to valve, titeflex—23"	A55-643-4	A

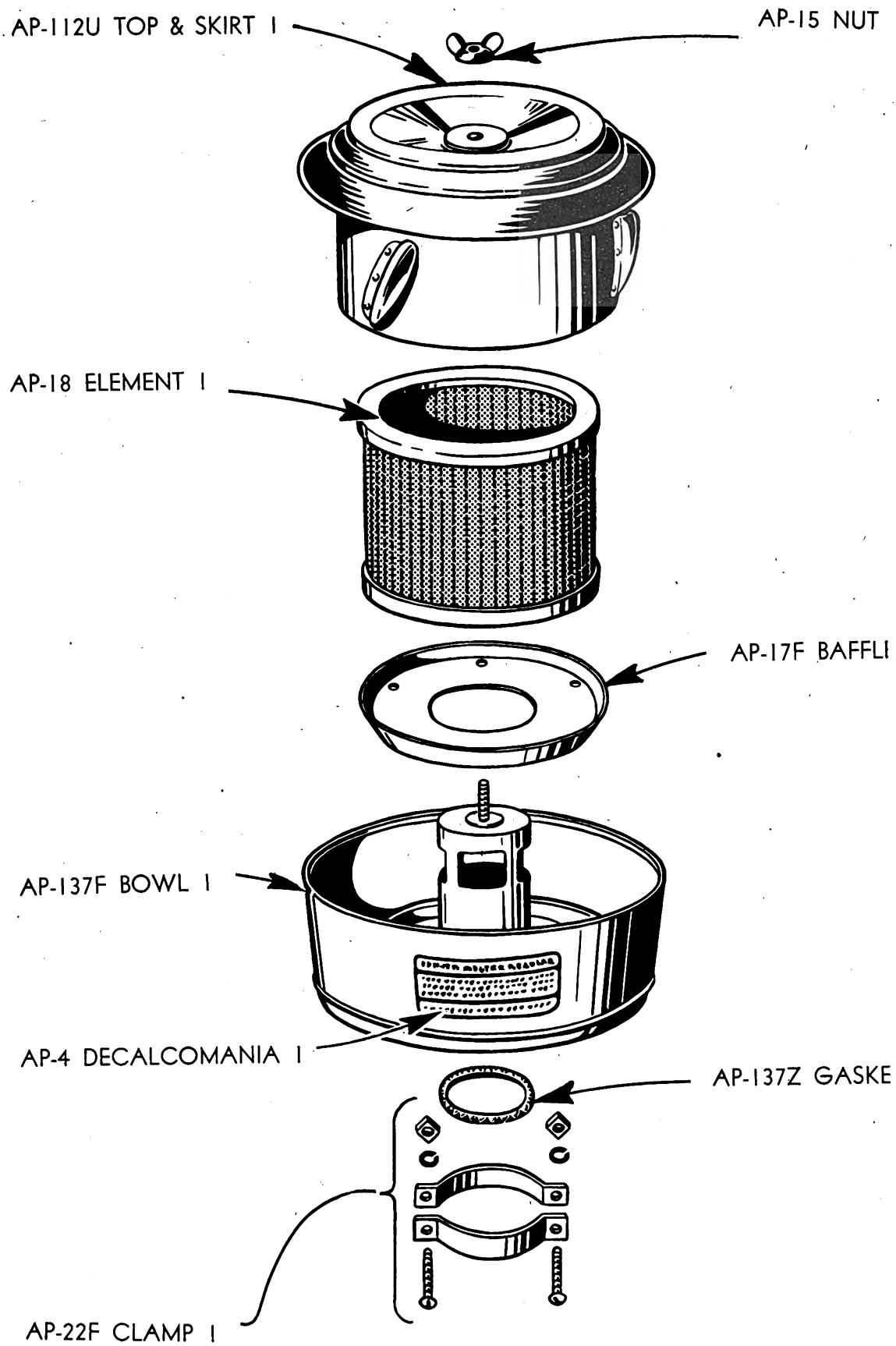


Fig. 98. Component Parts of Air Cleaner

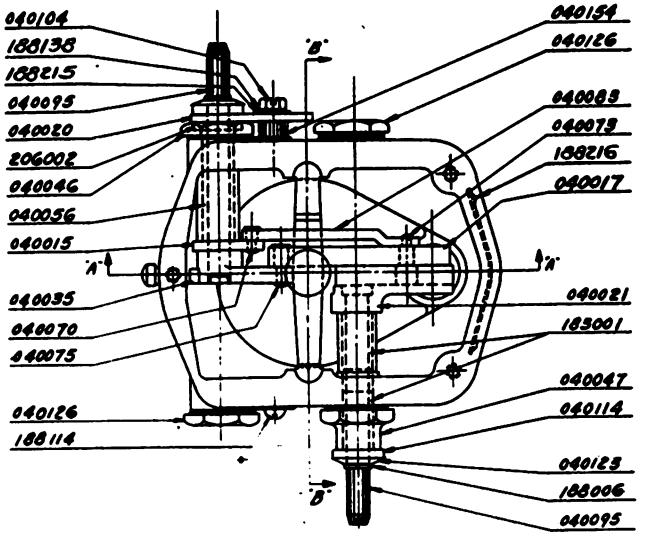
77. Fuel Tank, Lines, Etc. (Cont'd)

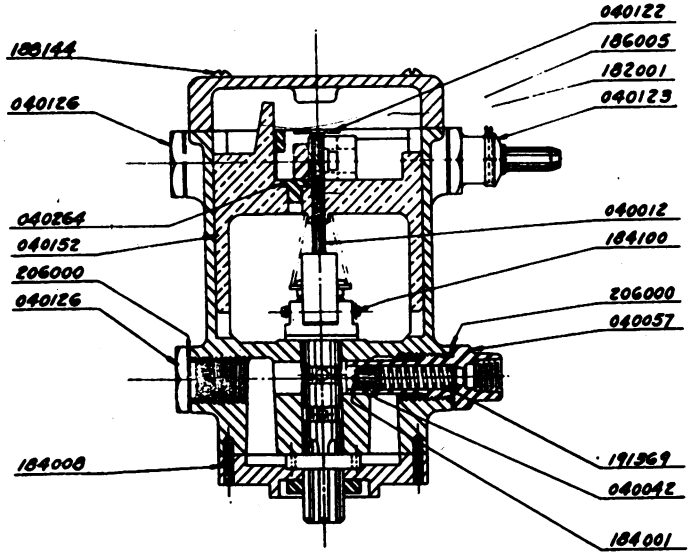
Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...	3H4574/L13	1	Fuel line—Fuel pump to carburetor, titeflex—38"	A55-643-6	A
...	3H4574/N15	1	Nipple, ⅛ x 2" lg.—brass	33-545	A
...	3H4574/E18	2	St. ell, ⅛"—90°—brass	33-542	A
...	3H4574/E17	1	St. ell, ⅛"—45°—brass	33-543	A
...		1	Clamp—For fuel line	83-44	A
...		1	Capscrew—For #83-44, ¼—28 x ½" hex	02-502	A
...		1	Lockwasher—For #02-502, ¼"	05-49	A
...		1	Nut—For #02-502, ¼"—28 hex	04-601	A
...	3H4574/C106	1	Choke control	120-2-9	A
...		1	Valve—Brass, ⅛" P. T	15-321	A
970		1	Support—Fuel tank (Carb. side)	39-1253	A
971		1	Support—Fuel tank (Mag. side)	39-1256	A
...	3H4574/S2	4	Capscrew—For supports, ⅜—16 x 1" hex	02-36	A
...		4	Lockwasher—For #02-36, ⅜"	05-51	A
...		1	Decalcomania—Instruction	62-101	A
...	3H4584A/H4	1	Gasoline hose, flexible, 35' lg	73-253-8	A
...		1	Coupling, 1 x ¼" reducing	33-548	A
...		1	Choke, engine control	120-2-9	A
...		2	Valve, fuel supply shutoff	15-321	A
...		1	Nipple, ⅛" x 2", Brass	33-545	A
...		1	Nipple, close, ⅛"—Brass	33-544	A
...		1	Street ell, ⅛"—90° brass	33-542	A
...		1	Condenser, SMFD, 200 volt	167-6	A

78. Governor Assembly. (Up to Serial No. 155895)

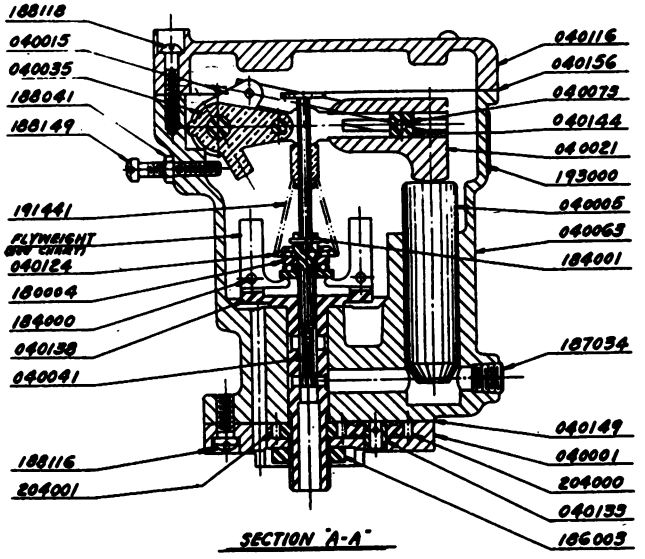
281		1	Governor assembly—Woodward Model SGB2-1 No. 040233.. Note: Above is interchangeable as a unit with No. 1A116-84.	A116-39	A-H
282		1	Gasket—Governor flange	16-873	A
...		4	Capscrew—Governor flange 5/16—18 x 1¼" hex	02-21	A
...		4	Lockwasher—5/16"	05-50	A
293		1	Lever—Governor operating	48-501	A
...		1	Pin—Governor operating lever, #000 x ½" taper	010-201	A
...		1	Screw—Governor operating lever, #10—24 x ½" fillister head	03-92	A
...		1	Base—Governor	040001A	H
...		1	Piston—Servomotor	040005A	H
...		1	Lever—Speed droop adj	040015A	H
...		1	Lever—Floating	040017A	H
...		1	Lever—Speed droop adj	040020A	H
...		1	Lever— Terminal L. H	040021A	H
...		1	Lever—Speed adj	040035A	H
...		1	Plunger—Pilot valve	040041A	H
...		1	Valve—Plunger relief	040042A	H
...		1	Bushing—Speed adj	040046A	H
...		1	Bushing—Terminal shaft	040047A	H
...		1	Sleeve—Speed droop adj	040056A	H
...		1	Sleeve—Relief valve	040057A	H
...		1	Case—Governor	040063C	H
...		1	Pin—Speed droop adj. lever	040070A	H
...		1	Pin—Droop roller	040073A	H
...		1	Pin—Speed adj. lever	040075A	H
...		1	Link—Speed droop adj	040083A	H
...		2	Shaft—Speed adj	040095A	H
...		1	Screw—Speed droop lever	040104A	H
...		2	Cap—Seal	040114A	H
...		1	Cap	040116A	H
...		2	Washer—Friction	040123A	H
...		1	Seat—Spring	040124A	H
...		3	Plug	040126A	H

TYPE "B" GOVERNORS			
GOV. N°	R.P.M.	FLYWEIGHT	TERM. SHAFT
040239	2400	196001	LEFT HAND





SECTION "B-B"



SECTION "A-A"

Fig. 99. Cross Section through Governor (up to Serial No. 155895)

78. Governor Assembly. (Up to Serial No. 155895) (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
...		1	Stud—Idler gear	040133A	H
...		1	Ballhead	040138A	H
...		1	Block—Droop adj.	040144A	H
...		1	Gasket—Vellumoid governor base	040149A	H
...		1	Crosshead—Speeder spring	040152A	H
...		1	Spacer—Speed droop lock	040154A	H
...		1	Gasket—Vellumoid governor cover	040156A	H
...		1	Rod assembly—Shutdown	040164A	H
...		1	Disc—Bearing	040264A	H
...		1	Thrust bearing	180004A	H
...		2	Washer—Shaft seal	182001A	H
...		2	Bushing—Oilite speed adj. shaft	183001A	H
...		2	Pin—Ball arm	184000A	H
...		2	Pin—Shutdown rod	184001A	H
...		2	Pin—Dowel	184008A	H
...		4	Cotter—1/16" x 3/8"	184100A	H
...		1	Collar—Drive shaft	186003A	H
...		2	Thrust washer	186005A	H
...		1	Pipe plug—1/8" socket head	187034A	H
...		2	Snap ring (open square)	188006A	H
...		1	Nut—#10—32 cadmium plated	188041A	H
...		1	Screw—#10—32 x 1/4" round head cadmium plated	188114A	H
...		3	Screw—#12—24 x 9/16" fillister head	188116A	H
...		1	Screw—#10—32 x 1" round head cadmium plated	188118A	H
...		1	Washer—3/16" x 3/8" x .022" thick shakeproof cadmium plated	188138A	H
...		2	Screw—#10—32 x 1 1/8" round head cadmium plated	188144A	H
...		1	Screw—#10—32 x 1 1/8" fillister head cadmium plated	188149A	H
...		1	Washer—3/16" x 1/2" x 1/32" steel cadmium plated	188215A	H
...		2	Screw—#2 x 3/16" type "U" drive chromium plated	188216A	H
...		1	Spring—Relief valve 75#	191369A	H
...		1	Spring—Speeder	191441A	H
...		1	Nameplate	193000A	H
...		1	Flyball	196001A	H
...		1	Gear—Pump idler	204000A	H
...		1	Gear—Pump drive	204001A	H
...		2	Gasket—Relief valve	206000A	H
...		1	Ring—Neoprene speed adj. shaft	206002A	H

79. Governor Assembly. (Serial No. 155896 Up)

281	3H4574/G43	1	Governor assy., Woodward Model SGX No. 040348, Includes next 3 items	1A116-84	A
...		1	Lever—Governor, operating	48-501-1	A
...		1	Taper pin for operating lever, #000 x 1/2"	010-201	A
...	3H4574/S3	1	Screw, for operating lever	03-92	A
282	3H4574/G17	1	Gasket—Governor flange	16-873	A
...		4	Capscrew—Governor flange, 5/16—15 x 1 1/4" hex.	02-21	A
...		4	Lockwasher, 5/16"	05-50	A
1		1	Serve piston	040005	H
2		1	Pilot valve plunger	040041	H
3		1	Relief valve plunger	040042	H
5		1	Base gasket	040149	H
6	3H4584A/G8	1	Cover gasket	040156	H
8		2	Spring fork pin	040307	H
10		1	Idler stud	040310	H
11		1	Speed adj. lever pin	040384	H
12		2	Terminal sleeve	040316	H

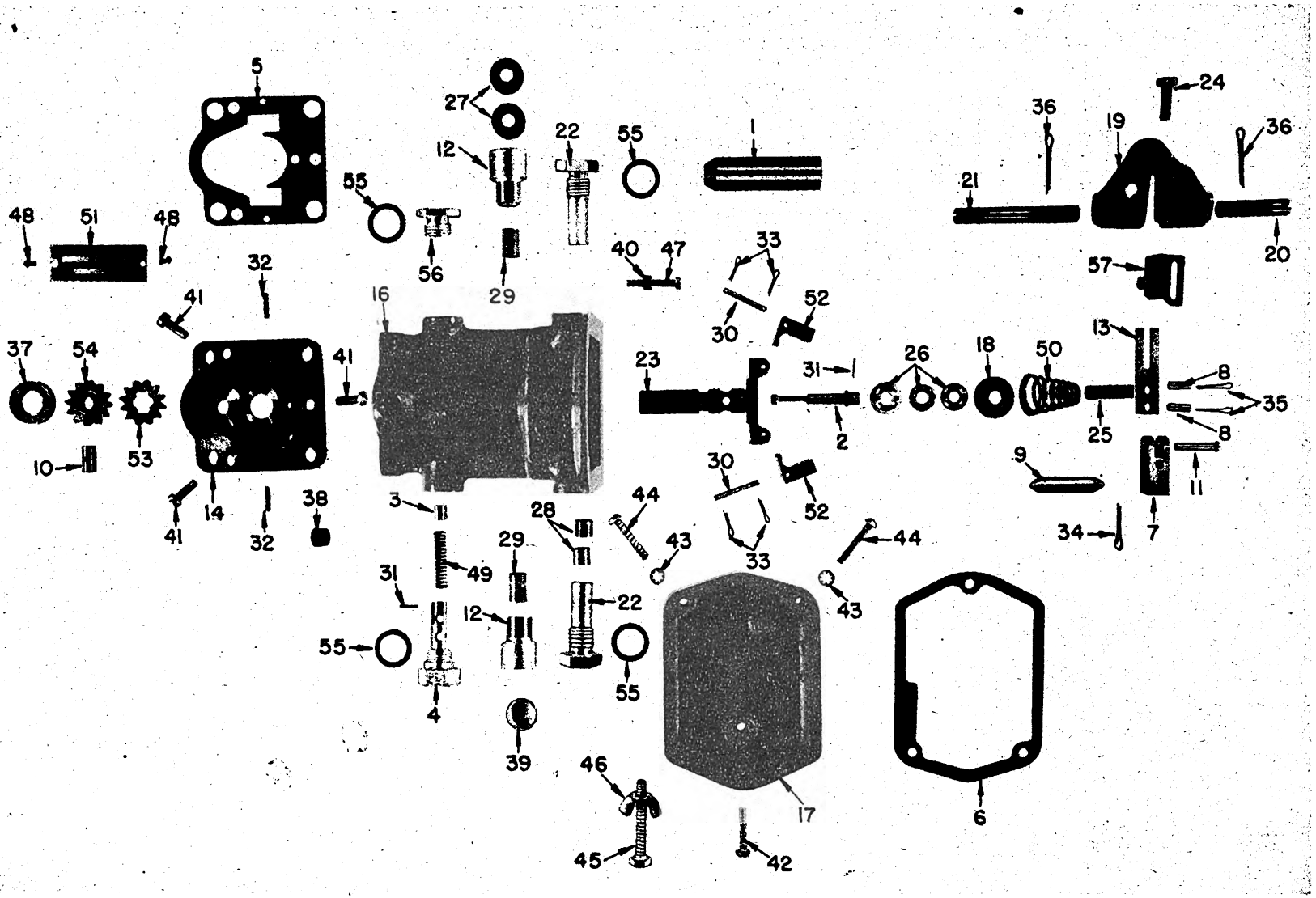


Fig. 100. Component Parts of Governor (Serial No. 155896 up)

79. Governor Assembly. (Serial No. 155896 Up) (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfr's. Part No.	Mfr's. Code
14		1	Governor base	040319	H
16		1	Governor case	040326	H
17		1	Cover	040328	H
18		1	Spring seat	040331	H
19		1	Terminal lever	040338	H
20		1	Terminal shaft (short)	040340	H
21		1	Terminal shaft (long)	040341	H
22		2	Spacer cap	040342	H
24		1	Droop adjusting screw	040346	H
25		1	Spring fork	040350	H
26		1	Thrust bearing	180004	H
27		2	Neoprene oil seal	182079	H
29		1	Oilite bushing	183180	H
28		2	Oilite bushing	183181	H
30		2	Ball arm pin	184000	H
31		2	Pin	184001	H
32		2	Dowel pin, base	184008	H
33		4	Cotter pin 1/16 x 3/8"	184100	H
36		2	3/32" Dia. cotter pin 1" long	184362	H
35		2	1/16" Cotter pin 5/8" long	184229	H
37		1	Drive shaft collar	186003	H
38		2	Pipe plug	187034	H
39		1	Welch plug	187109	H
40		1	Nut (speed limit)	188041	H
41		3	Screw (base)	188116	H
42		1	Screw (cover)	188118	H
43		3	#10 Shakeproof washer	188138	H
44		2	Screw (cover)	188144	H
45		1	Screw (low limit adj.)	188147	H
46		1	Wing nut—Cad. plated	188148	H
47		1	Screw (high limit adj.)	188149	H
48		2	#2 Drive screw	188216	H
50		1	Spring (speeder)	191441	H
51		1	Name plate	193000	H
49		1	Spring (relief valve)	191369	H
54		1	Idler gear	204361	H
53		1	Pump gear	204362	H
55		4	Copper washer gasket	206000	H
56		1	Plug	040126	H
23		1	Ball head	040352	H
13		1	Floating lever	040353	H
9		1	Speed adjusting shaft	040354	H
7		1	Speed adjusting lever	040355	H
4		1	Relief valve sleeve	040359	H
52		2	Flyball	196000	H
57		1	Droop adj. bracket assembly—Includes droop rivet pin	040364	H

80. Standard Parts List

Quantity	Size	Length	Thread	Description	Where Used
20	1/4"	1/2"	20	Hex. head capscrew	Magnetic switch mounting
					Rubber mountings
6	1/4"	5/8"	20	Hex. head capscrew	Oil pump
2	1/4"	2"	20	Hex. head capscrew	Control bracket
1	5/16"	1/2"	18	Hex. head capscrew	Bed plate
14	5/16"	3/4"	18	Hex. head capscrew	Camshaft
					Oil pump
					Water pump and fan
					Fuel pump mounting
3	5/16"	7/8"	18	Hex. head capscrew	Crankcase
2	5/16"	1"	18	Hex. head capscrew	Generator
6	5/16"	1 1/4"	18	Hex. head capscrew	Oil pump
					Governor flange
5	5/16"	1 3/4"	18	Hex. head capscrew	Water pump and fan
5	3/8"	1/2"	16	Hex. head capscrew	Cooling group
					Control box
6	3/8"	5/8"	16	Hex. head capscrew	Bell housing
13	3/8"	3/4"	16	Hex. head capscrew	Bell housing
					Generator
					Battery ground
					Conn. to cyl. block
6	3/8"	7/8"	16	Hex. head capscrew	Radiator support
15	3/8"	1"	16	Hex. head capscrew	Outlet conn. to manifold
					Cranking motor mounting
					Carburetor mounting
					Supports
18	3/8"	1/4"	16	Hex. head capscrew	Engine base flange
					Magneto mounting
2	3/8"	1 1/2"	16	Hex. head capscrew	Gear cover
11	3/8"	1 3/4"	16	Hex. head capscrew	Gear cover
2	7/16"	1/4"	14	Hex. head capscrew	Cooling group
					Inlet connection
6	1/2"	1 1/4"	13	Hex. head capscrew	Bell housing
					Cyl. hd. water connection to manifold
2	1/2"	1 1/2"	13	Hex. head capscrew	Crankshaft support
4	5/8"	1 1/4"	11	Hex. head capscrew	Support
2	5/8"	1 1/2"	11	Hex. head capscrew	Radiator
6	3/4"	2"	10	Hex. head capscrew	Engine to base
4	3/4"	2 3/4"	10	Hex. head capscrew	Generator to base
1	1/4"	1/2"	28	Hex. head capscrew	Fuel line

80. Standard Parts List (Cont'd)

Quantity	Size	Length	Thread	Description	Where Used
2	#6	7/8"	32	Fill. head machine screw	Switch mounting
3	#10	1/2"	24	Fill. head machine screw	Governor operating cross shaft lever
12	1/4"	1/2"	20	Rd. head machine screw	Cooling group
					Control box mounting
8	5/16"	3/4"	18	Button head machine screw	Cover
2	3/8"	3/4"	16	Rd. head machine screw	Bell housing
6	#10	3/8"		Binding head, Parker-Kalon Type Z screw	Cooling group
4	#10	3/8"		Stove head, Parker-Kalon Type Z screw	Breather
16	#2	3/16"		Drive screw, Parker-Kalon Type U	Crankcase
					Bed plate
9	1/4"		20	Square nut	Cooling group
2	3/8"		16	Square nut	Bell housing
3	5/16"		18	Hex. nut	Guide—governor controls
					Generator
5	3/8"		16	Hex. nut	Battery strap
					Battery ground
					Fuel tank hold down
2	1/2"		13	Hex. nut	Bed plate
4	3/8"		16	Hex. castellated nut	Bed plate
4	1/4"		28	Hex. nut—Clevis end	Governor
					Fuel line
6	5/16"		24	Hex. nut	Oil filter
					Support stud
					Ignition cables
5	3/8"		24	Hex. nut	Gear cover
					Water pump and fan
					Engine base
4	7/16"		20	Hex. nut	Rocker arm bracket
26	1/2"		20	Hex. nut	Cylinder head stud
					Manifold
					Cooling group
					Metal tool box
16	5/16"		18	Wing nut	Shield plate
1	3/8"		16	Wing nut	Cylinder head
4	7/16"		20	Hex. acorn nut	Cylinder head cover

80. Standard Parts List (Cont'd)

Quantity	*Size*	*Length*	*Thread*	*Description*	*Where Used*
2	6″			Machine screw lockwasher	Screw on switch mounting
29	¼″			Lockwasher	Oil pump
					Manifold
					Bed plate
					Magnetic switch
					Control box mounting
					Fuel line
42	5/16″			Lockwasher	Crankcase
					Oil pump
					Water pump and fan
					Bed plate
					Generator
					Ignition cables
					Fuel pump mounting
					Governor assembly
143	⅜″			Lockwasher	Bell housing
					Cylinder head
					Gear cover
					Governor drive
					Water pump and fan
					Cooling group
					Engine base
					Bed plate
					Cranking motor
					Generator
					Battery
					Magneto mounting
					Battery ground
					Carburetor mounting
					Connection to cylinder block
					Fuel tank hold down
					Fuel tank
2	7/16″			Lockwasher	Cooling group
10	½″			Lockwasher	Bell housing
					Cooling group
					Capscrew on crank support
					Metal tool box
6	⅝″			Lockwasher	Cooling group
					Support

80. Standard Parts List (Cont'd)

Quantity	Size	Length	Thread	Description	Where Used
9	1/4"			Flat washer	Cooling group
1	5/16"			Plain washer	Oil pump
2	3/8"			Plain washer	Magneto mounting
2	1/4"			Plain washer	Bed plate
4	3/8"			Plain washer	Bed plate
1	7/16"			Plain washer	Rocker arm bracket stud
2	5/8"			Plain washer	Cooling group
3	1/16"	7/16"		Cotter pin	Governor controls
26	3/32"	1"		Cotter pin	Bell housing Connecting rod Bed plate
4	#6	1/2"		Woodruff key	Oil pump drive gear Oil pump gear Magneto coupling
2	#A	7/8"		Woodruff key	Crankshaft
1	#13	1"		Woodruff key	Camshaft gear
1	5/8"	2 1/2"		Square key	Alternator
1	#2	1"		Taper pin	Oil pump drive gear
2	#3	1 1/4"		Taper pin	Governor drive gear
1	#4	1"		Taper pin	Fan hub
1	#4	1 1/2"		Taper pin	Impellor hub
2	#000	1/2"		Taper pin	Coupling for operating lever
2	#7	2"		Taper pin	Gear cover
4	#9	3"		Dowel pin	Bed plate
5	1/8"			Square head pipe plug	Crankcase
1	1/4"			Countersunk pipe plug	Oil pump
1	3/8"			Countersunk pipe plug	Crankcase
1	1/4"			Square head drain plug	Fuel tank
1	3/4"	2 1/2"		Oil drain line	Engine base
1	3/4"			90° Street ell	Oil drain line—Engine base
1	1/8"			45° Street ell	Water pump and fan
1	1/4"			45° Street ell	Cooling group
1	#000		1/8"	Grease cup	Water pump and fan
4	1 1/4"			Welch plug	Manifold
1	3"			Welch plug	Crankcase
3	1/4"		28	Clevis end	Governor rod and spring rod in governor controls
3	1/4"			Clevis pin	Governor controls

