RESTRICTED

TM 11-929

WAR DEPARTMENT

TECHNICAL MANUAL

POWER UNIT PE-145-A

July 21, 1943

WAR DEPARTMENT

WASHINGTON, MAY 21, 1943

This Technical Manual, published by Le Roi Company on order no. 1870-PHILA-42, is furnished for the information and guidance of all concerned.

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TECHNICAL MANUAL

POWER UNIT PE-145-A

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WAR DEPARTMENT, WASHINGTON, MAY 21, 1943

This Technical Manual covers Power Units PE-145-A supplied to the U. S. Signal Corps under the following orders.

LE ROI CO.	WESTERN ELECTRIC CO.	U. S. CONTRACT NO.	SERIAL NO. SPAN
18314	A-341736	W2124-SC-281	168619 and 168620
18742			168592 to 168618
18903			165750 to 166026

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SAFETY NOTICE

ELECTRIC SHOCK

WARNING: 110 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 Appendix)

Start artificial respiration immediately, or as soon as the body is removed from contact where this is necessary.

Do not regard early rigidity or stiffening as a sign for ceasing artificial respiration. Resuscitation should be continued three or four hours even though there is no sign of revival.

After revival, treat any burns to guard against infection.

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.

If the victim does not die in the gas, but is removed to the fresh air and given artificial respiration the carbon monoxide gradually leaves the blood. Some victims who are still breathing normally often cannot get the gas out of their blood fast enough to prevent their being very sick or even dying, afterward. Oxygen given to these patients helps to drive the carbon monoxide from the blood.

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.

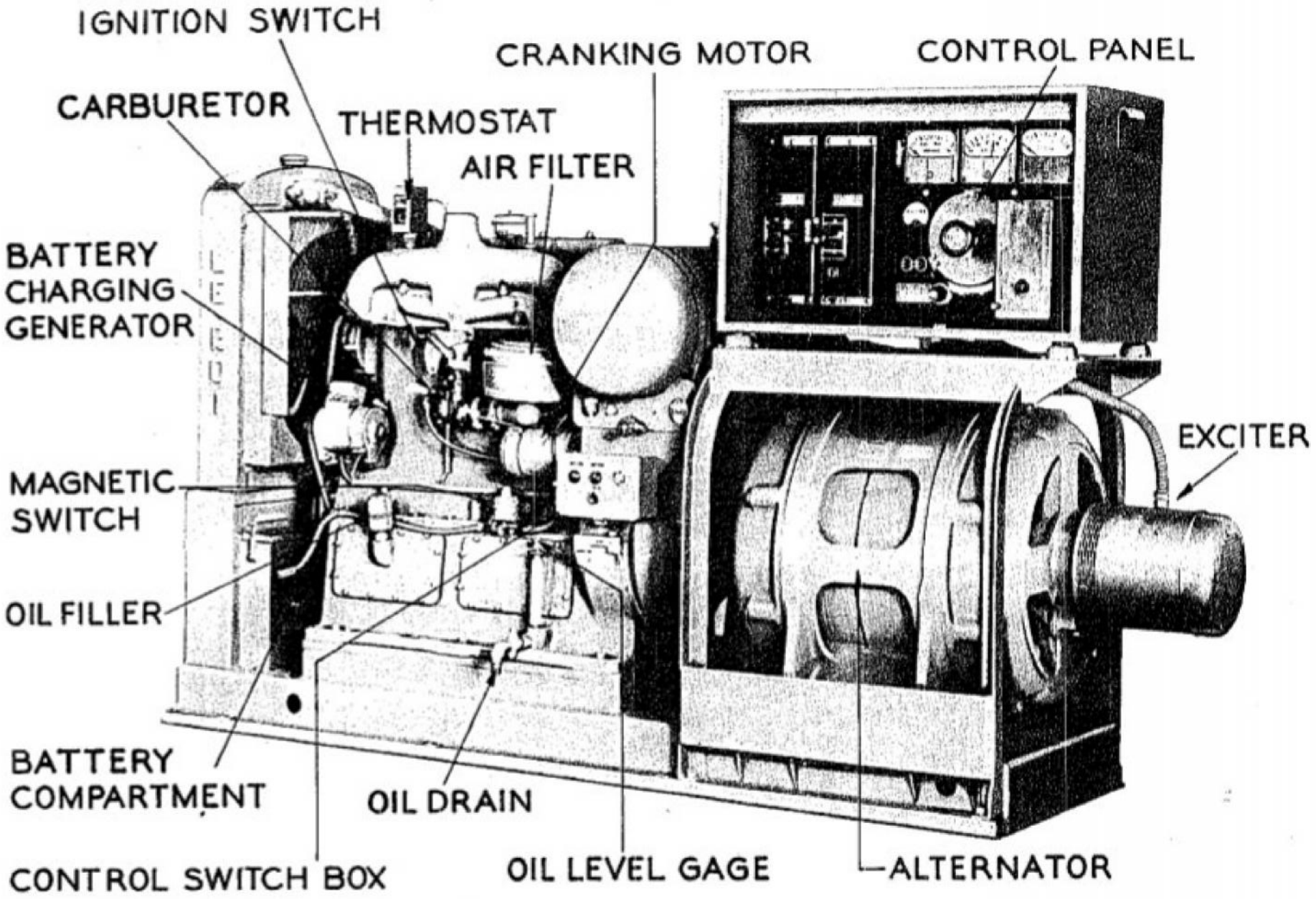

Fig. 1. Power Unit PE-145-A—Carburetor Side

SECTION I. DESCRIPTION

1. General Description of Power Unit.

a. Power Unit PE-145-A 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.

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

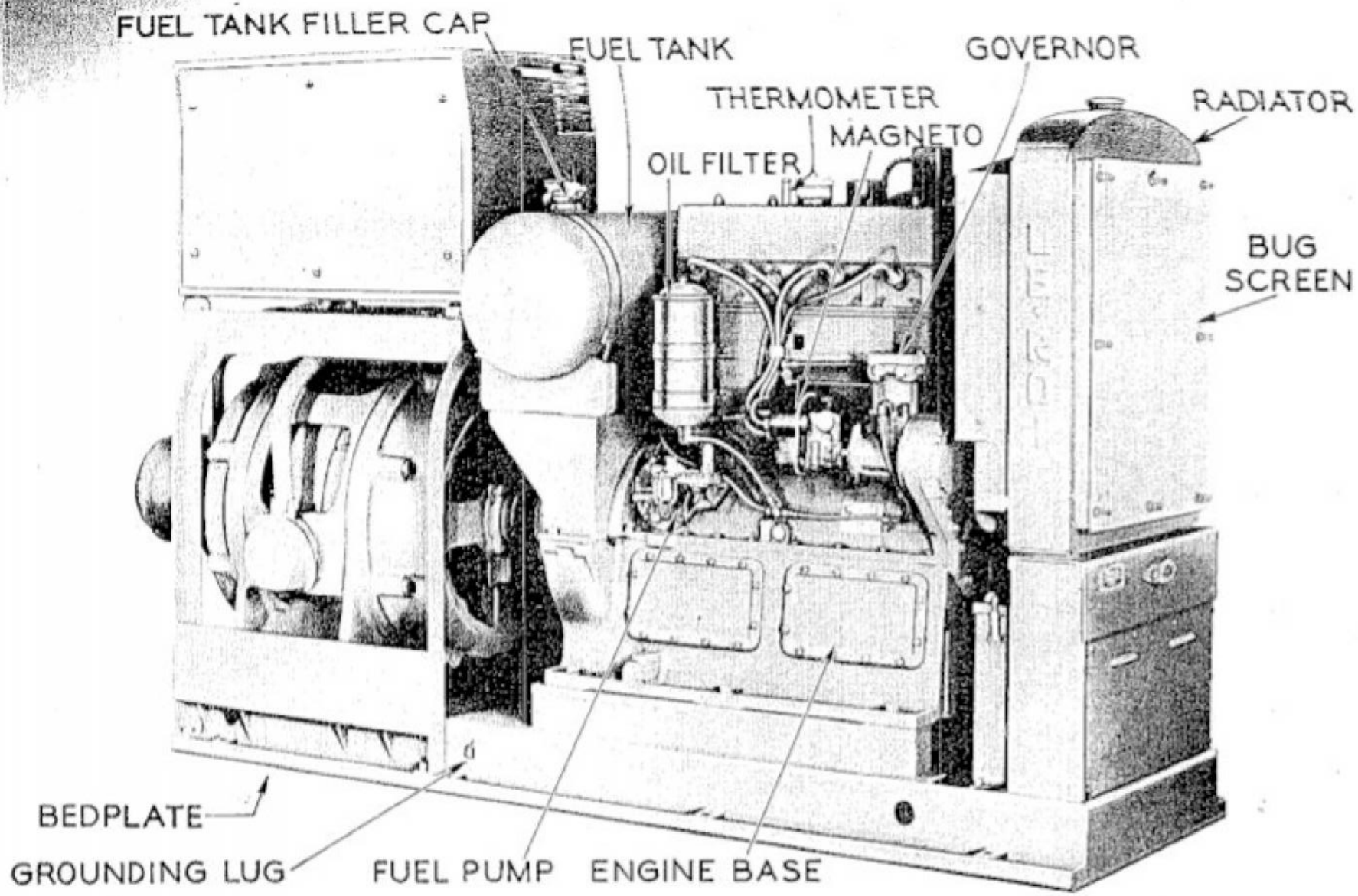

Fig. 2. Power Unit PE-145-A—Magneto Side

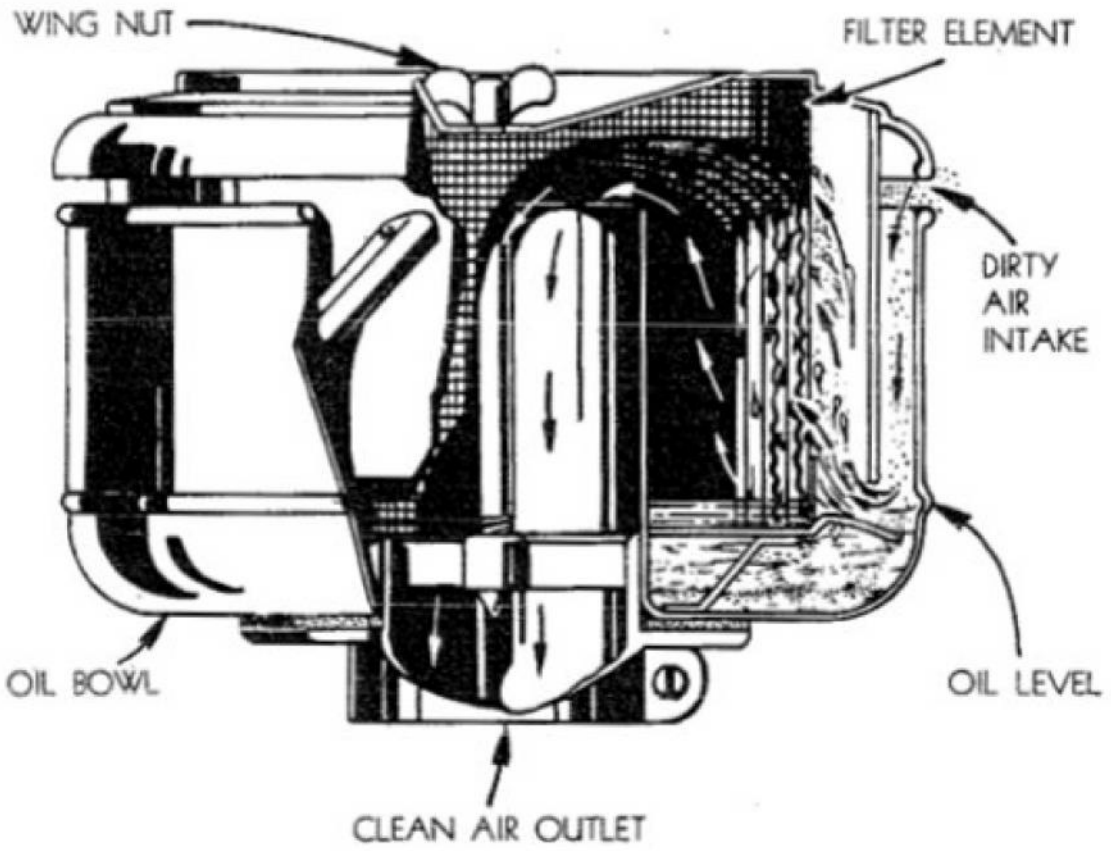

Fig. 3. Cross Section through Air Cleaner

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.

h. 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.

i. 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.

j. 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 func-

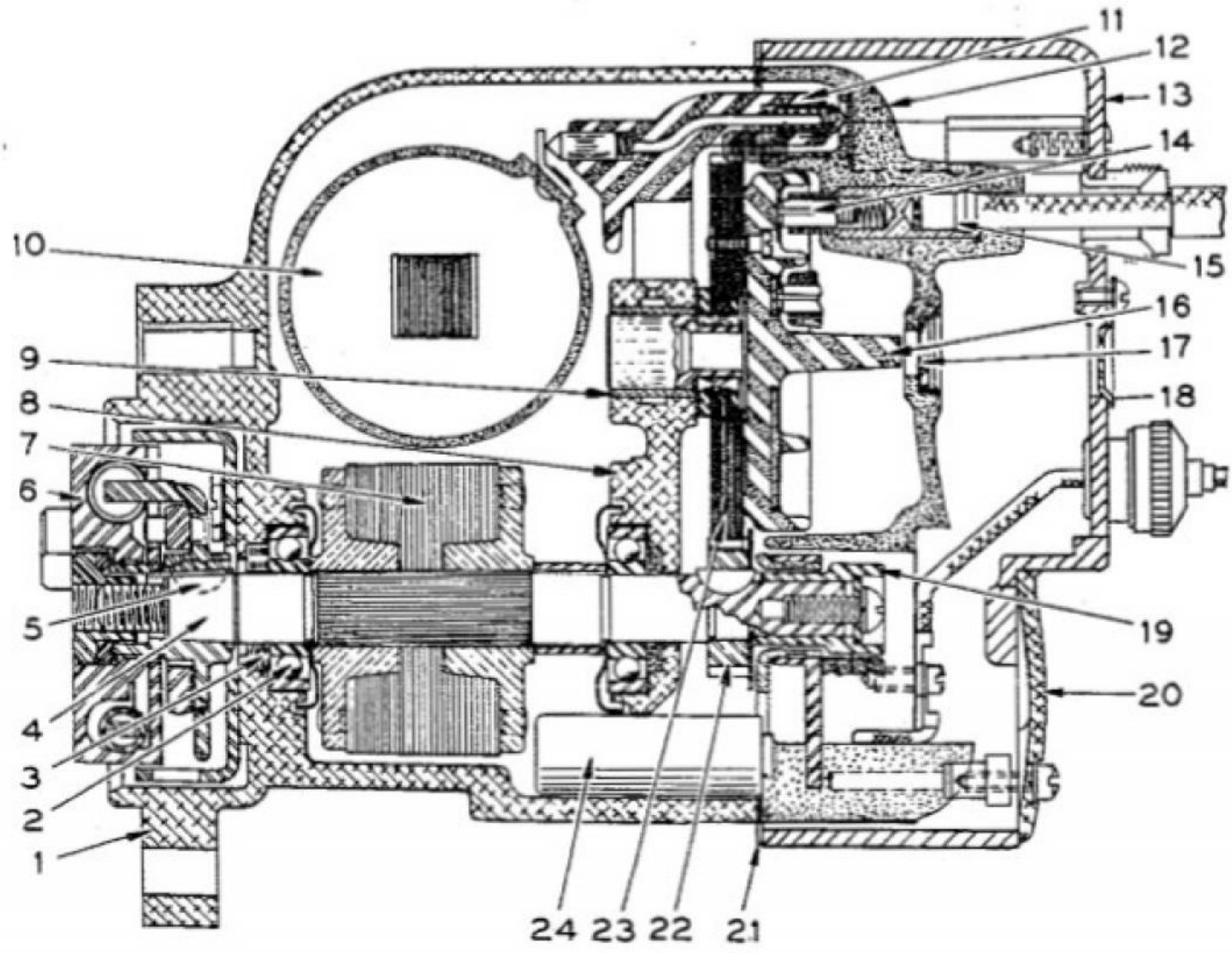

Fig. 4. Longitudinal Section through Magneto

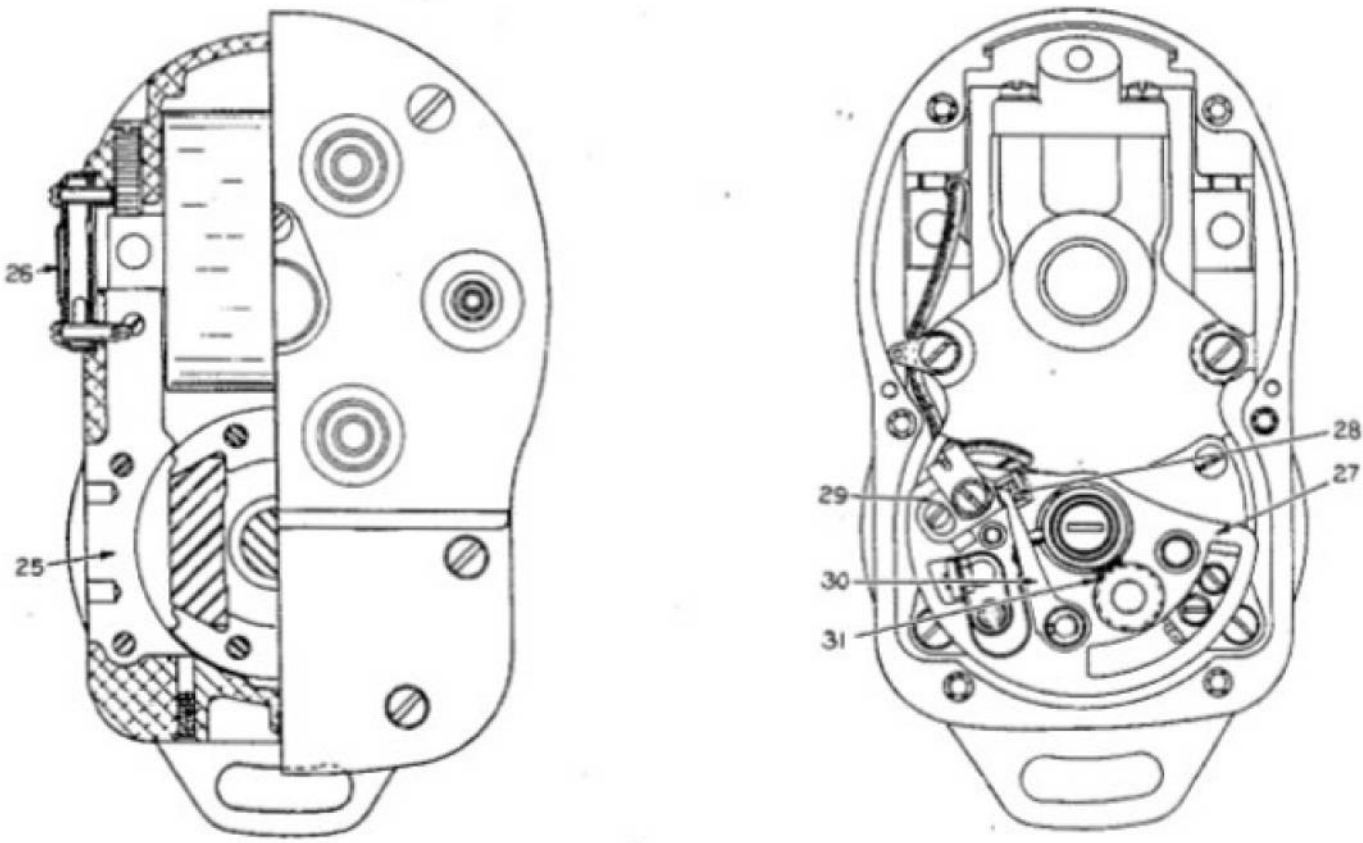

Fig. 5. Cross Section through Magneto

tion 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.

k. Fuel Pump.

The fuel pump (see Fig. 6) 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.

l. Governor.

The governor (see Fig. 7) 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 single-phase, two-wire generator of the revolving field type, rated at 120 volts, 60 cycles, 900 rpm, 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 avail-

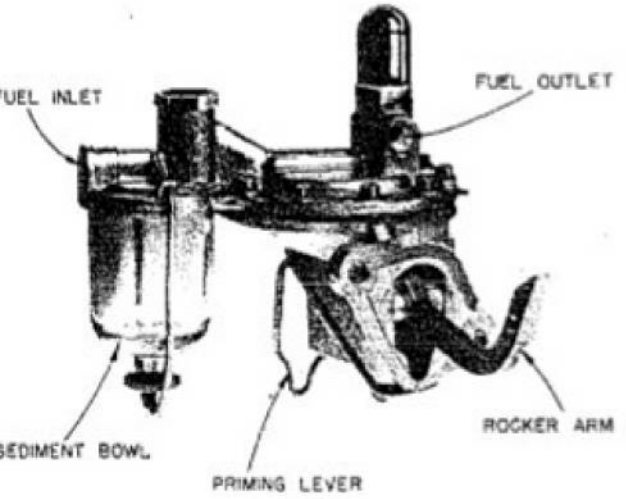

Fig. 6. AC Fuel Pump

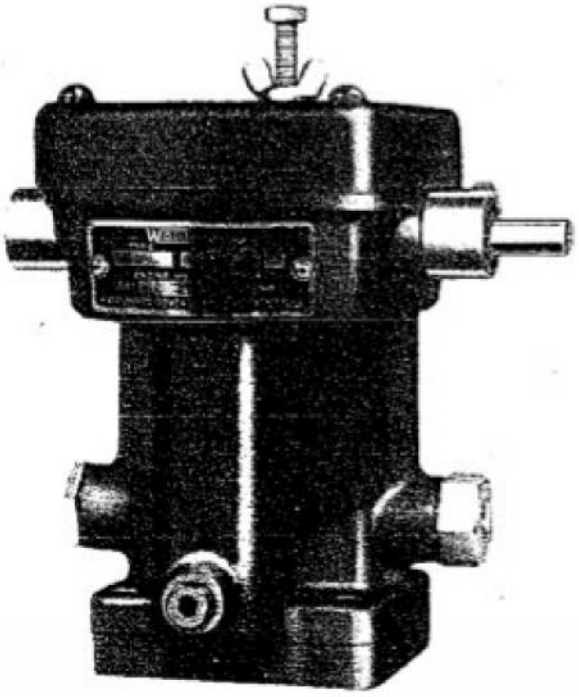

Fig. 7. Woodward Governor

able 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.

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

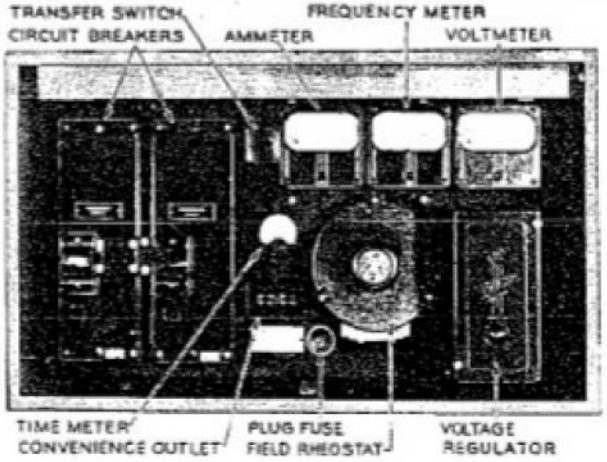

Fig. 8. Generator Control Panel—Front

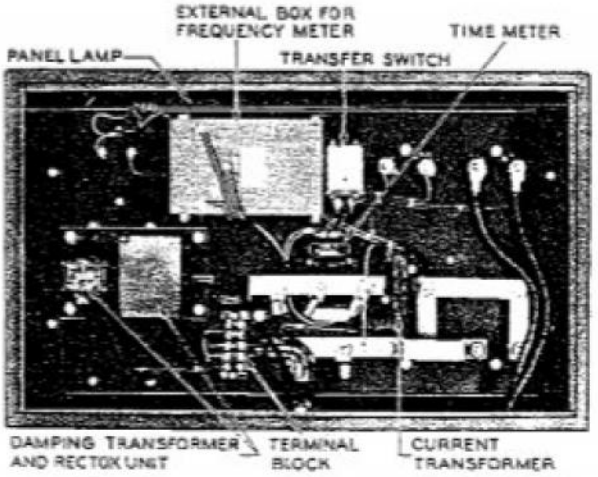

Fig. 9. Generator Control Panel—Rear

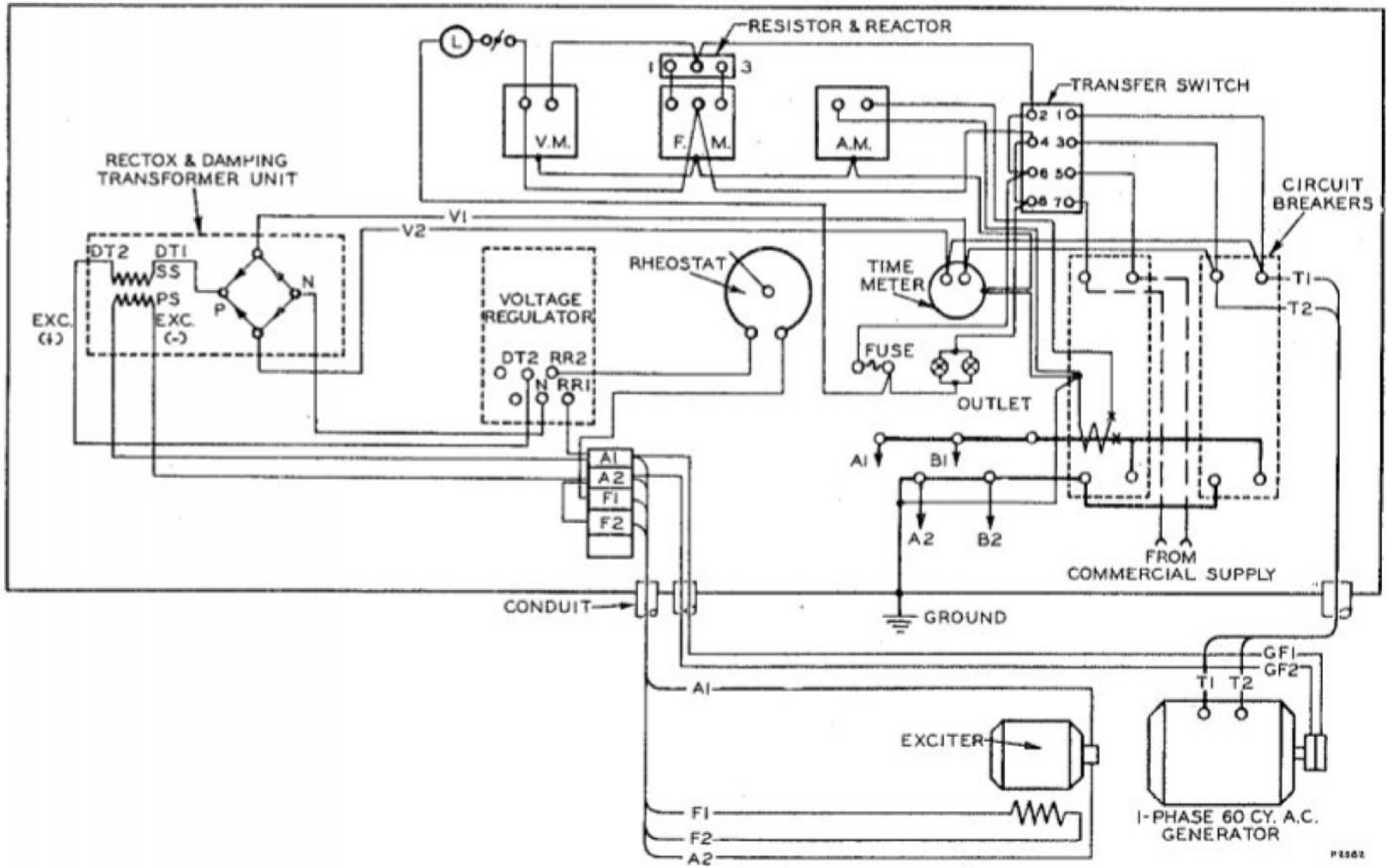

Fig. 10. Wiring Diagram—110 Volt System

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 time meter, generator-voltage regulator, two circuit breakers, and an exciter field rheostat. The purpose of selector switch is to transfer the voltmeter and frequency meter to the circuit breaker on that type of power (commercial or generator) that is in use. 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 Fig. 10

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

The current transformer for the line ammeter is on the rear of the panel together with the thermal boards and the protective fuses. The current transformer has a 60:1 ratio with five-ampere secondary. The wiring diagram for the unit is located on the inside of the left rear side cover. A twin extension receptacle, a light switch, ground stud, and illumination light are also mounted on the front of the panel.

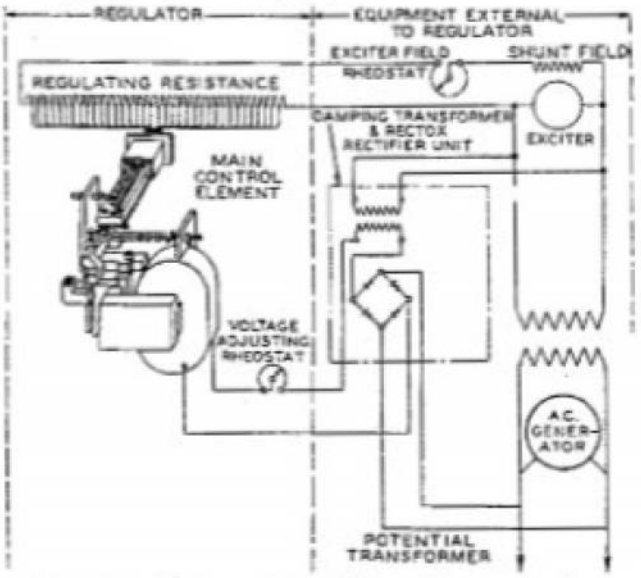

Fig. 11. Schematic Wiring Diagram of Voltage Regulator

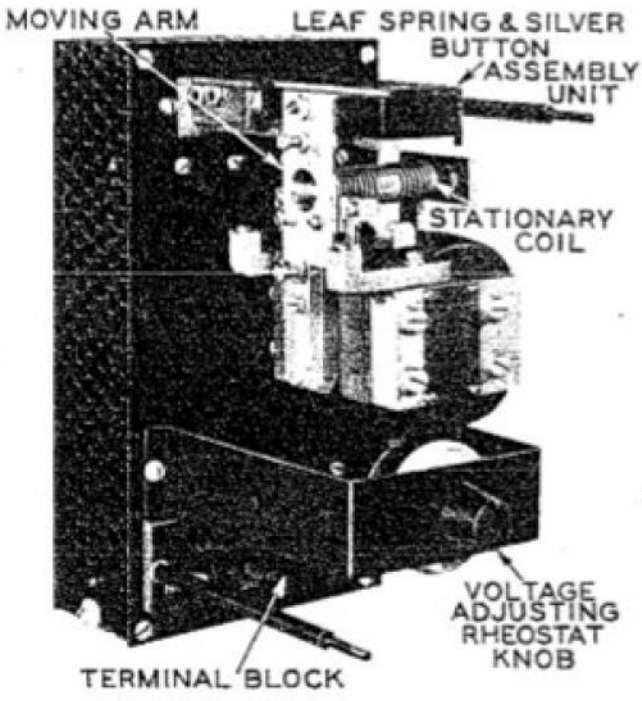

Fig. 12. Voltage Regulator with Front Cover Removed

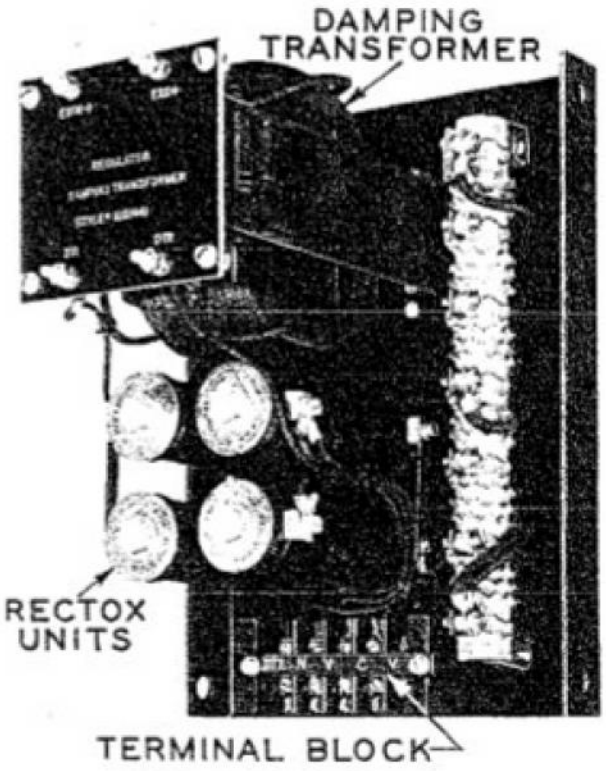

Fig. 13. Damping Transformer

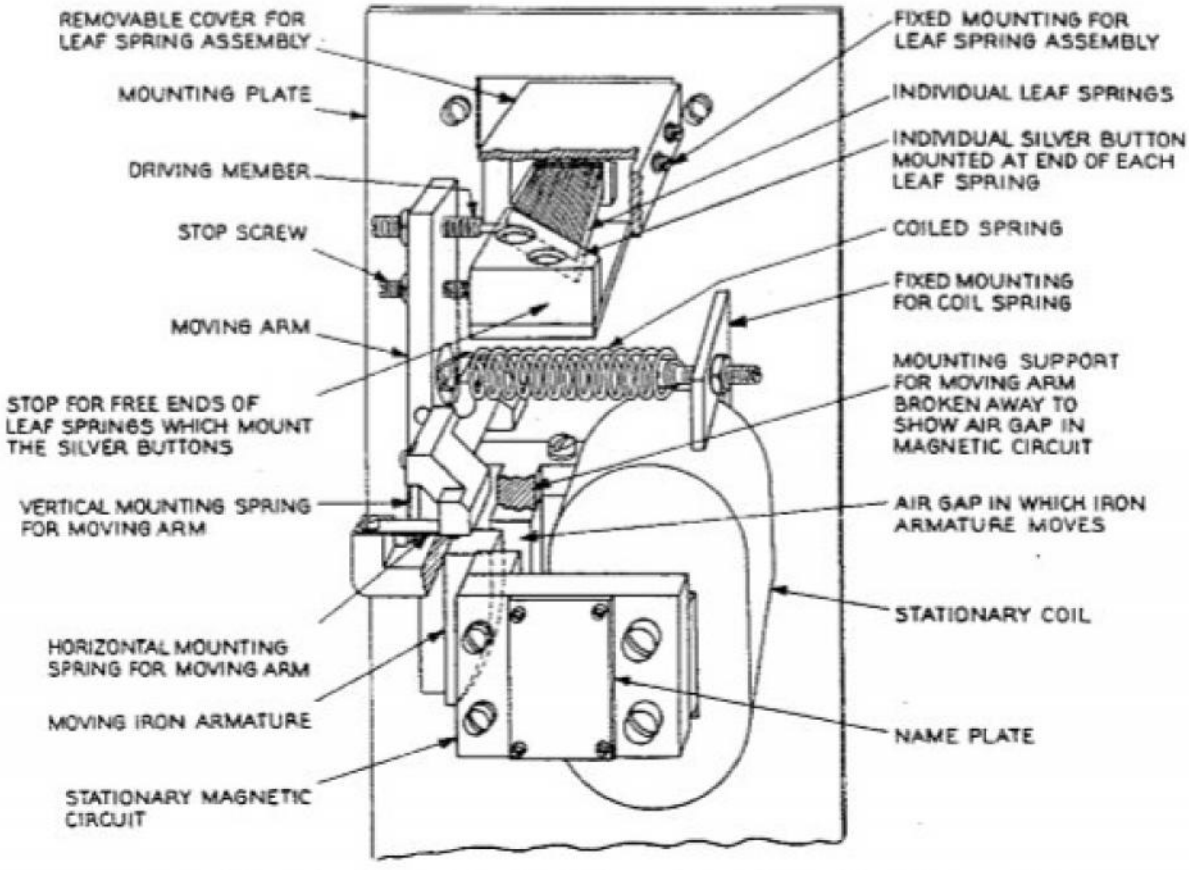

Fig. 14. Pictorial Diagram Showing Construction of Main Control Element in Voltage Regulator

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.

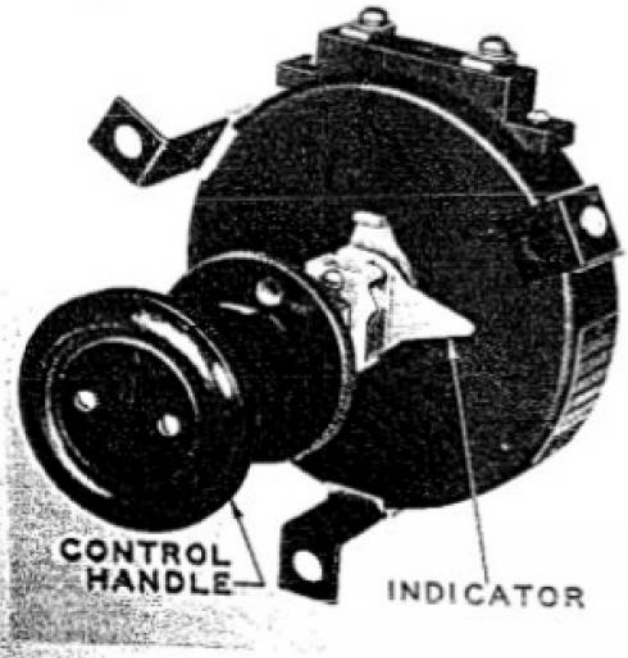

Fig. 15. Field Rheostat—Front

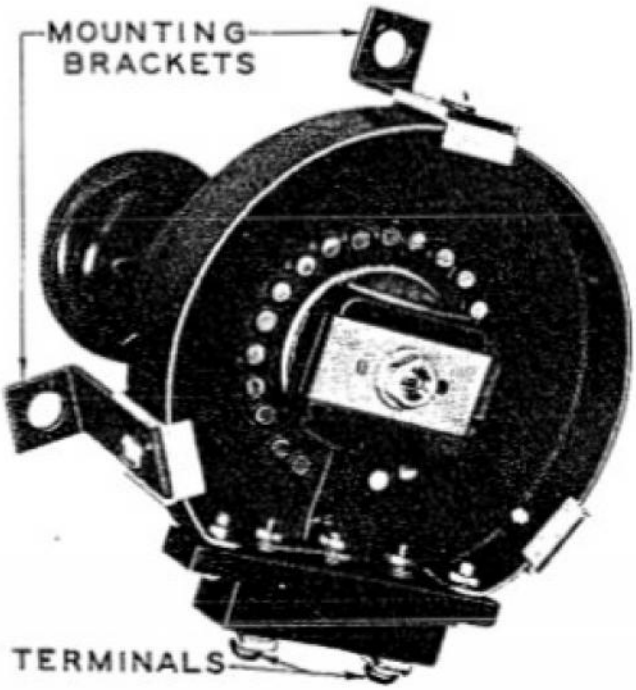

Fig. 16. Field Rheostat—Rear

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 Fig. 10.

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 bail 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. 17. 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 38).

(4) Drain the cooling system of water at the end of each run, or use one of the recommended antifreeze solutions shown in Fig. 20. 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, turn the selector switch to GP and 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.

When operating from commercial power, the engine need not be turned on. It is necessary only to turn the selector switch to CP and to throw the commercial power circuit breaker ON.

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.

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 25.)
(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 21.)
(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.

a. 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.

b. 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.

c. Adjusting the 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 screws and move the pulley flanges together; to increase the width, move the flanges apart. Retighten the lock screws after correct tension is obtained. To adjust the generator drive belt, loosen bracket, and move generator outward, away from the engine, until proper tension is secured. When

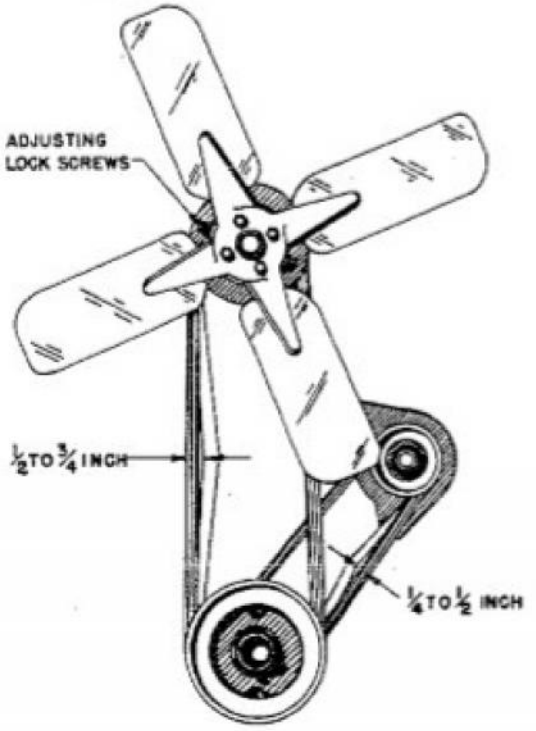

Fig. 18. Correct "V" Belt Tension

properly adjusted, belt must be slack enough to permit deflection by amount shown in Fig. 18 without appreciable pressure. Do not adjust the belt too tightly. After adjustment is obtained tighten the bracket securely.

d. 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.

e. 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.

f. 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 9e, 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.

g. Water Pump. The water pump may leak, owing to wear after considerable use. If this occurs, it is necessary to replace the seal assembly, as there is no adjustment.

10. 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.

11. Manifolds.

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

12. 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.

13. Oil Pump.

The oil pump screen should be cleared of sludge and foreign particles whenever oil-pan handhole covers are removed.

14. 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 Figure 19.

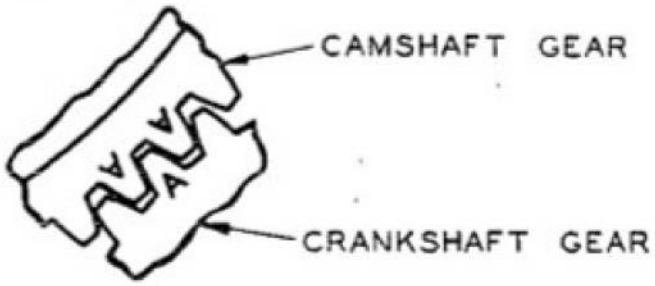

Fig. 19. Timing Gear Marks

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. 20) 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.

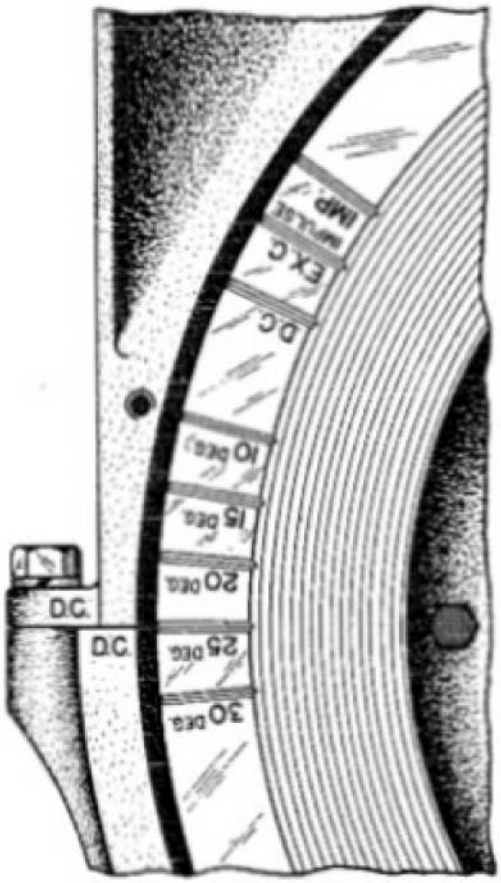

Fig. 20. Flywheel Timing Marks

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 19 b.)

15. 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.

Fig. 21. Installing Cylinder Sleeves

16. 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.

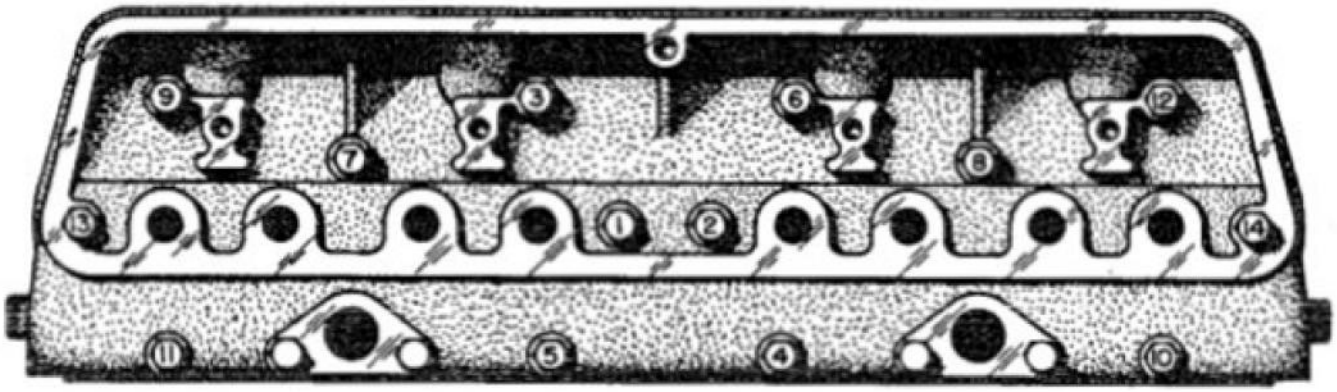

Fig. 22. Cylinder Stud Nut Tightening Sequence

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 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 the chart below. The cylinder-head stud nuts which are tightened when the engine is cold must be retightened when the engine is hot.

17. Piston Assemblies.

Piston Rings:	
Total required	4
Compression	3
Oil control	1
Width, compression	1/8"
Width, oil control	3/16"
Gap, compression	0.015" to 0.025"
Piston clearance	0.005" to 0.007"
Piston Pin:	
Length	3 15/16"
Diameter	1.500"
Clearance in bushing	0.0015" to 0.002"

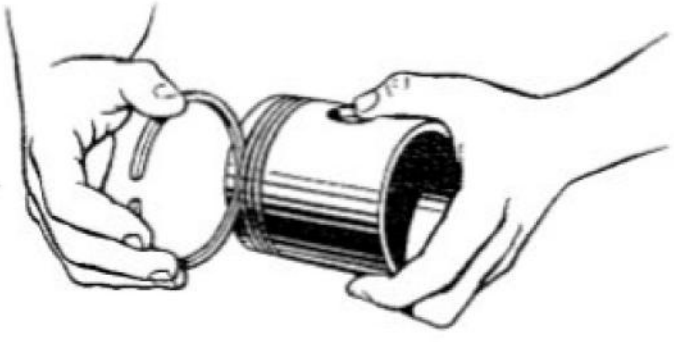

Fig. 23. Checking Piston Ring Fit to Piston

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.)

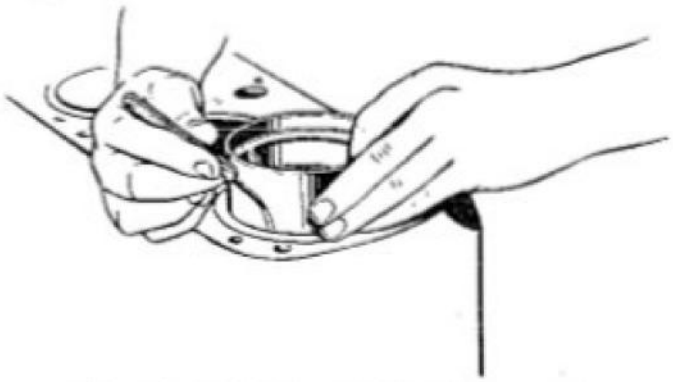

Fig. 24. Checking Piston Clearance in Cylinder

Fig. 25. Checking Piston Ring Clearance in Cylinder

18. Connecting Rods.

Connecting Rod Length, center to center	12½"
Crank pin diameter	2.875"
Bearing length, total	2.075"
Bearing running clearance	0.0025" to 0.004"
Bearing end clearance	0.012" to 0.20"
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.

19. 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.

20. Camshaft.

Bearings, number	3
Bearing material	Bronze
Bearing journal diameter	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. 19.)

21. Valves.

Valve seat, width	$\frac{3}{32}$"
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	$1\frac{7}{8}$"
Port diameter	$1\frac{11}{16}$"
Valve opens	5° after top dead center
Valve closes	41° after bottom dead center

b. Exhaust Valves.

Head diameter	$1\frac{3}{4}$"
Port diameter	$1\frac{11}{16}$"
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 necessary to press them into place and ream them. After new valve guides are installed it is necessary to recut the valve seats.

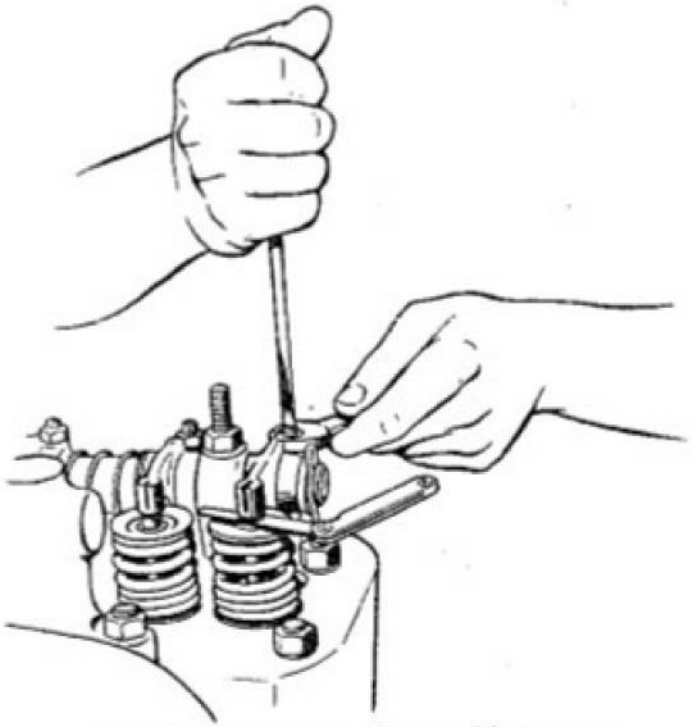

Fig. 26. Adjusting Valve Clearance

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

22. Engine and Alternator Alignment.

The engine and alternator are aligned accu-

rately 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.

23. 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.

24. 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. See instructions herein.
- (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 carburetor instructions herein.

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.