SECTION V. APPENDIX

81. Identification Index to Manufacturers

Le Roi Part Name	*Le Roi Part No.*	*Manufacturer's Name and Address*	*Manufacturer's Model or Type No.*
Air Cleaner	A77-145-1	Air-Maze Corporation, Cleveland, Ohio	37U-OBF
Alternator	A108-94	Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	SO85-11-380
Ammeter	A113-28	U. S. Gauge Company, Sellersville, Pa.	AU-1166
Battery	A117-55	Globe-Union, Inc., Milwaukee, Wisconsin	133
Breather, Cyl. head	A77-137	Air-Maze Corporation, Cleveland, Ohio	ZOH
Carburetor	A84-546-1	Zenith Carburetor Division, Detroit, Michigan	62AJ10
Control switch box	A76-175	Allen-Bradley Co., Milwaukee, Wis.	X84446
Coupling	A28-256	Thomas Flexible Coupling Co., Warren, Pa.	312-DF
Cranking motor	A107-37	Delco-Remy Div., Anderson, Indiana	412
Fuel pump	A81-99-4	AC Spark Plug Division, Flint, Michigan	1523019
Generator (12V)	A108-87	Delco-Remy Div., Anderson, Indiana	1101747
Governor	1A116-84	Woodward Governor Company, Rockford, Illinois	SGX-040348
Instrument panel	A151-210	Westinghouse Electric & Mfg. Co., Chicago, Illinois	MKZ-24372
Instrument panel	A151-217	Westinghouse Electric & Mfg. Co., Chicago, Illinois	
Magnetic switch	A76-46	Delco-Remy Div., Anderson, Indiana	1422
Magneto	A85-99-4	American Bosch Corp., Springfield, Massachusetts	MJB4A-314
Magneto ground switch	76-161	Micro Switch Corporation, Freeport, Illinois	YZ-RQT
Oil filter	A77-176	Briggs Clarifier Co., Washington, D. C.	G400
Oil pressure gauge	60-80	U. S. Gauge Company, Sellersville, Pa.	AU-1171
Spark plug	86-9	AC Spark Plug Div., Flint, Michigan	83 Spec.
Thermometer	60-146	Diesel Plant Specialties Co., Chicago, Illinois	426
Thermostat	116-54	Fulton Sylphon Company, Knoxville, Tenn.	155
Water temperature safety switch	76-177	Allen-Bradley, Milwaukee, Wisconsin	X66847

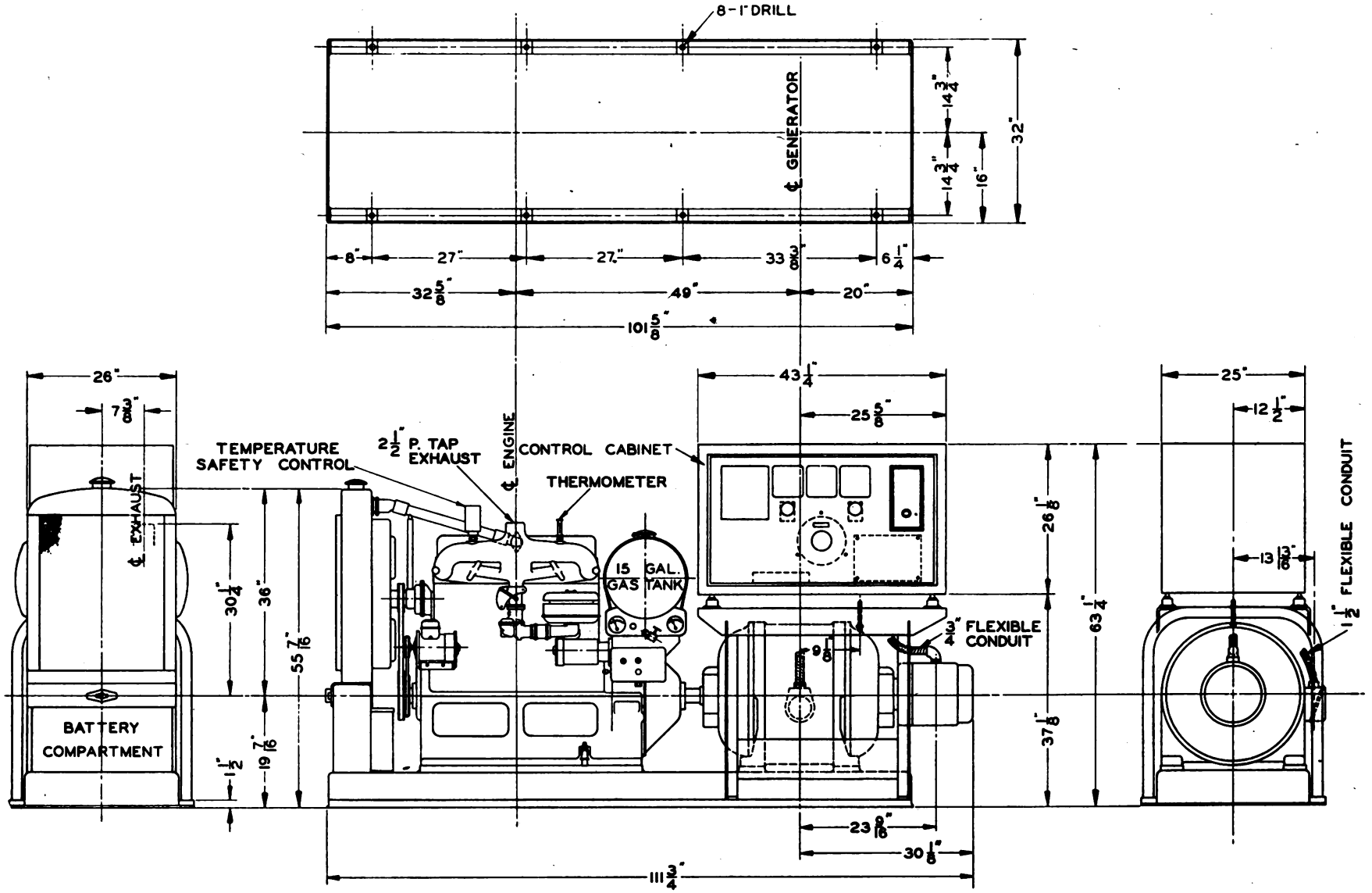


Fig. 101. Installation and Dimensional Drawing of Power Unit (All Except Serial Nos. 181832 to 181955)

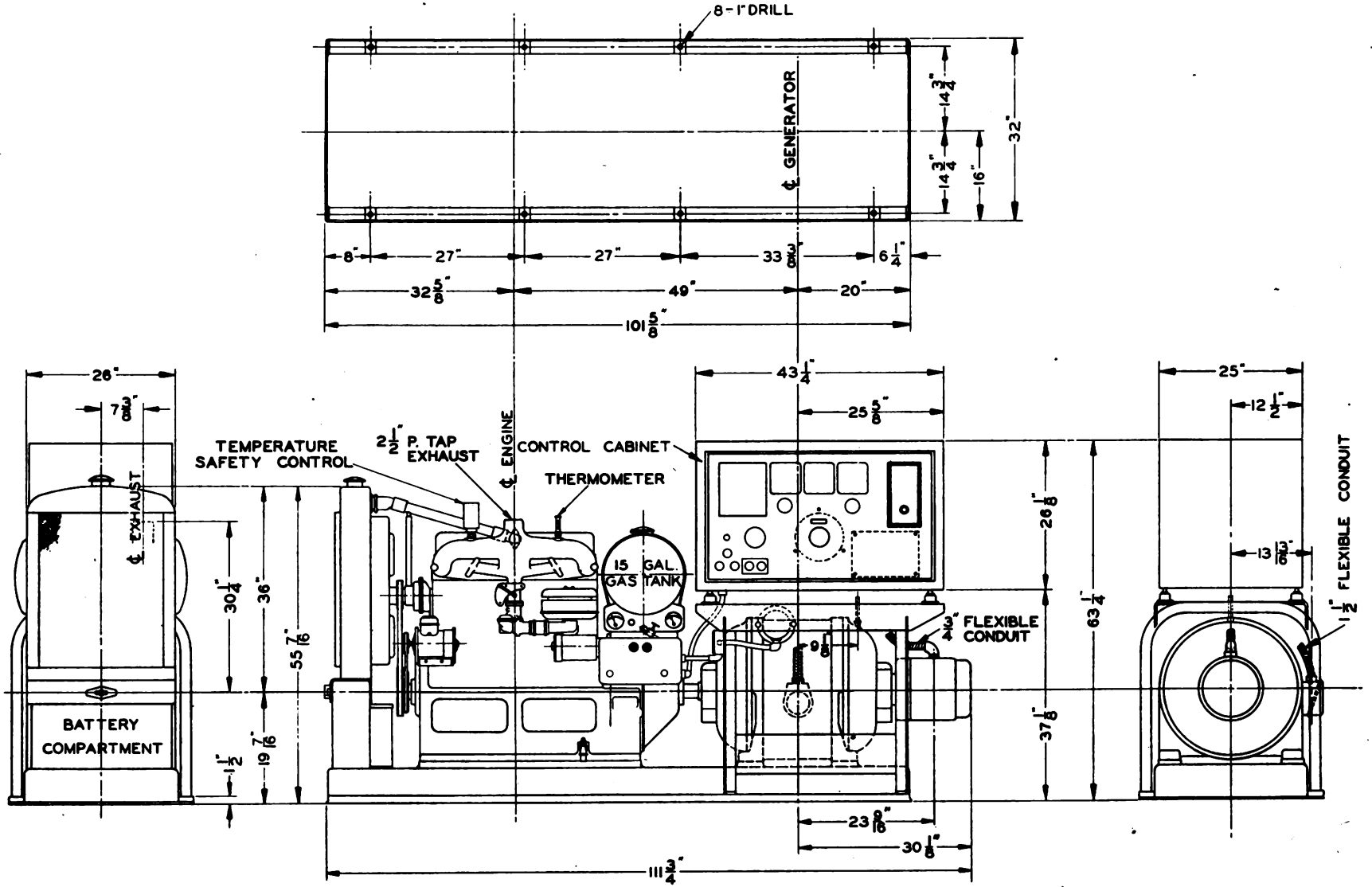


Fig. 102. Installation and Dimensional Drawing of Power Unit (Serial Nos. 181832 to 181955)

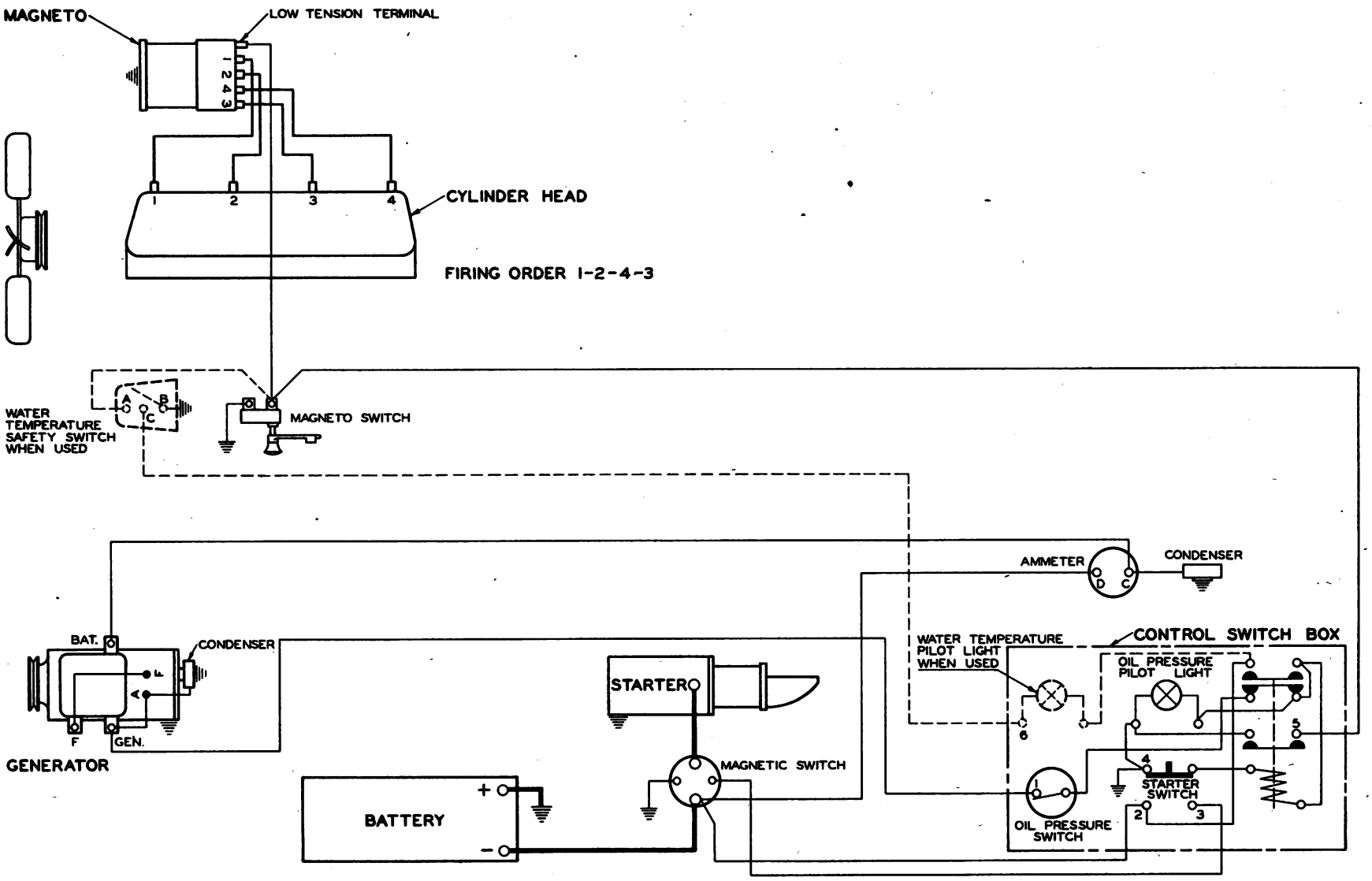


Fig. 103. Wiring Diagram, 12 Volt, Electrical System (All Except Serial Nos. 181832 to 181955)

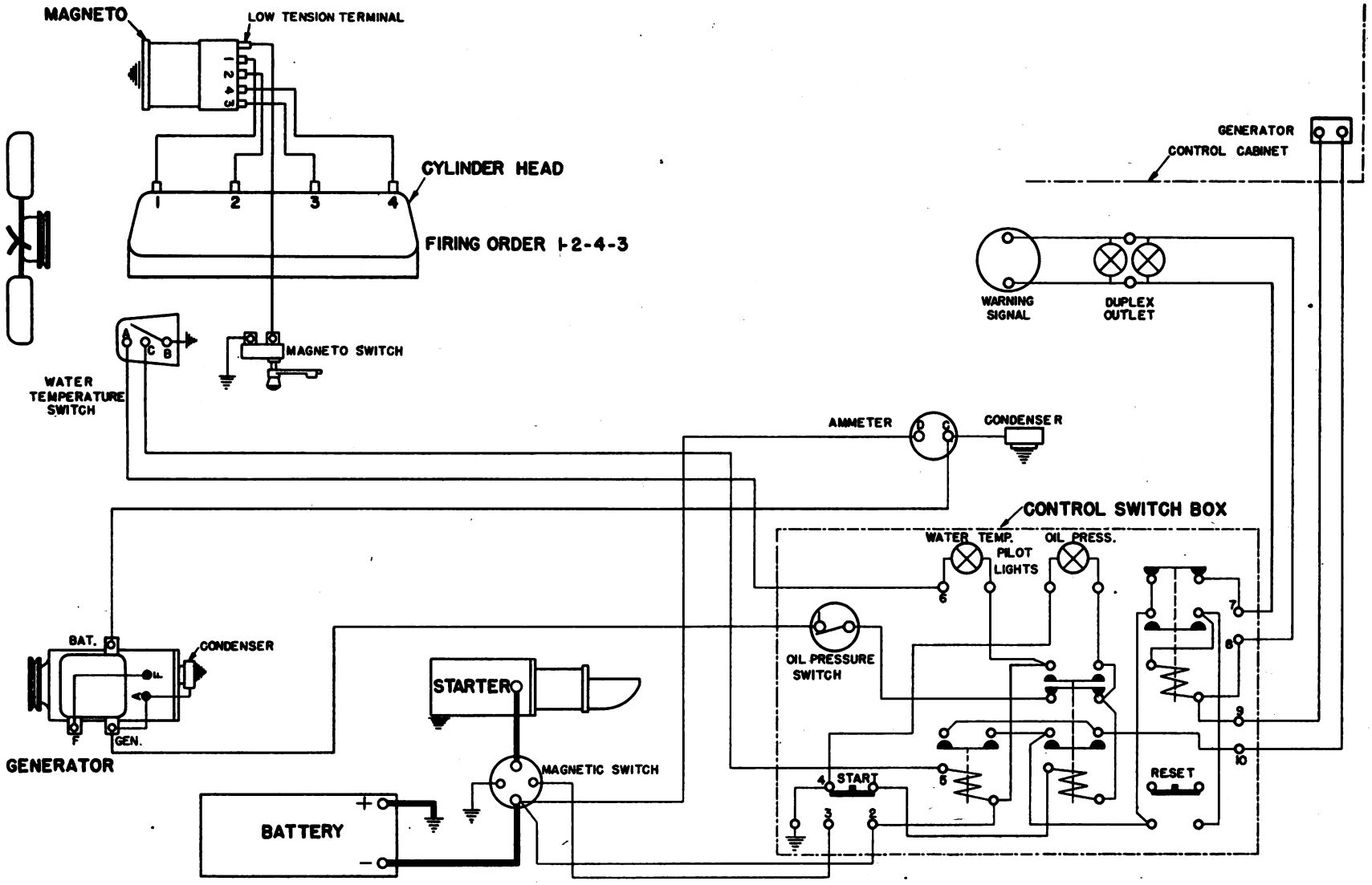


Fig.104. Wiring Diagram, 12 Volt, Electrical System (Serial Nos. 181832 to 181955)

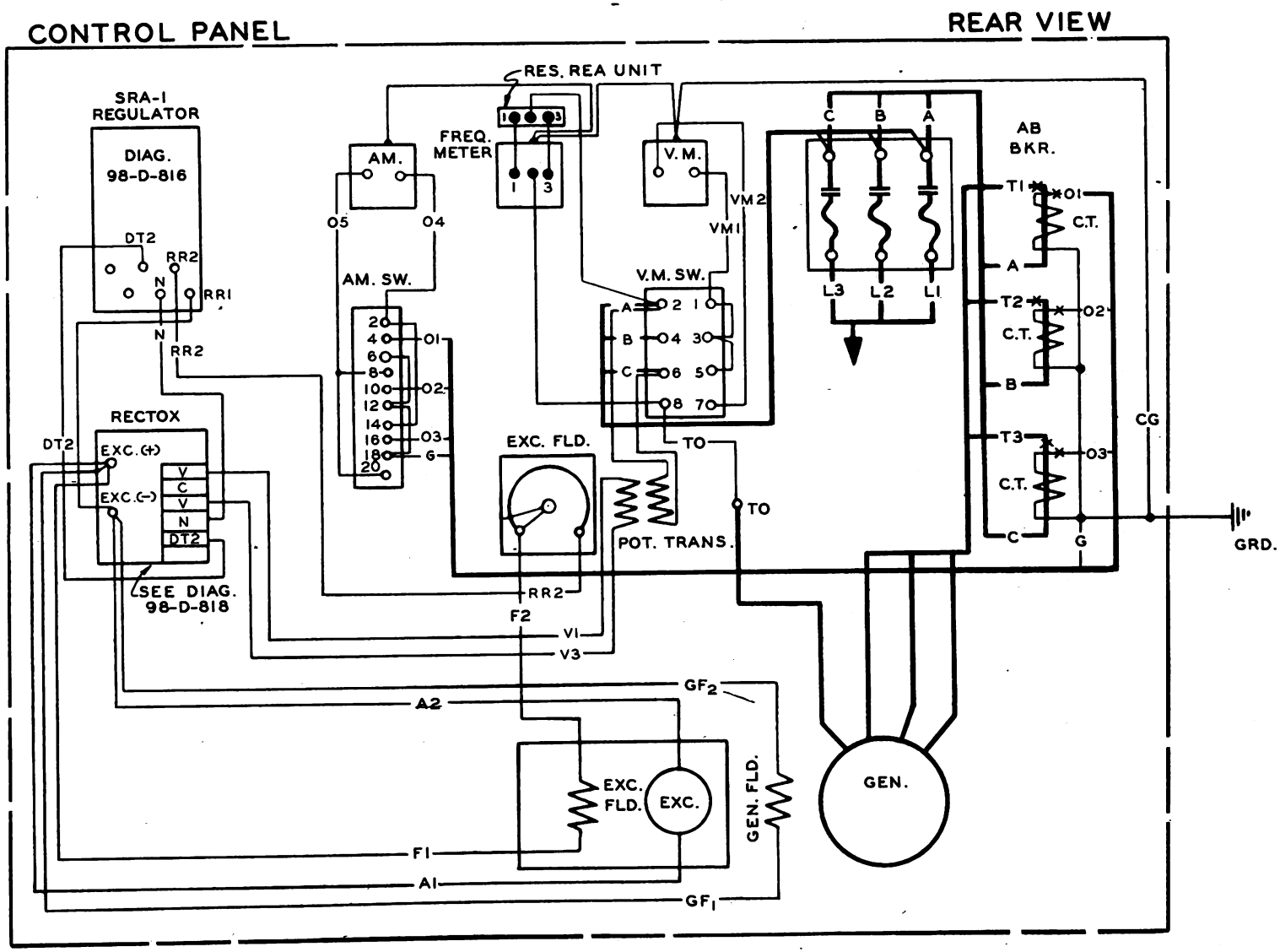


Fig. 105. Wiring Diagram, 110 Volt, Electrical System (All Except Serial Nos. 181832 to 181955)

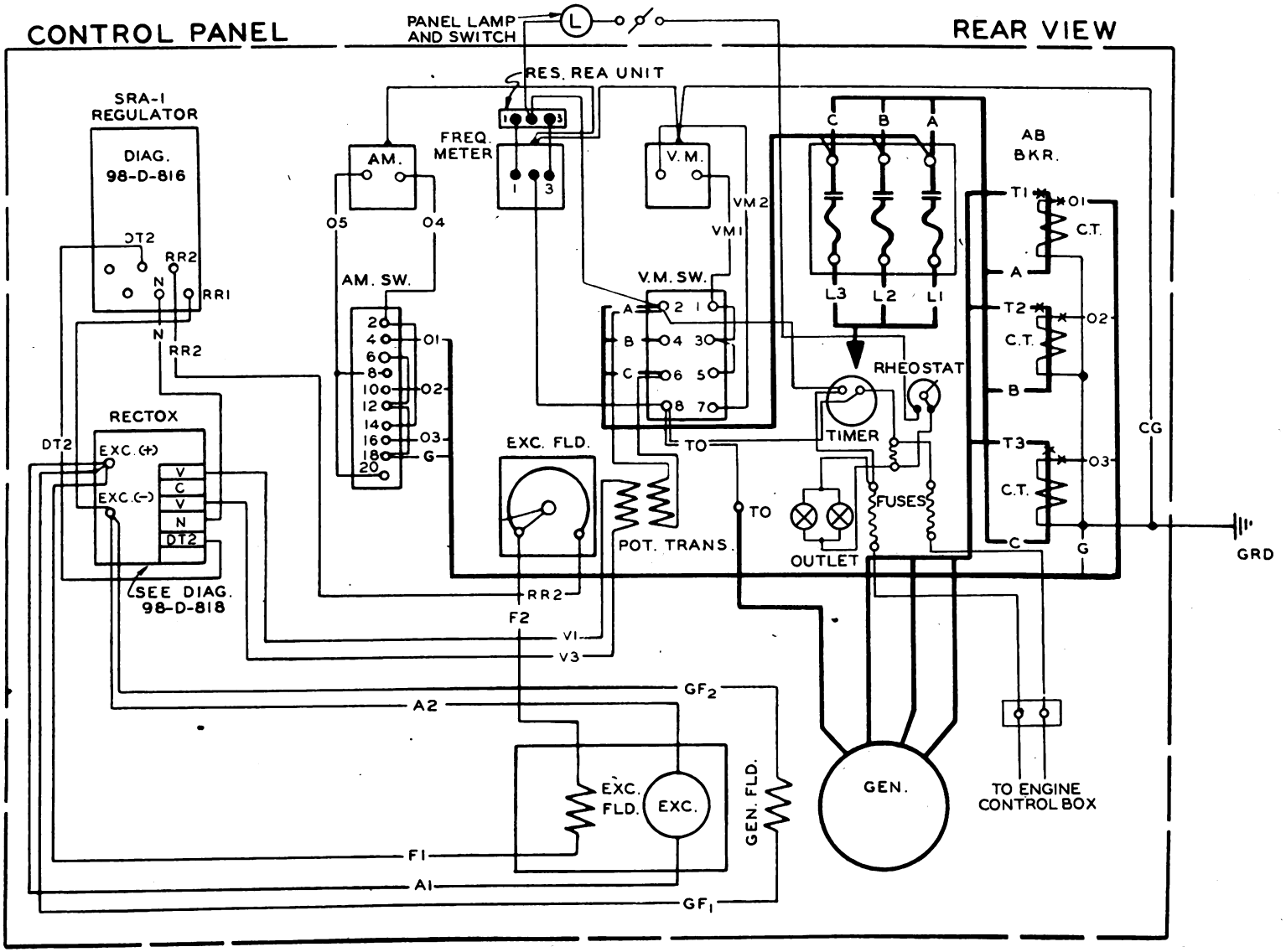


Fig. 106. Wiring Diagram, 110 Volt, Electrical System (Serial Nos. 181832 to 181955)

This Technical Manual covers Power Units PE-74-( ) supplied to the U. S. Signal Corps under the following orders:

LE ROI CO.	U. S. ORDER	U. S. CONTRACT
17773	84-SCRL-42	W1077-SC-1048
17774	84-SCRL-42	W2279-SC-52
17793	2824-CHI-42	W287-SC-4379
18301	84-SCRL-42	W2279-SC-52
18604	84-SCRL-42	W1077-SC-722
18925	84-SCRL-42	W2279-SC-52
19368	198-MPD-43	W3435-SC-122
19404	699-MPD-43	W3435-SC-360
19528	103-MPD-44	W3435-SC-531
19593	84-SCRL-42	W2279-SC-52

U. S. GOVERNMENT PRINTING OFFICE O—1945

TECHNICAL MANUAL

POWER UNITS PE-74, PE-74-A, PE-74-B, AND PE-74-D

CHANGES No. 1

WAR DEPARTMENT
WASHINGTON 25, D. C., 24 August 1945

TM 11-909, 15 January 1944, is changed as follows:

The title of this manual is changed to read "POWER UNITS PE-74, **PE-74-A,** PE-74-B, AND PE-74-D."