25. 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. 27 and 28), 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. 27 and 28). 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. 27 and 28). 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

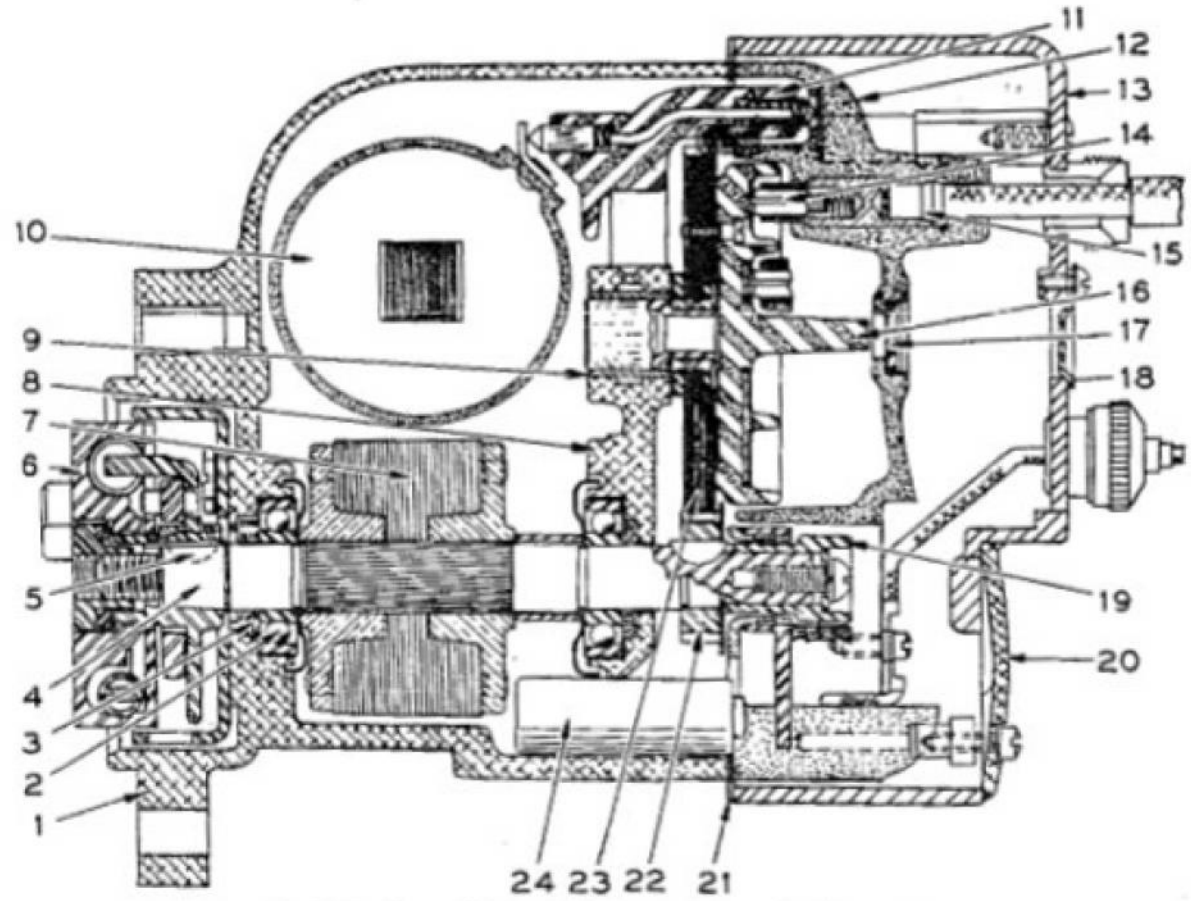

Fig. 27. Longitudinal Section through Magneto

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.

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.

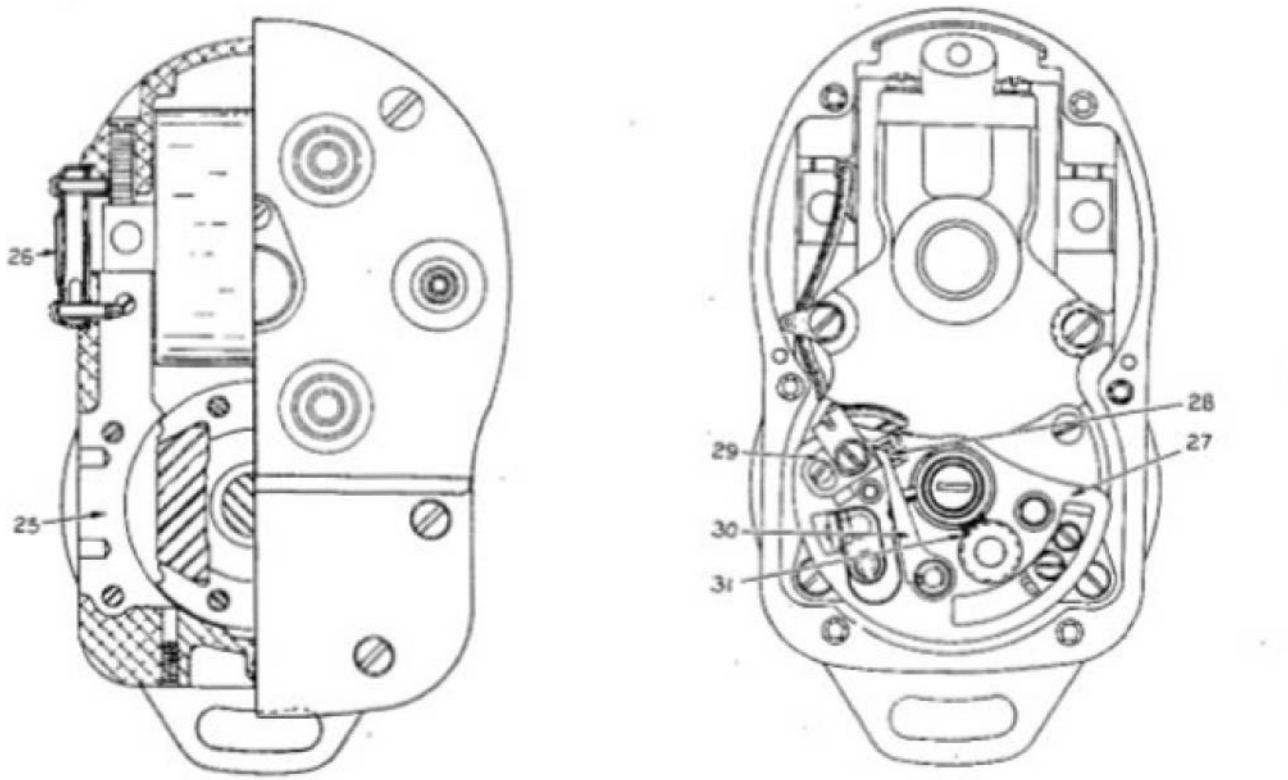

Fig. 28. Cross Section through Magneto

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. 28) 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 25 h below.)

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

i. 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

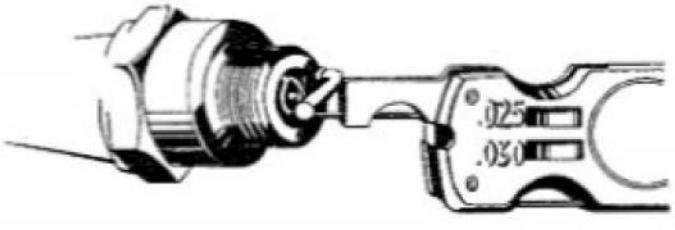

Fig. 29. Adjusting Spark Plug Gap

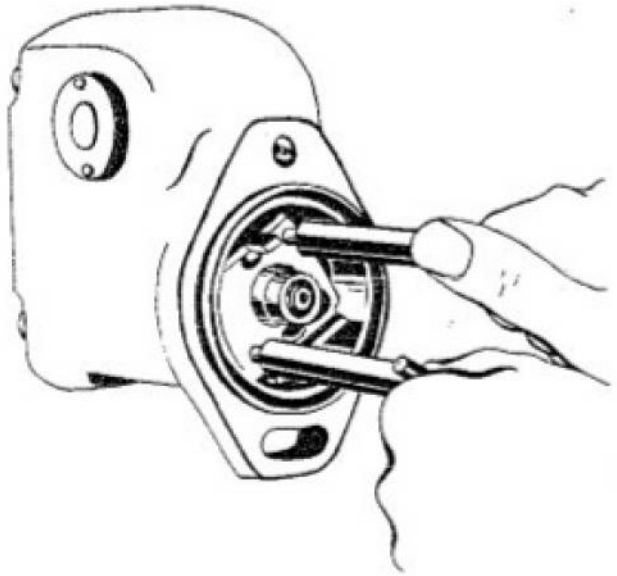

Fig. 30. Removing Impulse Coupling

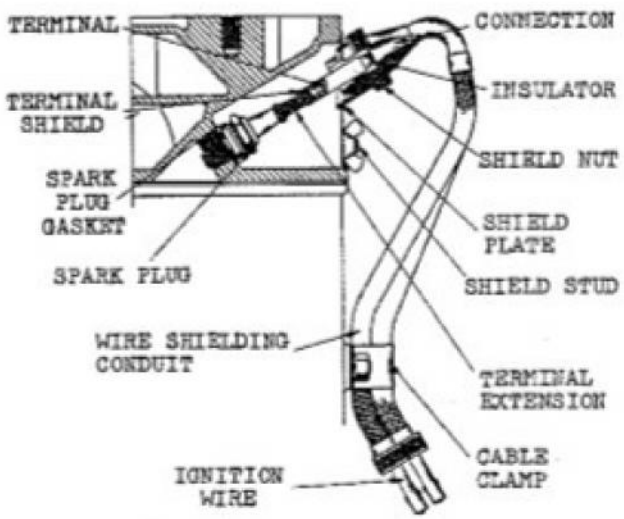

Fig. 31. Ignition Radio Shielding

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.

j. Spark Plug Cables.

If the spark plug cables are removed for any reason, mark or tag the number of each cable

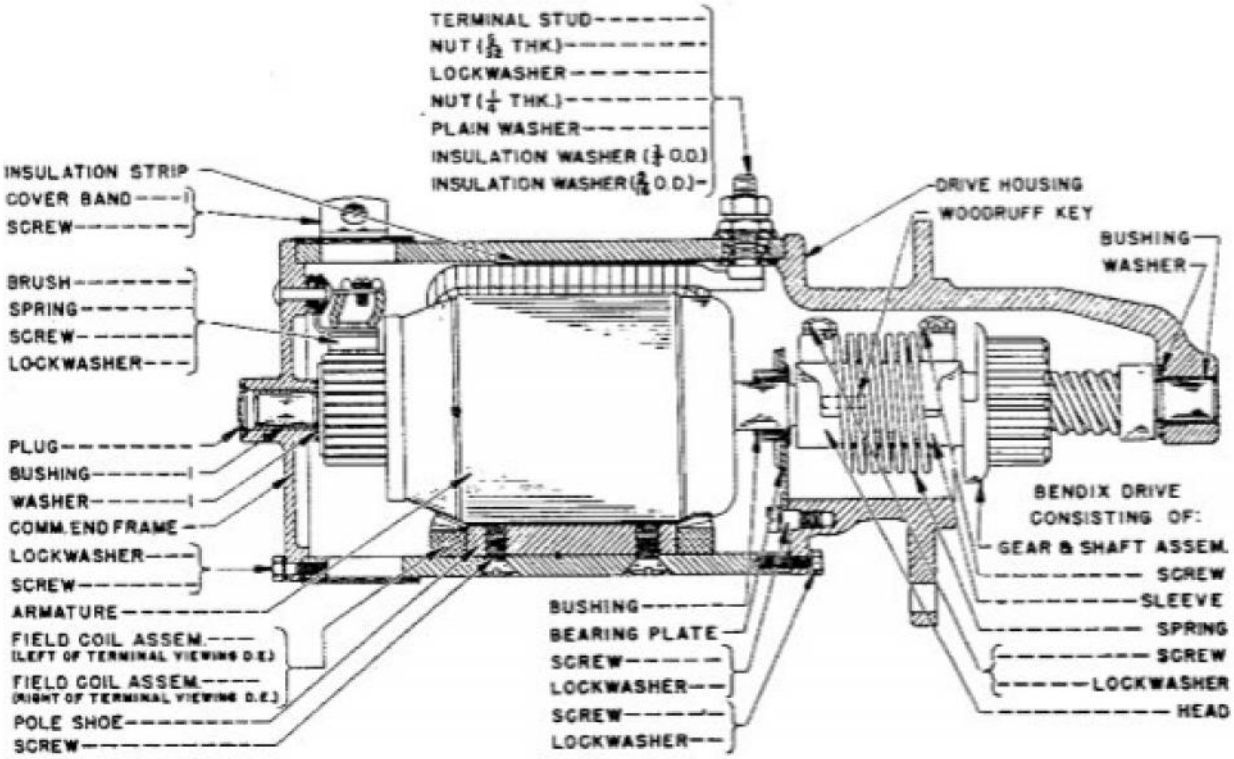

Fig. 32. Longitudinal Section through Cranking Motor

with reference to the magneto distributor cap. The wiring diagram in the appendix shows correct wiring.

26. Cranking Motor.

a. Service Instructions.

(1) No lubrication is required to service this motor, since all three bushings are of the oilless type. However, whenever the cranking motor is disassembled for cleaning, put a few drops of light engine oil in each bushing.

(2) Remove the cover band and inspect the commutator and brushes at regular intervals (approximately once every three months).

(3) If the commutator is dirty, clean with No. 00 sandpaper. **Never use emery cloth.**

(4) If the commutator is rough, out of round, or has high mica, turn it down in a lathe.

(5) Replace worn brushes. Check for high brush-spring tension, rough commutator or high mica if rapid brush wear is experienced.

(6) Burned commutator bars indicate open circuited armature coils. Inspect soldered connections at the riser bars, resolder if necessary and turn down commutator.

(7) The magnetic switch will require no servicing except to make sure that connections are tight and cover plug securely in place.

b. If Cranking Motor Does Not Operate Properly.

(1) Check battery, battery cables and connections.

(2) Remove cover plug from magnetic switch to make sure that the plunger is pulling in to close the cranking-motor-to-battery circuit when control switch is operated.

(3) Check commutator and brushes as above.

(4) Check for tight or dirty bushings, bent shaft or worn bushings which would allow the armature to drag on pole shoes.

(5) If the trouble has not yet been found, remove cranking motor, inspect Bendix drive, and check cranking motor specifications, which should be as follows:

Clockwise rotation viewing drive end.
Brush spring tension 36 to 40 ounces.
No load test—80 amperes at 11.2 volts at 4,500 rpm.
Stall torque test—670 amperes at 5.35 volts give 32 pound-feet torque.

Caution: Never operate the starter continuously for more than 30 seconds without pausing to permit the cranking motor to cool off. Excessively long cranking periods will cause the cranking motor to overheat and fail.

27. Magnetic Switch.

The magnetic switch requires no attention or lubrication. Check occasionally to make sure that mounting screws and electrical connections are clean and tight.

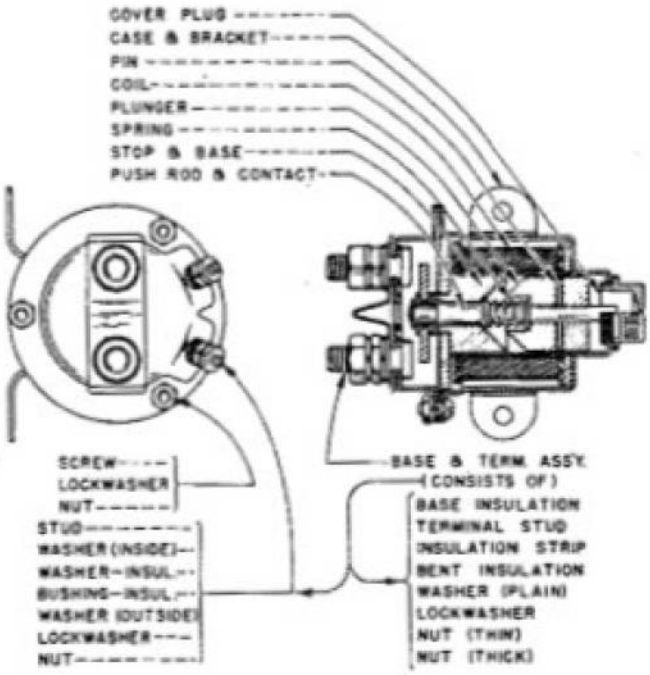

Fig. 33. Cross Section through Magnetic Switch

28. Generator.

The control unit consists of a cut-out relay which opens and closes the circuit between the generator and the battery, and a voltage control, which permits full generator output of from six to eight amperes (generator at operating temperature) until the battery becomes charged, at which time the voltage control operates and reduces the generator output to a small trickle charge of approximately two amperes—sufficient to maintain the battery in a charged condition without overcharging it.

(1) Add from eight to ten drops of light engine oil to each hinge cap oiler every 128 hours of operation.

(2) Remove the cover band and inspect the

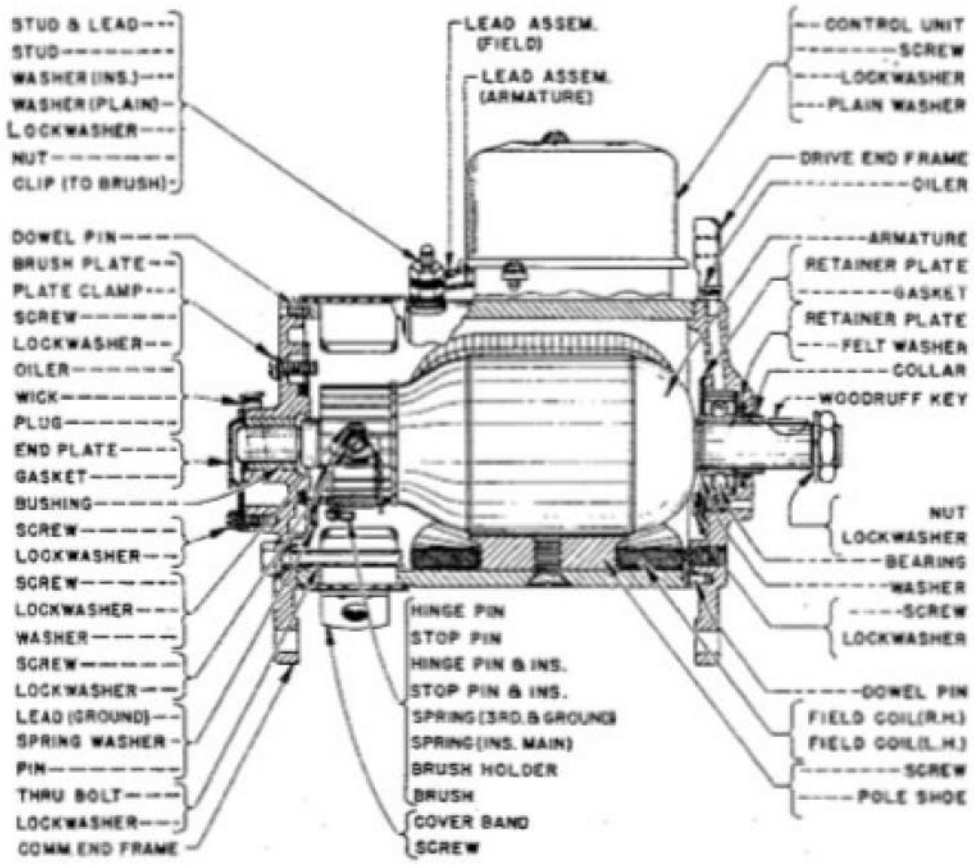

Fig. 34. Longitudinal Section through 12 Volt Generator

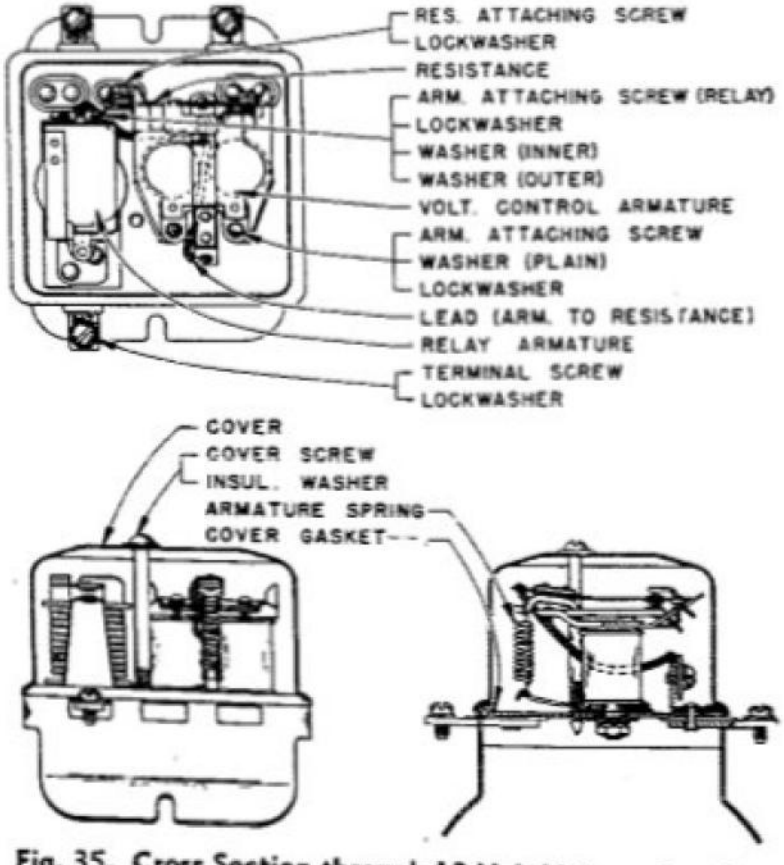

Fig. 35. Cross Section through 12 Volt Voltage Regulator

commutator and brushes at regular intervals (approximately once every three months).
(3) If the commutator is dirty, clean with No. 000 sandpaper. **Never use emery cloth.**
(4) If the commutator is rough, out of round, or has high mica, turn it down in a lathe, and undercut the mica.
(5) Replace worn brushes. Check for high brush-spring tension, rough commutator or high mica, if rapid brush wear is experienced.
(6) Burned commutator bars indicate open-circuited armature coils. Inspect the soldered connections at the riser bars, resolder if necessary, then turn down the commutator and undercut the mica.
(7) Be sure all leads are in good condition and all connections are tight. Generator specifications are as follows:

Clockwise rotation viewing drive end.
Brush spring tension—16 ounces.
Output at operating temperatures—6-8 amperes at 14.1-14.5 volts at 2400 rpm.

Voltage control specifications are as follows:

Cut-out relay closes—12.9-13.9 volts.
Voltage control points open (to cut down generator output)—14.1-14.7 volts.
Voltage control points close (to permit output to increase)—12.0 volts maximum.

NOTE: No attempt should be made to test or adjust any part of the generator circuit without the proper testing equipment.

Never operate the generator on open circuit (circuit between the generator and battery disconnected). To do so will cause damage to the generator. It is possible to operate with the circuit open between the generator and battery if the lead is disconnected from the F terminal of the generator.

29. 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

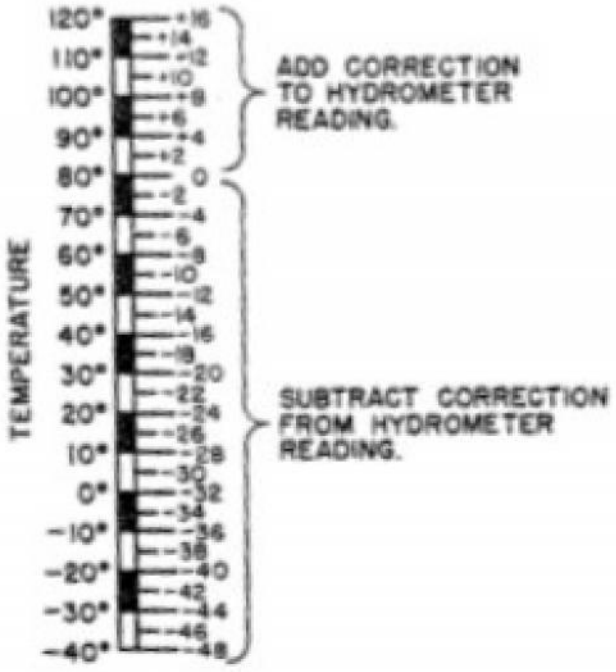

Fig. 36. Hydrometer Reading Correction Chart

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. Adjust 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. 36, 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.

30. Control Switch Box.

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 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.

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.

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.

31. Carburetor.

In servicing the carburetor, refer to Figs. 37 and 38.

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

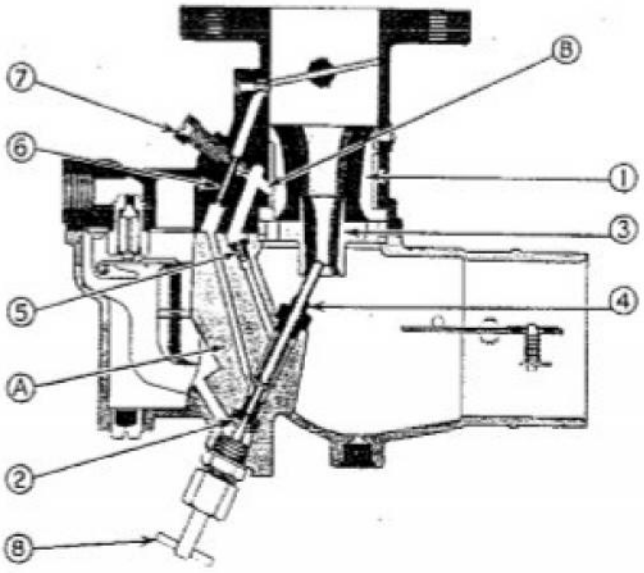

Fig. 37. Cross Section through Carburetor

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.

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 capscrews 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 31h.** 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 31k.)
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.
(30) Refer to paragraph for list of parts recommended for replacing when overhauling this type of carburetor.

g. Reassembly.
(1) Install air-shutter shaft packings and packing retainers.
(2) Install air-shutter shaft and air shutter. (See paragraph 31j.) 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 31h. 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 38, the A dimension should be $1\frac{3}{64}$ inches plus or minus $\frac{3}{64}$ 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.