The footnote at the bottom of page 1 is changed to read:

†*PE-74-(*) covers Power Units PE-74-, PE-74-A, PE-74-B, PE-74-D.*

1. General Description of Power Unit.

a. Power Unit PE-74-(*) †* * * alternating-current generator. **The engine has a 5-inch bore, a 6-inch stroke and develops 70 horsepower at 1,200 revolutions per minute. The alternating-current generator delivers 25 kw.** The entire unit * * * weight—4460 lbs. **For dimensions, see figures 101 and 102.**

b. Starting is accomplished * * * battery-charging generator. A grounding lug is located on the bedplates near the front leg of the control cabinet support **on the magneto side of the power unit.** (See fig. 2.)

c. (Added.) For reference, the two sides of the power unit will be referred to as follows: the side shown in figure 1 will be referred to as the carburetor side, and the side shown in figure 2 as the magneto side. For figure references not made in this manual consult list of illustrations.

1.1 Table of Major Components (Added).

Quantity	Name	Dimensions (inches)	Weight (pound)
1	Power Unit PE-74-(*).	(1)----------	4460
	Engine with accessories.	(1)----------	
	Generator with exciter.	(1)----------	
	Radiator assembly.	(1)----------	
	Fuel tank assembly.	(1)----------	
	Control panel assembly.	(1)----------	
	Base assembly----	(1)----------	
	Battery----------	10 x 20½ x 8½	
1 box	Tools and spare parts.[2]	26 x 40 x 23---	525

[1] For dimensions see figures 101 and 102.
[2] For list of spare parts see paragraph 82. For list of tools, see section IV.

2. Engine.

* * * * *

d. Oil Filter.

The replaceable cartridge-type lubricating oil filter is located on the **magneto** side of the engine. A quantity of * * * to the crankcase. **For maintenance service see paragraph 13.**

* * * * *

k. Control Switch Box (Superseded).

The purpose of the oil pressure and water temperature controls (located in the control box (fig. 1)) is to shut down the engine if the oil pressure drops below 5 pounds per square inch, or if the water temperature rises above 195° F. while the engine is running.

Both of these controls act to short circuit the magneto, stopping the engine when either of the above conditions occur. The controls turn on the proper pilot light on the control switch box also, giving a visual indication of the trouble. For complete operating details see paragraph 31.

* * * * *

3. Description of Generator (Alternating Current).

a. General.

The alternating current * * * the collector rings. The brush holders **are** located so that the brushes do not override the edges of the collector rings under normal conditions (when the generator is coupled to the engine).

The rotor is * * * radio-frequency interference.

* * * * *

5. Checks Before Starting Engine.

a. Routine Checks.

* * * * *

(2) The crankcase has * * * the starting motor. To check the oil level, remove the dip stick **from the oil level gauge on the carburetor side of the engine below the starting motor.** (See fig. 1.) Wipe it clean;

*These changes supersede TB 11-909-1, January 1945.

reinsert it slowly. Leave it there * * * the FULL mark. **If oil level is below the FULL mark, fill in accordance with War Department Lubrication Order No. 3024.**

(3) (Superseded.) Gasoline is supplied from a 15-gallon tank located just above the flywheel, or can be supplied from an external drum (not supplied with unit). A 35-foot long, flexible gasoline hose is supplied with this power unit for connection to the drum. Check the tank and drum to see that there is a sufficient supply of gasoline for running the engine. When refueling use motor fuel (all purpose), U. S. Army Spec. No. 2–103B (Amend. 1).

* * * * *

b. Additional Checks for New Engine or Engine Taken From Storage.

* * * * *

(1.1) (Added.) Connect the flexible fuel line to the remote fuel valve and to the remote fuel tank or drum.

(1.2) (Added.) For starting, check to make sure that the remote fuel valve is closed tightly and open the local fuel supply valve under the fuel tank.

(2) After connecting the fuel supply, prime the fuel pump and carburetor by manipulating the priming **lever** which will be found underneath the fuel pump. If the glass filter bowl on the fuel pump shows any amount of water and dirt, it should be removed, cleaned, and replaced, making sure that the edges of the bowl fit evenly and tightly against the cork gasket. (**See fig. 6.**)

(3) Grease the water pump by turning down the grease cup **in accordance with War Department Lubrication Order No. 3024.**

c. Additional Checks Before Starting in Cold Weather.

* * * * *

(3) (Superseded.) When the unit is to be operated in areas where the temperature is likely to drop below +32° F. observe the cold weather lubrication in accordance with War Department Lubrication Order No. 3024. For maintenance service lubrication see paragraphs 7.11 through 7.17.

(4) Drain the cooling system of water at the end of each run, or **protect the cooling system against freezing with Compound, Antifreeze (ethylene glycol type), U. S. Army Spec. No. 4–1116 in accordance with the following table. After the antifreeze has been added and the unit brought up to operating temperature, check the cooling system carefully for leaks as antifreeze will seep through small openings that would not show up under ordinary conditions.** To drain the * * * water drains completely.

Lowest expected temperature	Pints, antifreeze per gallon cooling system capacity
+10° F.	2
0° F.	2½
−10° F.	3
−20° F.	3½
−30° F.	4
−40° F.	4½
−50° F.	5

* * * * *

Figure 16 (page 12), Anti-freeze Solution Chart, is rescinded.

6. Starting the Power Unit.

* * * * *

f. As the engine * * * throttle partly open. The governor control rod will be found on the **magneto** side of the engine.

* * * * *

k. In order to * * * begins to fall. The voltage **regulator** rheostat should then be turned to increase the resistance. The regulator is * * * again operate automatically.

SECTION IIA. OPERATOR'S PREVENTIVE MAINTENANCE TECHNIQUES (Added)

7.1. Meaning of Preventive Maintenance.

Preventive maintenance is a systematic series of operations performed periodically on equipment in order to maintain top efficiency in performance, to reduce unwanted interruptions in service, and to eliminate major break-downs. To understand preventive maintenance, it is necessary to distinguish between it and trouble shooting and repair. The primary function of preventive maintenance is to prevent major break-downs and the consequent necessity of repair. The primary function of trouble shooting and repair to to locate and correct existing defects. The importance of preventive maintenance cannot be overemphasized. Power equipment is but one component of a complete system. Each component of an over-all system must be ready when needed and able to operate at peak efficiency. It is vitally important that operators and repairmen maintain all power supply equipment properly.

7.2. Purpose of Operator's Maintenance.

a. General.

To insure mechanical efficiency, it is necessary to inspect the power unit systematically at intervals each day it is operated and at other specified intervals, so that defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. The services set forth in this section are those performed before operation, during operation, during stop periods, after operation, and at other specified intervals. These services are the responsibility of the commanders of operating organizations. They comprise the scheduled maintenance services performed by power unit operators (first echelon) and unit mechanics (second echelon) respectively.

b. First Echelon.

Ordinarily the power unit operator (first echelon) will replenish fuel, oil, grease, coolant, and battery liquid. He will perform necessary cleaning operations; tighten loose nuts, bolts, screws, and other fastenings; care for tools and accessories; and make such emergency repairs as are within the scope of his ability, tool equipment, and parts available. He will see that all lubrication operations scheduled for daily lubrication on the War Department Lubrication Order for the unit under his care are properly and regularly performed. These operations are performed by the operator daily, before operation, at halt (during shut-down periods), and after operation. He will assist the unit mechanic (second echelon) in performing the weekly maintenance on the unit.

c. Second Echelon.

The unit mechanic (second echelon) will perform the weekly and monthly maintenance operations with the assistance of the unit operator (first echelon) and all service operations within the scope of his ability, tool, and spare part equipment available. He will also perform all lubrication operations scheduled for weekly lubrication on the War Department Lubrication Order for the unit and will check to see that all daily lubrication operations have been properly performed by the unit operator. The unit mechanic will report any maintenance or repair operations beyond the scope of the second echelon to the officer in charge.

7.3 Records and Reports.

a. First Echelon.

Except when otherwise prescribed, forms and records listed below will accompany each power unit assigned to using organizations.

b. Driver's Trip Ticket and P. M. Service Record (WD Form 48).

Every operator of an individual power unit or power unit installation will provide himself with WD Form 48 (Driver's trip ticket and P. M. service record). To adapt this form to power unit operation, the following interpretation of various headings on that form will be necessary. *Time Out* will be interpreted as the start of a period of power unit operation. *Time In* will be understood as the end of that operating period. *Kind of Work* will be interpreted as the equipment for which the power unit was used as a source of power. The *Speedometer* heading will be ignored and the reading of the

Hour Meter will be entered under that heading at the beginning and end of the operating period, if such a meter is provided on the unit. If no such meter is provided, only the total number of hours operated during the operating period will be recorded. No entry will be required under the heading *Trip or Load Record*. Under the heading *Passengers or Weight*, enter the load in amperes during the operating period and under the heading *Speedometer or Hour Meter*, enter the total number of hours for which the load entered was carried by the unit. The *Dispatcher's Signature* will be that of the officer charged with the equipment. All other entries on the front of the form are self-explanatory. On the reverse side of WD Form 48 are listed the before operation, during operation, at halt, and after operation services. The power unit operator will line out all operations listed which do not apply to power units and will perform all remaining operations. Upon the completion of each group of service operations, the unit operator will place his initials in the space provided. The balance of the back of the form is self-explanatory. (See figs. 16.1 and 16.2.)

DRIVER'S TRIP TICKET AND P. M. SERVICE RECORD

U.S.A. NUMBER: Serial PE-74-B 181832

DRIVER'S NAME: A. B. Smith — DATE: 23 Apr 45

REPORT TO: Capt R.A. Jones — TIME OUT: 0800

ORGANIZATION: Hq. Co 12th Inf — TIME IN: 1600

DEPARTMENT OR ADDRESS: Bldg. T-2931 - 7th Ave. & 4th St. Post

KIND OF WORK (or route): SCR-270

REQUESTED BY (Organization or individual): Capt R.A. Jones

DISPATCHER'S SIGNATURE: T/5 James A. Brown

SPEEDOMETER IN	SPEEDOMETER OUT	SPEEDOMETER TOTAL MILES	HOUR METER IN	HOUR METER OUT	HOUR METER TOTAL HOURS
			212	220	8

FUEL ADDED: 40 GALS.

OIL ADDED: 4 QTS.

I HAVE PERFORMED THE "PREVENTIVE MAINTENANCE SERVICES" OF THIS FORM AND RECORDED ALL DEFICIENCIES AND ANY ACCIDENT

A. B. Smith
DRIVER'S SIGNATURE

I HAVE NOTED ALL ENTRIES ON THIS FORM AND TAKEN THE NECESSARY ACTION

T/5 James A. Brown
DISPATCHER'S, ETC., SIGNATURE

TRIP OR LOAD RECORD	PASSENGERS OR WEIGHT	SPEEDOMETER OR HOUR METER
FROM		
TO	98 amp.	212 - 218
TO	79 amp.	218 - 220
TO		
TO		
TO		
TO		
TO		
TO		
TO		

VEHICLE RELEASED AT (Speedometer Hour Meter, date, hour): 212 — 23 April 1945 — 0800

OFFICIAL USER (Signature and Grade): T/Sgt A.L. Green

WAR DEPARTMENT FORM 48
APPROVED 15 DECEMBER 1944

TL96949

Fig. 16.1. WD Form 48, Front, Adapted for Power Unit PE–74–(*).

DRIVER'S DAILY PREVENTIVE MAINTENANCE SERVICES

PERFORM THESE SERVICES ACCORDING TO THE INSTRUCTION IN TM 37-2810, OR VEHICLE OPERATOR'S MANUAL.

BEFORE OPERATION SERVICE

1. TAMPERING AND DAMAGE
2. FIRE EXTINGUISHERS
3. FUEL, OIL AND WATER
4. ACCESSORIES AND DRIVER
5. [illegible]
6. LEAKS - GENERAL
7. ENGINE WARM-UP
8. CHOKE OR PRIMER
9. INSTRUMENTS
10. [illegible]
11. [illegible]
12. [illegible]
13. [illegible]
14. [illegible]
15. [illegible]
16. [illegible]
17. [illegible]
18. [illegible]
19. [illegible]
20. [illegible]
21. TOOLS AND EQUIPMENT
22. ENGINE OPERATION
23. OPERATOR'S PUBLICATIONS
24. [illegible]
25. [illegible]
26. [illegible]
27. [illegible]

OPERATOR'S INITIALS: A.B.S

DURING OPERATION SERVICE

28. [illegible]
29. [illegible]
30. [illegible]
31. ENGINE AND CONTROLS
32. INSTRUMENTS
33. [illegible]
34. [illegible]
35. [illegible]
36. [illegible]
37. [illegible]

OPERATOR'S INITIALS: A.B.S

AT HALT SERVICE

38. FUEL, OIL AND WATER
39. TEMPERATURES - [illegible]
40. [illegible]
41. PROPELLER SHAFTS
42. [illegible]
43. [illegible]
44. [illegible]
45. [illegible]
46. LEAKS - GENERAL
47. ACCESSORIES AND BELTS
48. AIR CLEANERS
49. [illegible]
50. [illegible]
51. [illegible]
52. [illegible]
53. [illegible]
54. [illegible]

OPERATOR'S INITIALS: A.B.S

AFTER OPERATION SERVICE

55. FUEL, OIL AND WATER
56. ENGINE OPERATION
57. INSTRUMENTS
58. [illegible]
59. [illegible]
60. FIRE EXTINGUISHERS
61. [illegible]
62. * BATTERY AND VOLTMETER
63. * ACCESSORIES AND BELTS
64. * ELECTRICAL WIRING
65. AIR CLEANERS AND BREATHER CAPS
66. * FUEL FILTERS
67. ENGINE CONTROLS
68. * [illegible]
69. * [illegible]
70. [illegible]
71. PROPELLER SHAFTS, [illegible]
72. [illegible]
73. LEAKS - GENERAL
74. [illegible]
75. [illegible]
76. [illegible]
77. * [illegible]
78. * [illegible]
79. [illegible]
80. [illegible]
81. [illegible]
82. * LUBRICATE AS NEEDED 3024 HOLD 86. DATE 10 May 1945
83. * CLEAN ENGINE AND VEHICLE
84. * TOOLS AND EQUIPMENT
85. * [illegible]
86. * [illegible]
87. * [illegible]
88. * [illegible]

OPERATOR'S INITIALS: A.B.S

*THOSE ITEMS MARKED BY AN ASTERISK (*) REQUIRE ADDITIONAL WEEKLY SERVICES AND IT IS MANDATORY THAT THEY BE PERFORMED AS PRESCRIBED.

RECORD ANY ACCIDENT AND ALL DEFICIENCIES, INDICATING IF CORRECTED:

TL96950

Fig. 16.2. WD Form 48, Back, Adapted for Power Unit PE–74–(*).

7.4. Operator's (Driver's) Preventive Maintenance Services.

a. Power unit operators must be trained so that they are thoroughly familiar with the items that apply to power units listed on WD Form 48, and with the manner in which they are to be inspected and serviced. Certain of the items listed on Form 48 have been capitalized to stress their importance. When tactical situations prohibit the accomplishment of all the operations listed on Form 48, as many of the listed items as possible will be performed giving primary consideration to the capitalized items.

b. The general inspection and service of each

item also applies to any supporting member, connection, or associated part and usually consists of a check to see whether or not it is in good condition, correctly assembled, secure, or excessively worn.

(1) The inspection for good condition is usually a visual inspection to determine whether or not the unit is damaged beyond safe or serviceable limits, or if it is in such condition that damage will result from operation. The term good condition is further defined by the following: not bent or twisted; not chafed or burned; not broken or cracked; not bare or frayed; not dented or collapsed; not torn or cut; in proper alignment; and properly lubricated.

(2) Inspection for correct assembly is usually a visual inspection to determine whether or not the item is in its normal position and properly aligned.

(3) To check to see if an item is secure, use a screw driver, wrench, pliers, or feel it by hand. Such an inspection should include all mountings, nuts, bolts, screws, and other fastenings. It should include a check to see that all cotter pins, locking wires, locknuts, and lockwashers are properly installed.

(4) Excessive wear will be understood to mean wear close to or beyond serviceable limits, wear which is likely to result in failure if the item is not replaced before the next scheduled inspection.

c. Any defects or unsatisfactory operating characteristics beyond the scope of repair of the first echelon must be reported at the earliest opportunity to the officer in charge.

7.5. Before-operation Service Items.

a. Item 1. Tampering and Damage.

Check for injury to the power unit or items of special equipment. Check for damage that may have resulted from falling debris, shell fire, sabotage, collision, or presence of booby traps. Look for signs of tampering or sabotage, such as loosened or damaged accessories or drive belts. To facilitate starting, dry wet spark plugs, distributor, or magnetos and wiring.

b. Item 2. Fire Extinguishers.

If one is present with the unit, check for tight mountings, full charge, corroded nozzles, and closed valves. Pay particular attention to extinguisher lines and nozzles.

c. Item 3. Fuel, Oil, and Water.

Check the amount of fuel in the tanks, noting any indications of leaks or tampering. Add fuel if necessary and check spare fuel cans. Check oil level. Add oil if necessary. Check level and condition of coolant. Add antifreeze with water if required.

Note. Any appreciable change in levels since the last after-operation service should be investigated and reported to designated authority.

d. Item 4. Accessories and Drives.

Check all accessories, carburetors, generators, regulators, starters, fans, shrouds, and water pumps for loose connections or mountings. Check couplings or belts for looseness and wear.

e. Item 6. Leaks, General.

Check under the power unit and in the engine compartment for indications of fuel, oil, or water leaks. Check the cooling system for indications of leaks, paying particular attention to radiator core and connecting hose. Check the engine crankcase, oil filters, and lines for indications of oil leaks. Check the fuel system for indications of leaks. Trace all leaks to their source and correct or report them to the officer in charge.

f. Item 7. Engine Warm-up.

Caution: As a precaution against fire or explosion, before starting the engine open all ventilators, and make sure that the engine compartment is clear of fuel drippings and gas fumes.

Start the engine and note the action of the starter mechanism. Note particularly whether the starter has adequate cranking speed and engages and disengages properly without unusual noise when the starting control is operated. If oil pressure gauge does not indicate properly within 30 seconds, the engine should be stopped and the trouble corrected or reported to the officer in charge. Set the throttle so that the engine will run at normal (fast idle) warm-up speed; during the warm-up period, proceed with the following before-operation services.

g. Item 8. Choke or Primer.

While starting the engine, check the operation of the choke. As the engine warms up, reset the choke as required to prevent overchoking and dilution of engine oil.

h. Item 9. Instruments.

(1) Oil Pressure Gauge

Check the gauge to see whether it indicates properly, and check the light indicator to see whether it fails to go out. If these instruments fail to indicate properly, stop the engine immediately, investigate the cause of the failure, and report it to the officer in charge.

(2) Ammeter

The battery-charging ammeter should show a high-charging rate for the first few minutes after starting until the generator restores to the battery the current used in starting. After this period, the ammeter should register a zero or slight positive charge with lights and accessories turned off and the engine operating at a fast idle. Any unusual drop or rise in the reading should be investigated. A high charge reading for an extended period may indicate a dangerously low battery or a faulty generator regulator. A light indicator should go out when the engine is running at fast idle.

(3) Frequency Meter

Observe whether the frequency meter is operating properly and indicating the approximate engine revolutions per minute. It should register between 59.5 and 61 cycles.

(4) Voltmeter

Note whether the voltmeter is operating properly. It should register at least the nominal load voltage.

(5) Temperature Gauge

Engine temperature should increase gradually during the warm-up period. Extremely low temperature after a warm-up period of reasonable length may indicate existing troubles that should be investigated and corrected.

i. Item 21. Tools and Equipment.

See that tools and equipment belonging to the power unit are present, serviceable, and properly mounted or stowed.

j. Item 22. Engine Operation.

If the engine has not yet reached normal operating temperature, as indicated by the temperature gauge, normal operating temperature may be assumed when the engine will operate under load with the choke fully released, and when the oil-pressure gauge indicates approximate normal operating pressure during engine acceleration. Gradually accelerate the engine several times after it has reached normal operating temperature, and note any unusual noise or unsatisfactory operating characteristics which would indicate trouble. Check dual engine installations in the manner described above.

k. Electrical Controls.

Add this item to Form 48. (See fig. 16.02.) Note whether electrical controls operate smoothly, and whether their operation is followed by the proper indications. Notify the officer in charge if there is indication of faulty operation of switches, buttons, circuit breakers, rheostats, potentiometers, relays, voltage regulators, or other electrical controls.

l. Item 25. During-operation Check.

The during-operation services should start as soon as the load is put on the unit.

7.6. During-operation Service.

a. General.

While the power unit is in operation and delivering its normal load, listen for rattles, knocks, squeaks, or hums that may indicate trouble. Look for indications of trouble in the cooling system. Watch for smoke from any part of the power unit. Be alert to detect the odor of overheated components or units such as the generator or the wiring, fuel vapor from a leak in the fuel system, exhaust gas, or other odors indicating trouble. Watch the instruments on the control panels frequently, and note unusual instrument indications that may signify trouble in the system to which that instrument pertains.

b. Procedures.

During-operation service consists of observing items listed below according to the procedures following each item, and investigating any indications of serious trouble. Note minor deficiencies to be corrected or reported at the earliest opportunity, usually the next stop period.

7.7. During-operation Service Items.

a. Item 31. Engine and Controls.

The operator must be on the alert for deficiencies in engine performance such as lack of usual power, misfiring, unusual noise or stalling, indications of engine overheating, or unusual exhaust smoke. Notice whether the engine responds to the controls satisfactorily, and see that the controls are in proper adjustment.

b. Item 32. Instruments.

Observe the readings of all instruments frequently during operation to see whether they are indicating properly.

(1) Temperature Gauge

See that the gauge reads in normal range (except when operating under unusual conditions). Excessive engine heat may indicate trouble and should be investigated immediately.

(2) Oil Pressure Gauge

In case of an unusual drop or no oil pressure, stop the unit immediately, and investigate. Lack of oil pressure may indicate insufficient oil, leaks, loose bearings, or a defective oil pump; and may result in premature wear or may damage the engine to the extent of failure. If the trouble cannot be readily corrected, report it to the officer in charge. When an oil pressure signal light is used, the light should remain off while the engine is operating.

(3) Ammeter

During operation, the battery-charging ammeter must indicate a positive reading. A discharge reading may indicate a faulty generator or regulator.

(4) Frequency Meter

See that the meter indicates the engine speed correctly at all times when the engine is running.

7.8 At-halt or Stop Service.

a. Purpose.

The at-halt or at-stop service may be regarded as minimum battle maintenance and must be performed under all tactical conditions.

b. Procedures.

This service consists of investigating any deficiencies noted during operation, inspecting the following items according to the procedures described below, and correcting any deficiencies found. At the end of the stop period, report immediately any uncorrected deficiencies to the officer in charge.

7.9. At-halt or Stop Service Items.

a. Item 38. Fuel, Oil, and Water.

Check the fuel supply to see that it is adequate to operate the unit until the next refueling time. When refueling, use safety precautions for grounding static electricity, and allow space in the filler neck for expansion. Filler cap vents must be open, pressure cap valves must be free, and the cap must be replaced securely. Check the crankcase oil level; if necessary, add oil to the proper level. Remove the radiator filler cap, being careful of steam, especially if a pressure cap is used. Check coolant to see that it is at the proper level, and replenish the coolant as necessary. Do not fill the radiator to overflowing; leave sufficient space for expansion. If the engine is hot, fill the radiator slowly while the engine is running unloaded.

b. Item 39. Temperatures: Generator or Motor Housings and Bearings.

Place hand cautiously on each bearing housing and the generator to see whether it is abnormally hot. If bearing housings are too hot to grasp with the hand, they may be inadequately lubricated, damaged, or improperly adjusted. Regular check of these items will go far to avoid premature failures or possible accidents.

c. Item 41. Propeller Shafts.

Check couplings for looseness, damage, and foreign material.

d. Item 46. Leaks, General.

Check in the engine compartment and beneath the unit for indications of leaks. Check to see whether oil is leaking from the crankcase, filters, or lines. Check the cooling system for leaks, paying particular attention to the radiator core and connecting hose.

e. Item 47. Accessories and Belts.

Check to see that all engine accessories are secure and that drive belts are in correct adjustment and not damaged. The operator should adjust belts only in emergencies. Ordinarily he should report them to the unit mechanic for adjustment and repair.

f. Item 48. Air Cleaners.

If operating under extremely dusty or sandy conditions, inspect the air cleaners and breather caps to see that they are in condition to deliver clean air properly. Service if necessary accord-

ing to instructions on War Department Lubrication Order No. 3024.

7.10. After-operation and Weekly Service.

a. Purpose.

After-operation service is particularly important. At this time the operator inspects the power unit to detect deficiencies that have developed, and corrects those he is permitted to handle. The operator should report promptly, to the officer in charge, the results of his inspection. If this schedule is performed thoroughly, the power unit should be ready to operate at a moment's notice. After completion of the after-operation service, the before-operation service, with a few exceptions, is necessary only to ascertain whether or not the power unit is in the same condition as that in which it was left.

b. Procedures.

When performing the after-operation service, the operator must remember and consider any irregularities noticed during the day in the before-operation, during-operation, and after-operation services. The after-operation service consists of inspecting and servicing the following items. Those items of the after-operation service that are marked on WD Form 48 by an asterisk require additional weekly service. The procedures for the additional weekly service are indicated in subparagraph (2) of each applicable item that follows.

7.11. After-operation and Weekly Service Items.

a. Item 54. Fuel, Oil, and Water.

(1) Check coolant level and replenish if necessary, taking care to leave sufficient space for expansion. If an appreciable amount of coolant is required, have the value of the antifreeze checked. Fill fuel tanks, observing safety precautions for grounding static electricity, and bring engine oil to proper level. Refill any spare fuel, oil, and water cans. If an unusual amount of oil or coolant is required for the engine, check for leaks and report the condition.
(2) During the period when antifreeze is in use, have hydrometer test made of coolant weekly.

b. Item 55. Engine Operation.

Check to see that the engine idles satisfactorily. Accelerate and decelerate the engine, and note any tendency to miss or backfire, or any unusual engine noise or vibration that might indicate worn parts, loose mountings, incorrect fuel mixture, or faulty ignition. Correct or report any unsatisfactory engine-operating characteristics noted during operation.

c. Item 56. Instruments.

Check all instruments to see that they are securely mounted, properly connected, and undamaged.

d. Item 60. Fire Extinguishers.

If one is present with the equipment, check to see that it is in good condition and securely mounted. If the red blow-off seal on the valve head of the fire extinguisher is blown, or if the extinguisher has been used, report it for refill or replacement. Be sure the nozzles are cleaned of obstructions such as dirt or corrosion.

e. Item 62. *Battery and Voltmeter.