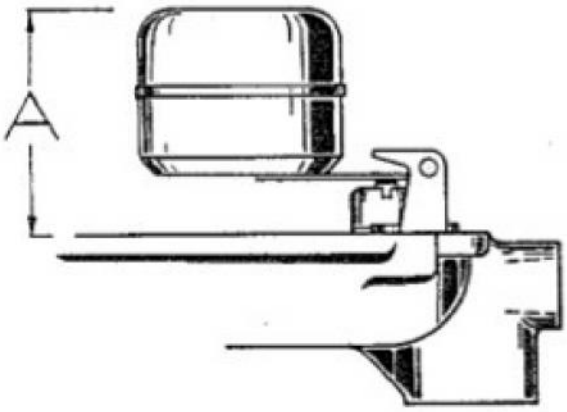

Fig. 38. Float Level Adjustment Diagram

(27) Install assembly screws and lockwashers. Be sure to tighten screws evenly and securely, using a screwdriver or a $\frac{5}{16}$-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

32. Fuel Pump.

a. Operation.
The rotation of the camshaft eccentric actuates the rocker arm, which pulls the link,

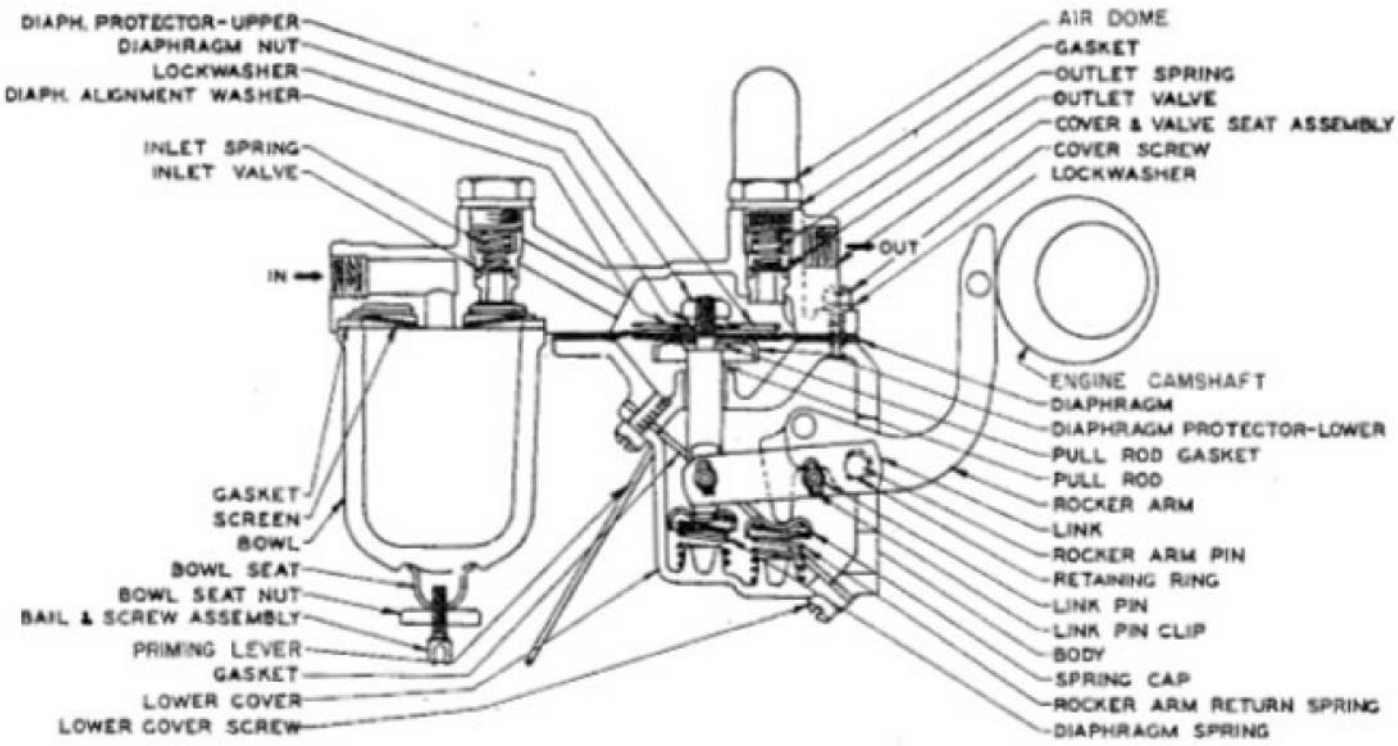

Fig. 39. Cross Section through Fuel Pump

diaphragm, and pull rod assembly downward against the diaphragm spring pressure, creating a vacuum in the pump chamber.

On the suction stroke of the pump, fuel from the tank enters through the inlet into the sediment bowl, passes through the screen and on through the inlet valve into the pump chamber.

On the return stroke, the diaphragm-spring pressure pushes the diaphragm upward, forcing fuel from the pump chamber through the outlet valve 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 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 is merely for the purpose of keeping the rocker arm in constant contact with the camshaft.

b. Service Instructions. Fuel pump repairs are divided into two classifications:
(1) Repairs made without disturbing pump installation.

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.

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.

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.

(2) Repairs which necessitate removal and disassembly of the pump.

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

c. Procedure in Assembling.

(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 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.

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.

(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.

(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.

(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.

33. 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-

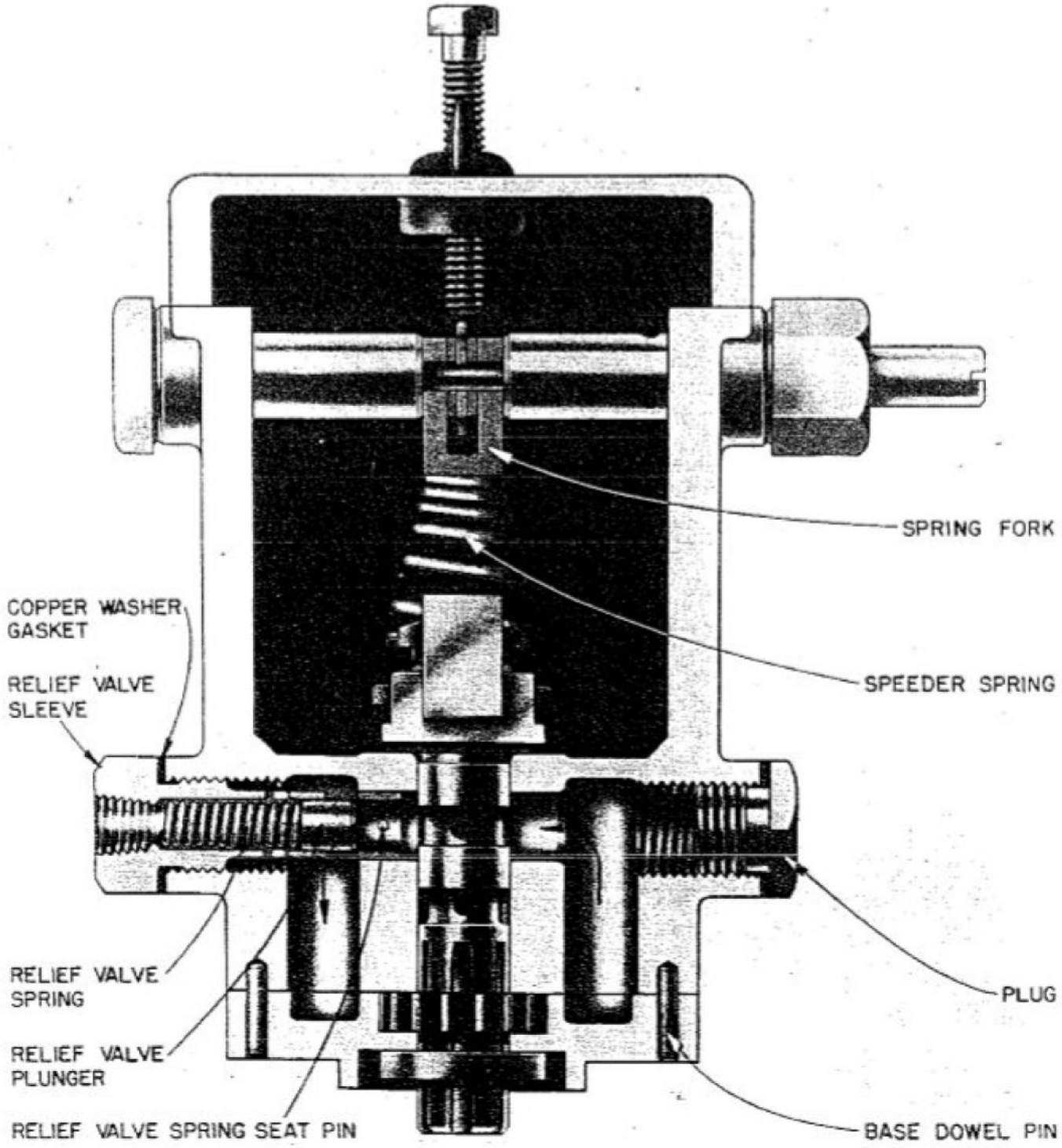

Fig. 40. Governor Cut-away Section—Front

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.

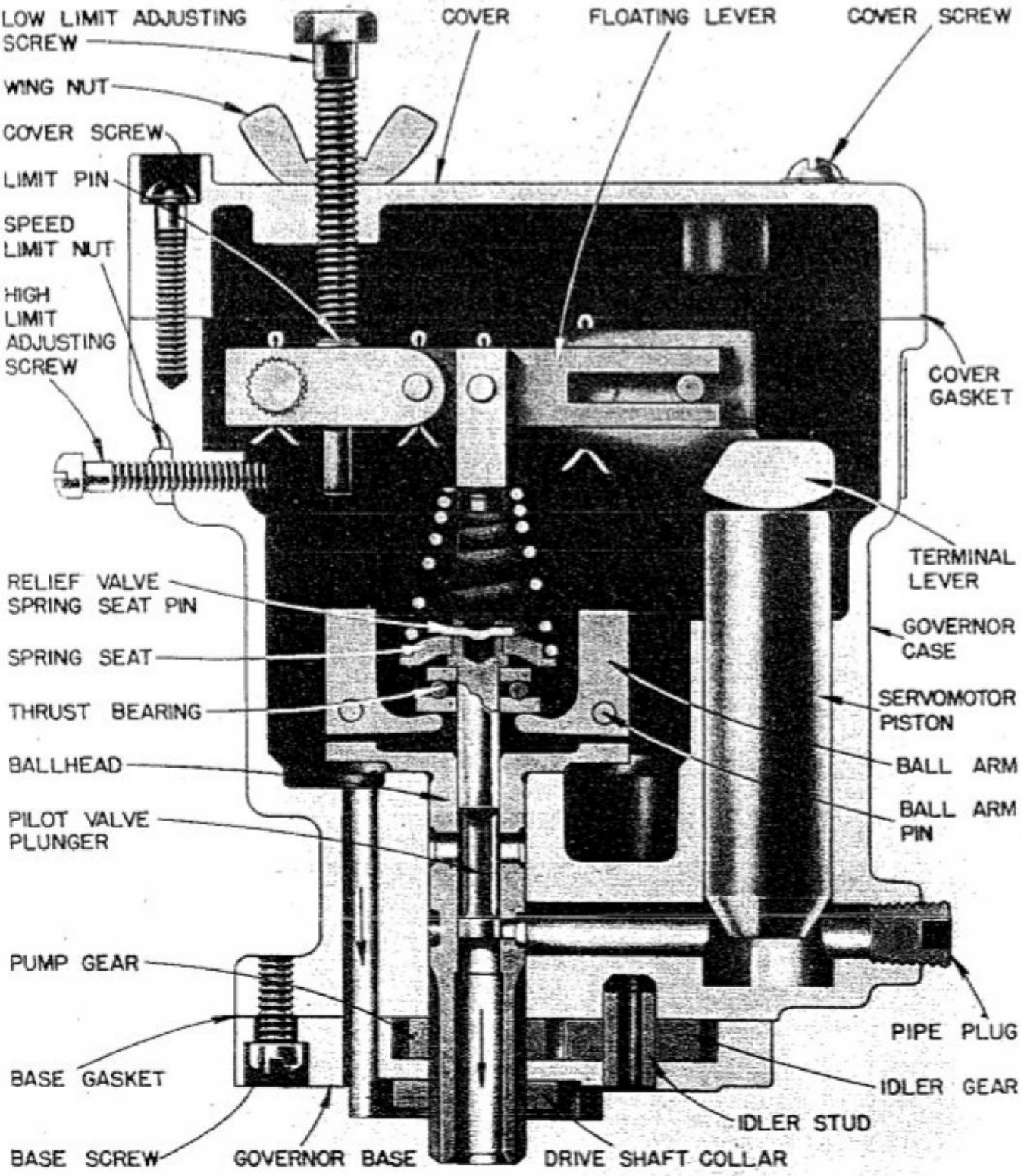

Fig. 41. Governor Cut-away Section—Side

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,

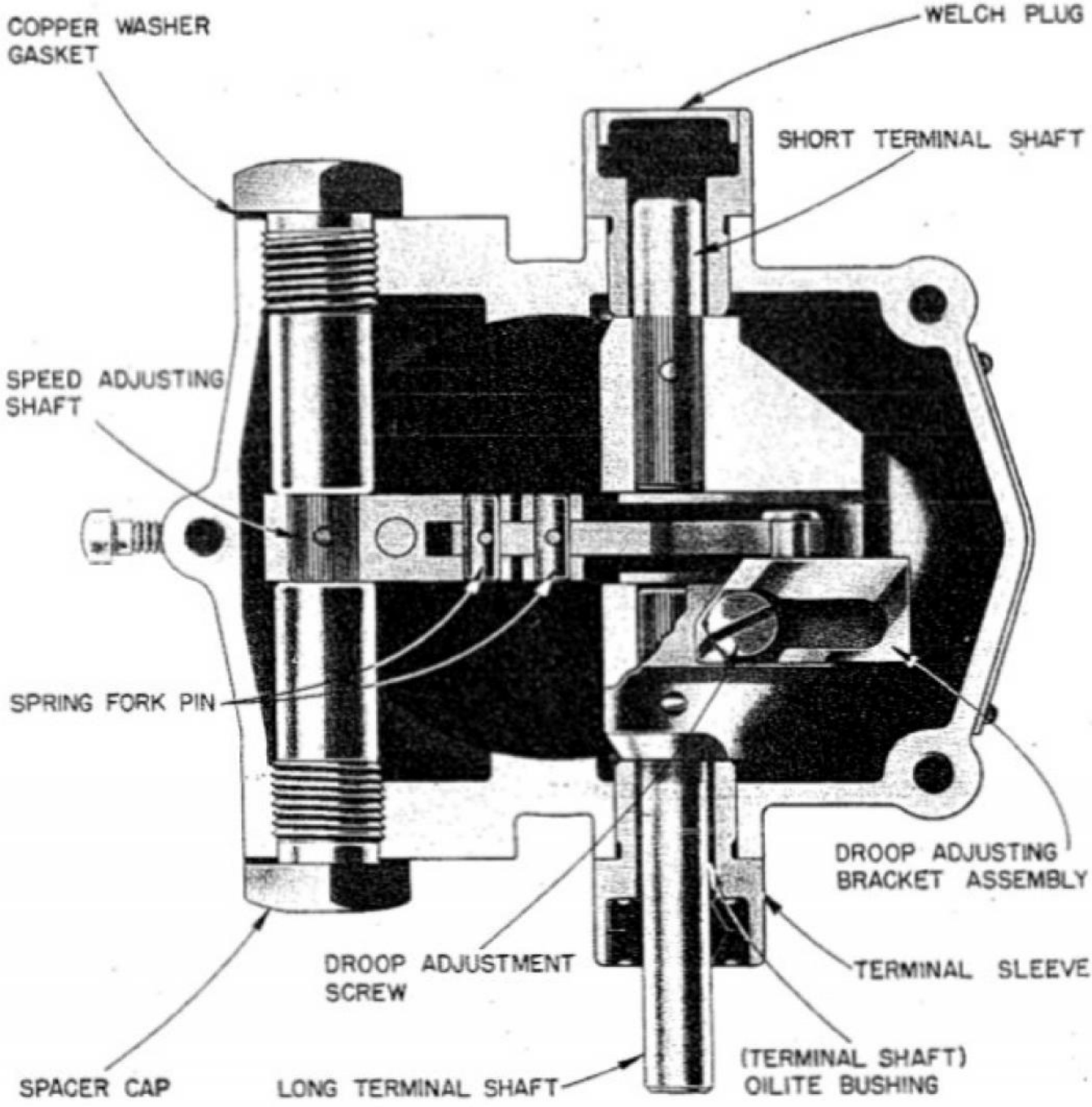

Fig. 42. Governor Cut-away Section—Top

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.

(Refer to Fig. 45.) The governor has been mounted vertically on the engine with a gasket between its base and the adapter pad. A $\frac{9}{16}$-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.

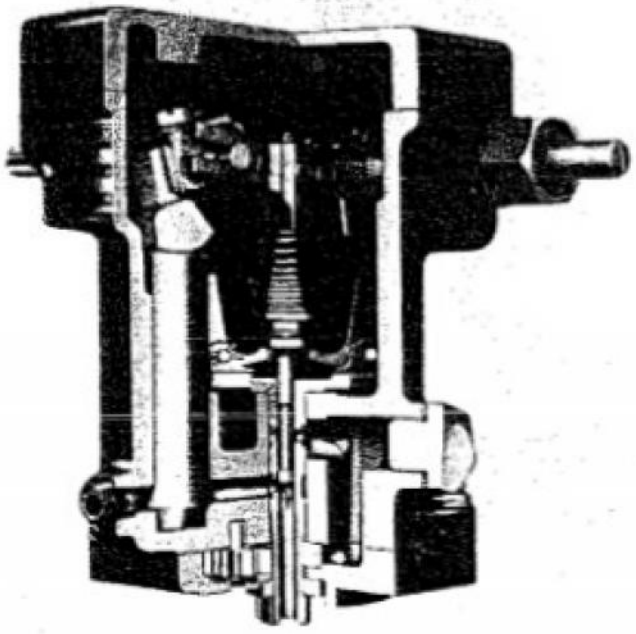

Fig. 43. Governor Operating Speed Position

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 Fig. 45), 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.

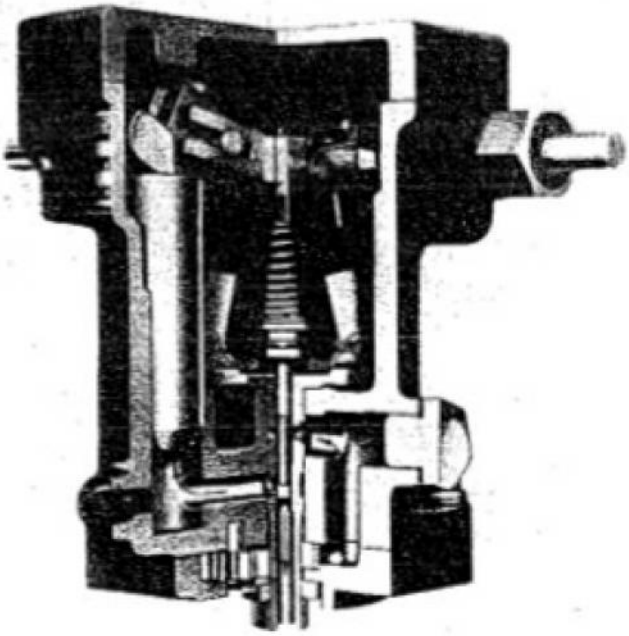

Fig. 44. Governor—Start Position

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

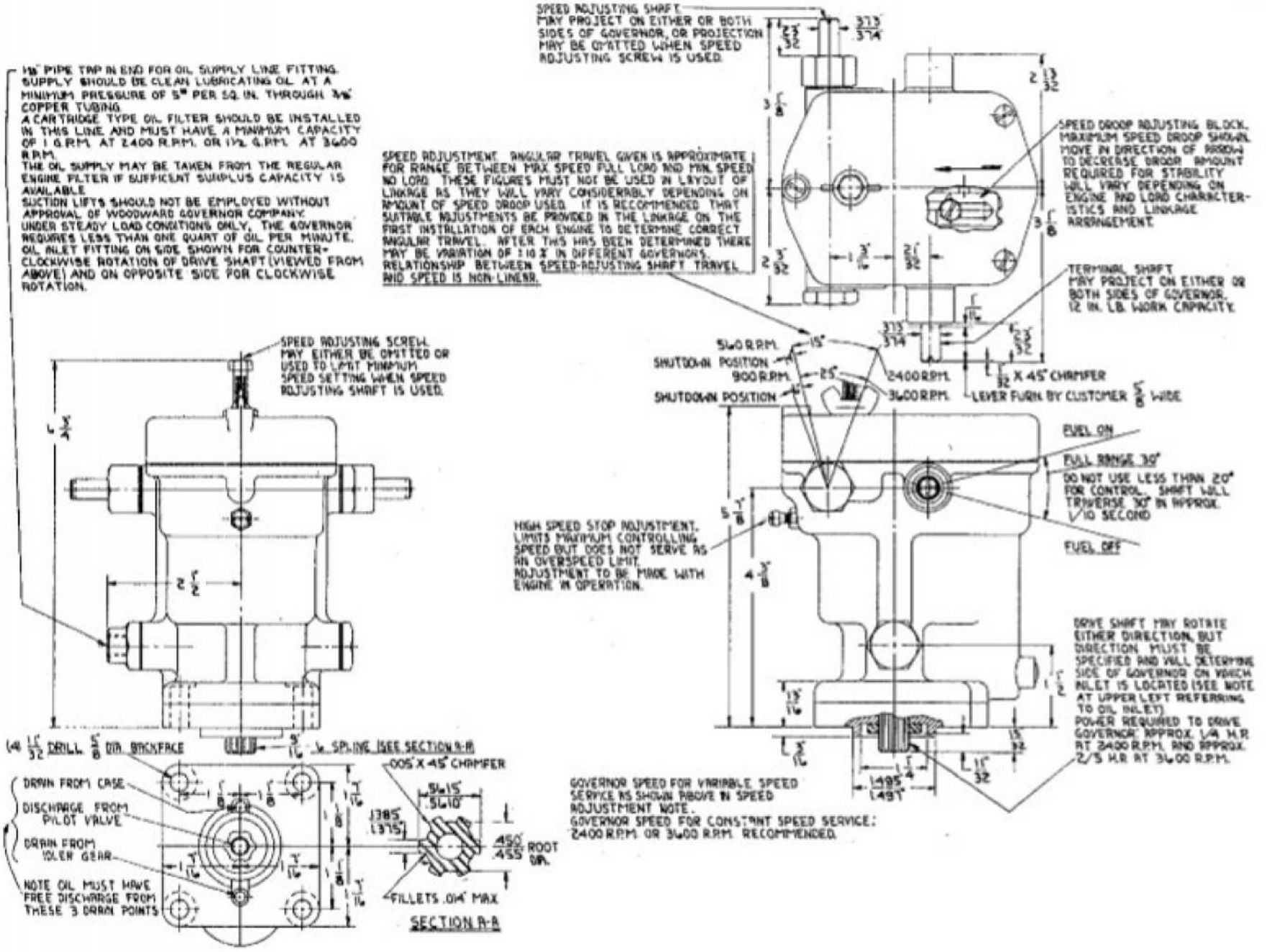

Fig. 45. Governor Installation and Dimensional Drawing

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.

34. Maintenance of Alternator.

a. Protection.

The alternator should be protected carefully against moisture, both before and after erection. It is particularly important to keep the windings dry since 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.

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 current in the damper windings, 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. The damper winding in this generator is designed for satisfactory single phase operation.

c. Collector Rings and Brushes.

(1) Sparking.

If sparking between the brushes and the collector rings occurs, 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. Pressure is correct when sparking is negligible.

Brushholder 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 brushholder by cleaning both thoroughly when necessary.

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

(d) 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.

35. 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.

36. 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	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.		
or CROSS CONNECTING MATERIAL FOR D-C ARMATURES	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.

37. Rewinding Material Classifications.

A careful analysis of what constitutes rewinding material has been made, and the following classifications for different types of rewinding material have been prepared. These classifications will meet all conditions.

All orders for rewinding material should be in line with these classifications.

38. 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

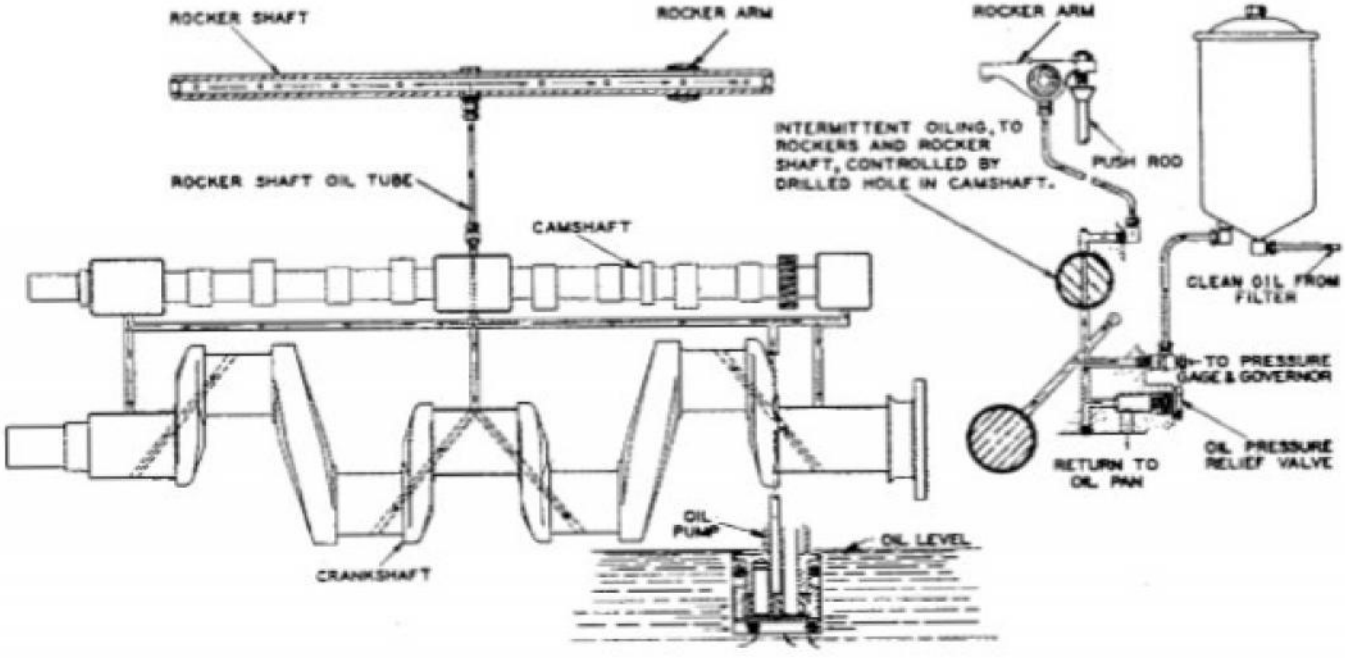

Fig. 46. Oil Circulation Diagram

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.

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.

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 slude. See paragraph 38d above.

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. 5) 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. A small amount of WB-3, sufficient to maintain a film of lubricant over the surface of the balls and races, is essential. Too much grease will cause churning, overheating and grease leakage. If grease leakage occurs, the bearing has been overfilled, or the grease used is not suitable for the particular application.

If high pressure guns are used, great care should be used to avoid over-lubrication.

When shipped from the factory, grease lubricated ball bearings have sufficient grease of the right grade to last for a limited period. However, a charge of grease should be added soon after the generator is put in operation, and thereafter at suitable intervals, as determined by experience. As a guide, it is suggested that grease should be added every six months of operation. If experience indicates that these quantities result in a surplus of grease in the bearing, the quantity should be reduced or the greasing periods lengthened, or both. The ideal condition is that the bearing housing be from one-third to one-half full of grease. **See Lubrication plate on generator.**

New grease is introduced at the side of the bearing farthest from the body of the generator. A sufficient charge will force the old grease through the rolling members and out a partially restricted escape port during operation.

A surplus grease sump below bearing is supplied and it should be kept empty at all times. Excess grease is removed from the sump through pipe plug openings. Periodic greasing and cleaning of the surplus grease sump will prevent damage to the bearings from deteriorated grease and will reduce or eliminate the need for bearing overhaul.

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.

SECTION IV. PARTS LIST

INDEX TO PARTS LISTS FOR POWER UNIT PE-145-A

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.

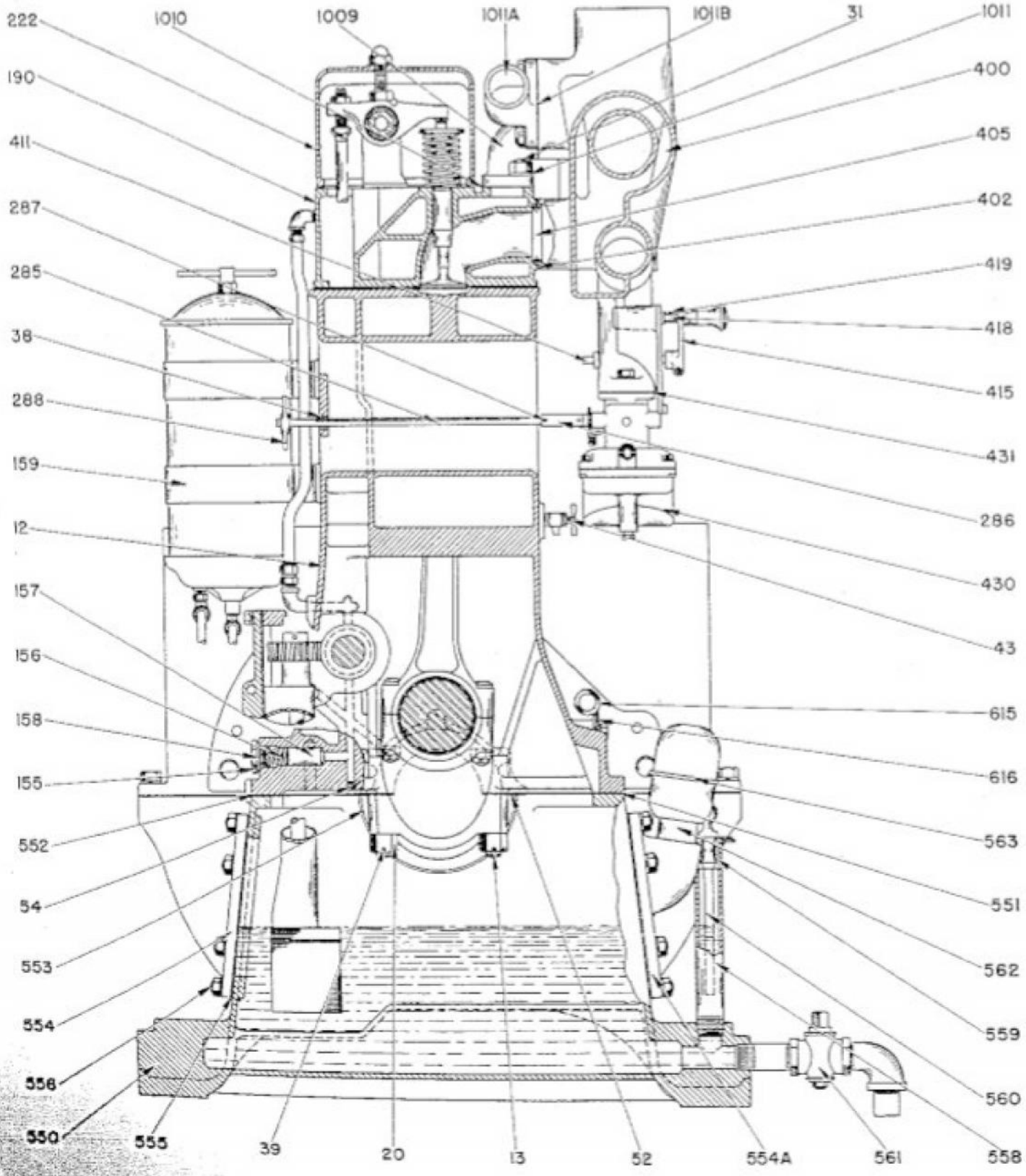

Fig. 47. Cross Section through Engine

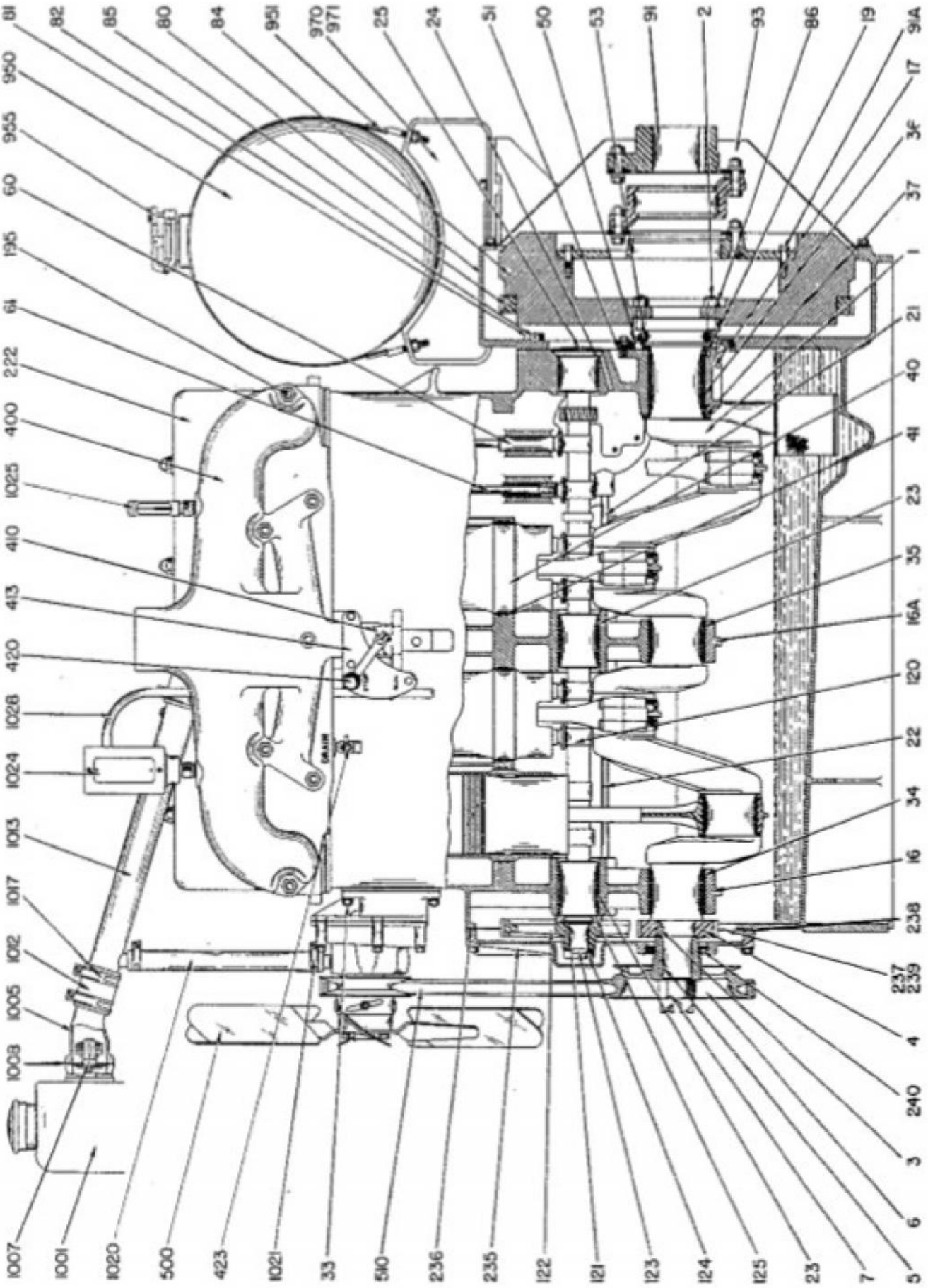

Fig. 48. Longitudinal Section through Engine

39. Crankshaft

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr'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	36-518	A
7		1	Cranking jaw	96-27	A

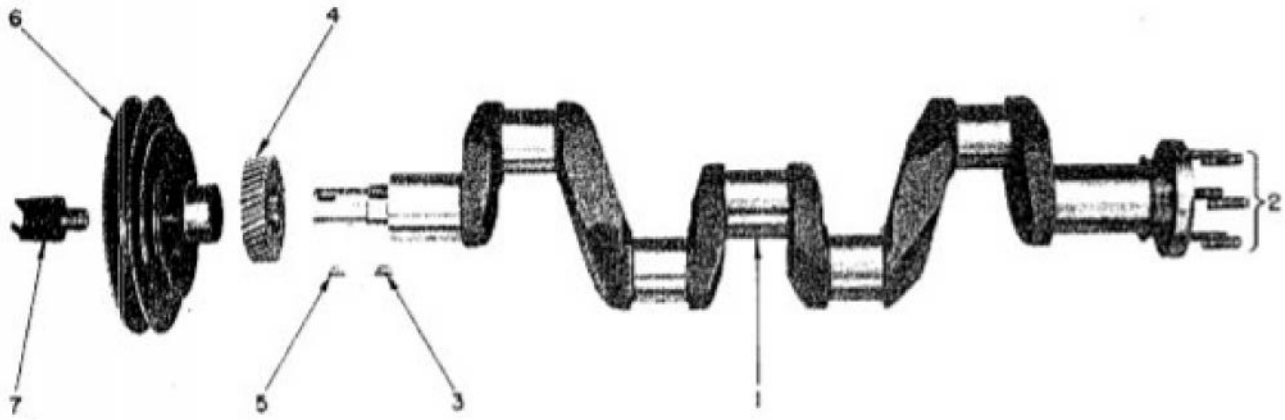

Fig. 49. Crankshaft and Component Parts

40. Crankcase

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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.)	3A100-149-5	A
13		12	Capscrew—Main Bearing	34-217	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

40. Crankcase (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Function	Mfgr's. Part No.	Mfgr's. Code
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 3/16", Type U		03-2001	A
..	3H4574/P21	1	Name Plate		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		175-6-1	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
..	3H4574/D7	1	Decal. (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		16-907-1	A
..		3	Capscrew, 5/16—18 x 3/4" 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—1/4" Slotted		19-13	A
55		5	Pipe plug, 3/8"		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	Instr. plate		62-110	A
..	3H4574/S18	4	Screw—Parker Kalon #2 x 3/16" Type U		03-2001	A
..		1	Stud, oil line clamp, 5/16 x 1"		B105-39	A

41. Bell Housing, Flywheel and Coupling

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
80	3H4574/H20	1	Bell housing—upper half	37-221	A
81		3	Capscrew, ¾—16 x 1½" hex.	34-37	A
82	3H4574/W10	1	Locking wire	61-44	A
..		2	Capscrew, ½—13 x 1¼" hex.	02-70	A
..		2	Lockwasher, ½"	05-53	A
84	3H4584A/F5	1	Flywheel assembly, Includes ring gear	A9-486-3	A
85	3H4574/G36	1	Ring gear, 8/10 pitch	26-270	A
86	3H4574/N3	6	Nut, ½"—20 hex. slotted	B53-25	A
..	3H4584A/P33	6	Cotter pin, 3/32 x 1" lg.	07-23	A
91A		8	Capscrew, ⅜—16 x 1¼" hex. hd.	34-209	A
..		8	Lockwasher, ⅜"	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, ⅜—16 x ⅝" hex.	02-33	A
..		6	Lockwasher, ⅜"	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, 2⅝" Bore, special	21188	E
..	3H4584A/R38	2	Laminated rings—Flexible (20 pieces)	10957	E
..	3H4584A/B40	16	Bolt, ½—20 x 2" lg. special	10966	E
..	3H4584A/W5	16	Washer—Beveled, ½	10965	E
..	3H4584A/N50	16	Nut, ½"—20, "Stay-on"	11118-6	E

42. Connecting Rod

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. PartNo.	Mfgr's. Code
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, 1/16" x 20 hex. special	53-31	A
104		8	Bearing shell—Connecting rod, ½	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

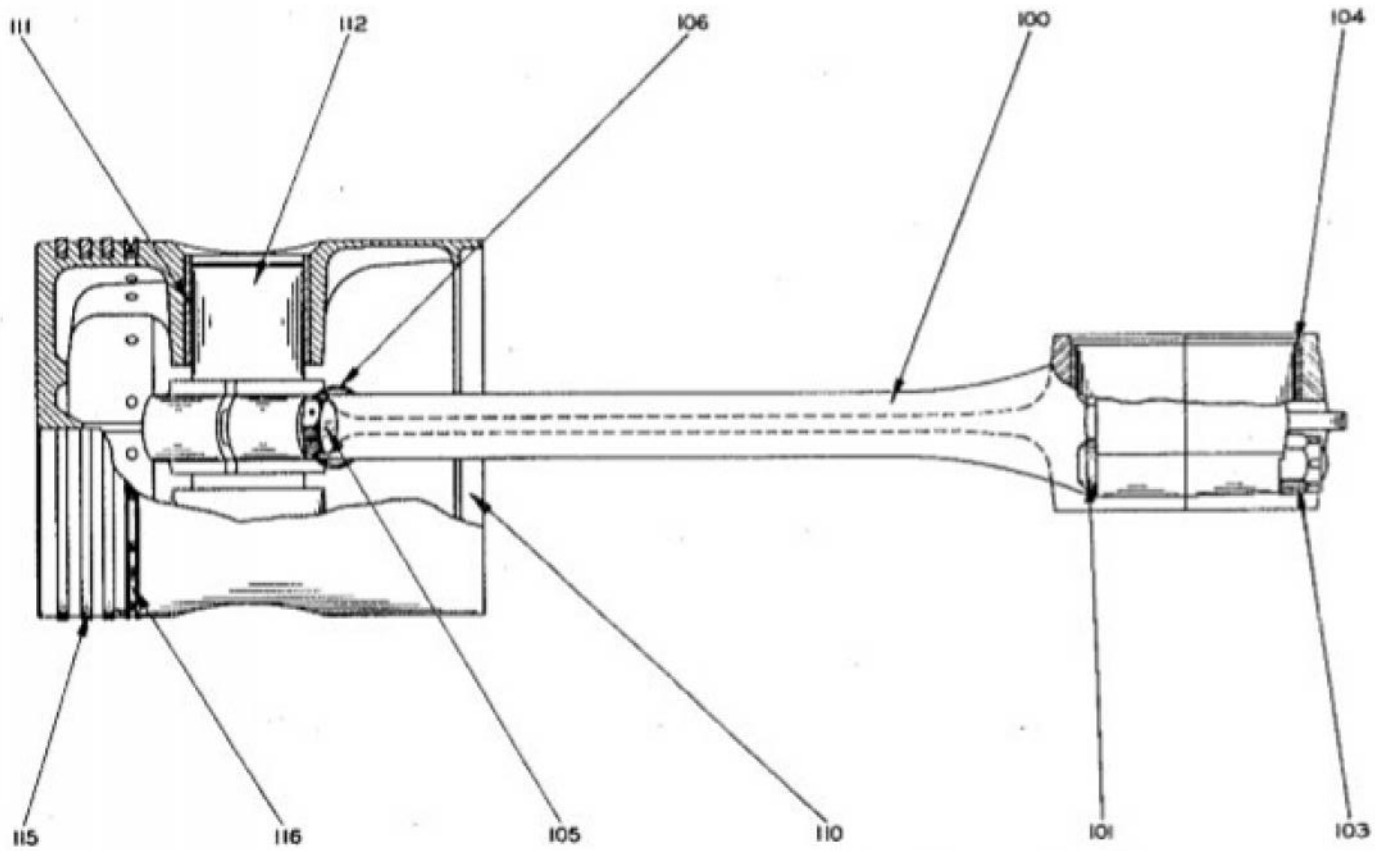

Fig. 50. Cross Section through Connecting Rod and Piston Assembly

43. Piston

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Function	Mfgr's. Part No.	Mfgr's. Code
110		4	Piston Assembly, includes pin and bushings		1A8-208-3	A
111	3H4584D/B18	8	Bushing—Piston pin		21-334	A
112		4	Piston pin		B17-17	A
115	3H4584A/R7	12	Compression ring—P. C. 4½ x ⅛"		18-233	A
116	3H4584A/R8	4	Oil Ring—P. C. 4½ x 3/16"		18-114	A

44. Camshaft

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

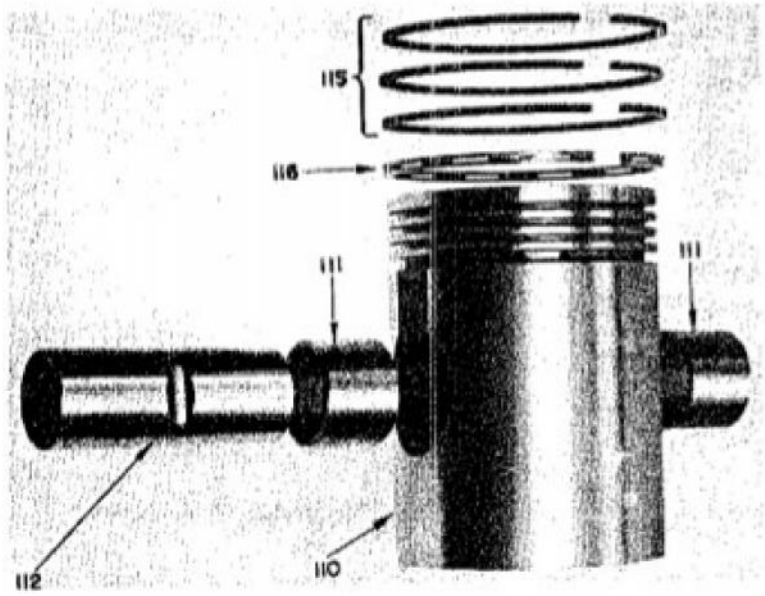

Fig. 51. Piston and Component Parts—Left

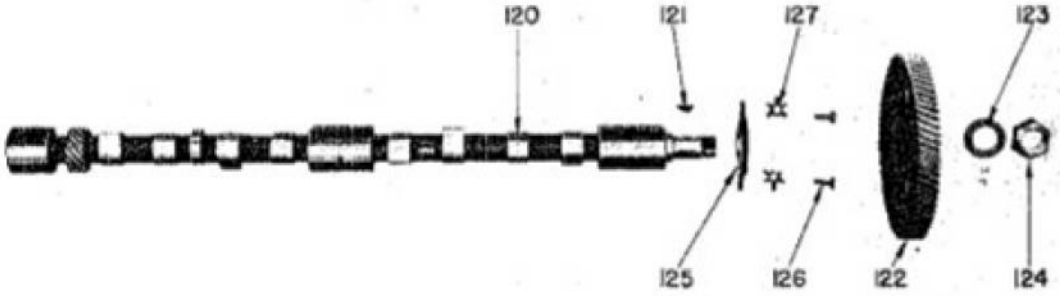

Fig. 52. Camshaft and Component Parts

45. Lubrication, Oil Pump, Lines and Filter

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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
133-140		2	Key—Oil pump gear, Woodruff #6	09-6	A
134-141		2	Oil pump gear	26-519	A
135-142		1	Lock wire—Oil pump gear	64-29	A
143		1	Cover—Oil pump	14-538	A
148		6	Capscrew, ¼—20 x ⅝" 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
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
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

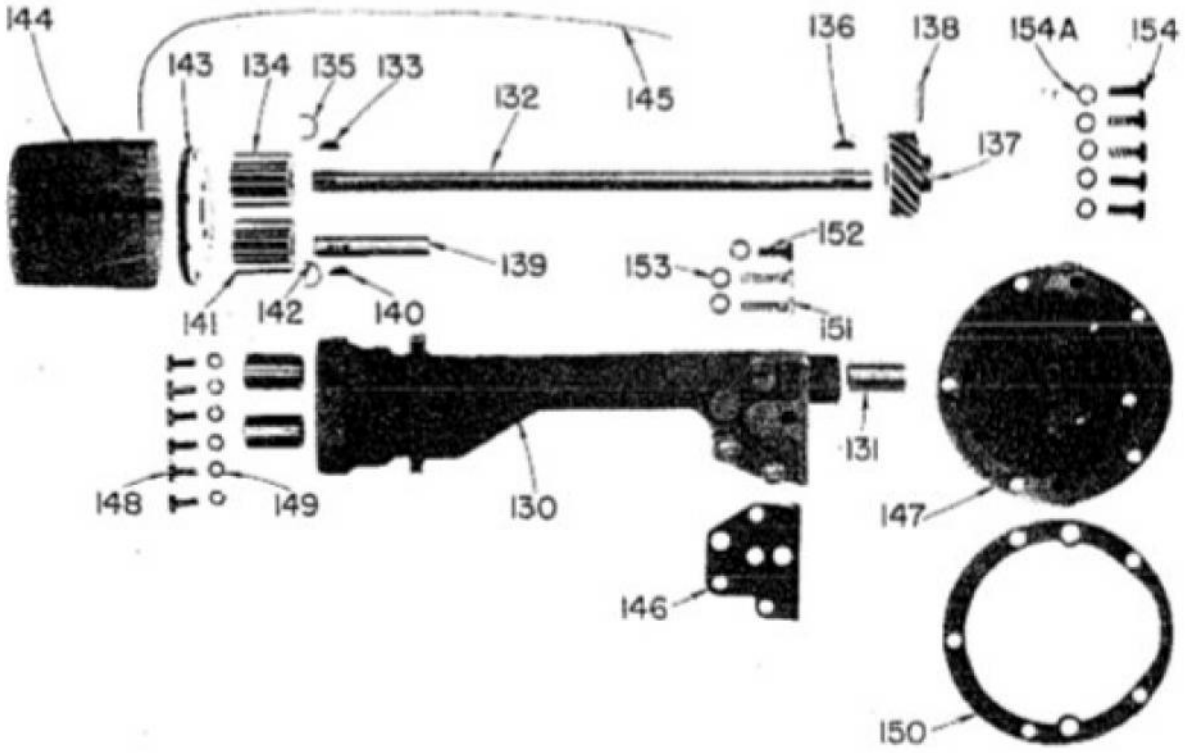

Fig. 53. Oil Pump and Component Parts

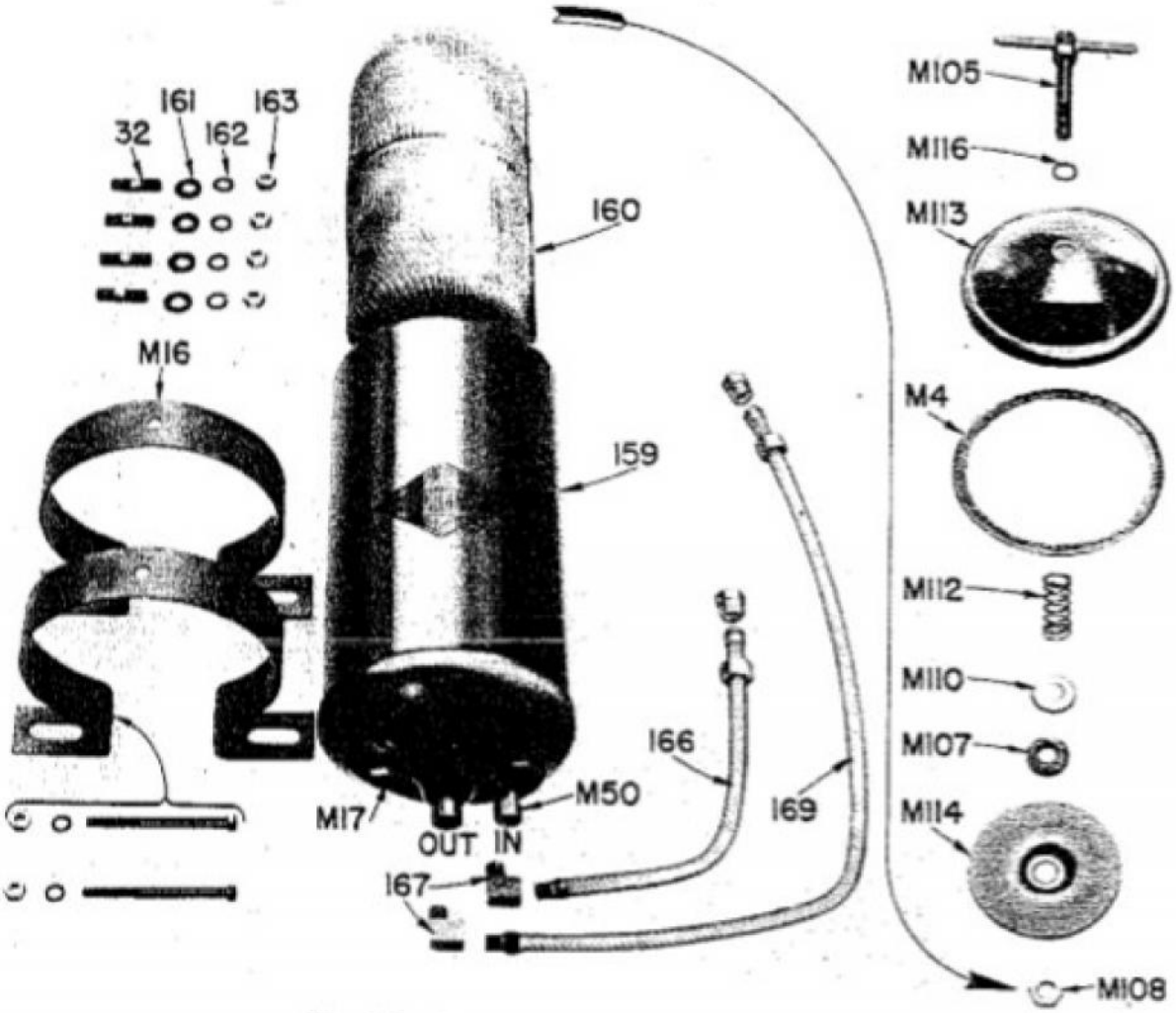

Fig. 54. Oil Filter and Component Parts

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

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr'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)	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, 10 1/4" lg.	A55-642-5	A
167	3H4574/E18	4	Connection, 1/8" x 90° brass str. ell	33-542	A
169	3H4574/L34	1	Oil line—Filter outlet, Titeflex metal, 21 1/2"	A55-642-7	A
171	3H4574/C48	2	Connection—Filter lines, 1/8" brass nipple	33-544	A
172	3H4574/L9	1	Oil line—To cyl. hd., Titeflex metal hose, 16 1/4" lg.	A55-642-4	A
173	3H4574/E18	2	Connection—Cyl. hd. oil line, 1/8" 90° brass str. ell	33-542	A
174	3H4574/C48	1	Connection—Cyl. hd. oil line, 1/8" brass close nipple	33-544	A
175	3H4574/C48	1	Connection—Oil line crankcase, 1/8" brass close nipple	33-544	A
176		1	Connection—Oil line, 1/8" cross	54-101	A
164		1	Gauge—Oil pressure	60-80	A
177	3H4574/L11	1	Oil line—To oil gauge, Titeflex metal hose, 29 3/4" lg.	A55-642-8	A
178	3H4574/C48	1	Connection—Oil line to oil gauge, 1/8" brass close nipple	33-544	A
179	3H4574/L10	1	Oil line—To governor, Titeflex metal hose, 22 1/2" lg.	A55-642-6	A
...	3H4574/E18	1	Connection—Oil line to gov., 1/8" 90° brass str. ell	33-542	A
180	3H4574/C48	1	Connection—Oil line to gov., 1/8" 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
...	3H45884A/T5	1	Brass tee, 1/8 x 1/8 x 1/8"	33-554	A
...	3H4574/E16	1	Brass elbow, 1/4 x 1/8", special reducing	33-547	A
...	3H4574/L14	1	Oil line—Pressure switch to gauge, Titeflex metal hose, 11 5/8" lg.	A55-642-13	A
...	3H4574/C48	2	Brass close nipple, 1/8"	33-544	A