(1) Check the battery to see that it is clean and secure. Check with voltmeter to see whether it registers at least the nominal battery rating.
(2) Clean dirt from the top of the battery weekly. If terminal connections or posts are corroded, clean them thoroughly and apply a fresh, thin coating of grease. Tighten loose terminal bolts. Remove vent caps and check the level of the electrolyte. Add water if required, taking precautions not to damage the battery during freezing temperatures. The battery should be secure, and should not be bulging, cracked, or leaking electrolyte. The battery carrier should be secure, clean, free of rust, and well painted. If mountings are loose, tighten them cautiously in order not to damage the battery case. Report any defects to the officer in charge.

f. Item 63. *Accessories and Belts.

(1) Check all accessories, carburetors, generators, regulators, starters, fans, shrouds, and water pumps for loose connections in couplings or mountings. Check the adjustment of the fan and drive belts. Belts should deflect approximately ½ inch. (See par. 9d.) Loose or unserviceable belts should be reported to the officer in charge.
(2) Tighten or adjust weekly any loose connections, linkage, or mountings on accessories. Examine all belts for fraying, wear, cracking, or presence of oil. Check all belts halfway between their respective pulleys to determine whether the belts are properly adjusted. Loose belts may cause improper operation and cause damage to the unit. Too tight an adjustment may cause

damage to both the accessories and the belts. Ordinarily the operator should not adjust the belts except in an emergency. Improper adjustment or unserviceable belts should be reported.

g. Item 64. *Electrical Wiring.

(1) Check all ignition and control circuit wiring to see that it is securely connected, clean, and not damaged.

(2) Check all accessible wiring to see that it is securely connected and supported, that the insulation is not cracked or chafed, and that its conduits and shielding are in good condition and secure. Report any unserviceable wiring.

h. Item 65. *Air Cleaners and Breather Caps.

(1) Check to see that oil in the air cleaner is at the correct level and not excessively dirty. Excessive dirt in the oil may be felt with the fingers. It is not usually necessary to remove the air cleaner from the carburetor air horn to make this inspection. If the oil in the cleaner is excessively dirty, clean and refill the cleaner with fresh oil. If operating in sandy or dusty territory, remove air cleaner and breather cap, and clean them. In order to keep abrasive dirt out of the engine, air cleaners and breather caps must be kept clean and properly serviced at all times.

(2) If hourly interval on lubrication order requires it, remove and disassemble the air cleaner. (See par. 11.) Clean the body and element in solvent. Fill the reservoir to the correct level with clean engine oil. Apply engine oil to the element and allow excess to drain. When reassembling the cleaner, make sure that all gaskets are in good condition and in place. Reinstall the air cleaner, giving special attention to mountings to see that cleaner is correctly aligned, and secure. Also check to see that all ducts connecting air cleaners to carburetors are secure and not damaged. Remove all breather caps and crankcase-filter cleaning elements. Wash them thoroughly in solvent, dip them in engine oil, drain off the excess, and reinstall.

i. Item 66. *Fuel Filters.

(1) Examine fuel filters for leakage, damage, and loose mounting.

(2) Close the shut-off valve in the fuel line. Remove the sediment bowl and screen and wash them in dry-cleaning solvent. Then replace all parts, tighten securely, reopen the shut-off valve in the fuel line, and note whether fuel is leaking from the filter.

j. Item 67. Engine Controls.

Check for worn or disconnected linkage. Also correct or report any unsatisfactory engine control linkage operation noted during operation. Tighten or report weekly any defects found.

k. Item 71. Propeller Shafts and Bearings.

Check couplings for loose connections, lubricant leaks from bearing housings, and damage.

l. Item 73. Leaks, General.

Check in the engine compartment and beneath the unit for indications of fuel, oil, or water leaks. Trace all leaks to their source and correct or report them.

m. Item 83. *Lubricate as Needed.

(1) Items such as linkage, hinges, latches, and other points that are lubricated by the operator should be lubricated if inspection indicates the necessity. See War Department Lubrication Order. (See fig. 16.03.)

(2) Lubricate in accordance with the lubrication order. Lubricate all points shown on lubrication order requiring weekly lubrication. The need for more frequent lubrication than is provided by the regular lubrication schedule is usually due to abnormal hot, wet, or dusty operating conditions.

n. Item 84. *Clean Engine and Vehicle.

(1) Remove dirt and excess grease from the exterior of the engine.

(2) Wipe greasy surfaces of the unit thoroughly with dry-cleaning solvent. Do not rub lusterless paint enough to create a shine that might cause reflection. If the unit is cleaned, care must be taken to see that solvent or dirt does not get into the bearings, fuel tank, or crankcase.

o. Item 85. *Tools and Equipment.

(1) Check unit packing lists to see that all tools and equipment assigned to the unit are present and properly stowed or mounted.

(2) Clean all tools and equipment of rust, mud, or dirt, and see that they are in good condition. Report missing or unserviceable items to the officer in charge.

SECTION IIB. LUBRICATION (Added)

7.12. War Department Lubrication Orders.

War Department Lubrication Orders are illustrated, numbered, and dated cards or decalcomania labels which prescribe approved first and second echelon lubrication instructions for mechanical equipment which requires lubrication by using organizations. Current War Department Lubrication Orders which are available are listed in the latest edition of FM 21–6. Lubrication orders should be requisitioned in conformance with instructions and lists in FM 21–6, which is published monthly by The Adjutant General.

7.13. Compliance With War Department Lubrication Orders.

Instructions contained in War Department Lubrication Orders are mandatory and supersede all conflicting lubrication instructions of an earlier date. Applicable War Department Lubrication Orders which are available will be obtained, carried with the equipment at all times, and complied with fully. Difficulties experienced in obtaining and complying with such orders will be reported through technical channels to the Commanding General, Army Service Forces, Attention: Maintenance Division.

7.14. War Department Lubrication Order for Power Unit PE–74–(*).

a. Location.

The War Department Lubrication Order for Power Unit PE–74–(*) is attached to the side of the control cabinet, above the exciter.

b. Facsimile.

A facsimile of the War Department Lubrication Order for Power Unit PE–74–(*) is shown on page 11.

7.15. Routine Lubrication.

Perform the following operations at intervals specified on the War Department Lubrication Order:

a. Fill Air Cleaner.

Remove the wingnut at the top center of the oil-bath air cleaner and remove the cover. Check to see that the oil is up to the level indicated by the bead pressed into the body of the cleaner. If the oil is not up to this level, add oil in accordance with the lubrication order. Be sure to replace the cover and tighten the wingnut securely.

b. Crankcase Oil Level.

Lift out the bayonet type oil gauge at the side of the crankcase and below the air cleaner. Check the level of the lubricating oil in the crankcase. If the evel is not up to the FULL mark on the bayonet gauge, add oil as specified on the War Department Lubrication Order. See special instructions for cold weather operation on the lubrication order.

c. Water Pump Grease Cup.

Turn the grease cup down snugly as instructed on the lubrication order. If unable to turn the grease cup down, unscrew it in a counterclockwise direction and refill it with grease as specified in the lubrication order. Replace the grease cup and follow instructions on lubrication order.

d. Throttle Control Linkage.

Wipe off the throttle control linkage and lubricate the joints in accordance with the lubrication order.

e. Valve Cover Breather.

Remove the wingnut from the top of the breather on the top of the valve cover. Lift off the cover and remove the filter element. Wash the top and cover thoroughly in dry-cleaning solvent or Diesel oil and allow them to dry. Replace the element and cover, and make sure that the wingnut is moderately tight.

f. Draining Oil Filter.

Remove the drain plug from the bottom of the oil filter and allow the filter to drain thoroughly. Replace the drain plug, start the engine, operate the unit for about 5 minutes, and then check the level of the lubricating oil in the crankcase. Add oil as specified on the lubrication order to bring the crankcase oil level up to the FULL mark on the bayonet oil gauge.

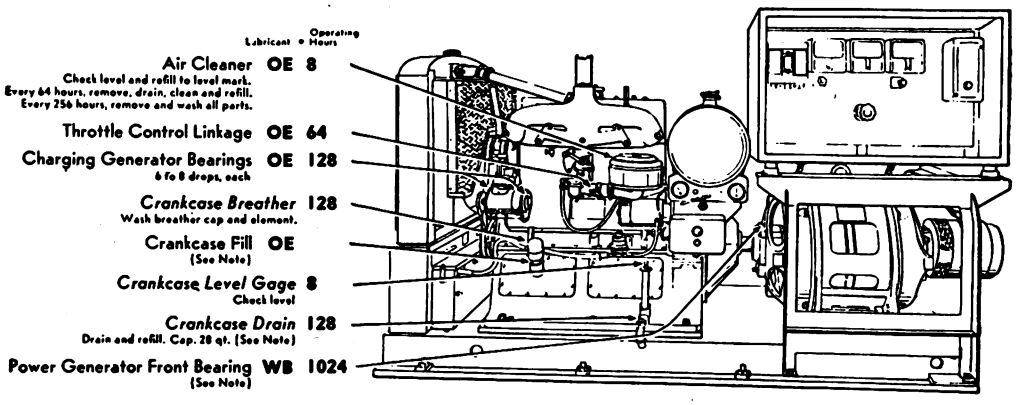
g. Cleaning Oil-Bath Air Cleaner.

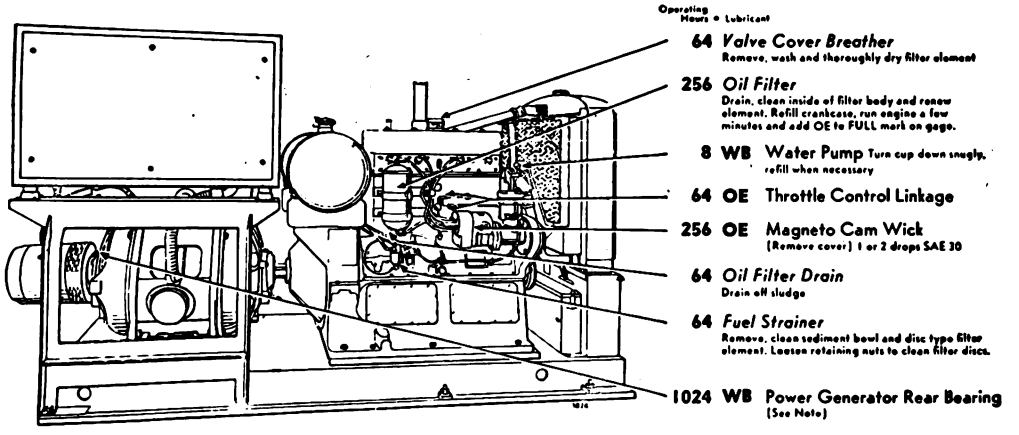
Remove the wingnut and cover as instructed in above. Lift out the filter element and lift off the oil reservoir. Spill out the old oil and

WAR DEPARTMENT LUBRICATION ORDER No. 3024

WAR DEPARTMENT, WASHINGTON 25, D.C., 20 MAY 1944

POWER UNITS PE-74, PE-84, PE-137 & PE-145





COLD WEATHER—Below 0°F., drain crankcase. Refill crankcase with 21 qts. OE SAE 10, check level and mark this level "X" on the gage. Add 7 qts. gasoline to bring level from "X" to FULL mark. During operation maintain at "X" level mark by adding OE SAE 10. Immediately before shut-down, fill to "X" level mark with OE SAE 10, then add gasoline to FULL mark. Run engine five minutes.

CRANKCASE—Drain only when hot. Refill to FULL mark on gage. Run engine a few minutes and recheck oil level. CAUTION. Be sure pressure gage indicates oil is circulating. Every 512 hours, remove crankcase inspection covers and thoroughly clean sludge from oil pan and oil pump screens.

POWER GENERATOR BEARINGS—For Power Units PE-74, PE-84 and PE-145 remove top plug, install fitting, lubricate sparingly; also remove bearing sump drain plug. For Power Unit PE-137, remove bearing housing vent plug, turn down grease cup until lubricant appears at vent plug opening. For all models run generator until operating temperature is reached to expel excess lubricant. Remove fitting and re-install plugs.

FITTINGS—Clean before applying lubricant.

HOURS—Reduce hours under severe operating conditions.

CLEAN parts with SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Allow parts to dry thoroughly before lubricating.

KEY

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine Crankcase	OE SAE 30	OE SAE 10	See Cold Weather Note
Except Crankcase	OE SAE 30	OE SAE 10	PS
WB—GREASE, general purpose, No. 2. All air temperatures			
PS—OIL, lubricating, preservative, special			

DO NOT LUBRICATE—Engine Governor, Exciter, Generator Drive Coupling.

LUBRICATED BY MAINTENANCE PERSONNEL—Magneto Rotor Bearings and Distributor Gear, Starting Motor Bearings, and Time Meter Motor (Some models)

REFERENCE—Technical Manual TM 11-909 for Power Unit PE-74; Technical Manual TM 11-915 for Power Unit PE-84; Technical Manual TM 11-921 for Power Unit PE-137, Technical Manual TM 11-929 for Power Unit PE-145.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 20 May 1944.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

REQUISITION REPLACEMENT LUBRICATION ORDERS IN CONFORMANCE WITH INSTRUCTIONS AND LISTS IN FM 21-6

No. 3024

TL 94142A

Fig. 16.3 War Department Lubrication Order No. 3024.

wipe out the reservoir with a clean lint-free cloth. Reassemble the air cleaner and refill the oil reservoir in accordance with the lubrication order.

h. Crankcase Breather.

Remove the crankcase breather and lubricating oil filler cap and wash it thoroughly in dry-cleaning solvent or Diesel oil. Allow it to dry and replace it on the engine.

i. Charging Generator.

Wipe off the oil cups on the battery-charging generator and apply oil in accordance with the lubrication order.

j. Crankcase Draining.

At times specified on the lubrication order, place a pan or other suitable container under the crankcase drain, and drain the crankcase as instructed on the lubrication order. Be sure to close the drain and refill the crankcase with specified lubricant.

k. Crankcase Cleaning.

At periods indicated on the lubrication order, remove the inspection covers on the sides of the crankcase and clean the sludge from the oil pan and oil pump screen. Scrape out any heavy accumulation with a putty knife and, with the drain cock open, wash the oil pan with a clean, lint-free cloth and Diesel oil or dry-cleaning solvent. Be sure that all solvent or Diesel oil is drained from the oil pan and wipe it dry with a clean, lint-free cloth. Be sure to close the drain when finished.

l. Cleaning Oil Pump Screen.

Remove the cap screws that hold the oil pump assembly to the side of the crankcase and lift out the oil pump assembly. Remove the screen from the assembly and wash it thoroughly in Diesel oil or dry-cleaning solvent. Wash the entire pump assembly and then replace the screen. Allow the assembly to dry before replacing it in the engine. Replace the pump assembly and the crankcase inspection covers, using new gaskets if the old ones have been damaged or are unfit for further service. Be sure that the holding screws are drawn up tight. Refill the crankcase in accordance with the lubrication order.

m. Lubricating Generator.

At periods specified on the lubricating order, remove the plugs from both the top and bottom of the bearing housings on both ends of the alternator. Screw a pressure grease fitting into the top holes and, with the lubricant specified on the lubrication order, lubricate the bearings sparingly with a pressure grease gun. Be sure to consult the lubrication order for correct procedure.

n. Lubrication by Maintenance Personnel.

(1) Magneto.

At the time of overhaul or when repairs to the magneto are made, clean the magneto rotor bearings with dry-cleaning solvent (SD). Protect the bearings against dust and dirt and allow them to dry thoroughly. Repack the bearings one-half full with general purpose grease No. 2 (WB). Also apply general purpose grease No. 2 (WB) to the distributor gear. Apply 4 or 5 drops of engine oil (OE SAE 10) to the distributor bearing.

(2) Starting Motor

At the time of overhaul or when making repairs, apply 3 or 4 drops of engine oil (OE SAE 10) to the bushings at each end of the starting motor. Apply special lubricating, preservative oil (PS) to the Bendix drive shaft and rotate the gear back and forth on the worm to distribute the oil.

(3) Time Meter Motor

At the time of overhaul, lubricate the running time meter in the following fashion.

(a) Unfasten motor from time meter mechanism and remove rotor unit. Remove reoiling screw cap at end of rotor unit.

(b) Hold open end of rotor unit up and add two teaspoonfuls of dry-cleaning solvent (SD) to the rotor. Replace cap and shake unit vigorously.

(c) Place unit in a motor field and run with the shaft down for 5 minutes.

(d) Remove screw cap, upturn rotor so that open end faces directly down, and allow it to drain for 15 minutes. At the end of this period shake the unit vigorously to expel remaining oil and solvent.

(e) Flush again by adding two teaspoonfuls of oil, clock and watch, U. S. Army Spec. No. 2–47B, to the motor and again shake vigrously to mix this oil with any solvent remaining. Drain as described in (d) above and add 15 drops of clock and watch oil. Replace screw cap tightly.

Note. Inspect condition of cap gasket before replacing screw cap.

(f) Replace rotor in motor field so that side marked TOP will be at the top when the complete motor is reassembled to the time meter mechanism. The rotor unit must be assembled in the laminations on the same side from which it was removed, or the motor will run backwards.

7.16. Special Lubricating Instructions.

a. Severe Operating Conditions.

Under severe operating conditions, or over prolonged periods of operation in high surrounding temperatures, be sure to reduce the time intervals between lubrication periods for the unit. Under desert conditions take precautions to prevent sand and dust from blowing around the unit, either during operation or when idle.

b. Cold Weather Instructions.

Since subzero temperatures affect both metals and lubricants, special precautions are necessary to prevent poor performance or total operational failure of the unit. The following methods for keeping crankcase oil fluid will be used, according to facilities available. Preference is given to the order listed.

(1) Keep the unit in a warm place when it is not in operation. Place a tarpaulin or similar cover over the unit, and provide some means of heat within the inclosure formed. When this is done, give due consideration to the fire hazard involved.

(2) If no means can be provided to keep oil fluid as described above, and the engine is to be idle for a period of 1 hour or more with the temperature expected to go below 0° F., proceed as follows:

(a) Drain the crankcase.

(b) Refill the crankcase according to instructions in COLD WEATHER note on the War Department Lubrication Order. (See fig. 16.3.)

7.17. Records and Reports.

a. Records. A complete record of lubrication must be kept for each power unit in WD AGO Form 460 (Preventive maintenance roster), adapted as explained in paragraph 7.19.

b. Reports. If lubrication instructions are closely followed and proper lubricants used, and satisfactory results are not obtained, make a report to the officer responsible for the maintenance of the material. WD AGO Form 468, (Unsatisfactory Equipment Report) will be forwarded, by officer responsible, through channels, when conditions warrant. (See fig. 67.2.)

SECTION IIC. UNIT MECHANICS' PREVENTIVE MAINTENANCE TECHNIQUES (Added)

7.18. Scope.

a. Preventive Maintenance Services.

Regular schedules, maintenance, inspections, and services are a preventive maintenance function of the using arms, and are the responsibilities of commanders of operating organizations. An efficient control system is an essential aid in determining when power units are due for periodic maintenance services either because of time elapsed or hours operated.

b. Frequency.

The frequency of the preventive maintenance services performed by unit mechanic (second echelon) outlined herein is considered a minimum requirement for normal operation of Power Unit PE–74–(*). Under unusual operating conditions, such as extreme temperatures or dusty or sandy terrain, it may be necessary to perform certain maintenance services more frequently.

c. Operator's Participation.

The operators (first echelon) should be present and should assist mechanics while periodic second echelon preventive maintenance services are performed. Ordinarily the operator should present the power unit for a scheduled preventive maintenance service in a reasonably clean condition; that is, it should be dry and should not be caked with mud or grease to such an extent that inspection and servicing will be seriously hampered. However, the power unit should not be washed or wiped thoroughly clean, since certain types of defects, such as cracks, leaks, and loose or shifted parts or assemblies, are more evident if the surfaces are slightly soiled or dusty.

d. Technical Inspections.

(1) These inspections are performed by technically qualified personnel (usually third echelon or higher), under direct supervision of technically qualified officers. Technical inspections are made for the following purposes:

(a) To determine whether a power unit should be continued in service or withdrawn for overhaul or reclamation of component parts.

(b) To determine extent of damage and estimated cost of repair in report of survey and other similar proceedings.

(c) To discover causes of difficulties encountered by combat troops with matériel, so that efficiency may be improved.

(2) Whenever a power unit goes to a third- or higher-echelon maintenance shop for repair, it will receive a technical inspection to insure that all defects have been corrected before it is returned to the using organizations.

(3) Except in a theater of operations, technical inspections will be made whenever power unit accountability is transferred, to determine power unit conditions.

(4) After a technical inspection, the unit should be restored to a safe operating condition, unless it is to be scheduled for repair by a higher echelon. Any disassembled parts or assemblies that are found to be damaged during the inspection should be replaced by serviceable ones.

7.19. Preventive Maintenance Roster (Fig. 16.4).

a. WD, AGO Form 460.

This form is the only form authorized for recording lubrication and maintenance service records for this power unit.

b. Use of Preventive Maintenance Roster.

Preventive maintenance services will be scheduled over a 31-day period. The inside right-hand page contains 31 columns of the 31 days of a month. The adjacent columns on the left-hand page will be used to list rank and name of operator, equipment nomenclature, remarks, unit serial number (this will be the number assigned the unit by the using organization and not that of the piece of equipment), accessory (this column will remain blank), and equipment registration number (this will be the serial number of the power unit). Only one line for each power unit will be used to record the periodic maintenance services performed during the month.

(1) Recording Services

Services will be recorded on the corresponding line with the nomenclature of each power unit.

(2) Legend

In the column representing the appropriate date, the symbol legend for weekly (W) monthly (M), semiannual (S), will be entered. The letter symbol P will be used to indicate equipment deadlined for lack of parts. The letter symbol A will be used to indicate equipment deadlined because of accident. The letter symbol O will indicate equipment forwarded to higher echelons for repair.

(3) Interpretation of Symbols

For purposes of power unit maintenance, any period of 9 operating hours or any number of periods of operation totaling 8 hours will be considered as 1 day; a total of 64 operating hours will be considered as 1 week; a total of 256 operating hours will be considered as 1 month; and a total of 1,024 operating hours will be considered as ½ year.

(4) Entries

The officer in charge will plot WD AGO Form 460 in advance of each monthly period making his entries in pencil. These penciled entries will be traced in with ink when the service is performed. These services will be entered in the appropriate spaces as W_1 indicating the first weekly service, W_2 indicating the second weekly service, and W_3 indicating the third weekly service. These weekly services will be figured from the last preceding monthly service. The monthly services will be similarily entered with M_1, M_2, M_3, M_4, and M_5, and will be figured from the last preceding semiannual service of the unit. The letter symbol S will be used to indicate the semiannual service. If the unit is deadlined for lack of parts, accident, or higher echelon repairs, the appropriate symbol will be entered in the proper space for each day that the unit is out of service. When the unit is returned to service, the previously plotted services will be carried out the same as though there had been no interruption of the service. A sample of WD AGO Form 460, properly filled out is shown in figure 16.4.

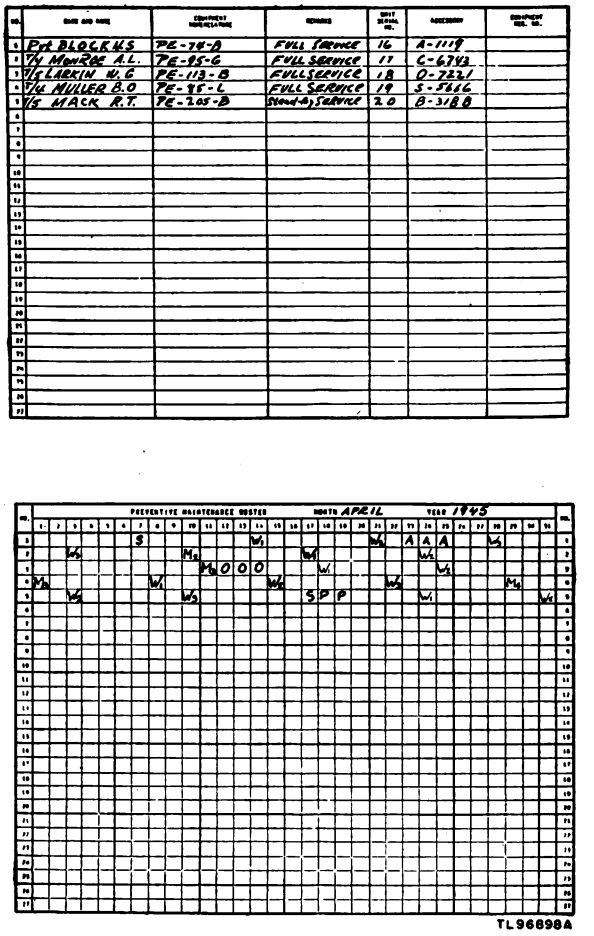


Fig. 16.4. Preventive Maintenance Roster.

7.20. Preventive Maintenance Work Sheet.

a. General Description of Work Sheet.

(1) WD AGO Form 461 (Work sheet for wheeled and half-track vehicles—Preventive maintenance service and technical inspection) adapted for use with Power Unit PE–74–(*), is provided to serve as a reminder and record of the unit mechanic's preventive maintenance services and technical inspections. (See figs. 16.5 and 16.6.)

(2) The columns headed "6000 Mile" and "1000 Mile" on WD AGO Form 461 are comparable to the semiannual and monthly maintenance periods of these power units. Notations to that effect should be made on this form. The column headed "Technical Inspection" applies without modification to power units.

b. Usage of Work Sheet.

(1) The general procedures listed in this paragraph are to be applied in conducting the maintenance services and technical inspection. The manner in which each item listed on the form is to be inspected and serviced is explained in detail in paragraph 7.21.

(2) If instructions other than those contained in either the general or the specific procedures are required for the correct performance of a preventive maintenance service or for the correction of a deficiency, consult the officer in charge.

Note. Second echelon personnel must be so thoroughly trained in these procedures that they will apply them automatically.

c. Adapting Work Sheet for Use With Power Unit PE–74–(*).

(1) All of the required identification data for the power unit should be entered in the space provided at the top of each form. The unit nomenclature should be complete; the serial number, operating organization, date, and hours of operation should also be recorded.

(2) In order to indicate on the work sheet whether one of the periodic preventive maintenance services or the technical inspection is being performed, line out all words in the headings that do not apply to the service or inspection to be performed.

d. Explanation of Work Sheet.

Opposite each item on these work sheets, a rectangle or box is placed, either under the periodic maintenance service heading, under the technical inspection heading, or under both. These boxes indicate which of the maintenance services or inspection is to be performed for each item. Each box indicates that the item is to be inspected and corrected when necessary. Special service symbols like C, T, A, L, or S appear in some of the boxes. These symbols indicate that certain additional mandatory services are to be performed, and are explained in detail in e below. All defects should be corrected upon discovery, or reported or evacuated to higher echelon for correction.

(1) The general inspection of each item applies also to any supporting member or connection, and usually includes a check to see whether the item is in good condition, correctly assembled, secure, or excessively worn. The mechanics must be thoroughly trained in the following explanations of these terms.