46. Cylinder Head

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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 ⅛ 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
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, ⅛" 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

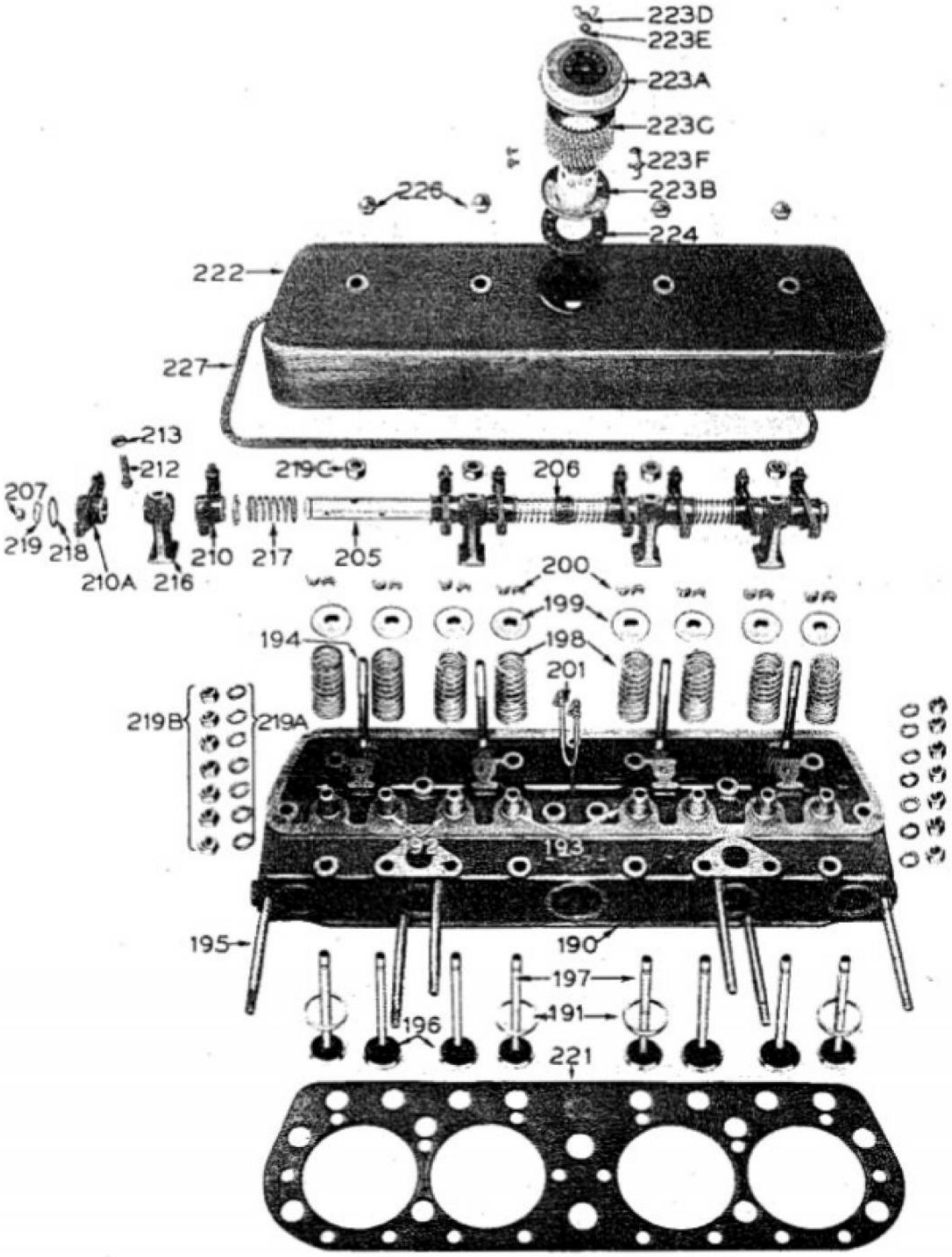

Fig. 55. Cylinder Head and Component Parts

46. Cylinder Head (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
223D		1	†Wing nut, 3/8" std	04-1002	A
223E		1	Lockwasher, 3/8"	05-51	A
223F	3H4574/S63	4	Screw—Breather, Parker Kalon, Type Z Stove head #10 x 3/8"	03-1538	A
224	3H4574/G21	1	Breather gasket N	16-643-1	A
226	3H4574/N7	4	Nut—Cylinder head cover, 1/16"—20 Acorn	04-1129	A
227	3H4574/G20	1	Gasket—Cylinder head cover	16-634-1	A

47. 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, 2 1/2" I.D.	125-58-2	A
243		11	Capscrew, 3/8—16 x 1 3/4" hex	02-39	A
244		2	Capscrew, 3/8—16 x 1 1/2"	02-38	A
245		14	Lockwasher, 3/8"	05-51	A
241		2	Taper pin, #7 x 2" lg	010-315	A
242		2	Nut, 3/8"—24 hex	04-603	A

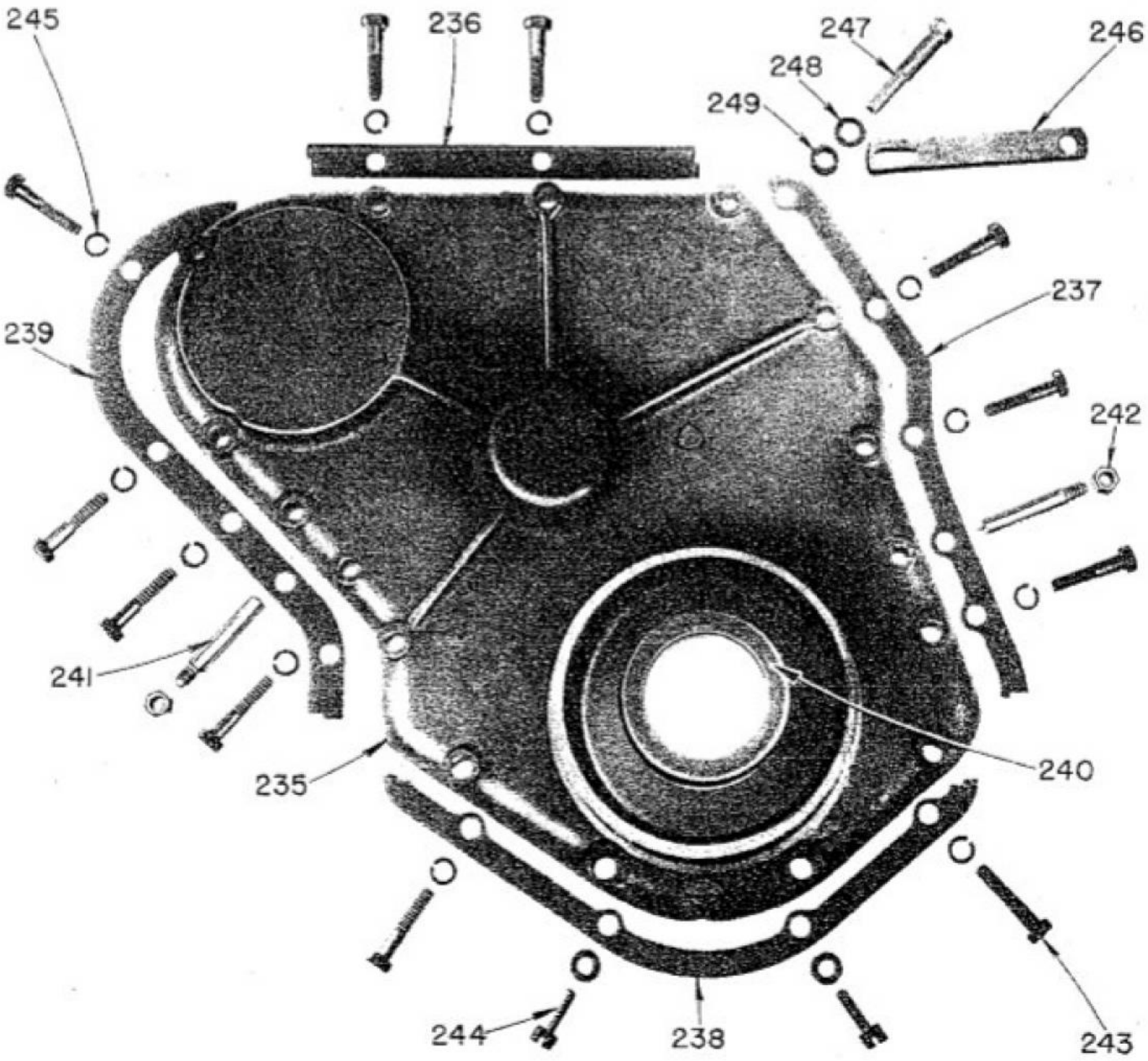

Fig. 56. Gear Cover and Component Parts

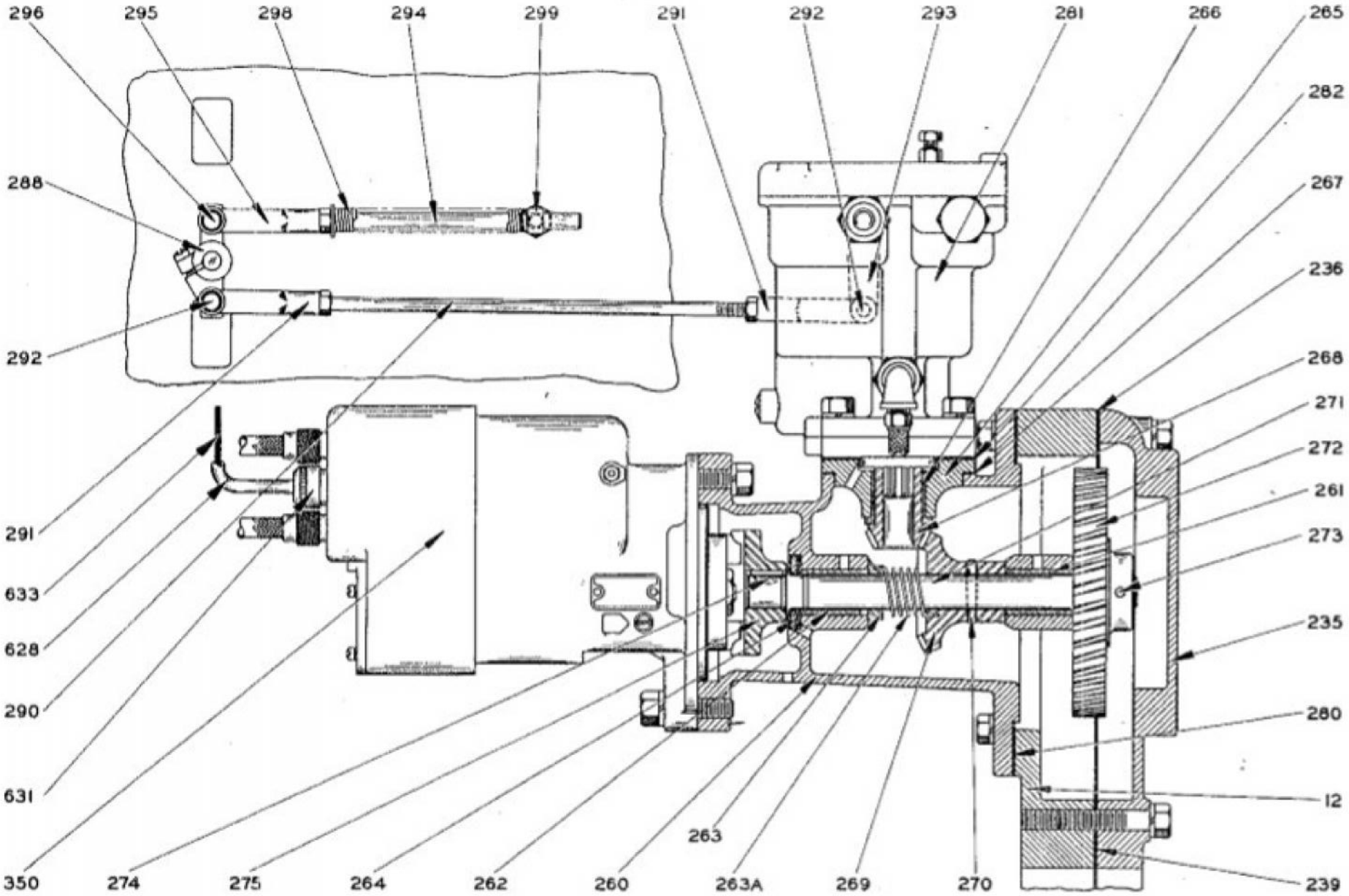

Fig. 57. Cross Section through Governor Drive Assembly

48. Governor Drive Assembly

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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
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

49. Governor Controls

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	04-501	A
292	3H4574/P8	2	Clevis pin	031-62	A
...	3H4574/P9	2	Cotter pin, 1/16 x 5/16"	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	04-501	A

49. Governor Controls (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
296	3H4574/P8	1	Clevis pin	031-62	A
...		1	Cotter pin, 1/16 x 1/16"	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

50. Manifold

400	3H4574/M5	1	Manifold assembly (Includes Welch plugs)	A10-355-1	A
...	3H4574/P29	4	Welch plug, 1 1/4" 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, 1/2"	B20-1	A
405	3H4574/C42	1	Collar—Manifold center outlet	63-94	A
...	3H4574/N8	6	Nut, 1/2"—20 hex	04-605	A
410		1	Butterfly valve	15-329	A
411		1	Shaft for butterfly valve	27-1327	A
...		2	Screw, 1/8"—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, 1/4—20 x 2" hex	02-10	A
...		2	Lockwasher, 1/4" dia	05-49	A
415		1	Control lever	48-489	A
...	3H4574/S3	1	Screw for control lever, #10—24 x 1/2" 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, 1/8" slotted	19-13	A
423	3H4574/C28	1	Drain cock, 1/4" male x 1/4" female	15-338	A

51. 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, 3/8 x 24" lg	16-886	A

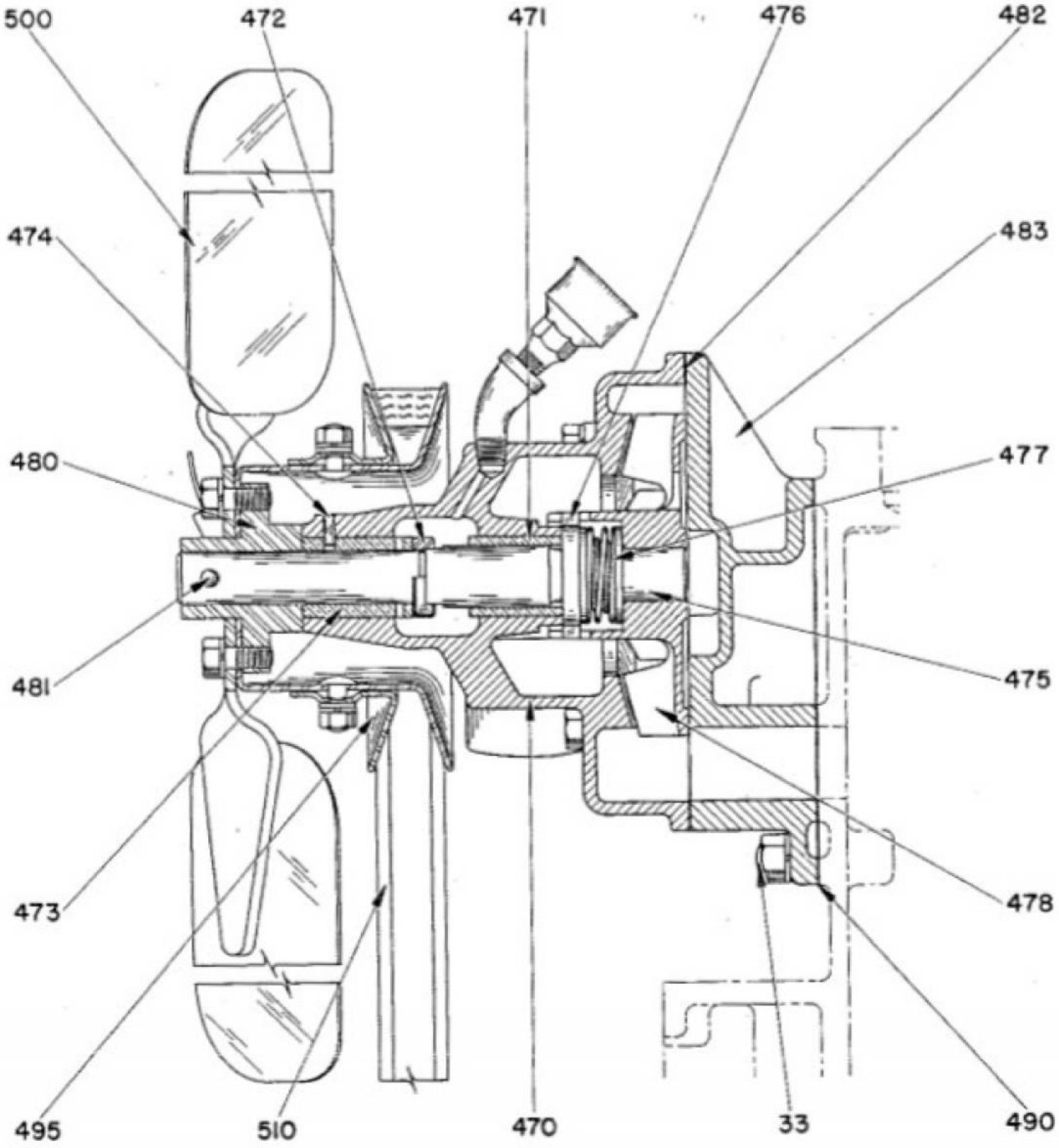

Fig. 58. Cross Section through Water Pump (Up to Serial No. 165842)

52. Water Pump and Fan (Up to Serial No. 165842)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr'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
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 1 3/4"	02-23	A
...		5	†Lockwasher, 5/16"	05-50	A
...		1	†Street ell, 1/8" P. T. x 45°	013-531	A
...	3H4574/C117	1	†Grease cup, 1/8" MPT	017-11	A
...	3H4574/N32	1	Nipple, 1/2 x 2 1/2" thread one end	33-114-21	A
490	3H4574/G8	1	Gasket—Water pump bracket to cylinder	16-638	A
...		4	Hex. nut, 3/8"—24	04-603	A
...		4	Lockwasher, 3/8"	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 1 1/2"	010-55	A

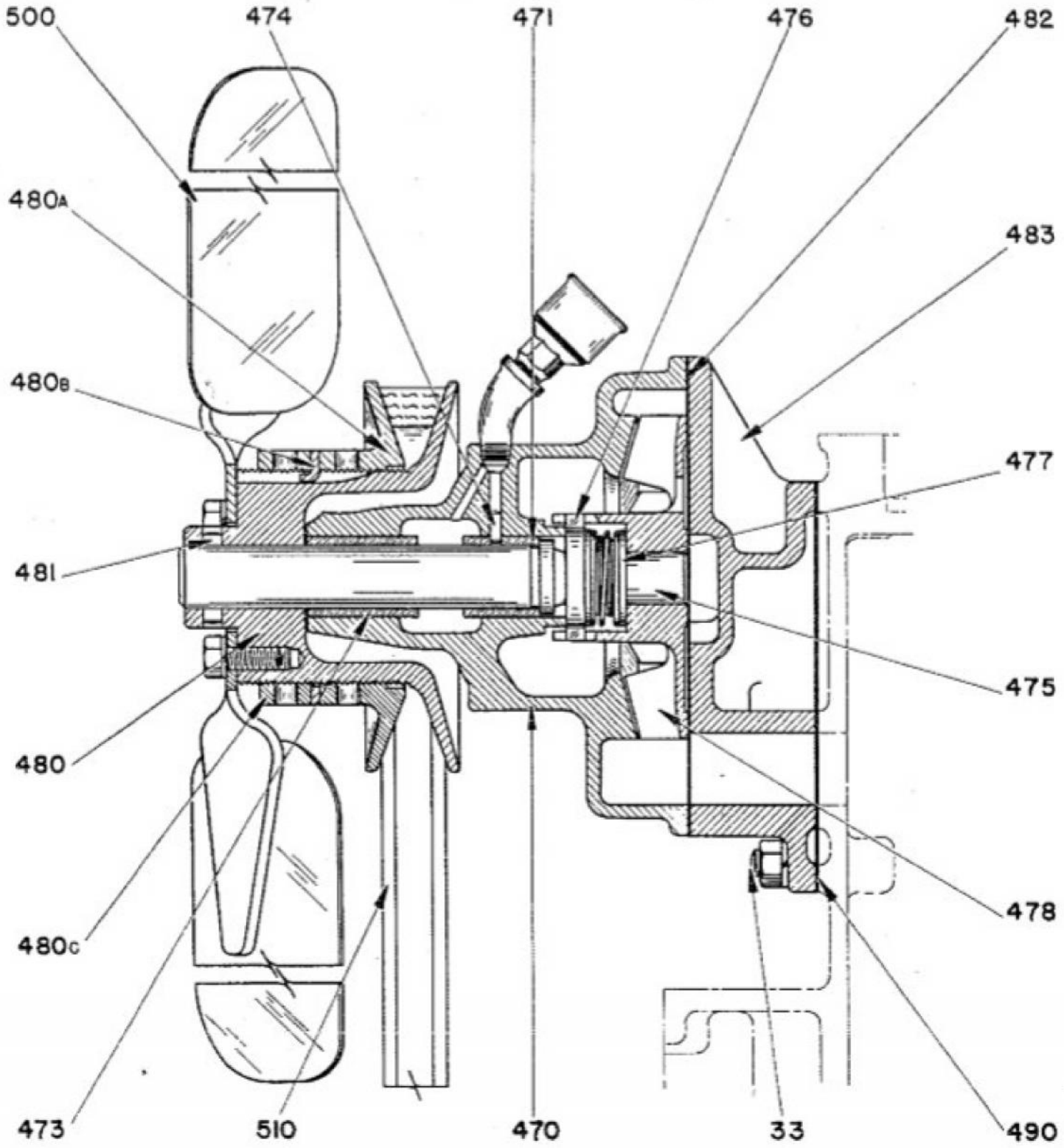

Fig. 59. Cross Section through Water Pump (Serial No. 165843 and up)

53. Water Pump and Fan (Serial No. 165843 Up)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
		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 1⅜" 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	53-521	A
481		1	†Pin—Fan pulley retainer, #4 taper x 1¾" 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	62-23	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	41-235	A
500		1	Fan blade assembly	42-107-1	A
	3H4574/S52	4	Capscrew—Fan blade, 5/16"—18 hex.	02-18	A
		4	Lockwasher—For #02-18, 5/16"	05-50	A

54. Cooling Group

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
1001	3H4574/B3	1	Radiator assembly	A71-243-9	A
1002	3H4574/P3	2	Packing, radiator	B74-4	A
....		2	Capscrew—For radiator, 5/8—11x1½"	02-101	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, 1/4—20 x ½" lg. rd. hd.	03-619	A
....		9	Square nut, 1/4"—20	04-18	A
....		9	Flat washer, 1/4"	06-2	A
....		1	Street ell, 1/4"—45°	013-532	A
1004	3H4574/C28	1	Drain cock, 1/4 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. 1/16—14 x 1¼"	02-55	A
....		2	Lockwasher, 1/16"	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, 3/4 x 11½"	73-29-8	A
1021	3H4574/669	2	Hose clamp assembly	83-92	A
1025		1	Thermometer	60-146	A
....	3H4584A/S27	1	Bug Screen	43-131	A
....	3H4584A/S54	8	Spring—Bug Screen	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

55. Engine Base (Oil Pan Group)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
550		1	Engine base (Oil Pan)	118-250-1	A
551	3H4574/G7	1	Gasket—Eng. base flange, carb. side	16-647	A
352	3H4574/G8	1	Gasket—Eng. base flange, mag. side	16-648	A
553	3H4574/G5	1	Gasket—Eng. base, rear	16-649-1	A
....		16	Capscrew—Eng. base flange, ⅜—16 x 1¼" hex.	02-37	A
....	3H4574/C58	16	Lockwasher, ⅜"	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, ⅜"	05-51	A
...		48	Nut, ⅜"—24 hex.	04-603	A
555	3H4574/G1	4	Gasket, Hand hole cover	16-359-1	A
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

56. Bed Plate (Engine and Alternator)

...		1	Bedplate—Engine and alternator	118-464	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, ¾—10 x 2¾"	02-150	A
...		4	Lockwasher—For #02-121, ¾"	05-59	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	39-1377	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