(2) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or satisfactory limits, or whether it is in such a condition that damage will result during operation. The term "good condition" is explained further by such terms as the following: not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, not deteriorated, and adequately lubricated.

(3) The inspection of a component to see that it is "correctly assembled" is usually an external visual inspection to determine whether it is in its normal assembled position in the unit.

(4) The check of a component to determine whether it is "secure" is usually an external visual inspection or a hand-feel, a pry-bar, or a wrench check for looseness in the unit. Such an inspection will always include any brackets, and all lockwashers, locknuts, locking wires, or cotter pins, used to secure the tightening.

(5) The frequently used term "excessively worn" will be understood to mean worn close to or beyond serviceable limits, and likely to result in failure if not replaced before the next scheduled inspection.

e. Explanation of Service Symbols.

Special service symbols, as applied to the items of the periodic preventive maintenance services, indicate that the part is to receive certain mandatory services. For example: an inspection box with a T in it indicates that the part must not only be secure, but that the mounting bolts must be tightened properly with a wrench. These symbols are:

(1) A, Adjust

Make all necessary adjustments in accordance with the Technical Manual, Special Bulletins, or other current directives.

(2) C, Clean

(a) Clean components of the power unit to remove lubricant or dirt, using specified dry-cleaning solvent. After the parts are cleaned, rinse them in clean fluid and dry them well. Take care to keep the parts clean until reassembled. Keep cleaning fluid away from rubber or other material which it will damage.

(b) Clean the protective grease coating from new parts. This material is usually not a good lubricant.

Note.—Gasoline will not be used as a cleaning fluid for any purpose. Solvent, dry-cleaning, is available as a cleaning fluid through established supply channels. Oil, fuel, Diesel, may be used for cleaning purposes when dry-cleaning solvent (SD) is not on hand. Car-

bon tetrachloride will be used as a cleaning fluid only in the following cases: where inflammable solvents cannot be used because of the fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

(3) L, Special Lubrication

Special lubrication (L) applies either to lubrication operations that do not appear on the lubrication order, or to items that do appear on the order but should be performed in connection with the maintenance operations if parts have to be disassembled for inspection.

(4) S, Serve

Compliance with the symbol S usually consists of performing special operations, such as replenishing battery water; draining and refilling units with oil; and changing or cleaning the fuel or oil-filter cartridge.

(5) T, Tighten

All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice, using the proper tool without additional extension handle. Use torque-indicating wrench where specified. Do not overtighten, as this may strip threads. Tightening will always be understood to include the correct installation of lockwashers, locknuts, and cotter pins or locking wires provided to secure the tightening.

f. Recording of Markings on Work Sheet.

The condition in which items are found and the correction of defects should be indicated by the following markings:

(1) Mark the box with a ✓ if found satisfactory.

(2) Mark the box X if adjustment is required.

(3) Mark the box XX if repair or replacement is required.

(4) When a defect is found and is not corrected immediately, or if correction is to be made by higher echelon, explain under REMARKS, recording the item number of identification. When such a defect is corrected, either by organization mechanics or by higher echelon mechanics, encircle the X or XX, thus Ⓧ or ⊗⊗

g. Determining Higher Echelon Participation.

The following considerations will determine whether a maintenance operation should be referred to a higher echelon, or performed by the operating organization. Repair to power units will be performed in the lowest echelon of maintenance consistent with:

(1) Availability of suitable tools.

(2) Availability of necessary parts.

(3) Capabilities of mechanics.

(4) Time available.

(5) Tactical situation.

h. Special Conditions.

(1) When conditions make it difficult to perform the complete preventive maintenance service at one time, it can sometimes be handled in sections, planning to complete all operations within the week if possible. All available time at rest periods and in bivouac areas must be utilized if necessary. When limited by the tactical situation, items marked with special service symbols in the boxes should be given first consideration.

(2) If a job order, WD AGO Form 9–76 (Request for job order), is used when a power unit is sent to a higher echelon for the correction of any defect beyond the scope of organization maintenance, the job order number will be inserted in the space provided on the reverse side of the form.

i. Handling of Work Sheet.

(1) The forms may be reduced to convenient size for filing, by folding up the line marked "Vehicle Nomenclature" but are to be filed only after all items marked X or XX have been corrected.

(2) All monthly maintenance work sheets may be held in the organization file until the next semiannual maintenance work sheet is filed, and then destroyed. The semiannual maintenance work sheet, or technical inspection reports, may be held until the next semiannual maintenance form is filed, and then destroyed.

7.21. Performing Items on Work Sheet.

a. Use of WD AGO Form 461.

The items on this form should be performed in the numerical sequence in which they are listed wherever possible, since they have been so arranged for maximum efficiency and economy of motion. The general order of the listed items is:

(1) A running test, and closely related items.

(2) Maintenance operations, consisting of oper-

PREVENTIVE MAINTENANCE SERVICE AND TECHNICAL INSPECTION

WD No. _____

WORK SHEET

Mileage _____ Date 15 Dec 44

FOR

WHEELED AND HALF-TRACK VEHICLES

Organization _____

(See AR 850-15)

Vehicle nomenclature Power Unit (Make) PE-74-B (Model) 25 kva (Size) (Drive) Serial No 149799 (Body Type)

Special instructions: See TM 9-2810 for detailed instructions and procedures. See vehicle maintenance manual for technical information.

Legend for marking. √—Satisfactory X—Adjustment required XX—Repair or replacement required O—Defect corrected

SYMBOLS: □ —INSPECT AND CORRECT C—CLEAN T—TIGHTEN A—ADJUST L—SPECIAL LUBRICATION S—SERVE

~~1000-MILE MAINTENANCE~~ ~~OR TECHNICAL INSPECTION~~ Monthly ~~1000-MILE~~ MAINTENANCE

Line out words and column that do not apply.

ROAD TEST

1 Before Operation Inspection

~~2 Air Pressure (build up) (governor cut-off) (low pressure indicator)~~

3 Dash Instruments and Gages: (oil pressure) (viscometer) (ammeter) (voltmeter) (speedometer and odometer) (tachometer) (temperature) (fuel) (air pressure)

~~4 Horns, Mirrors, and Windshield Wipers~~

~~5 Brakes: foot, hand and trailer (braking effect) (travel) (side pull) (noise) (chatter) (pedal travel) (hand control on electric)~~

~~6 Clutch (free travel) (drag) (noise) (chatter) (grab) (slip)~~

~~7 Transmission and Transfer (lever action) (declutching) (vibration) (noise)~~

~~8 Steering (free play) (bind) (wander) (shimmy) (side pull) (column and wheel)~~

9 Engine (idle) (acceleration) (power) (noise) (governed speed)

10 Unusual Noises (attachments) (cab) (body) (wheels or tracks)

~~11 Brake Booster Operation~~

~~12 Air Brake System Leaks~~

13 Temperatures ~~(brake drums) (hubs) (axles) (transmission) (transfer)~~

14 Leaks (engine oil) (water) (fuel)

~~15 Track Tension (final road test)~~

~~16 Gear Oil Level and Leaks (axles) (transmission) (transfer)~~

~~Power Vehicles Drawn Behind~~

~~17 Unusual Noises (engine) (belts) (accessories) (transmission) (transfer) (shafts and joints) (axles) (wheel bearings)~~

ENGINE AND ACCESSORIES

18 Cylinder Head and Gasket

19 Valve Mechanism (clearances) (lubrication) (cover gaskets)

20 Spark Plugs (gaps) (deposits)

21 Compression Test (record)

22 Battery (cables) (hold-downs) (carrier) (record gravity and voltage)

23 Crankcase (leaks) (oil level)

24 Oil Filters, Coolers, and Lines

25 Radiator (core) (shell) (shutters) (mountings) (hose) (cap and gasket) (antifreeze, record) (overflow tank) (steam relief tube and valve)

26 Water Pump, Fan, and Shroud

27 Generator, Starter, and Switch

~~28 Air Compressor (governor) (unloader valve) (lines)~~

29 Drive Belts and Pulleys

~~30 Tachometer Drive and Adapter~~

31 Distributor (cap) (rotor) (points) (shaft) (advance units)

32 Coil and Wiring (high and low voltage) (supports)

~~1000-MILE MAINTENANCE~~ ~~OR TECHNICAL INSPECTION~~ Monthly ~~1000-MILE~~ MAINTENANCE

33 Manifolds and Heat Control (gaskets) (seasonal setting)

34 Air Cleaners (carburetor) (Diesel) (air compressor)

35 Breather Caps and Ventilators

36 Carburetor (choke) (throttle) (linkage) (governor)

37 Fuel Filters, Screen, and Lines

38 Fuel Pump (vacuum and pressure)

39 Starter (action) (noise) (speed)

40 Leaks (engine oil) (fuel) (water)

41 Ignition Timing (advance)

42 Engine Idle and Vacuum Test

43 Regulator Unit (connections) (voltage) (current) (cut-out)

~~44 Power Tire Pump (drive) (lines)~~

~~45 Diesel Fuel Injector Pump~~

~~46 Diesel Fuel Nozzles and Lines~~

~~CHASSIS, BODY, & ATTACHMENTS~~

47 *Tires and Rims (valve stems and caps) (condition) (direction) (matching) (spare carriers)

On Half-Tracks Do 100 to 175 Now

48 *Rear Brakes (drums) (supports) (cylinders) (cams and shafts) (magnets and armatures)

49 *Rear Brake Shoes (linings) (links) (guides) (anchors)

50 *Torque Rods (bushings) (brackets)

51 *Rear Spring Seats and Bearings

52 *Rear Wheels (bearings) (seals) (drive flanges) (nuts)

53 *Front Brakes (drums) (supports) (cylinders) (cams and shafts) (hose) (air chambers) (push rods and seals) (adjusters)

54 *Front Brake Shoes (linings) (links) (guides) (anchors)

55 *Steering Knuckles (joints) (bearings) (seals) (boots)

56 *Front Springs (clips) (leaves) (U-bolts) (hangers) (shackles)

57 Steering (arms) (tie rods) (drag link) (seals and boots) (Pitman arm) (gear) (column) (wheel)

58 Front Shock Absorbers and Links

59 Knee Action Suspension

60 *Front Wheels (bearings) (seals) (flange) (axle end play) (nuts)

61 Front Axle (pinion end play) (seal) (vent) (alinement)

62 Front Propeller Shaft (joints and alinement) (seals) (flanges)

63 Engine (mountings and braces) (ground strap) (side pans)

64 Hand brake (ratchet and pawl) (linkage) (drum or disk) (lining)

65 Clutch Pedal (free travel) (linkage) (return spring)

66 Brake Pedal (free travel) (linkage) (return spring)

67 Brake Master Cylinder (vent) (fluid level) (leaks) (switch)

68 Brake Vacuum Booster (linkage) (air cleaner and hose) (cylinder)

~~1000-MILE MAINTENANCE~~ ~~OR TECHNICAL INSPECTION~~ Monthly ~~1000-MILE~~ MAINTENANCE

~~69 Air Brake Application Valve~~

~~70 Air Brake Reservoirs~~

~~71 Transmission (mounting) (seals) (power take-off) (linkage)~~

~~72 Transfer (mountings) (linkage) (seals) (vent) (power take-off)~~

~~73 Rear Propeller Shafts (inc U)~~

74 Center Bearing (seals) (vent) (oil level) (mountings)

~~75 Rear Axles (pinion end play) (seals) (vents) (alinement)~~

~~76 Rear Air Brake (chambers) (rods and seals) (slack adjusters)~~

~~77 *Rear Springs (clips) (leaves) (U-bolts) (hangers) (shackles)~~

~~78 Rear Shock Absorbers and Links~~

~~79 ACab and Body Mountings~~

80 *Frame (rails and cross members)

81 *Wiring, Conduits, and Grommets

82 Fuel Tanks, Fittings, and Lines

~~83 *Brake Lines (fittings) (hose)~~

84 Exhaust Pipes and Muffler

85 *Vehicle Lubrication

~~Lower Vehicle to Ground~~

~~86 Tow-In and Parking Stops~~

~~87 Winch (clutch) (brake) (drive) (shear pin) (cable) (guides)~~

~~88 Fifth Wheel (lock plate and bolts)~~

~~89 Tractor-to-Trailer Brake Hose, Wiring and Connections~~

~~90 Hoist (mounting) (drive) (controls) (pump) (lines) (cylinder)~~

91 *Lamps (head, tail, body, running, directional, stop, and blackout)

~~92 *Safety reflectors~~

~~93 Front (bumpers) (roller) (tow hooks) (brush guards) (grille)~~

~~94 Hood (hinges) (fasteners)~~

~~96 Front Fenders and Running Boards~~

~~96 Cab or Body Doors (hood-panel) (glass) (top and frame) (curtains and fasteners) (seats) (upholstery and trim) (safety straps and grab rails) (door boards and mats) (ventilators) (map compartment and tables)~~

~~97 Heater, Fan, and Defroster~~

98 Circuit Breaker and Fuse Block

~~99 *Rear Fenders and Splash Guards~~

~~100 *Body (panels) (rear doors) (tailgate and chains) (floor) (skid strips) (stakes) (cushion) (bows) (tops) (tarpaulins) (end curtains) (troop seats) (storage compartments)~~

~~101 Rear Bumper and Pintle Hook (latch and lock pin) (draw-bar)~~

~~102 Armor Plate (body) (cowl) (doors) (windshield) (port covers)~~

103 *Paint and markings

104 Radio Bonding (suppressors) (filters) (condensers) (shielding)

~~105 Armament (guns) (mounts) (rails) (spare parts) (covers)~~

*TRAILER ITEMS ALSO COMMON TO OTHER WHEELED VEHICLES

FOLD TO ◄— VEHICLE NOMENCLATURE LINE —► AND FILE

W.D., A.G.O. Form No. 461 April 15, 1943

U. S. GOVERNMENT PRINTING OFFICE 19-16—38520-1

TL94909

Fig. 16.5. WD AGO Form 461—Front, adapted for Power Unit PE-74-(*).

RECORD: Compression pressure: Cylinder No. 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____ 10 ____ 11 ____ 12 ____

BATTERY: Specific Gravity—Cell No. 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ Antifreeze protection to ____ °F.

Voltage— Cell No. 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____

Man hours required for this ~~1,000 mile~~ Monthly maintenance 4.5 ~~6,000 mile maintenance ____ or technical inspection ____~~

Driver Frank Jonson T/5 (Grade or title) Mechanic or inspector Lester Smith T/4 (Grade or title)

Repairs by higher echelon entered on Job Order Request No. 403 Supervising officer James P. Casey 1st Lt. (Grade or title)

Repairs requested 16 Dec 1944 F.J. (Date) (Initials) Vehicle forwarded 17 Dec 44 J.P.C. (Date) (Initials) Vehicle returned 22 Dec 44 B.B. (Date) (Initials)

Disposition of work sheets: 1000 Mile—May be retained until completion of next 6000 mile, then destroy
6000 Mile—May be retained until completion of next 6000 mile, then destroy
Technical inspection—May be retained until completion of next 6000 mile, then destroy
} EARLIER DESTRUCTION MAY BE ORDERED BY LOCAL COMMAND

Remarks or Recommendations: ____

~~6000-Mile Maintenance or Technical Inspection~~
~~1000-Mile Maintenance~~

ITEMS SPECIAL TO HALF-TRACKS

T — 106 Tracks (guides) (tread wear)
CLAT — 107 Sprockets (flanges) (bearings) (seals)
CT — 108 Brake (drums) (supports) (cylinders)
CA A — 109 Brakes Shoes (linings) (links) (guides) (anchors)
CLAT — 110 Idlers (flanges) (bearings)
111 Idler (posts) (shackles) (shafts) (adjusting rods) (brackets)
T — 112 Frame Brackets and Cross Tube
113 Bogie (crab assemblies) (springs and blocks) (guides and slides) (arms and bolts)
CL — 114 Bogie Rollers: Upper and Lower (tires) (bearings) (seals) (bolts)
A A — 115 Track Tension (on ground)

ITEMS SPECIAL TO AMPHIBIANS

Note: The following items 116 to 123 are the required minimum maintenance for amphibian vehicles in land operations. For maintenance requirements for water operations, consult the vehicle maintenance manual.

~~6000-Mile Maintenance or Technical Inspection~~
~~1000-Mile Maintenance~~

T T — 116 Rudder and Shearpins, Propeller Strut and Bearing
117 Propeller Shaft Housings (seals) (boots) (plugs)
118 Hull (plugs) (rub strakes) (decks) (hatches) (ventilators) (compartments) (bulkheads) (plates) (frame)
TA TA — 119 Bilge Pumps (drives) (valves) (controls) (lines) (strainers)
T T — 120 Water Propeller (shafts) (joints) (bearings) (stuffing box)
121 Hand Crank Ratchet and Cover
T — 122 Rudder (shafts) (arms) (cables) (rod) (brackets) (stuffing-box)
123 Anchor, Hand Bilge Pump and Boat Hook

ITEMS SPECIAL TO TRAILERS

T — 124 Tow Hitch (king pin) (5th wheel plates) (lunette) (tongue)
125 Air and Electric Connections
~~126 Safety Devices (chains) (switch and battery)~~

~~6000-Mile Maintenance or Technical Inspection~~
Monthly Maintenance
~~1000-Mile~~

LT L — ~~127 Landing gear (shafts) (wheels) (supports) (lock pin) (gears) (cotter)~~
~~128 Front and Rear Axles~~
~~129 Electric Brake (application controller) (load control) (resistor)~~
~~130 Parking Brakes (ratchet) (pawl)~~

TOOLS AND EQUIPMENT

✓ — 131 Tools (vehicle) (pioneer)
✓ — 132 Fire Extinguishers
~~133 Decontaminator~~
134 First-Aid Kit (if specified)
✓ — 135 Publications and Form No. 26
~~136 Traction Devices (chains) (plates and connectors) (grousers)~~
~~137 Tow (chain) (cable) (rope) (block)~~
✓ — 138 Spare (shearpins) (fuses) (bulbs)
✓ — 139 Fuel and Water Cans and Bracket
✓ — 140 Fuel Can Nozzle and Bucket
✓ — 141 Modifications (FSMWO's completed)
✓ — 142 Final ~~Road~~ Test (repeat items 2 to 16)

Note: Correct or report all deficiencies found during final road test.

TL95316

Fig. 16.6. WD AGO Form 461—Back, Adapted for Power Unit PE-74-(*).

ations in the engine compartment and a group of body and attachment items.

(3) Tools and equipment.

(4) Final running test.

b. Omissions.

Line out all items on the form which do not apply to maintenance procedures for Power Unit PE–74–(*). Figures 16.5 and 16.6 show WD AGO Form 461 with nonapplicable items deleted.

c. Performing Items on Work Sheet.

Specific procedures for performing each item in the monthly and semiannual maintenance services and in the technical inspection are described on the following pages. Each of these pages of specific procedures has three columns at its left edge, corresponding to the monthly maintenance, the semiannual maintenance, and the technical inspection of WD AGO Form 461, respectively. While the semiannual maintenance and technical inspection are both indicated in the same column on the work sheet, separate columns are provided in the procedure pages for clarification. The detailed procedures for each maintenance service and technical inspection will be found on the following pages opposite the item numbers in the procedure columns.

d. Nonapplicable Items.

Very often a particular item does not apply to both the monthly maintenance, the semiannual maintenance, or the technical inspection. To determine which items to perform, follow the item numbers down the appropriate columns, opposite the procedures.

e. Special Items.

Whenever it is necessary to disassemble a part or assembly during the technical inspection, perform the special services indicated for the item on the semiannual maintenance service on the disassembled unit.

f. Sample Procedures.

Examination of the sample procedures on the spark plug (shown below) will show the number 20 (item number) appearing in three columns. The first place the number appears is in the monthly column, opposite that part of the spark plug procedures dealing with the examination of the spark plug without removing it from the engine. The position of item number 20 in this column opposite this particular portion of the spark plug procedures means: once monthly, the spark plug is to be examined as described in that portion of the complete spark plug text. Similarly, the appearance of item number 20 in the technical inspection, and semiannual columns, opposite the part of the spark plug procedures that deals with the removal of the spark plugs from the engine for examination means: every 6 months, and also when a technical inspection is made, the spark plugs are to be removed from the engine and examined as described in that part of the complete spark plug procedure. Item number 20 also appears opposite the clean and adjust procedures, meaning that every 6 months the spark plug is to be cleaned as described, and adjusted as outlined in the text below. To summarize: The spark plugs are examined, without removal from the engine, every month; removed for technical inspection every 6 months to determine the advisability of discarding, or cleaning and adjusting them for further use. Examination of Form 461 (figs. 16.5 and 16.6) shows the letters C and A appearing in the semiannual box opposite item No. 20. Upon examination of the work sheet (Form 461), the unit mechanic will be directed to clean and adjust the spark plugs, detailed information for which is contained in item 20 procedures shown below.

Technical inspection	Semi-annual	Monthly	SAMPLE
		20	SPARK PLUGS. Examine the spark plugs to see that their insulators are in good condition and clean; note any evidence of leakage around the insulators or gaskets. — Applies to monthly maintenance only.
			It will be necessary to remove the spark shields and shield plates to make this inspection.
20	20		Remove the spark plugs and examine for poor condition, paying particular attention to broken insulators, excessive carbon deposits, and to electrodes which are burned thin. Replace unserviceable plugs. Report excessive deposits or damaged insulators, as these conditions may indicate incorrect heat range. — Applies both to technical inspection and semiannual maintenance.
	20		*Clean* Clean the deposits from the insulators and electrodes, and check again for cracks. If a plug cleaner is not available, install new or reconditioned plugs.
	20		*Adjust* Adjust gaps to 0.025 inch (par. 26) by bending the grounded electrodes. After completing item number 21, reinstall the plugs, using new gaskets and taking care not to overtighten them as this may cause distortion and damage. — Applies to semiannual maintenance only.

7.22. Maintenance Items.

RUNNING TEST

The operator of a power unit is often unaware of defects in the equipment which have developed gradually, and to which he has become accustomed. The fact that many operators lack the ability to detect the developing causes of failures makes it desirable for the mechanic to test the operation of the unit as part of the periodic preventive maintenance services. During and before this test, any repairs or adjustments necessary to insure safe operation should be made. The appropriate paragraph in the following service procedures should be consulted. If a defect is found during the test which does not require immediate correction, note it on the check sheet and make provisions for securing necessary replacement parts. The defect can be corrected later during the service.

Note. If the tactical situation does not permit a complete test, perform items 3, 9, 10, and 14.

Technical inspection	Semi-annual	Monthly	
1	1	1	BEFORE-OPERATION SERVICE.
			Perform the before-operation service as a check to determine whether the power unit is in a satisfactory condition to make the running test safely, and that it is adequately supplied with fuel, engine oil, and coolant.
3	3	3	DASH INSTRUMENTS AND GAUGES.
			During the warm-up period, operate the engine at fast idle speed and observe as follows:
			Oil Pressure Gauge
			Observe oil pressure at frequent intervals and under all conditions of engine speed to see that the oil pressure is between 20 and 30 pounds.
			Caution: If the gauge indicates zero or excessively low oil pressure, stop the engine immediately and investigate the cause.
			Ammeter and Voltmeter
			Observe the battery-charging ammeter to see that it is indicating normally. With the battery fully charged, the reading should show charge for a short time after starting motor, and then return to slightly above zero. If the battery is low, charge will be indicated for a longer period of time. Watch the meter for proper operation.
			Temperature
			Note the temperature gauge to see that it indicates in the normal range. The temperature should increase gradually during the warm-up period and normally should not exceed 180° F. The temperature at which the gauge hesitates indicates the opening of the thermostat. Extremely low temperature after a reasonable warm-up period may indicate that the thermostat is stuck open. Temperatures above normal may indicate that the thermostat is stuck closed or that the cooling system is clogged.
9	9	9	ENGINE.
			Observe engine-operating characteristics as follows:
			Unusual Noises
			Listen for knocks and rattles as the engine is accelerated and decelerated, and while it is under both light and heavy loads.
			Acceleration and Power
			Operate the engine at various speeds with all loads, noting whether the engine has normal pulling power and acceleration. A slight ping during fast acceleration is normal; continued or heavy ping may indicate early timing, heavy accumulation of carbon, or low-octane fuel.
10	10	10	UNUSUAL NOISES.
			Be on the alert continually for unusual noises that would indicate looseness of parts or damaged or malfunctioning components.

Technical inspection	Semi-annual	Monthly	
13	13	13	TEMPERATURES. After completing the run, note as follows: *Generator Housing* Feel the generator housing cautiously for abnormal temperatures as determined by previous experience with the unit. *Generator Bearings* Feel the bearing housings for evidence of overheating. If any bearing appears to be overheated, lack of proper lubrication or excessive wear of the bearing is indicated. Report worn bearings promptly to the officer in charge. *Motor Bearings* Feel motor bearing housings of starting motors or drive motors of motor generators, in same manner as generator bearings.
14	14	14	LEAKS. Look within the engine compartment and underneath the unit for engine oil, water, and fuel leaks, and determine their source.
18	18	18	CYLINDER HEAD AND GASKET. Look for cracks or indications of oil, water, or compression leaks around studs, cap screws, and gasket. ***Caution:*** Cylinder heads should not ordinarily be tightened unless there is a definite indication of looseness or leaks. If tightening is necessary, use a torque-indicating wrench and tighten in the sequence and to the tension specified in the manual. (See par. 17.) When a new gasket is installed, tighten three times as follows: first, upon installation, second, after engine is warmed up, and third, after completing final test. Adjust the tappet clearances to specifications after the final tightening of the head nuts.
19	19	19	VALVE MECHANISM. Remove valve mechanism cover, and observe valve clearances and the condition of valve mechanisms. Examine valve tappet clearances while hot. Valve tappets, rocker arms, shafts, and springs should appear in good condition, correctly assembled, and secure. Oil should be delivered properly. Also make sure that the valve cover gaskets are in good condition.
	19		*Adjust* Adjust the clearances to 0.015 (hot) or 0.018 (cold) (par. 22), taking care that the locknuts are secure when the clearances are last noted during the adjustment.
		20	SPARK PLUGS. Examine the spark plugs to see that their insulators are in good condition and clean, and that there is no leakage around the insulators or gaskets. It will be necessary to remove the spark shields and shield plates to make this inspection. When operating conditions indicate the need, the spark plugs may be removed for service.

Technical inspection	Semi-annual	Monthly	
20	20		Remove the spark plugs and examine for poor condition, paying particular attention to broken insulators, excessive carbon deposits, and to electrodes which are burned thin. Replace unserviceable plugs. Report excessive deposits or damaged insulators, as these conditions may indicate incorrect heat range.
	20		*Clean* Clean deposits from the electrodes and insulators, and check again for cracks. If a plug cleaner is not available, install new or reconditioned plugs.
	20		*Adjust* Adjust gaps to 0.025-inch (par. 26) by bending the grounded electrodes. After completing item 21, reinstall the plugs, using new gaskets and taking care not to overtighten them, as overtightening may cause distortion and damage.
21	21		COMPRESSION TEST. With all spark plugs out, insert the compression gauge in a spark plug hole and, with the throttle wide open, rotate the engine at cranking speed until the maximum compression is indicated. Do not crank the engine more than is necessary to obtain the maximum reading (approximately 90 pounds). Be sure battery is fully charged. Record the reading in the space provided on the back of the form. Repeat this process for each cylinder. If pressure in a cylinder is appreciably below normal, squirt sufficient engine oil on the piston head to prevent loss of compression temporarily, and recheck. Low compression, brought up to normal by oil sealing, indicates piston, ring, or cylinder wear or damage. Low compression, not brought up to normal by this method, indicates valve or gasket leakage.
22	22	22	BATTERY (CABLES, HOLD-DOWNS, CARRIER, RECORD GRAVITY, AND VOLTAGE). Inspect battery case for cracks and leaks. Clean top of battery. Inspect cables, terminals, bolts, posts, straps, and hold-downs for good condition. Test specific gravity and voltage and make a record on WD AGO Form 461. Specific gravity readings below 1.225 indicate battery should be recharged and replaced. Electrolyte level should be above top of plates and may extend ½ inch
22	22		above plates. Perform the high-rate discharge test according to the instructions for "condition" test which accompany the test instrument and make a record of the voltage on WD AGO Form 461. Cell variation should not be more than 30 percent.
	22	22	*Clean and Service* Bring electrolyte to proper level by adding distilled or clean water. Clean entire battery and carrier. Repaint carrier if corroded. Clean battery cable terminals, terminal bolts and nuts, and battery posts, and grease them lightly. Inspect bolts for serviceability. Tighten terminals and hold-downs carefully to avoid damage to battery.

Technical inspection	Semi-annual	Monthly	
23	23	23	CRANKCASE. With engine idling, examine crankcase, valve covers, and timing-gear cover for oil leaks. Stop the engine, and after oil has been drained into the crankcase, see whether the oil is at the proper level.
	23	23	*Note.*—If an oil change is due, drain the crankcase and refill to proper level with specified oil. Do not start the engine again until item 24 is completed.
24	24	24	OIL FILTERS, COOLERS, AND LINES. Inspect oil filters and all external engine oil lines to see whether they are in good condition, secure, and do not leak.
	24	24	*Note.*—When due, or when oil-filter cartridge condition indicates a filter cartridge change is necessary, remove the filter cartridge, clean the case, and install a new filter cartridge of the correct type, installing new gaskets and tightening the cover securely. *Clean* Drain and clean the filter body as instructed on the lubrication order. (See fig. 16.3.) *Clean and Serve* Renew the filter element at the interval specified on the lubrication order. (See fig. 16.3.)
25	25	25	RADIATOR (CORE, SHELL, SHUTTERS, MOUNTINGS, HOSE, CAP AND GASKET, OVERFLOW TANK, AND STEAM RELIEF TUBE AND VALVE). See that these items are in good condition correctly assembled securely mounted and connected, and do not leak; note whether the core air passages are obstructed with dirt, insects, or trash, and whether the core fins are badly bent; examine the shutter-control linkage to see that it is in good condition, secure, and operates properly; note whether the steam-relief valve operates freely and is in correct position for the prevailing atmospheric temperature. Also examine the coolant to see whether it is so contaminated with rust, oil, or other foreign matter that the cooling system should be cleaned. If cleaning is necessary, proceed as follows: Drain the radiator, taking care to save the drainings to put back into radiator if ethylene-glycol antifreeze is in use. Clean the cooling system according to current directives, using only specified cleaner. Flush cleaner from the entire cooling system with clean water. Refill radiator with coolant, adding specified inhibitor unless new antifreeze, which contains inhibitor, is used. Do not fill to top; allow room for expansion. *Antifreeze* If antifreeze is in use, determine its protective value and make a record in the space provided on the reverse side of the work sheet.

Technical inspection	Semi-annual	Monthly	
	25	25	*Clean* Clean the dirt, insects, and trash from the exterior of the core by blowing out with compressed air or with a stream of water applied carefully from the rear side of the core. (Do not use steam.) ***Caution:*** Use only a suitably shaped piece of wood or blunt instrument in straightening fins; otherwise tubes may be punctured.
	25		*Tighten* Tighten all loose radiator mountings and hose clamps.
26	26	26	WATER PUMP, FAN, AND SHROUD. Observe water pump to see that it is in good condition, not leaking, and securely installed. Loosen drive belts and leave them loose until adjustment is made (item 29). Examine shaft for end play and loose bearings. Inspect fan blades to see whether they are in good condition, properly secured to the hub, and whether the shroud is in good condition, properly aligned with the fan, and securely mounted.
	26	26	*Tighten* Tighten all mounting bolts securely.
27	27	27	GENERATOR, STARTER, AND SWITCH. Note whether these items are in good condition, securely mounted, and whether the wiring connections are clean and secure; see that the starter linkage and retracting spring are in good condition and secure.
27	27		Remove the generator and starter inspection covers and see that the commutators and brushes are in good condition and not excessively worn; that the brushes are free in the holders and have sufficient spring tension to hold them in contact with commutator; and that the brush-connecting wires are secure and not chafing. Inspect slip rings and brushes of the power generator.
	27		*Clean* Clean the commutator end of the generator and starter by blowing out with compressed air. If the commutator is dirty, clean with fine sandpaper only (#00) according to instructions in paragraph 35c and blow out the dust with compressed air. See that air passages in generator are clean and unobstructed.
	27		*Tighten* Tighten all mounting bolts securely.
29	29	29	DRIVE BELTS AND PULLEYS. Observe all drive belts for evidence of fraying condition, excessive wear, and deterioration. See that all drive pulleys and hubs are in good condition and securely mounted. Check coupling between engine or motor and generator.

Technical inspection	Semi-annual	Monthly	
	29	29	*Adjust* Adjust all accessory drive belts. (See par. 9.)
31	31	31	DISTRIBUTOR OR MAGNETO. Observe whether the magneto body and external attachment are in good condition and secure. Examine other parts of the magneto as follows: *Cap, Rotor, and Points* Remove the radio shield cover and blow or wipe the dirt or dust from the distributor cap, remove the cap, and see that the cap, rotor, and the breaker-plate assembly parts are in good condition, correctly assembled, secure, and serviceably clean. Pay particular attention to cracks in the cap and distributor rotor, corrosion of terminals, and connections in these parts, and to burning of the rotor contact. Also see whether the breaker points are in good condition, well aligned, and adjusted to specifications. If the breaker points are unserviceably dirty, dress them with an ignition point file or a fine grit hone. If the breaker points are pitted, burned, or worn to an unserviceable condition, install a new set of points. If the points are badly pitted, replace the capacitor also, as it is probably the cause of the pitting. Install the new points so that they are well aligned and engage squarely. If the points are slightly pitted or burned, dress them with an American-Swiss file (or equivalent) or #00 sandpaper (do not use emery cloth), and remove the filings with compressed air. *Special Lubrication* Lubricate the cam surfaces, the movable breaker-arm pin, the wick, and the camshaft according to the lubrication instructions. Take care to keep lubricant away from the distributor point not to apply more lubricant than is specified, and to wipe the cam clean before lubricat ng its surface.
	31		*Adjust* Adjust the breaker point gap to 0.015 inch.
32	32	32	COIL AND WIRING. Examine to see that all ignition wiring, including shielding or conduits, is in good condition and securely fastened to all support mountings and terminals. See that all insulation and connections are clean. Inspect all low-voltage wiring in the engine compartment in the same manner. Inspect resistors and capacitors for condition and connections. Inspect power outlet receptacles, connections, and convenience outlets for cleanliness and security of mounting. *Note.*—Do not tighten wiring connections unless actually loose as overtightening of terminals will cause damage.

Technical inspection	Semi-annual	Monthly	
33	33	33	MANIFOLDS.
			Observe the intake and exhaust manifold to see that it is in good condition, secure, and that manifold gaskets appear to be in good condition and not leaking.
	33		*Tighten.*
			Tighten all manifold assembly, mounting, exhaust pipe, and carburetor connecting flange nuts evenly and securely.
34	34	34	AIR CLEANERS.
			Remove the carburetor air-cleaner elements. (See par. 11.) See that all gaskets, seals, clamps, and the connecting hose and tube are present and in good condition. Observe the condition of the cleaning element, baffle, and body. Note the oil in the reservoir, paying particular attention to the amount of dirt present in the oil. Also see that the oil level is satisfactory.
	34	34	*Clean and Serve.*
			Wash cleaner element in dry-cleaning solvent, dry, apply engine oil to element, and drain excess oil. Refill the reservoir to the correct level with clean engine oil. Reassemble, making certain all gaskets are in good condition and in place. Install air cleaner, being careful that it is pressed firmly into place and that the mounting is secure. Also note whether the connecting hose is in good condition and properly clamped to the air cleaner and air horn.
35	35	35	BREATHER CAPS AND VENTILATORS.
			See that they are in good condition, correctly assembled, secure, and that the ventilator tubes are open.
	35	35	*Clean and Serve*
			Remove the cleaner elements (fig. 77), and clean both the element and body thoroughly in dry-cleaning solvent, drain or blow off the dry-cleaning solvent with compressed air, dip the element in engine oil, drain excess oil, and reinstall.
36	36	36	CARBURETOR (CHOKE, THROTTLE, LINKAGE, GOVERNOR).
			See that these items are in good condition, correctly assembled, and securely installed; that the carburetor does not leak; that the control linkage, including the choke and throttle shaft, is not excessively worn; that the choke valve opens fully when the control is in its released position; that the throttle valve responds properly to governor action; and that the governor is secure and properly adjusted.
37	37	37	FUEL FILTERS, SCREEN, AND LINES.
			Examine all fuel filters and sediment bowls, fuel lines, and connections to see that they are in good condition, secure and not leaking.

Technical inspection	Semi-annual	Monthly	
	37	37	*Clean* Close the fuel shut-off valve, and remove filter bowls, gaskets, and filter elements or screens (par. 33); clean the filter elements, sediment bowls, and screens in dry-cleaning solvent (SD). Dry the elements thoroughly. Be sure to clean any screen or filter element at carburetor fuel line connection or at the fuel pump. Reinstall the removed parts, using new gaskets. Turn on the fuel shut-off valve after assembling, and recheck for leaks. *Note.*—If filter element or screen is damaged or clogged beyond cleaning, replace it.
38	38	38	FUEL PUMP. See that the fuel pump and lines are in good condition, secure, and not leaking. Attach a fuel test gauge properly and with engine idling (after starting the engine in item 39), note whether the pump pressure is within 5 to 6 pounds (par. 33). Replace any pump that does not produce proper pressure, being sure to make a similar check of the new pump to see that it is satisfactory.
39	39	39	STARTER (ACTION, NOISE, AND SPEED). Start the engine, observing whether the general action of the starter is satisfactory, particularly whether it engages and operates properly without excessive noise and has adequate cranking speed; and whether the engine starts readily. Also, as soon as the engine starts, note whether the oil-pressure gauge and ammeter indications are satisfactory.
40	40	40	LEAKS. Look in the engine compartment and under the unit for engine oil, fuel, and water leaks. Trace all leaks to their source, and report or correct them.
41	41	41	IGNITION TIMING (ADVANCE). With the engine running, observe the ignition timing.
42			ENGINE IDLE. Observe whether the engine idles smoothly at normal idle speed.
	42	42	*Adjust* Connect a vacuum gauge to the intake manifold, adjust the engine to its normal idle speed by means of the throttle stop screw, and adjust the idle mixture adjusting needle until the vacuum gauge indicates a steady maximum reading. If this latter adjustment changes the idle speed appreciably, reset the idle speed and mixture until both are satisfactory. If the two adjustments are made simultaneously, time will be saved. On units where a vacuum gauge cannot be connected to the intake manifold, adjust the idle by the following procedure: Adjust the engine idle speed to specifications by means of the throttle stop screw. Turn the mixture adjusting needle in the direction which "leans" the mixture until the engine idle becomes

Technical inspection	Semi-annual	Monthly	
			"rough;" then turn the needle slowly in the opposite direction to enrich the mixture until the "roughness" disappears and the engine idles smoothly. Do not turn further than necessary to smooth out the idle so the engine will not stall. If making this mixture adjustment increases or decreases the engine idle speed from the specified range, reset the throttle stop to obtain the correct idle speed again and recheck the mixture adjustment as described above.
42	42	42	*Vacuum Test* With the engine running at normal idling speed, the vacuum gauge should read about 18 to 21 inches and the pointer should be steady. A badly fluctuating needle between 10 and 15 inches may indicate a defective cylinder head gasket or valve. An extremely low reading may indicate a leak in the intake manifold or gasket. Accelerate and decelerate the engine quickly. If the gauge indicator fails to drop to approximately 2 inches as the throttle is opened, and fails to recoil to at least 24 inches as the throttle is closed, it may be an indication of diluted oil, poor piston ring sealing, or abnormal restriction in the carburetor, air cleaner, or exhaust. *Note.*—The above readings apply to sea level. There will be approximately a 1-inch drop for each 1,000 feet of altitude.
43	43	43	REGULATOR UNIT (CONNECTION, VOLTAGE, CURRENT, AND CUT-OUT). See whether it is in good condition and whether all connections and mountings are secure. Connect the low-voltage circuit tester and observe the voltage regulator, current regulator, and the cut-out to see if they control the generator output properly. Follow the instructions in paragraph 25, and those which accompany the test instrument. Replace if test shows faulty operation. ***Caution:*** This test should be made only after the regulator unit has reached normal operating temperature.
63	63	63	ENGINE MOUNTINGS AND BRACES, GROUND STRAP, AND SIDE PANS. These items should be in good condition and securely mounted and connected. Be sure to examine both front and rear engine mountings, and make certain that rubber is not separating from its metal backing on rubber type mountings. If the mounting bolts are loose, tighten them properly, taking care not to overtighten any rubber-spacer type or spring type mountings. Remove oil or grease from rubber type mountings.
74	74	74	BEARINGS (SEALS, OIL LEVEL, AND MOUNTINGS). Examine the bearings for any excessive end play. See that they are adequately lubricated, that seals are not leaking, and that the mountings are secure.
	74	74	*Tighten* Tighten the bearing mountings securely.

Technical inspection	Semi-annual	Monthly	
80	80	80	*Frame (Side and Cross Members). Inspect frame, brackets, side rails, and cross members to see that they are in good condition, secure, and correctly aligned. If the frame appears to be out of line, report the condition to the officer in charge.
81	81	81	*Wiring, Conduits, and Grommets. Observe these items to see that they are in good condition, properly supported, connected, and secure.
82	82	82	Fuel Tanks, Fittings, and Lines. Inspect fuel tanks to see that they are in good condition and securely mounted. Examine caps for defective gaskets or plugged vents. See that the filler necks are in good condition and the caps fit securely. Check fuel lines and fittings to see that they are in good condition, securely supported, and not leaking.
	82		Remove the fuel tank drain plugs and drain off the accumulated water and sediment. Drain only until the fuel starts to run clear.
84	84	84	Exhaust Pipes and Muffler. Examine the exhaust pipe to see that it is securely attached to the exhaust manifold, that the gasket or packing does not show visible evidence of leakage, and that the other end is clamped securely to the muffler. Inspect the muffler to see that it is in good condition and securely mounted. Check to see that it is properly supported, and unobstructed at its outer end. See that the drain holes in the muffler are at lowest point and not clogged.
85			Lubrication. Inspect the lubrication of the entire power unit. On any unit where disassembly was necessary for inspection purposes, lubrication must be performed, unless it is to be scheduled for repair.
	85	85	*Lubricate* Lubricate all points of the power unit in accordance with instructions in War Department Lubrication Order No. 3024, current lubrication bulletins, or directives and the following instructions: Use only clean lubricant. Keep all lubricant containers and dispensers covered except when withdrawing lubricant. Lubrication of items on the Preventive Maintenance Service and Technical Inspection Work Sheet that are marked with an L (special lubrication symbol) should be omitted on this lubrication service *with the exception of the external lubrication cup of the distributor*. This will avoid duplication and, in some cases, overlubrication. Before applying lubricant, clean the lubrication fitting or plug, so that dirt will not enter with the lubricant. If lubrication fittings, flexible lines, vents, or plugs are found missing or damaged, they should be replaced immediately. Clean

Technical inspection	Semi-annual	Monthly	
			the hole in which the new fitting is to be installed, install the fitting and lubricate the unit. On all unsealed bushings or joints, the lubricant should be applied until it appears at the openings. Open any clogged lubrication passages until lubricant is properly delivered. When draining oil from the engine, always drain the oil immediately after it has been warmed and agitated to a good draining condition by operation of the engine. Refill to the correct level with specified oil as soon as the draining is completed. ***Caution:*** Do not fill to overflowing. Reinstall all drain and filler plugs securely. Take care that any required gaskets are in good condition and in place on the reinstalled plugs. Do not apply more than the specified amount of lubricant to generators, starters, or water pump. Wipe off excess lubricant that may drip onto rubber parts or on the body of the power unit.
91	91	91	*Lamps (Lights). Examine all lamps (lights) to see that they are in good condition and secure.
			Circuit Breaker, Fuse Block Rheostats, and Control Switches. Observe whether these items are clean, dry, in good condition, secure, and whether any electrical connections are loose. See that all fuses are held securely by their clips. Check all other components of the control panel for good condition.
103	103	103	*Paint and Markings. Examine the paint of entire unit to see that it is in good condition, paying particular attention to any bright spots in finish that might cause glare or reflection. Inspect markings and identification for legibility. Include identification plates and their mountings if furnished.
104	104	104	Radio Bonding (Suppressors, Filters, Capacitors, and Shielding). See that their bonding connections are in good condition, clean, and secure. Note whether all items are securely mounted. *Note.*—Any irregularities, except cleaning and tightening, should be reported to the officer in charge.
131	131	131	Tools (Standard). Check all the standard tools against the packing list to see that they are all present. Inspect to see that tools are in good condition, clean, and properly stowed or securely mounted. Also examine the tools which have cutting edges to see that they are sharp.

Technical inspection	Semi-annual	Monthly	
135	135	135	PUBLICATIONS AND FORMS. See that the following are present in a legible condition: Technical manual. WD AGO Form 48 (Trip Ticket). War Department Lubrication Order. WD AGO Form 468 (Unsatisfactory equipment report).
138	138	138	SPARE PIN, FUSES, AND BULBS. Observe whether or not the prescribed number and sizes are present, in good condition, and properly stowed.
139	139	139	FUEL AND WATER CANS, AND BRACKETS. Observe whether they are in good condition, and secure; that the caps fit tightly and are secured to the can with a chain. Note if the cans are leaking.
140	140	140	FUEL CAN NOZZLE AND BUCKET. This equipment should be present, in good condition, clean, and properly stowed.
141	141	141	MODIFICATIONS (MWO's). Inspect the equipment to determine whether all modification work orders have been completed.
142	142	142	FINAL TEST. Make a final test, rechecking items 3, 9, 10, 13, and 14. Confine this test to the minimum time necessary for satisfactory observation. *Note.*—Correct or report all deficiencies found during final test.

SECTION IID. MOISTUREPROOFING AND FUNGIPROOFING

(Added)

7.23. Moistureproofing and Fungiproofing.

When operated in tropical areas where temperature and relative humidity are extremely high, Signal Corps equipment requires special attention. These are some of the problems met:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

b. Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

c. Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and cross talk.

e. Moisture provides leakage paths between battery terminals.

7.24. Treatment.

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. See TB SIG 13, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this equipment.

Caution: Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

7.25. Power Unit PE-74-( ).

a. Preparation.

Make all repairs and adjustments necessary for proper operation of the equipment.

b. Disassembly.

(1) Remove the two knurled nuts holding the Silverstat voltage regulator cover.

(2) Remove the cover from the voltage regulator. (See figs. 16.7 and 16.8.)

(3) Remove the back cover and attached components from the frequency meter control frame.

(4) Remove the cover from the rectifier. (See figs. 16.7 and 16.8.)

c. Cleaning.

Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed. Clean all oil and grease from the surfaces to be varnished.

d. Masking (fig. 16.9).

(1) Mask with tape, all lugs on unfastened leads.

(2) Mask with tape, rheostat which controls panel light.

(3) Mask the rectifier with paper and tape.

e. Drying.

Place equipment in oven or under heat lamps, and dry for 2 or 3 hours at 160° F.

f. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (lacquer, fungus-resistant, Spec. No. 71-2202 (stock No. 6G1005.3), or equal). Allow each coat to air-dry for 15 or 20 minutes before applying the next coat.

(2) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

(3) Spray the reverse side of the panel and all components remaining on the panel.

(4) Spray the inside of the rectifier and the frequency meter control cover.

(5) Varnish by brush all meter case screws, the zero correction adjustment, and the seams around the glass windows.

(6) Varnish by brush all exposed wiring connected to the panel.

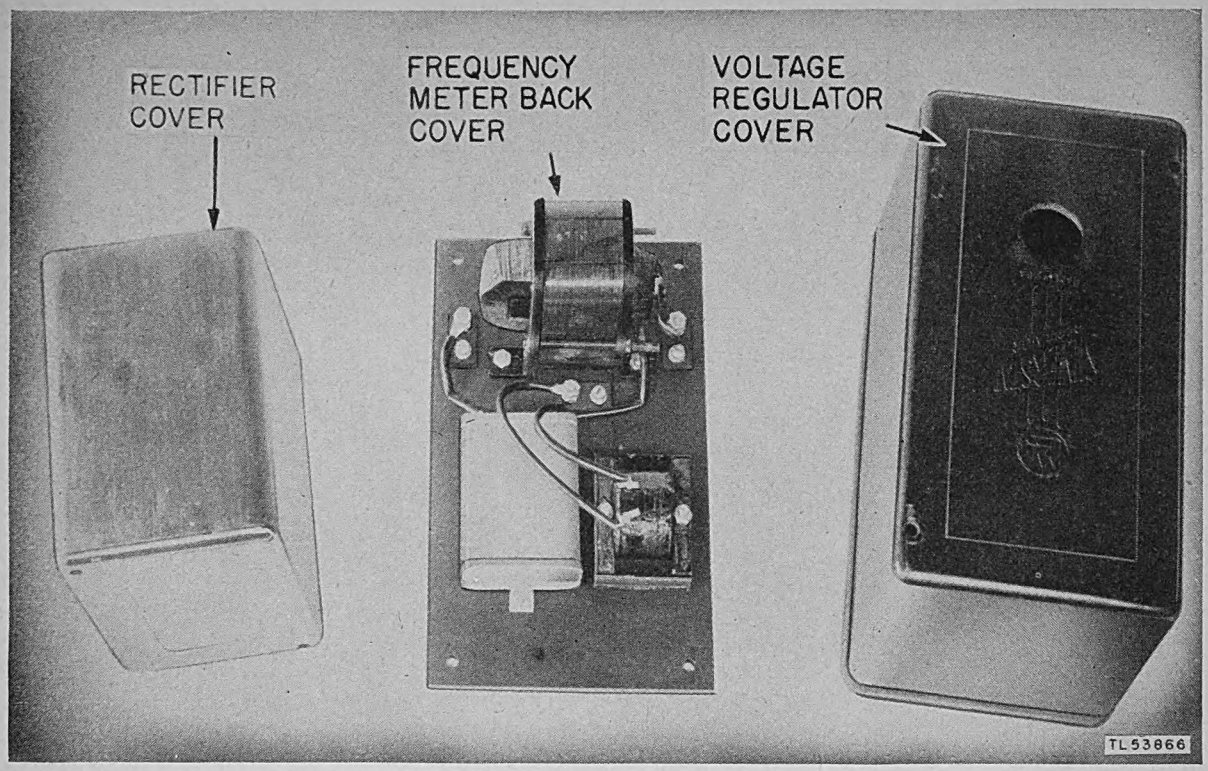


Fig. 16.7. Parts Removed Before Masking.

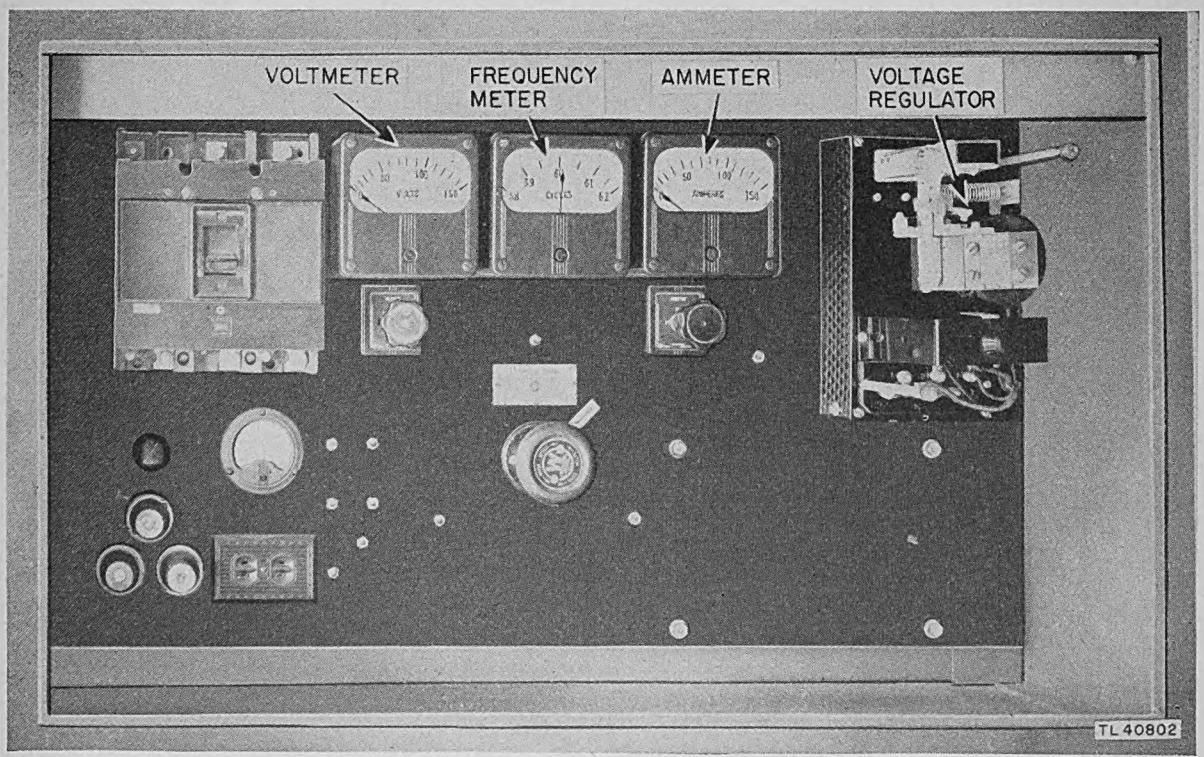


Fig. 16.8. Front View of Control Panel.

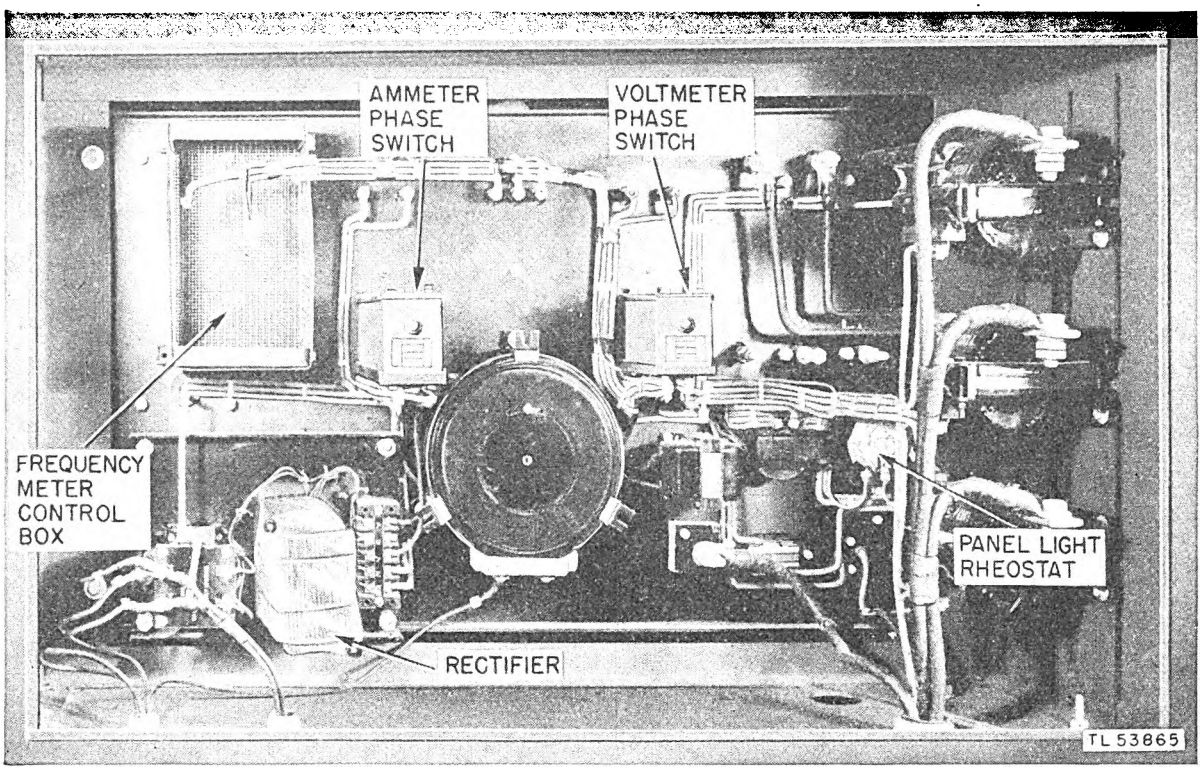


Fig. 16.9. Rear View of Control Panel. Masked and Ready for Spraying.

g. Reassembly.

(1) Remove all masking tape, being careful not to peel varnish from nearby areas.
(2) Clean all contacts with burnishing tool.
(3) Reassemble the unit and test its operations.

h. Marking.

Mark the letters MFP and the date of treatment on the front of the panel under the field rheostat knob.

Example: MFP—8 Dec 44.

7.26. Moistureproofing and Fungiproofing after Repairs.

If, during repair, the coating of protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is completely sealed.

SECTION III. MAINTENANCE

8. (Superseded.) **Tools and Test Equipment Available for Repairs.**

a. Repairs attempted by personnel of the first three echelons should be limited to those which can be accomplished with the tools and spare parts available and dependent upon the using repairman's training.

b. The following tools are available for use with Power Unit PE–74–(*).

(1) First and Second Echelon

See list of tools in section IV.

(2) Third Echelon

Tool Equipments TE–113 and TE–114.

c. The following test equipments are available for use with Power Unit PE–74–(*).

(1) First and Second Echelon

Test Set I–56.

(2) Third Echelon

Test Equipment IE–9.

9. Cooling System.

* * * * *

b. Cleaning Out Dirt and Sludge.

(1) Drain the cooling * * * close the cocks.

Note (added). If there is ethylene-glycol antifreeze in the cooling system, catch the drainings in a suitable container and save it for future use.

(2) (Superseded.) Clean the cooling system according to current directives, using specified cleaner only. Flush the cleaner from the entire cooling system with clean water. Fill the radiator with clean water.

(3) Leave the radiator filler cap off and run the engine until the water is hot. **Inspect the hose and hose clamps, making sure they are in good condition. If they are not in good condition replace them. Then** drain and flush the system with clean water.

(4) (Superseded.) Drain and refill with coolant, adding specified inhibitor, unless new antifreeze which contains inhibitor is used. Do not fill the radiator to the top, but allow room for expansion when the engine heats up.

* * * * *

d. (Superseded.) **Adjusting Fan and Generator Drive Belts (fig. 17).**

(1) To adjust the battery-charging generator belt, loosen the generator bracket and swing the generator towards the engine or from the engine as required.

(2) The tension of the fan and water-pump-drive belt is adjusted by changing the width of the pulley groove. Two types of assemblies are used in these units.

(a) The earlier assembly consists of an outer flange which slips over the fan hub and is provided with two diagonal slots and two locking bolts. (See item 495, fig. 18.) To adjust this type, loosen the locking bolts and rotate the flange as necessary to increase or decrease the distance between the pulley flanges. Be sure to lock the locking bolts as soon as adjustment has been completed.

(b) The newer assembly which replaces the earlier assembly (MWO SIG 9, C 1) has a threaded hub, and an internally threaded flange, lockwasher and threaded lock collar. The flange and collar are secured with two setscrews which engage a groove in the hub. To adjust this type, loosen the setscrews and screw the flange and lock collar in the necessary direction to increase or decrease the distance between the pulley flanges. Lock the adjustment by tightening the setscrews. Make sure that the setscrews are in the correct position to enter the groove in the hub when they are tightened. Screw the threaded lock collar against the washer and lock it in the same manner as the pulley flange. (See figs. 19 and 20.)

* * * * *

10. (Superseded) **Fan and Water Pump** (fig. 18.1).

The only service necessary to the fan and water pump is to keep the pulley flange bolts and setscrews tight. Should a water pump leak develop, replace the entire pump assembly as there is no means of adjustment provided. To replace the pump, proceed as follows:

a. Drain the cooling system.

b. Disconnect the water bypass hose and the intake hose.

c. Remove the fan blade assembly.

d. Remove the four nuts that secure the pump assembly to the cylinder block, and remove the assembly.

e. Install the new pump by reversing the operations for disassembly. Be sure that the gasket between the pump and cylinder block is in place and in good condition. Tighten evenly and gradually, the nuts that hold the pump so as to keep the pressure evenly distributed at all times.

f. Close the drain cocks and refill the cooling system.

g. Figures 19 and 20 show the pulley on the new pump which is used for replacement. Figure 18 shows the old type water pump. Figure 18 is to be used to show adjustment on pulley only, for correcting belt tension (item 495).

11. (Superseded) **Air Cleaner (Fig. 3).**

Service the air cleaner in accordance with the War Department Lubrication Order. To service the cleaner, remove the wingnut at the top center of the air cleaner unit and lift off the cover. When complete cleaning is required,

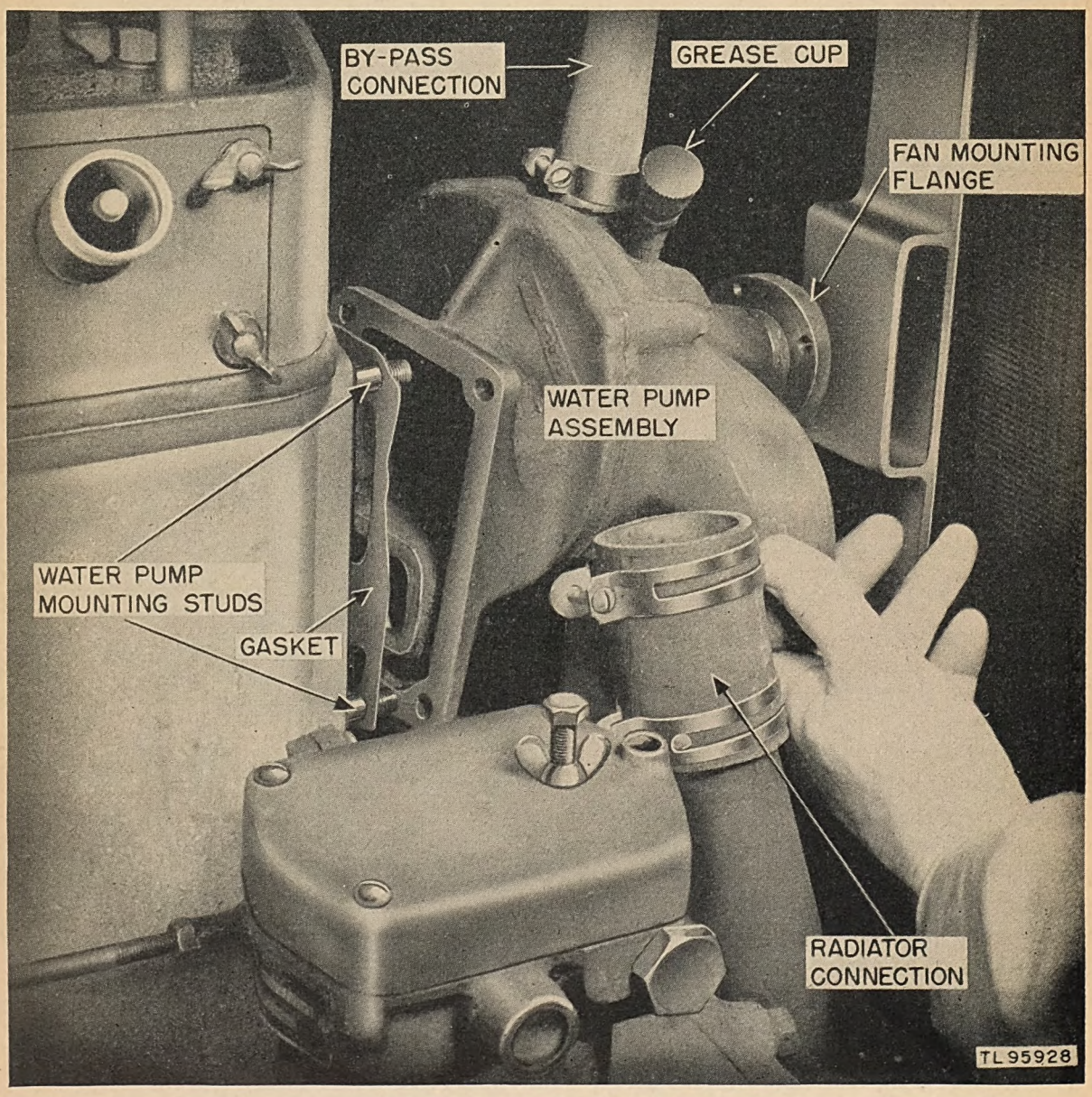


Fig. 18.1. Replacing Water Pump.

lift out the filter element and remove the body of the cleaner from the carburetor air intake. Wash all parts of the cleaner thoroughly in dry-cleaning solvent (SD) or Diesel oil (DA) and allow them to dry. Dip the filter element in lubricating oil and allow the excess oil to drain off. Reassemble the cleaner, replace it on the engine, and make sure that all gaskets are in place and that all connections are dust-tight and airtight.

13. Oil Filter.

The oil filter is located on the **magneto** side of engine. (**See fig. 2.**) A quantity of * * * to the crankcase. Filter elements cannot be cleaned. **The oil filter** should be **drained and the filter element** replaced **in accordance with War Department Lubrication Order No. 3024.** Filter service operations are as follows (**fig. 76**):

* * * * *

e. Flush the filter, using **dry-cleaning solvent (SD).**

* * * * *

l. Add oil, if necessary, to bring crankcase up to the proper level **in accordance with War Department Lubrication Order No. 3024.**

14. Oil Pump.

a. Description.

The oil pump is (**fig. 21**) located between fuel pump and bellhousing on Magneto side of engine. It is a * * * keyed to shaft). Oil Pump screen should be cleaned of sludge and foreign particles **at the interval shown on War Department Lubrication Order No. 3024.**

* * * * *

25. (Superseded) Standard Test Equipment Used in Trouble Shooting.

a. General.

The standard test equipment for use with power units of 2.5 kw and over consists of the following items:

1 spark plug adjusting tool and feeler gauge.
1 set standard feeler gauges.
1 battery hydrometer.
1 antifreeze hydrometer.
1 cylinder compression gauge.
1 combination vacuum and pressure gauge.
1 neon-tube timing light.
1 universal battery tester.
1 low-voltage circuit tester.

b. Use of Battery Hydrometer.

See par. 30.

c. Use of Antifreeze Hydrometer.

The antifreeze hydrometer is similar to a battery hydrometer but is larger and has a number of graduations on its float. There is a separate graduation for each type of antifreeze and the type of antifreeze must, therefore, be known before any test can be made. Figure 16 indicates the correct hydrometer readings at various temperatures for the three types of antifreeze in most general use.

d. Use of Cylinder Compression Gauge.

This gauge is calibrated from 0 to 200 pounds in 5-pound divisions, with a hexagon stem equipped with a pressure relief valve and ball check valve, a flexible hose connection with screw type adapters to fit 10-, 14-, 18-mm, 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, remove the spark plugs from the engine. Block the choke and carburetor throttle in 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 strokes required to reach a maximum reading (4 or 5 strokes). Release the pressure in the gauge by unscrewing the valve cap on the hexagon of the adapter one-half turn, returning the pointer to zero. Close the relief valve by tightening the valve cap, and proceed to cylinder No. 2. Repeat this operation until all cylinders have been tested.

e. Use of Combination Vacuum and Pressure Gauge.

This gauge is intended for diagnosing troubles in high-compression gasoline engines at a speed slightly above idling speed. It consists of a dial indicator with two indicator hands—the dark hand for steady, and the light hand for fluctuating readings—a rubber hose, and adapters. The equipment is for making tests for burnt valves, weak valve springs, valve timing, warped and burnt manifolds, fuel pump, carburetion, and other engine functions.

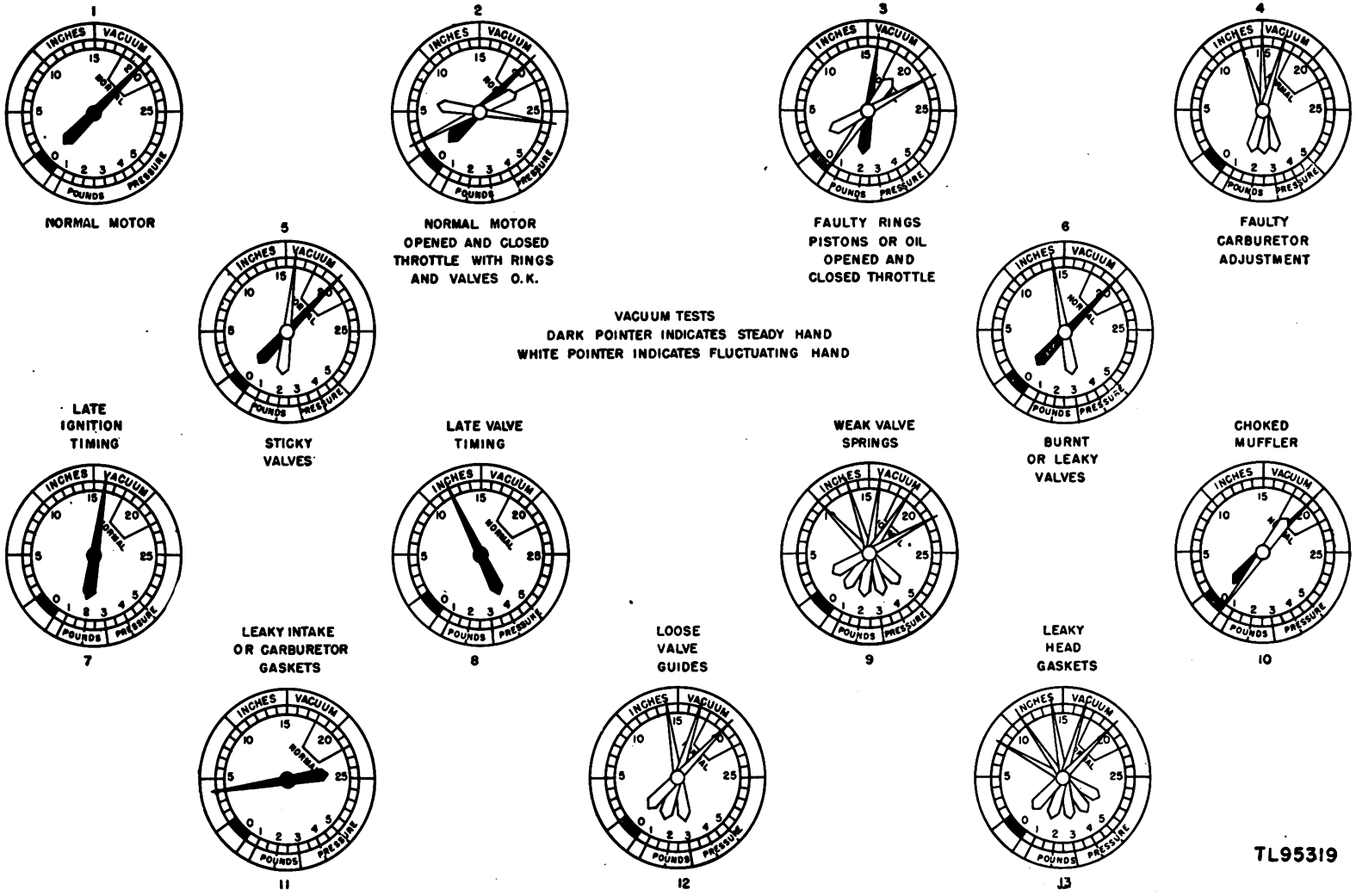


Fig. 31.1. Dial Readings for Vacuum Lift Tests.

(1) Vacuum Lift Test (fig. 31.1)

The lift test is made to determine the normal compression of the engine. Connect the T fitting to the intake manifold and attach the rubber hose. Disconnect the throttle-shaft connector link, and turn the throttle-stop screw to completely close the throttle valve. With the ignition OFF, crank the engine with the starter. Remove the distributor cap to prevent the engine from starting or if it is magneto-equipped, ground the magneto. As the starter turns the engine, the gauge pointer will rise to where it stands when the engine is idling. If the pointer does not lift over 5 inches, the intake manifold or gaskets are faulty. If the pointer rises a point between 10 and 15 inches and fluctuates badly, a cylinder head gasket is faulty or a bad valve condition exists.

(2) Test With Engine Running

Start the engine, and block the throttle in half-open position; the pointer on the gauge should register between 18 and 21 inches. Accelerate the engine by opening and closing the throttle. The gauge pointer should drop to 2 inches and recoil to 24 inches, or over. If the recoil is not more than 24 inches, there is every indication of badly diluted oil in the crankcase or poorly sealing piston rings. Allow the engine to operate at its top governed speed and hold the speed steady. If the pointer on the gauge fluctuates rapidly between 10, 21, and 22 inches, it is an indication that the valve springs are weak.

(3) Testing Fuel Pumps

Connect the T fitting in the intake side of the fuel pump and attach the gauge. Start the engine and operate the unit at no-load speed. The gauge should read 8 inches or over. If the pointer indicates a lower vacuum, there is an air leak, a faulty diaphragm, or the sediment bowl gasket is not properly seated. Any reading above 8 inches is normal.

f. Universal Battery Tester.

There are two models of battery testers, both of which are universally used. The tester described in this subparagraph is the prod type with meter attached. The prods of this tester are adjustable to accommodate the various distances between battery terminals. Adjust the prods to suit the battery to be tested and scrape the surface of the battery terminals for good contact. Press the tester firmly onto the battery with one prod on a negative pole and the other prod on a positive pole of the battery cell being tested. Be sure that the load switch on the tester is screwed down tight. Screw this switch up when it is desired to take an open circuit reading. The condition of the cell will be indicated by the meter attached to the instrument.

g. Low-voltage Circuit Tester.

This is a self-contained instrument mounted in a steel box. This instrument is intended for testing the battery-charging circuit, including any current and voltage regulators, cut-out settings, and charging generator performance. The tester operates on the power generated into the battery system and will operate on either 6- or 12-volt systems. Complete operating instructions are given on a plate attached to the cover of the instrument.

25.1. Improvised Test Equipment (Added).

A simple test equipment for testing open circuits, grounds, and short circuits may be improvised by the use of a storage battery, two test leads with prods, and a lamp socket and lamp inserted in series with one of the test leads. Figure 31.2 illustrates this equipment being used in checking a commutator. This test will determine whether or not there is an open armature winding. The same test may be used in checking field windings by placing one test prod on the collector rings and touching the other prod to the generator frame. Stator

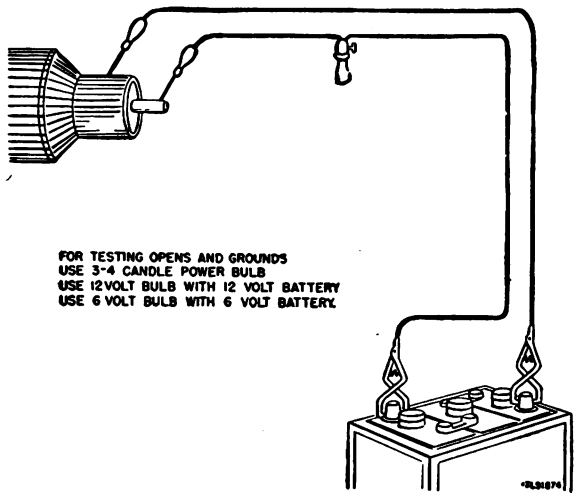


Fig. 31.2. Checking Commutator.

windings may be checked for open circuits by the use of the same equipment.

25.2. General Trouble-shooting Information (Added).

Regardless of how carefully equipment is designed, manufactured, and maintained, faults will occur in service. The repairman must locate and correct these faults as rapidly as possible. The material supplied in this manual will aid in the rapid location of such faults. Consult the following data when necessary:

a. Engine and generator trouble charts.

b. Wiring diagrams.

c. Illustrations of components and cross-section views.

25.3. Sequence of Trouble Shooting (Added).

The sequence of trouble shooting is entirely dependent upon certain symptoms which are self-evident to an experienced operator. Engine troubles may be divided into three classifications: electrical, fuel supply, and mechanical. Electrical troubles may involve either the starting circuit or the ignition circuit. Symptoms will again be obvious and will govern the trouble-shooting procedure. The trouble chart that follows lists various trouble symptoms, their possible cause, and remedy. The same general comments that apply to engines also apply to the generating equipment, except that only electrical or mechanical troubles will be experienced in the latter.

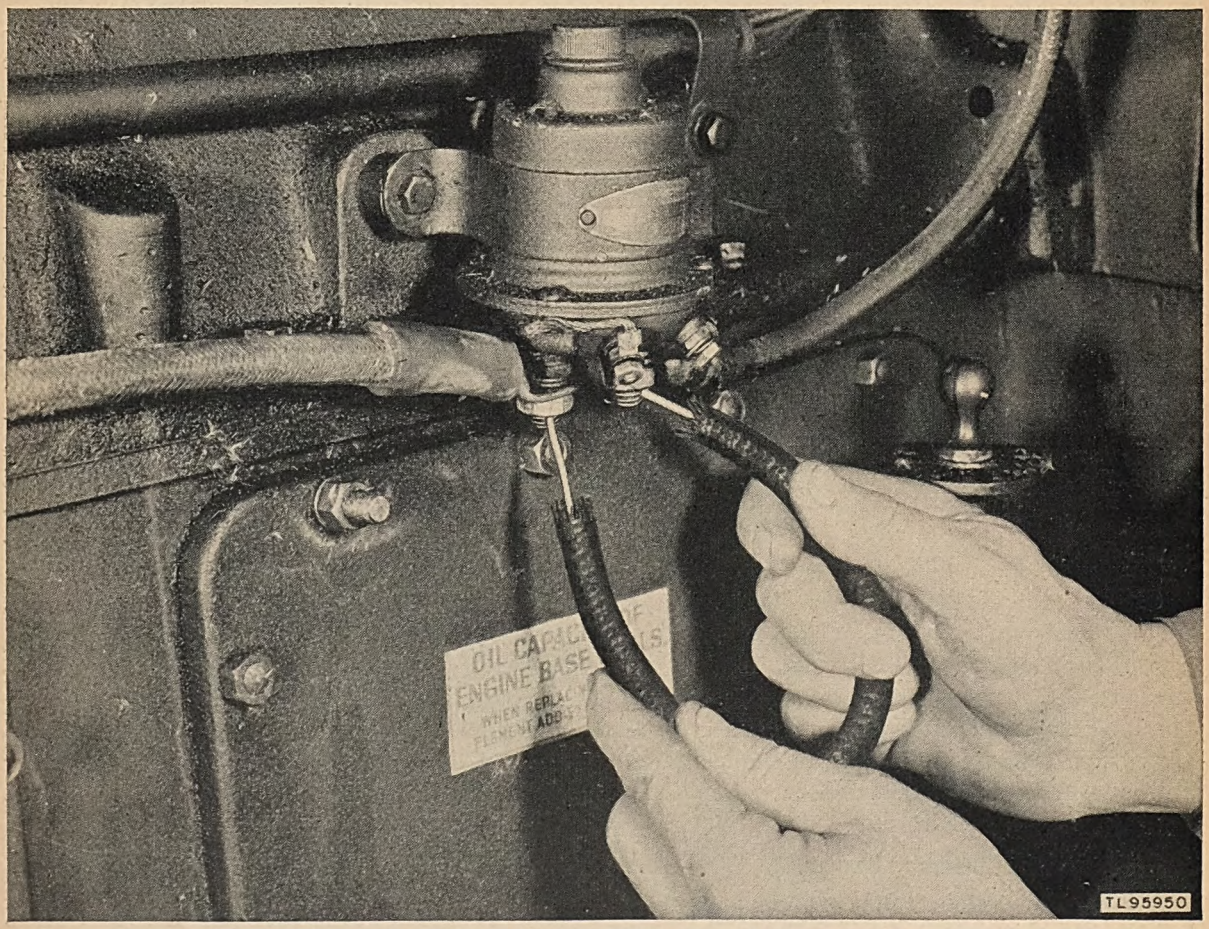


Fig. 31.3. Using Jumper on Solenoid Starting Switch.

25.4. Engine Trouble Chart (Added.)

a. Electric Starter Fails to Function.

Symptom	*Possible cause*	*Remedy*
Starter fails to crank engine.	Battery not fully charged	Recharge battery or replace with one fully charged.
	Battery terminals corroded or loose.	Clean and tighten battery connections.
	Faulty connection in starting circuit.	Check all connections and wires. Clean and tighten connections. Replace defective wires.
	Worn or dirty commutator or brushes in starting motor.	Inspect commutator and brushes. Clean commutator and/or replace brushes.
	Bendix-drive gear jammed	Rock crankshaft with hand crank or loosen starting motor and free gear.
	Defective starter switch	Short switch terminals. If starter functions, replace switch.
	Defective starter solenoid	Place jumper across solenoid terminals. If starter functions, replace solenoid. (See fig. 31.3.)
	Defective starting motor	Replace starting motor.

b. Starter Functions But Engine Does Not Fire.

Symptom	*Possible cause*	*Remedy*
No spark at spark plug.	Ignition switch in OFF position.	Place switch in correct position.
	Ignition switch shorted	Disconnect switch. Replace switch if shorted.
	High-water temperature switch closed.	Press release button on top of the high-water temperature cut-off.
	Low-oil-pressure switch stuck.	Disconnect switch. Replace switch if defective.
	Low oil in crankcase	Check oil supply and add oil as needed.
	Magneto-breaker points burned or pitted.	Clean and adjust or replace breaker points.
	Magneto-breaker points out of adjustment.	Adjust breaker points.
	Defective capacitor in magneto.	Test capacitor and replace if defective.
	Internal magneto trouble	Replace magneto.
Spark at spark plug but engine does not fire.	Fuel tank empty	Check fuel supply. Fill tank.
	Fuel valve closed	Open fuel valve.
	Fuel-tank air vent clogged	Clear air vent.
	Foreign matter in fuel	Check fuel strainer bowl for foreign matter. Drain tank and refill with clean fuel.
	Engine flooded from excessive use of choke.	Push in choke and crank engine.
	Fuel strainer clogged	Clean fuel strainer. (See par. 33.) Check fuel in tank for foreign matter. Drain and refill tank.

Possible cause	*Remedy*
Defective fuel pump	Replace pump. (See par. 33.)
Broken fuel line	Repair or replace fuel line.
Carburetor clogged or defective	Clean or replace carburetor.

c. Engine Starts But Misfires.

Possible cause	*Remedy*
Spark plug fouled	Test and clean or replace faulty spark plugs.
Loose wire in ignition system	Inspect and tighten ignition wires.
Spark plug gaps too wide	Check and correct spark plug gaps.
Magneto-breaker points out of adjustment.	Check and correct breaker-point adjustment.
Magneto-breaker points dirty	Clean and adjust or replace breaker points.
Magneto-capacitor defective	Replace capacitor.
Defective high-tension insulation.	Check wires and other insulation in high-tension system. Replace defective parts.

d. Engine Starts But Runs Unevenly.

Possible Cause	*Remedy*
Any of the causes under c above	Remedies which apply.
Valves not seating properly	Check for weak or broken valve springs, bent valve stems, or incorrect tappet adjustment.
Defective cylinder-head gasket	Check for leaks between cylinder head and cylinder block.
Leaking intake manifold	Check for leaks at intake manifold. Replace gaskets and tighten manifold as indicated.
Carburetor mixture incorrect	Check carburetor and readjust for correct mixture. Replace carburetor if necessary.
Incorrect governor adjustment	Readjust governor.

e. Engine Lacks Compression.

Possible cause	*Remedy*
Incorrect valve-tappet adjustment.	Readjust valve tappets.
Valve stems or tappets sticking	Inspect and service or replace if faulty.
Valve faces in need of grinding	Grind valves.
Valve stems or valve guides worn.	Check and install new parts where needed.
Valve springs weak or broken	Replace faulty springs.
Cylinder-head gasket leaking	Tighten cylinder head or replace gasket.
Piston rings worn or broken	Install new piston rings.
Worn pistons and/or cylinders	Replace pistons and/or cylinder sleeves.

f. Engine Lacks Power.

Possible cause	*Remedy*
Any of the causes in above	Remedies which apply.
Carburetor incorrectly adjusted	Readjust carburetor.

Possible cause	*Remedy*
Governor not functioning properly.	Check governor operation and adjust if needed.
One or more spark plugs fouled.	Clean and adjust spark plugs.
Magneto-breaker points out of adjustment.	Readjust magneto-breaker points.
Carburetor air intake obstructed	Clean air cleaner.
Engine overheated because of obstructed air passages.	Clean air passages.
Engine overheated because of lack of water in cooling system.	Fill cooling system.
Engine overheated because of slipping fan and water-pump drive belt.	Adjust belt.
Engine overheated because of overload on generator.	Reduce load.
Engine not up to operating temperature.	Check operation of thermostat.
Faulty lubrication	Check oil in crankcase. Use oil as specified in lubrication order. Check oil filter. Check for leaks in oil lines.
Exhaust obstructed	Check all exhaust passages and muffler. Clean where necessary.

g. Excessive Oil Consumption.

Possible cause	*Remedy*
Too light oil	Follow specifications in lubrication order.
Leaking oil lines	Check for leaks.
Defective gasket at valve cover or crankcase.	Replace gasket.
Piston rings worn, broken, or stuck.	Replace worn parts. Clean ring grooves.
Worn cylinders	Replace cylinder sleeves.
Worn oil seals	Replace oil seals.
Worn bearings	Adjust or replace faulty bearings.

h. Low Oil Pressure.

Possible cause	*Remedy*
Any of the causes in g above	Remedies which apply.
Oil-pressure-relief valve stuck	Remove and clean valve; test spring; replace faulty parts.
Oil-pump screen clogged	Remove and clean screen. (See par. 14).
Faulty oil-pressure gauge	Test with gauge known to be accurate. Replace gauge.

i. Engine Knocks.

Possible cause	*Remedy*
Excessive carbon or lead deposits in combustion chamber.	Remove cylinder head and clean combustion chamber.
Loose bearing	Rock engine against compression with hand crank, and feel for loose bearings.

Possible cause	*Remedy*
Engine overheated	See f above.
Worn piston or cylinder	Check compression. Make necessary replacements.
Loose flywheel	Rock with hand crank and feel for play. Tighten flywheel.
Loose generator coupling	Tighten coupling.
Low octane fuel	Use higher octane fuel.

j. Explosions in Carburetor or Manifold.

Possible cause	*Remedy*
Engine not up to operating temperature.	Run with choke slightly out until engine heats up.
Carburetor adjustment too lean	Readjust carburetor.
Valves or valve-tappets sticking.	Check valve action. Remove cause.
Weak or broken valve springs	Check valve springs. Replace faulty parts.
Intake-valve warped, burned or broken.	Replace faulty valve.
Intake-valve tappets set too close.	Readjust valve tappets.
Leak in intake-manifold or gasket.	Tighten manifold or replace gasket. Check manifold for cracks. Replace manifold if defective.

25.5. Generator Trouble chart (Added).

a. No Generator Output.

Possible cause	*Remedy*
Circuit breaker open	Close circuit breaker.
Lack of excitation	Inspect exciter brushes and commutator. Clean commutator; replace brushes.
Open circuit, short circuit, or ground in generator.	See paragraph 25.1.
Alternator brushes not seating properly.	Inspect alternator brushes and slip rings. Clean slip rings; replace brushes.
Broken wire	Check for broken wire. Replace faulty wire.
Defective voltage regulator	Try manual control. Replace regulator if defective.
Defective voltmeter	Try meter known to be satisfactory. Replace meter if defective.

b. Voltage Output Unsteady.

Possible cause	*Remedy*
Poor commutation or poor brush contact at slip rings.	Check commutator and slip rings. Check brushes. Clean commutator and slip rings. Replace brushes.
Loose connections (especially in exciter circuits).	Check and tighten connections.

Possible cause	*Remedy*
Fluctuating load	Check load. Some fluctuating loads, such as a motor driving a single action reciprocating pump, are normal conditions. Correct any abnormal conditions.

c. Generator Overheating.

Possible Cause	*Remedy*
Excessive load	Check and correct load.
Generator cooling air passages obstructed.	Blow out air passages with air hose.
Defective generator winding	Check windings. (See par. 25.1.)
Lack of ventilation around unit	Provide better ventilation.
Faulty lubrication	Check lubrication.

d. Excessive Voltage Drop Under Heavy Load.

See f in engine trouble chart.

e. Circuit Breaker Trips.

Possible Cause	*Remedy*
Excessive load	Check and correct load.
Short circuit in load line	Check load lines and remove load.

f. Generator Frequency Too High or Too Low.

Possible Cause	*Remedy*
Engine not operating at proper speed.	Check engine speed. Adjust governor.

26. Magneto.

* * * * *

f. Irregular Firing.

If the cables * * * paragraph 26h.) **If the trouble lies in the magneto, replace it. All repairs and adjustments to the magneto and distributor will be done by authorized maintenance personnel only.**

* * * * *

i. Impulse Coupling.

* * * * *

(2) Rescinded.

(3) Rescinded.

(4) Rescinded.

* * * * *

27. Cranking Motor.

* * * * *

e. Inspection Checks.

Inspection checks include **an investigation** of the condition of the battery, battery cables and connections, cranking motor switch, commutator, brushes, lead connections and mounting, **at the intervals specified in the Preventive Maintenance Roster.** (See par. 35c.)

f. Periodic Disassembly. Rescinded.

g. Disassembly into Main Sub-assemblies. Rescinded.

h. Disassembly of Commutator End Frame. Rescinded.

i. Disassembled Field Frame Assembly. Rescinded.

j. Disassemble Magnetic Switch. Rescinded.

k. Inspection and Repair of Parts. Rescinded.

Figure 39 (page 34), Undercutting Mica, is rescinded.

Figure 40 (page 34), Checking Armature on Growler, is rescinded.

Figure 41 (page 35), Checking Brush Spring Tension, is rescinded.

l. Assembly Procedure. Rescinded.

m. Cranking Motor Checks (Motor Removed from Engine).

* * * * *

28. Magnetic Switch.

* * * * *

b. Tabulated Data.

The magnetic switch * * * 12.0–13.0 amperes. **If the switch becomes defective replace complete unit.**

c. Disassembly. Rescinded.

d. Assembly. Rescinded.

29. Generator.

* * * * *

c. Inspection Checks. (Superseded).

Inspection checks include a periodic investigation of the generator brushes, commutator, and leads in accordance with the Preventive Maintenance Roster. (See par. 35c.)

d. Periodic Disassembly. Rescinded.

e. Trouble Shooting. Rescinded.

f. Disassembly Procedure. Rescinded.

g. Inspection of Parts. Rescinded.

Figure 45 (page 41), Checking Armature on Growler, is rescinded.

Figure 46 (page 42), Checking Brush Spring Tension, is rescinded.

h. Overhaul Procedure. Rescinded.

i. Servicing of Step-Voltage Control (Superseded).

If trouble in the step-voltage control is indicated by the starter battery not charging properly, or by any other trouble, replace the entire unit. Mark leads to assure correct reconnection.

Figure 47 (page 43), Cross Section through Voltage Regulator, is rescinded.

Figure 49 (page 44), Cut-Out Relay Adjustments, is rescinded.

Figure 50 (page 45), Step-Voltage Control Adjustments, is rescinded.

Figure 51 (page 46), Meter Connections to Check Cut-Out Relay, is rescinded.

Figure 52 (page 46), Meter Connections to Check Step-Voltage Control and Generator Output, are rescinded.

j. Assembly Procedure. Rescinded.

k. Installation. Rescinded.

Figure 54 (page 48) Jumper Lead to Polarize Generator is rescinded.

Note (Added). Never operate the battery-charging generator and step-voltage control with any of the leads disconnected.

32. (Superseded) **Carburetor Adjustment** (fig. 56).

a. The carburetor used on Power Unit PE–74–(*) has two adjustments. The main jet is adjusted by means of the main-jet needle valve. This valve has a tee handle which projects below the carburetor body. When it is necessary to adjust the carburetor, first close the main-jet needle valve by turning the tee handle clockwise as far as it will go without forcing. DO NOT FORCE THIS VALVE AS DAMAGE WILL RESULT.

b. The second adjustment is the idle adjustment which is controlled by an adjusting screw on the side of the carburetor, above the main carburetor body. Turn this screw clockwise as far as it will go without forcing.

c. With both the main jet and idling adjustment in extreme clockwise position, open the main jet by turning the tee handle counterclockwise about one and one-half turns; turn the idle adjusting screw counterclockwise about three-fourths turn.

d. With the carburetor adjustments set as instructed in c above, start the engine and allow it to reach operating temperature.

e. When the unit has reached operating temperature, apply a load and adjust the carburetor main jet to the point where best operation is obtained with the choke fully open.

f. Set the throttle in idling position one-third open and adjust the idle adjusting screw to the best operating point.

g. Move the throttle to wide open position quickly and note if an explosion occurs in the carburetor. If there is a tendency to backfire, open the main-jet needle valve slightly. If it is necessary to keep the choke part way out for several minutes after starting the engine, this is also an indication that the mixture is too lean, and the main-jet needle valve must be opened to a point where the engine operates smoothly with the choke wide open.

h. If carburetor fails to function properly after the above operation, notify the officer in charge, and replace.

i. Removal of the carburetor may be accomplished in the following manner.

(1) Disconnect the air cleaner and connection from the carburetor.

(2) Disconnect the choke wire and remove the lever from the end of the governor operating cross shaft.

(3) Disconnect the fuel inlet line.

(4) Take out the carburetor-to-manifold cap screws and remove the carburetor by pulling away from the engine. Be careful not to damage cross shaft or bushings.

j. Replacement.

The carburetor may be replaced by reversing the order of removal. Make certain that the gasket is in good condition and that the connections are tight.

Add the following between figure 56 (page 53) and its legend:

1. Venturi.
2. Main jet.
3. Secondary venturi.
4. Main discharge jet.
5. Well vent.
6. Idle jet.
7. Idle adjusting needle.
8. Main-jet adjustment.

A. Fuel channel.
B. Air-fuel channel.

33. Fuel Pump.

* * * * *

b. (Superseded.) **Servicing Fuel Pump.**

(1) Replace the entire fuel pump assembly if difficulty is experienced with the fuel pump. Make sure, before doing this, that there is fuel in the tank, that the fuel valve is in the correct position for the source of fuel, that the fuel lines are in good condition, that there are no air leaks, and that the carburetor float and needle valve are operating properly. Remove the valve plugs in the pump and make sure that the valves are in good condition, and seating properly. Inspect the filter screen in the pump and make sure that it is not clogged. Check the cover screws and make sure that they are tight and that there is no leakage at this point. Be sure that the valve plugs are tight. If all of these possibilities have been eliminated, disconnect the fuel pump inlet and outlet pipes, and remove and replace the fuel pump with one that is known to be in good condition. When a new fuel pump has been installed, prime it by operating the priming lever until the glass sediment bowl on the fuel strainer is full. Push this lever down when priming is finished. When installing the pump to the base of the engine, make sure that the gasket used is in good condition and that the flange surfaces are clean.

(2) In the event of fuel pump failure, if a new pump is not available, or time will not permit replacement, the unit may be operated by using gravity fuel feed from the built-in fuel tank. Do this by shutting off both fuel valves, disconnecting the fuel pipe from the carburetor fuel intake, and disconnecting the fuel pipe leading from the fuel tank to the fuel pump at the fuel pump intake. Swing this pipe to the carburetor side of the engine and connect it to the carburetor intake. Open the fuel valve for the built-in fuel tank, and operate the unit in this manner until the necessary repair or replacement can be made. Keep a close check on the fuel supply on the built-in tank while this expedient is being used.

c. Maintenance. Rescinded.

On page 59, Fuel Pump Trouble Chart, is rescinded.

34. Governor.

* * * * *

e. Governor Service.

* * * * *

(3) See that the * * * is probably defective. **Notify the office in charge, and replace.**

If the speed * * * correct this fault.

* * * * *

35. Maintenance of Generator.

c. (Superseded) **Collector Rings, Commutator, and Brushes.**

(1) Remove the exciter end cover and inspect the commutator. Keep the exciter commutator clean and the brushes properly seated. The commutator should have a smooth, dark brown color and be free from pits and burns. The brushes should make good contact with the surface of the commutator and should move freely in their holders. If the commutator is dirty, clean it by placing a piece of coarse cloth over one end of a dry stick and holding it against the commutator while the unit is operating. If the commutator is slightly pitted, clean it by using a piece of #00 sandpaper applied in the same manner as the cloth. Inspect the commutator for evidence of high mica between the commutator bars. If the mica between the com-

mutator bars is higher than the surface of the bars, report this fact to the officer in charge. If the commutator surface is badly pitted or burned, report this fact.

(2) If the brushes are dirty, remove and clean them with dry-cleaning solvent (SD). If they are badly worn, replace them with new ones. If the brushes do not make good contact with the commutator, reseat them as follows:

(a) Cut a strip of fine sandpaper the same width as the commutator.

(b) Insert the sandpaper under the brushes with the sanded side against the brushes. (See fig. 67.1.)

(c) Lift all but one brush clear of the sandpaper and with this one brush resting against the sanded surface, pull the sandpaper around the commutator in the direction of its rotation. Lift the brush and return the sandpaper to its original position. Repeat this operation until a satisfactory seat is obtained and then do the same with the remaining brushes. When new brushes are installed, they must be seated in the same manner.

Note. The foregoing instructions also apply to the battery-charging generator and starting motor.

(d) Treat the collector rings and brushes on the alternator in the same manner as those on the exciter. If the collector rings are badly burned or pitted, report this fact to the officer in charge.

(e) Exciter and alternator windings may be checked as explained in paragraph 25.1. If internal trouble is evident in the exciter or alternator, report this to the officer in charge. If internal trouble is evident in the battery-charging generator or starting motor, replace the faulty unit assembly.

* * * * *

g. Spare Parts. Rescinded.

* * * * *

39. Lubrication of Power Unit. (Superseded).

See section IIB.

39.1. Unsatisfactory Equipment Report (Added).

a. When trouble in equipment used by Army Ground Forces or Army Service Forces occurs more often than repair personnel feel is normal, WD AGO Form 468 (Unsatisfactory equipment report), should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, Army Air Forces Form 54 should be filled out and forwarded through channels.

c. If either form is not available, prepare the data according to the sample form reproduced in figure 67.2.

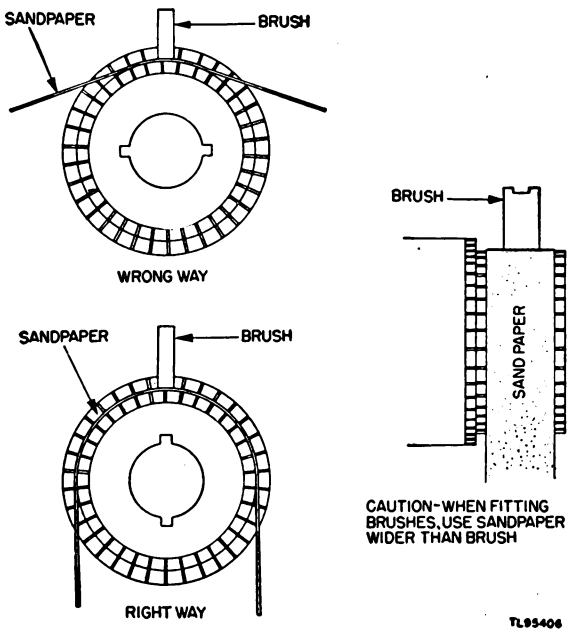
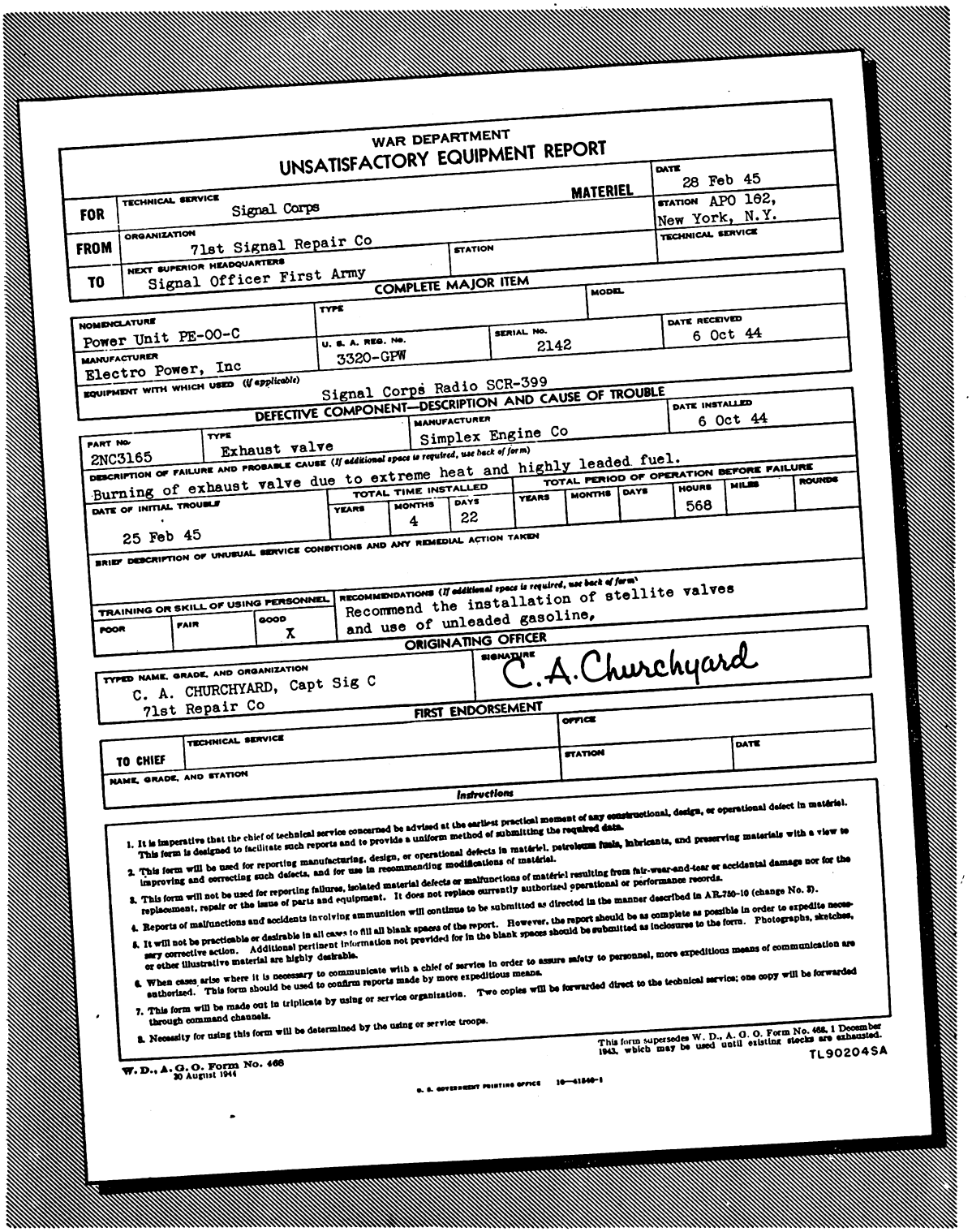


Fig. 67.1. Seating Brushes.



WAR DEPARTMENT

UNSATISFACTORY EQUIPMENT REPORT

FOR	TECHNICAL SERVICE: Signal Corps	MATERIEL	DATE: 28 Feb 45
FROM	ORGANIZATION: 71st Signal Repair Co	STATION	STATION: APO 102, New York, N.Y.
TO	NEXT SUPERIOR HEADQUARTERS: Signal Officer First Army		TECHNICAL SERVICE

COMPLETE MAJOR ITEM

NOMENCLATURE	TYPE	MODEL	
Power Unit PE-00-C			
MANUFACTURER: Electro Power, Inc	U. S. A. REG. No.: 3320-GPW	SERIAL No.: 2142	DATE RECEIVED: 6 Oct 44

EQUIPMENT WITH WHICH USED (*If applicable*): Signal Corps Radio SCR-399

DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE

PART No.	TYPE	MANUFACTURER	DATE INSTALLED
2NC3165	Exhaust valve	Simplex Engine Co	6 Oct 44

DESCRIPTION OF FAILURE AND PROBABLE CAUSE (*If additional space is required, use back of form*)

Burning of exhaust valve due to extreme heat and highly leaded fuel.

DATE OF INITIAL TROUBLE	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE					
	YEARS	MONTHS	DAYS	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
25 Feb 45		4	22				568		

BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN

TRAINING OR SKILL OF USING PERSONNEL			RECOMMENDATIONS (*If additional space is required, use back of form*)
POOR	FAIR	GOOD: X	Recommend the installation of stellite valves and use of unleaded gasoline.

ORIGINATING OFFICER

TYPED NAME, GRADE, AND ORGANIZATION	SIGNATURE
C. A. CHURCHYARD, Capt Sig C 71st Repair Co	C. A. Churchyard

FIRST ENDORSEMENT

TO CHIEF	TECHNICAL SERVICE	OFFICE	
		STATION	DATE
NAME, GRADE, AND STATION			

Instructions

1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design, or operational defects in matériel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of matériel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 2).
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service; one copy will be forwarded through command channels.
8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. Form No. 468
30 August 1944

This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.

TL90204SA

U. S. GOVERNMENT PRINTING OFFICE 16—61846-1

Fig. 67.2. Unsatisfactory Equipment Report.

SECTION IV. PARTS LIST

INDEX TO PARTS LISTS FOR POWER UNIT

Note (Added). Use the following tabular list to identify parts shown on illustrations only. For Maintenance Parts see paragraph 82. The following is a list of tools supplied with PE-74-(*).

Quantity	Tool
1	Oiler, hand, 8-oz.
1	Abrasive, compound, 2 oz.
1	Grease, cup, 5 lb.
1	Gauge, set (Koster) 20 B.
1	Permatex, aviation type.
1	Grinder, valve.
1	Hammer, machinist's, 1-lb.
1	Lifter, valve.
2	Paper, sand flint, #00.
1	Pin, cotter.
1	Pliers, 6-in., gas.
1	Screw driver, 6-in. blade.
1	Screw driver, 10-in. blade.
1	Wrench, set, 12-point, box.
1	Wrench, set.
1	Wrench, adjustable, 8-in.
1	Wrench, box, socket.
1	Wrench, spanner.
1	Wrench, spark plug.
1	Wrench, hex, ¼-in.

* * * * *

SECTION V. APPENDIX

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82. Maintenance Lists (Added).

The following information was compiled on 8 March 1945. The appropriate pamphlets of the ASF Signal Supply Catalog for Power Units PE–74, PE–74–A, PE–74–B, and PE–74–D are:

SIG 7–PE–74, Organizational Spare Parts.
SIG 8–PE–74, Higher Echelon Spare Parts.

For an index of available catalog pamphlets see the latest issue of ASF Signal Supply Catalog SIG 2.

[AG 300.7 (31 May 45)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL
Chief of Staff

OFFICIAL:
EDWARD F. WITSELL
Major General
Acting The Adjutant General

DISTRIBUTION:

AAF (5); AGF (5); ASF (2); T of Opn (5); Dept (5); Base Comd (5); Island Comd (5); Gulf Comd (5); AAF Comds (2); Arm & Sv Bd (1); Def Comd (2); S Div ASF (1); Tech Sv (2); SvC (5); FC (2); Class III Instls (2); PE (2); Dep 11 (2); Gen Oversea SOS Dep (2); Pro Dist 11 (2); Gen & Sp Sv Sch (5); ROTC (2); Lab 11 (2); Sig AS (2); Rep Shops 11 (2); A (5); CHQ (5); D (2); AF (2); Three (3) copies to each of the following: T/O and E 11–107; 11–127; 11–237; 11–287; 11–400 (C); 11–500 (EC); 11–587; 11–592; 11–597; 11–617.

Refer to FM 21–6 for explanation of distribution formula.

U. S. GOVERNMENT PRINTING OFFICE: 1945