56. Bed Plate (Engine and Alternator) (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...		1	Front cover—For support	14-802	A
...		8	Screw—For cover, 5/16—18 x 3/4" 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	39-1387	A
...		4	Capscrew—For supp., 5/8—11 x 1 1/4" hex	02-100	A
...		4	Lockwasher—For #02-100, 5/8"	05-55	A
...	3H45840/M9	4	Rubber mounting—For cabinet	39-1180-1	A
...		16	Capscrew—For rubber mountings, 1/4—20 x 1/2" lg. hex	02-2	A
...		16	Lockwasher—For #02-2, 1/4"	05-49	A
...		2	Wire—Cabinet to ground	61-451	A
...		2	Capscrew, 1/4—20 x 1/2" hex	02-2	A
...		2	Plain washer, 1/4"	06-67	A
...	3H4584A/S20	4	Capscrew—For rubber mountings, 3/8—16 x 2" hex	34-205	A
...		4	Plain washer, 3/8"	06-69	A
...	3H4584A/N42	4	Nut, 3/8"—16 castle	04-303	A
...	3H4584A/P33	4	Cotter pin, 1/2 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/D8	1	Decal.—Instr. for water capacity	62-113	A
...	3H4574/D7	2	Decal.—Instr. for water drain	62-109	A
...	3H4574/D9	1	Decal.—Instr. for weight	62-116	A
...		1	Lug—For ground	121-31	A
...		1	Capscrew, 5/16—18 x 1/2"	02-16	A
...		1	Lockwasher, 5/16"	05-50	A
...	3H4574/11	1	Decal.—Oil capacity	62-115	A

57. Cranking Motor

...	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

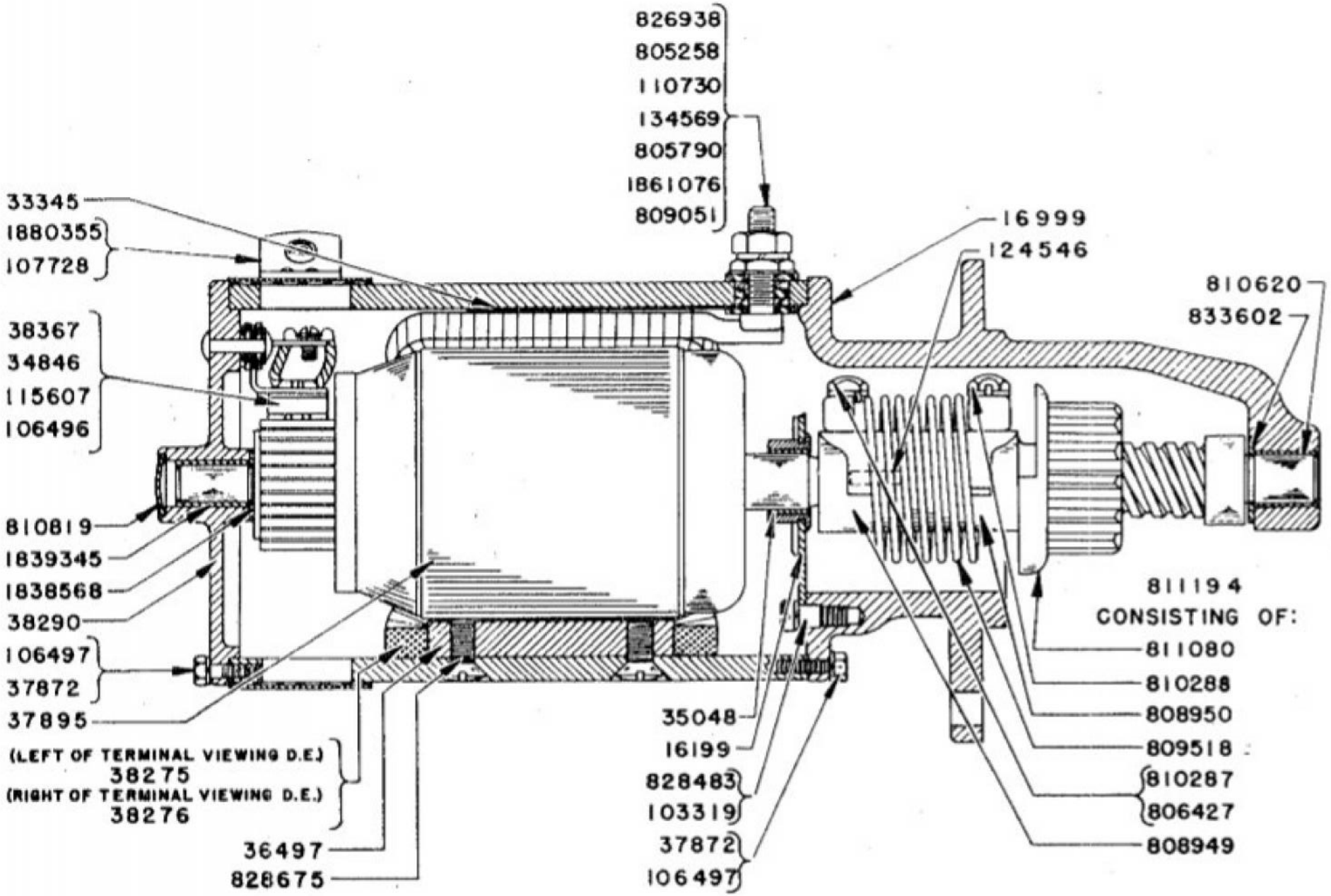

Fig. 60. Longitudinal Section through Cranking Motor

57. Cranking Motor (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...		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 (¼" thick)	134569	F
...		1	Nut (3/32" thick)	805258	F
...		1	Washer	805790	F
...		2	Lockwasher	806427	F
...		1	Head	808949	F
...		1	Sleeve	808950	F
...		3	Insulation washer (5/16" 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

58. Magnetic Switch

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...	3H4574/S45	1	Magnetic Switch—Delco-Remy Model 1422	A76-46	A
...		2	Spacer—For magnetic switch	22-189	A
...		2	Capscrew—Mag. switch mounting, ¼—20 x ½"	02-2	A
...		2	Lockwasher—For #02-2, ¼"	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
...		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)	825319	F
...		4	Lockwasher	825498	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

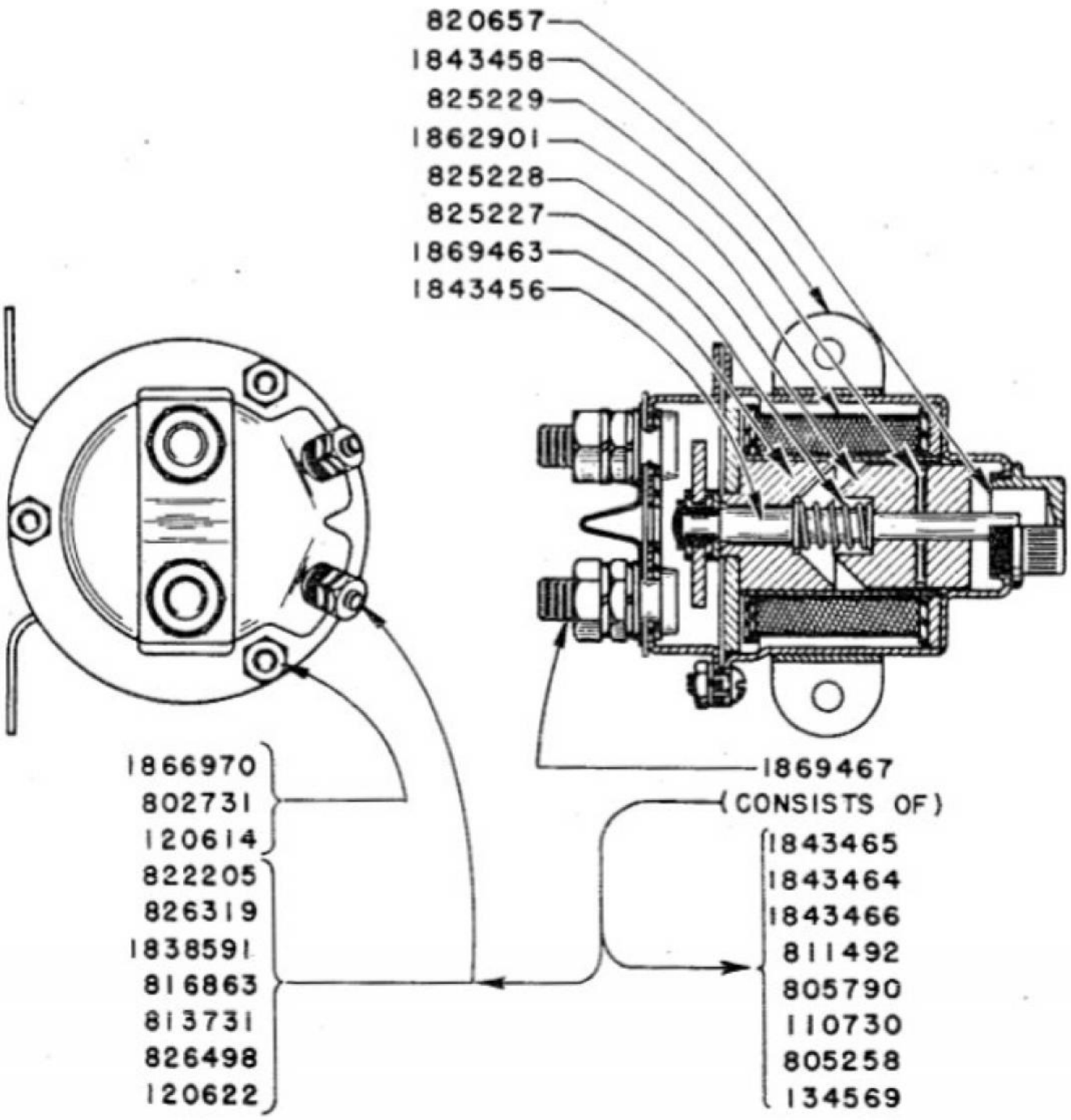

Fig. 61. Cross Section through Magnetic Switch

59. Generator

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr'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
...		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	36-519	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

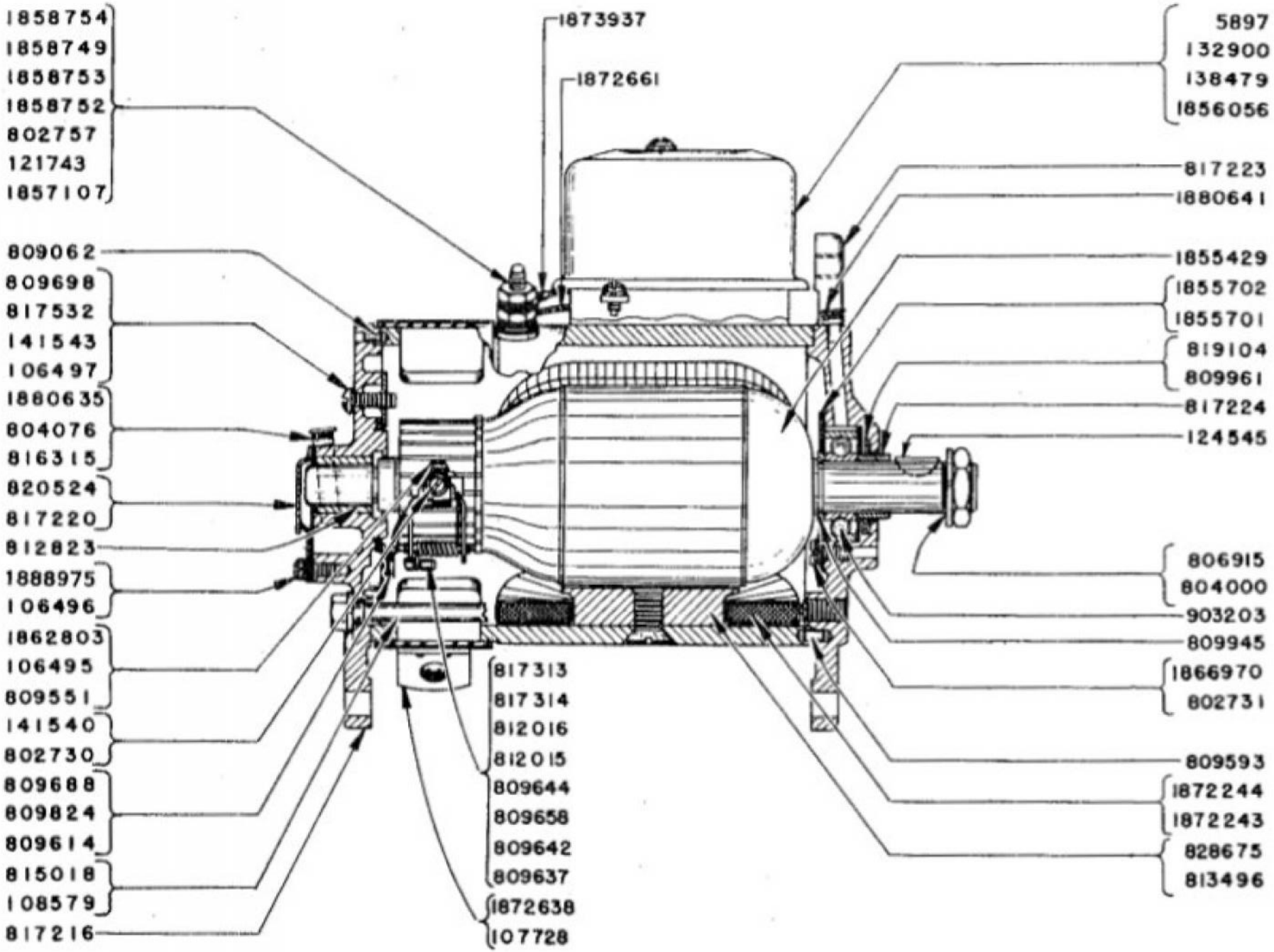

Fig. 62. Longitudinal Section through 12 Volt Generator

59. Generator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...		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
...		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

60. Battery

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...		1	Battery—Globe-Union #133, 12 volt	A117-55	A
...	3H4574/S138	1	Battery strap	83-90	A
...		2	Lockwasher—For #83-90, ⅜"	05-51	A
...		2	Nut—For #83-90, ⅜"—16 hex	04-103	A
...		2	Spacer—For battery, rubber	22-191	A

61. Control Switch Box Assembly

640	3H4584D/S46	1	Control switch box assy. Allen-Bradley No. X-84446	A76-176	A
...		3	Machine screw—Control box mounting, ¼—20 x ½" rd. hd.	03-619	A
...		3	Lockwasher—For #03-619, ¼"	05-49	A
1		1	Rubber grommet	F-13342	D
2		1	Mounting strap	A-22509	D
3		2	Pilot light unit (with lamp)	X-49323	D
...		2	12 Volt lamp only	X-84317	D
4		2	Red lens	X-70103	D
5		1	Mounting strap	A-22508	D
6			See below for Bul. 200 Parts List		
7		1	Adapter	X-67088	D
8		1	Pressure switch	X-62153	D
9		1	Push button	X-49579	D
10		1	Cabinet (for 2 pilot lights)	X-84561	D
11		8	Screw (with M-1100 washer)	M-718	D
12		1	Thermostat (Le Roi No. 76-177)	X-66847	D
...		1	Cabinet (for 1 pilot light)	X-84562	D

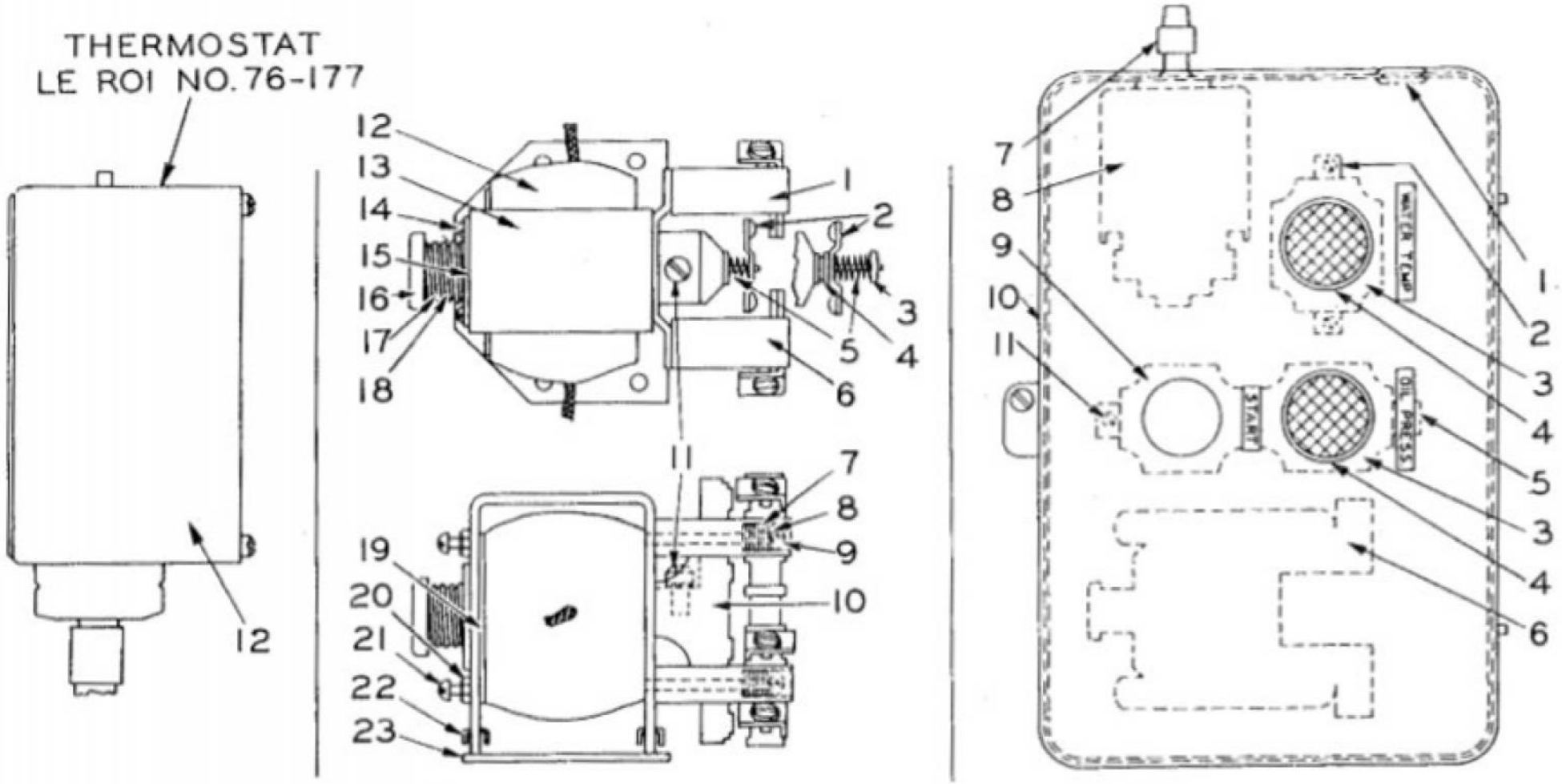

Fig. 63. Control Switch Box Assembly

61. Control Switch Box Assembly (Cont'd)

Bulletin 200 D. C. Relay

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr's. Code*
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
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 & 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

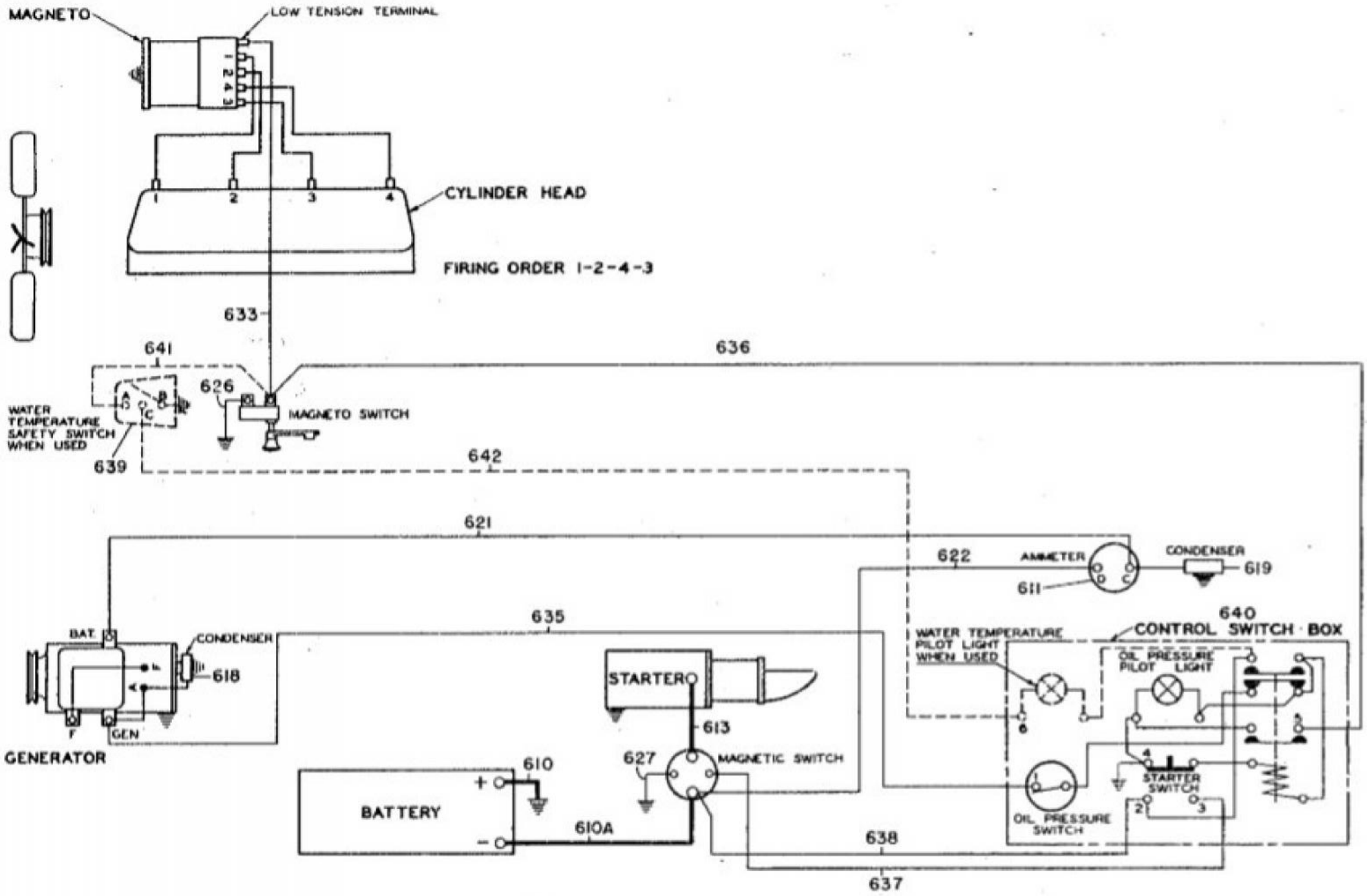

Fig. 64. Electrical Wires and Cables Diagram

62. Cables, Wires, Etc.

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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, 3/8—16 x 1/2" hex	02-32	A
...		3	Lockwasher—For #02-32, 3/8"	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 2 1/2"	A61-5-4	A
627	3H4584A/W13	1	Wire—Magnetic switch to ground, #14 x 2 1/2"	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
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	76-177	A
641		1	Wire—Temp. safety switch to micro switch	A61-306-37	A
642	3H4574/W81	1	Wire—Temp. safety switch to control box	A61-306-38	A
1028	3H4574/T19	1	Tube—Wire conduit	55-674	A
...	3H4574/C62	1	Clamp for tube	83-91	A
...		1	Capscrew, 3/8 x 1/2" hex	02-32	A
...		1	Lockwasher, 3/8"	05-51	A

63. Magneto

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
350		1	Magneto assy., American Bosch Model MJB4A-314: Includes impulse coupling 1CA2A2	A85-99-4	A
...		2	Capscrew—Magneto mounting, ⅜—16 x 1¼"	02-37	A
...		2	Plain washer—For #02-37, ⅜"	06-4	A
...		2	Lockwasher—For #02-37, ⅜"	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	GA 1003	I
5		1	Clip for grounding cable (terminal block end)	EC 1003	I
7		1	Clip for external grounding cable	EC 1001	I
8		1	Fastening screw—grounding cable to distributor plate	SC 23-6 CA	I
9		1	Lockwasher for fastening screw	WA 6-5	I
10		1	Insulation under cable clip	IS 5257	I
11	3H4584A/S65	2	Distributor plate fastening screw	SC 1003 CA	I
12	3H4584A/P41	2	Cover supporting post—long	SD 527	I
13	3H4584A/P40	2	Cover supporting post—short	SD 526	I
14		6	Lockwasher for fastening screw and cover supporting post	WA 288	I
15		6	Plain washer for fastening screw and cover supporting post	WA 98922	I
16	3H4584A/W45	6	Sealing washer for fastening screw and cover supporting post	WA 5280	I
17		1	Distributor plate center brush and spring	SA 82736	I
18		4	Distributor plate brush and spring	SA 82876	I
19		1	Metal plate between frame and distributor plate	PL 5232	I
20	3H4584A/C61	1	Radio shield cover	CV 5224	I
21		2	Cover fastening screw—upper	SC 78-7 OA	I
22		1	Round nut for low-tension terminal outlet	NT 571	I
23		4	Terminal outlet ferrule—small	FP 84020	I
24		4	Terminal outlet ferrule—large	FP 84832	I
25	3H4584A/B50	1	Insulation bushing for low-tension terminal outlet	IB 84016	I
26	3H4584A/B47	1	Cable outlet insulation bushing	IS 524	I
27		1	Observation cover	CV 5287	I
28		1	Fastening screw for observation cover	SC 39-5 CA	I
29		1	Lockwasher for fastening screw	WA 6-4	I
30	3H4584A/C56	1	Cap for radio shield cover	CP 5223	I
31		4	Cap fastening screw	SC 24-7 CA	I
32		4	Fastening screw lockwasher	WA 5-5	I
33		1	Magneto housing	HG 527	I
67	3H4584A/S74	2	Packing strip for magnet rotor ball bearing	IS 504	I
68	3H4584A/W44	2	Bearing paper washer	IS 222	I
69	3H4584A/T13	1	Oil thrower for ball bearing	CV 522	I

63. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
70	3H4584A/S71	1	Spacer on rotor	SR 1023	I
71		1	Woodruff key for gear	KY 11-3	I
72	3H4584A/G14	1	Magnet rotor gear	GE 5212	I
73	3H4584A/C55	1	Cam	CA 522	I
74		1	Cam fastening screw	SC 42-10 CA	I
75		1	Fastening screw lockwasher	WA 22-6	I
76		1	Cam retaining washer	WA 5241	I
77	3H4584A/W46	1	Indicating washer	WA 522	I
78	3H4584A/G16	1	Distributor gear and rotor assembly	GE 528	I
79	3H4584A/G15	1	Distributor gear only	GE 5247	I
80		1	Distributor rotor only	RT 525	I
81		3	Distributor rotor fastening screw	SC 521	I
82		3	Plain washer for screw	WA 1005 CA	I
83	3H4584A/W42	1	Distributor gear spacing washer	WA 78682	I
84		1	Interrupter assembly complete with platinum point	IN 5223	I
85		1	Interrupter plate with riveted parts and support plate	PL 52119	I
86	3H4574/P19	1	Interrupter lever with platinum point	LE 5220	I
87		1	Plain washer for lever stud	WA 86678	I
88		1	Interrupter lever cotter pin	FP 84791	I
89		1	Interrupter lever spring fastening screw	SC 1004 CA	I
90		1	Fastening screw lockwasher	WA 5-4	I
91	3H4574/P18	1	Adjustable contact bracket with platinum point	BK 5236	I
92		1	Contact bracket fastening screw	SC 104347	I
93		1	Fastening screw lockwasher	WA 6-4	I
94	3H4584A/G52	1	Interrupter grounding cable	CB 5227	I
95	3H4584A/B45	1	Interrupter grounding brush and spring	BR 521	I
96	3H4584A/C53	1	Cable between interrupter and clip on terminal block	CB 5223	I
97		1	Stop plate	PL 528	I
98		1	Stop plate fastening screw	SC 21-6 CA	I

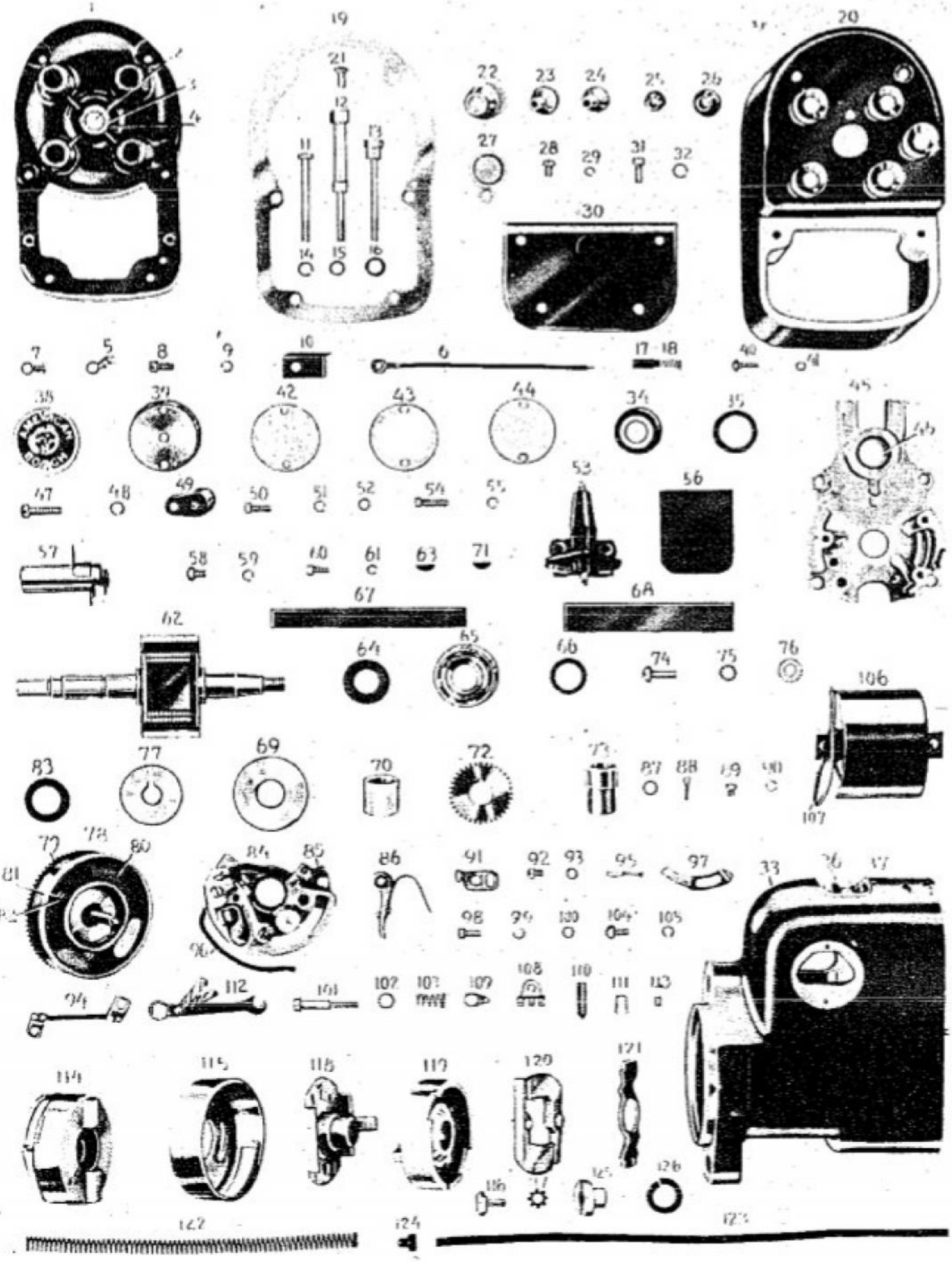

Fig. 65. Magneto and Component Parts

63. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
34	3H4584A/S66	1	Leather oil seal—drive end	PK 521	I
35	3H4584A/W43	1	Washer under oil seal	WA 1071	I
36		1	Name plate for type designation	NP 521	I
37		2	Name plate fastening screw	SC 121-6 CA	I
38		2	Name plate on ventilator cover	NP 522	I
39		2	Ventilator cover	CV 52128	I
40		4	Cover fastening screw	SC 1096	I
41		4	Fastening screw lockwasher	WA 6-3 CA	I
42	3H4584A/G13	2	Ventilator felt gasket	GA 5210	I
43		2	Ventilator washer	WA 5269	I
44		2	Ventilator wire screen	SN 526	I
45	3H4584A/B44	1	Gear bracket with bearing	BK 527	I
46	3H4584A/B43	1	Bearing only	BG 521	I
47		4	Bracket fastening screw	SC 25-12 CA	I
48		4	Fastening screw lockwasher	WA 6-6	I
49	3H4584A/T12	1	Terminal block on gear bracket	BL 522	I
50		1	Terminal block fastening screw	SC 21-8 CA	I
51		1	Fastening screw lockwasher	WA 6-4 CA	I
52		1	Fastening screw plain washer	WA 72613	I
53	3H4584A/C60	1	High-tension conductor	EC 5212	I
54		2	Conductor fastening screw	SC 21-10 CA	I
55		2	Fstening screw lockwasher	WA 6-4 CA	I
56	3H4584A/J14	1	Conductor insulation	IS 5226	I
57	3H4574/C123	1	Condenser with bracket	CW 524	I
58		1	Condenser fastening screw	SC 21-6 CA	I
59		1	Fastening screw lockwasher	WA 6-4 CA	I
60		1	Condenser lead fastening screw	SC 42-5 CA	I
61		1	Fastening screw lockwasher	WA 76919 CA	I
62	3H4584A/R46	1	Magnet rotor	RT 5217	I
63		1	Woodruff key—drive end	KY 11-4	I
64	3H4584A/W41	1	Felt washer for magnet rotor—interrupter end	WA 81751	I
65		2	Ball bearing	BB 60226	I
66A	3H4584A/S67	As Req'd	Bearing shim (.0126")	WA 61	I
66B	3H4584A/S69	As Req'd	Bearing shim (.0071")	WA 106	I
66C	3H4584A/S68	As Req'd	Bearing shim (.004")	WA 107	I
66D	3H45842/S70	As Req'd	Bearing shim (.0197")	WA 1009	I

63. Magneto (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
99		1	Fastening screw lockwasher	WA 6-4 CA	I
100		1	Fastening screw plain washer	WA 72613	I
101		1	Stop plate stud	SD 1001 CA	I
102		1	Plain washer for stud	WA 98904	I
103	3H4584A/S73	1	Spring for stud	SP 525	I
104		1	Fastening screw for interrupter support plate	SC 1029 CA	I
105		1	Fastening screw lockwasher	WA 6-4 CA	I
106		1	High-tension coil	CL 524	I
107		1	Cable for coil—specify length	KL 100657	I
108	3H4584A/C59	1	Terminal clip for interrupter and coil cables	EC 5214	I
109	3H4584A/C58	1	Clip for retaining coil cable	EC 1002	I
110		2	Lock screw for mounting high-tension coil	SC 1060	I
111	3H4584A/C57	4	Terminal clip for distributor plate high-tension cable	FP 81953	I
112		1	Magneto wrench	WR 521	I
113		1	Set screw for edge distance holes	SC 1040	I
114		1	Impulse member assembly	HG 73118	I
115		1	Arrester plate assembly	PL 7365	I
116		4	Arrester plate fastening screw	SC 732	I
117		4	Fastening screw lockwasher	WA 1116	I
118	3H4584A/H18	1	Impulse member hub	HB 7328	I
119	3H4584A/H17	1	Impulse member housing	HG 73120	I
120	3H4584A/W47	2	Impulse member weight	SA 65972	I
121	3H4584A/C54	1	Cam	CA 739	I
122	3H4584A/S72	2	Spiral spring	SP 736	I
123	3H4584A/W48	1	Felt wick for spring	PK 734	I
124	3H4584A/P36	2	Pin for spring	PN 731	I
125	3H4584A/C62	1	Coupling to shaft securing nut	NT 731	I
126		1	Lockwasher for coupling	WA 5-16	I

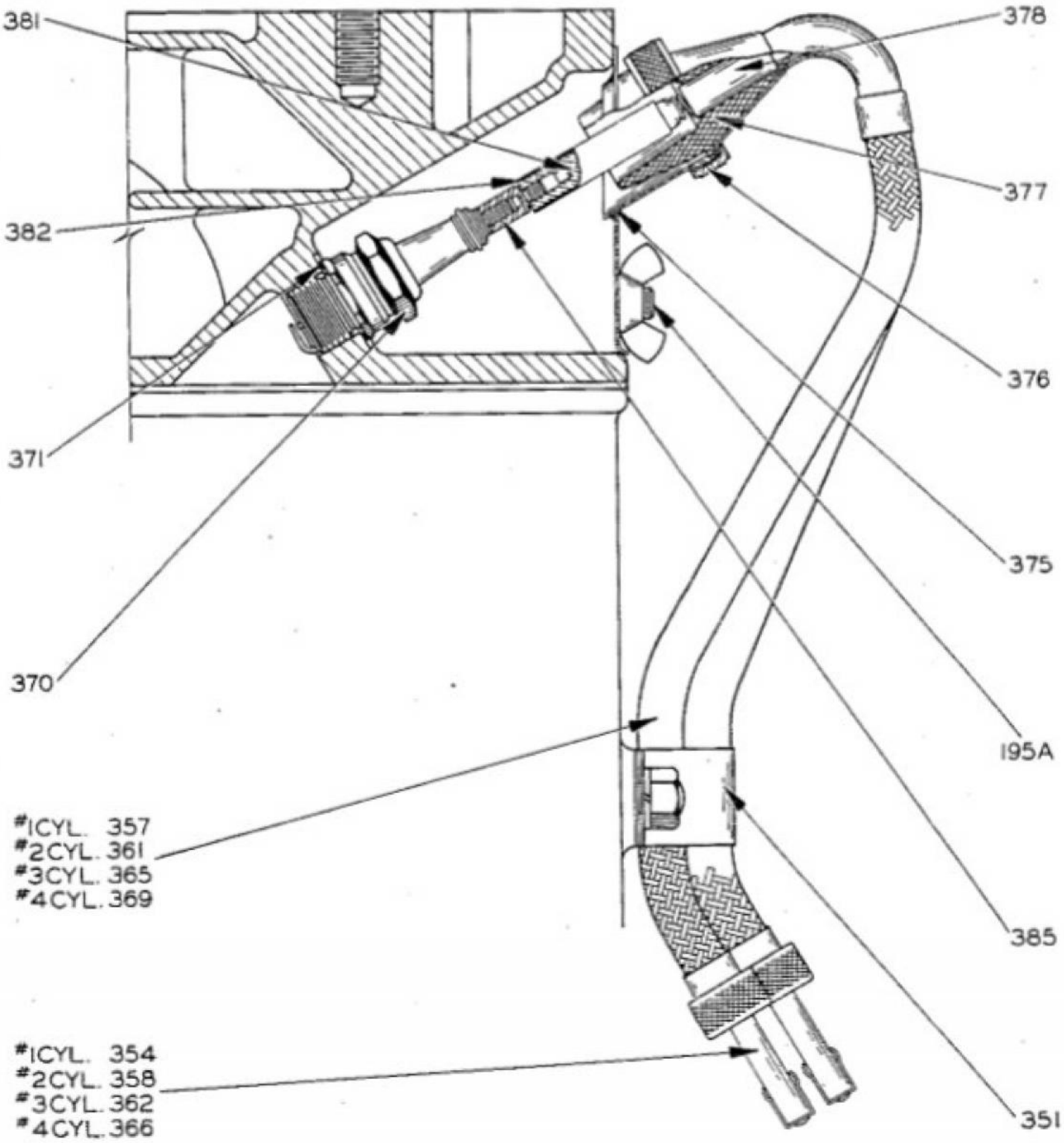

Fig. 66. Ignition and Radio Shielding Parts Diagram

64. Ignition Cables, Conduits, Etc.

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
351	3H4574/C29	1	Clamp—Ignition cable	83-40	A
...		1	Lockwasher, ⅝"	65-50	A
...	3H4574/N4	1	Nut, ⅝"—24, hex.	64-602	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, ⅛"—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 ⅜"	03-61	A
...		2	Lockwasher—For #03-61	05-23	A
...		1	Capscrew—Battery ground, ⅜—16 x ¾"	02-34	A
...		1	Lockwasher—For #02-34, ⅜"	05-51	A
...		1	Nut—For #02-34, ¾"—16, hex.	04-103	A

65. Type G Synchronous Alternator with Exciter

Generator Frame No. 8-24-6 — Exciter Frame No. E-83
25 KVA — 12 Volts — 900 RPM — 1 Phase — 60 Cycles
S. O. 85-H-380

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr's. Code*
1		—	Alternator complete with exciter	S. O. 85H380	J
2		1	Field assembly complete with shaft	1287924	J
3		4	Open field coil complete with pole and damper	1287922	J
4		4	Crossed field coil complete with pole and damper	1287923	J
..		32	Bolt to connect damper segments, ¼—20 x ⅝" hexagon head steel bolt	Std. Hdw.	J
..		32	Steel lock nut for bolt, ¼"—20	Std. Hdw.	J
..		32	¼" Lockwasher for nut	Std. Hdw.	J
5		1	Laminated spider	1287925	J
..		16	Key (pole dovetail to spider)	1168061	J
6		1	Collector	1092211	J
7		2	Collector terminal	11040	J
8		4	Collector terminal nut, ¼"—20 hexagon, brass machine screw nut	Std. Hdw.	J
..		2	Insulation tube for collector leads	124863	J
..		2	Clamp for insulation tube and leads	27395	J
..		1	Screw for clamps, #10—32 x ⅝" fillister head steel machine screw	Std. Hdw.	J
..		1	.190" Lock washer for clamp screw	Std. Hdw.	J
9		1	Shaft with spider key	1287926	J
10		2	Spacing ring for bearings	750162	J
11		2	Blower complete without hub	1287927	J
12		1	‡Front blower hub	x1287928	J
13		1	Rear blower hub	1287928	J
14		12	Bolt for blowers, ½—13 x 1¼" hexagon head steel bolt	Std. Hdw.	J

Parts indented are included in the part under which they are indented.
‡On front blower hub drill and tap one hole .190—32 x ½" deep assy. for collector lead clamp screw.

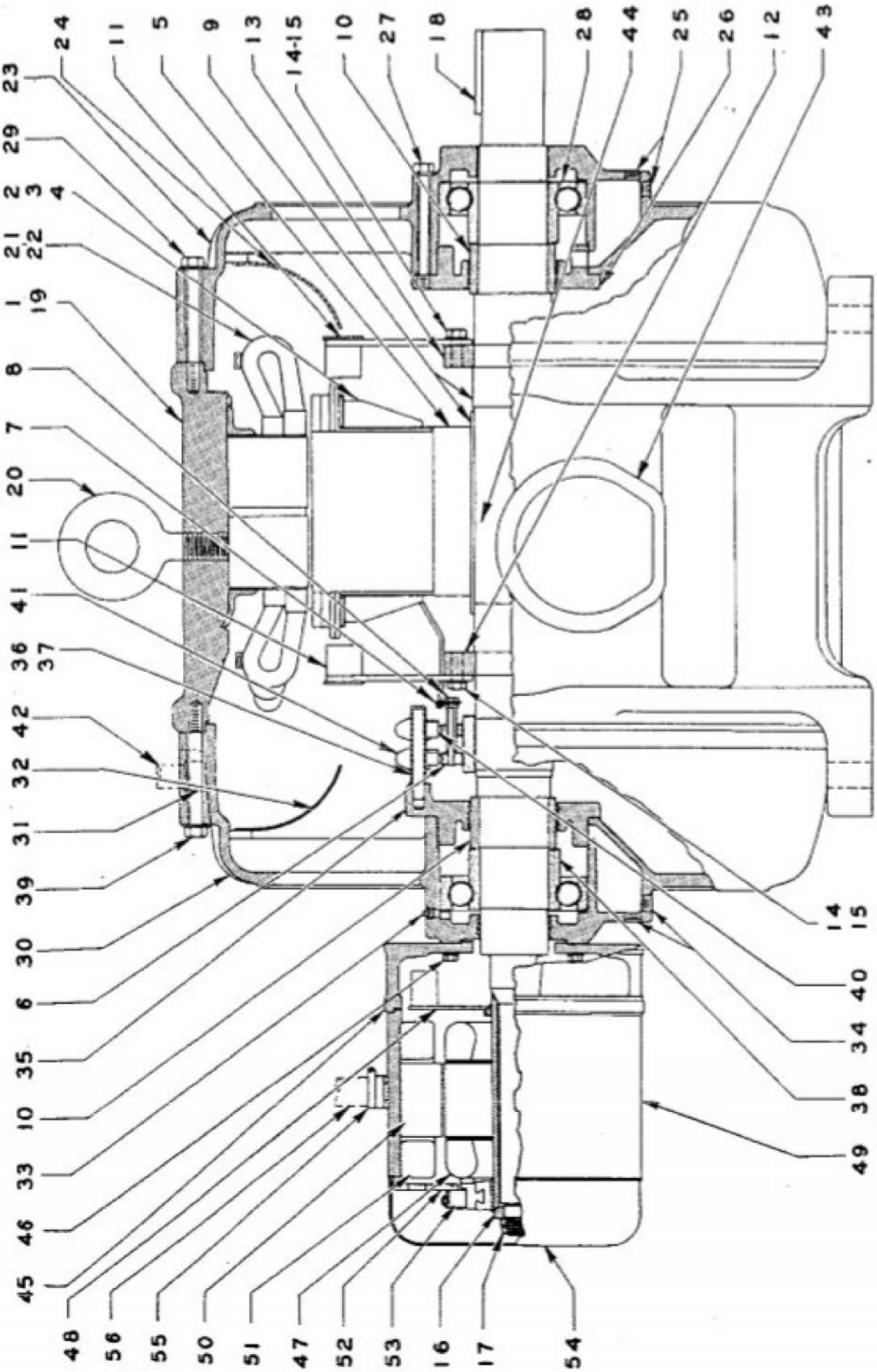

Fig. 67. Longitudinal Section through Alternator

65. Type G Synchronous Alternator with Exciter (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
15		12	Lockwasher for bolt	295498	J
16		1	Bushing to clamp exciter armature	1106568	J
17		1	Jam nut	1168084	J
..		1	Steel cotter pin for jam nut, 1/8 x 1 1/2"	Std. Hdw.	J
18		1	Key for shaft extension	1248997	J
19		1	Frame with eye bolt and stator core	1287929	J
20		1	Eye bolt—1 or 1 1/4" as req	Std. Hdw.	J
21		48	Stationary armature coil	1287930	J
22		1 set	Complete winding material class #3 for the above coils		J
23		1	Rear bracket	1239969	J
24		1	Rear air shield	458429	J
..		8	Screw to fasten rear air shield to rear bracket, 5/16—18 x 1/2" fillister head steel machine screw	Std. Hdw.	J
..		1	1/8" Pipe plug for rear bracket	Std. Hdw.	J
25		2	1/2" Countersunk pipe plug for rear bracket	Std. Hdw.	J
26		1	Housing cover for rear bearing	766706	J
27		4	Bolt to fasten housing cover to rear bracket, 1/2—13 x 5" hexagon head steel bolt	Std. Hdw.	J
28		1	Rear ball bearing	664664	J
29		8	Bolt to fasten rear bracket to frame, 3/4—11 x 5" hexagon head steel bolt	Std. Hdw.	J
30		1	Front bracket	1239970	J
31		1	3/4" Straight squeeze connector for flexible conduit	1196551	J
32		1	Front air shield	458429	J
..		8	Screw to fasten front air shield to front bracket, 5/16—18 x 1/2" fillister head steel machine screw	Std. Hdw.	J

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

65. Type G Synchronous Alternator with Exciter (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
33		1	⅛" Pipe plug for front bracket	Std. Hdw.	J
34		2	½" Countersunk pipe plug for front bracket	Std. Hdw.	J
35		1	Housing cover with brush holder rods and insulation	1287931	J
36		2	Brush holder rod	817364	J
37		2	Brush holder rod insulation tube	1239831	J
..		4	Bolt to fasten housing cover to front bracket, ½—13 x 5" hexagon head steel bolt	Std. Hdw.	J
38		1	Front ball bearing	664664	J
39		8	Bolt to fasten front bracket to frame, ⅝—11 x 5" hexagon head steel bolt	Std. Hdw.	J
40		4	Brush for generator, Stackpole WS-86, size ⅜ x ¾ x 1¼"	777889	J
41		2	Brush holder complete for generator	884027	J
..		4	Spring	444435	J
..		4	Screw to fasten brush shunt to brush holder, No. 10—32 x ⅜" fillister head brass machine screw	Std. Hdw.	J
..		4	Washer for shunt screw	779354	J
..		2	Bolt to clamp brush holder to rod, ¼—20 x ⅞" hexagon head steel bolt	Std. Hdw.	J
..		2	Lock nut for bolt, ¼"—20	Std. Hdw.	J
..		2	¼" Lockwasher 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
42		1	Conduit for field leads, 14"—¾" flexible steel	Standard	J
..		1	Squeeze connector for field leads conduit, ¾—90°	52747	J
43		1	Conduit box complete	974311	J
..		1	Squeeze connector for main leads conduit, 1½"	1198554	J
44		1	Conduit for main leads, 29"—1½" flexible steel	Standard	J
..		1	Squeeze connector for main leads conduit, 1½"—90°	752750	J
..		2	Terminal for main leads	229120	J
45		1	Exciter support with cover	1239971	J
..		1	Band cover for exciter support	1042282	J
..		2	Screw, to fasten cover to exciter support #10—32 x ½"	Std. Hdw.	J
46		6	Bolt, exciter support to front bracket, ⅜—16 x ⅞" hex.	Std. Hdw.	J
..		4	Bolt, exciter frame to support ⅜—16 x 1⅜" hex.	Std. Hdw.	J
..		1	Name plate, generator rating	NP-28788	J
..		1	Name plate, generator lubrication	NP-34630	J

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

66. Type SK Exciter

Frame No. E-83

1¼ KW — 900 RPM — 125 Volts

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr's. Code*
47		1	Exciter armature complete with quill	1287939	J
48		1	blower	359038	J
49		1	Exciter frame	1239962	J
50		4	Exciter pole	452945	J
..		8	Bolt to fasten pole to frame, hexagon head	359311	J
51		1	Exciter field coil set (4 coils per set)	1239963	J
..		2	Terminal for field coil head	229105	J
52		1	Panel complete with brushes and brush holder for exciter	1124998	J
..		4	Brush spring	281633	J
53		4	Brush (exciter), stockpole WL-21, size ⅜ x ¾ x ⅞"	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" Lockwasher 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" Lockwasher for screw	Std. Hdw.	J
55		1	¾" Straight squeeze connector for conduit for exciter leads	1198551	J
56		1	28" of ¾" Steel flexible conduit for exciter leads	Standard	J
..		1	¾"—90° Squeeze connector for conduit for exciter leads	752747	J
..		4	Terminal for exciter leads	229105	J
..		1	Exciter name plate	NP-17415	J

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

67. Alternator Controls

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
..		1	Type HA ammeter -0-300 ampere (sold only as an assembly)	724215	J
..		1	Type HA voltmeter -0-150 volts (sold only as an assembly)	721721	J
..		1	Type HY frequency meter -58-62 cycles (sold only as an assembly)	721766	J
..		1	Type NH-35 total hour meter—120 volts (sold only as an assembly)	1205858	J
..		1	Type SRA-1 Silverstat regulator	S. O. 77Y440	J
..		2	Type AB breaker unit	807003	J
..		2	Type AB breaker trip unit	807134	J
..		1	Type WL rheostat	874473	J
..		1	Type W instrument switch	S. O. 62Y674	J
..		1	Terminal block	MKZ-24372	J
..		1	Block	805430	J
..		1	Cover	790073	J
..		1	Current transformer (sold only as an assembly)	MKZ-22349	J
..		1	Receptacle, female—Hubbell No. WE-22427		J
..		1	Lamp socket	484980	J
..		1	Plug fuse, pyrex glass—20 ampere	PYX-20	J

68. 1700 — Type SRA-1 Voltage Regulator

..		1	Type SRA-1 voltage regulator complete	S. O. 77Y440	J
..		1	Regulator without regulating resistor tubes	S. O. 77Y440	J
1		1	Contact device complete	1151948	J
2		1	Contact device plate (rear support)	1091989	J
3		1	Pusher screw	1092295	J
4		1	Magnet block, core and armature assembly, Items 2-8-12-13-14	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	1123305	J
12		1	Armature arm with spring holder, Item 1	94B503	J
			Item 4	94B504	J

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

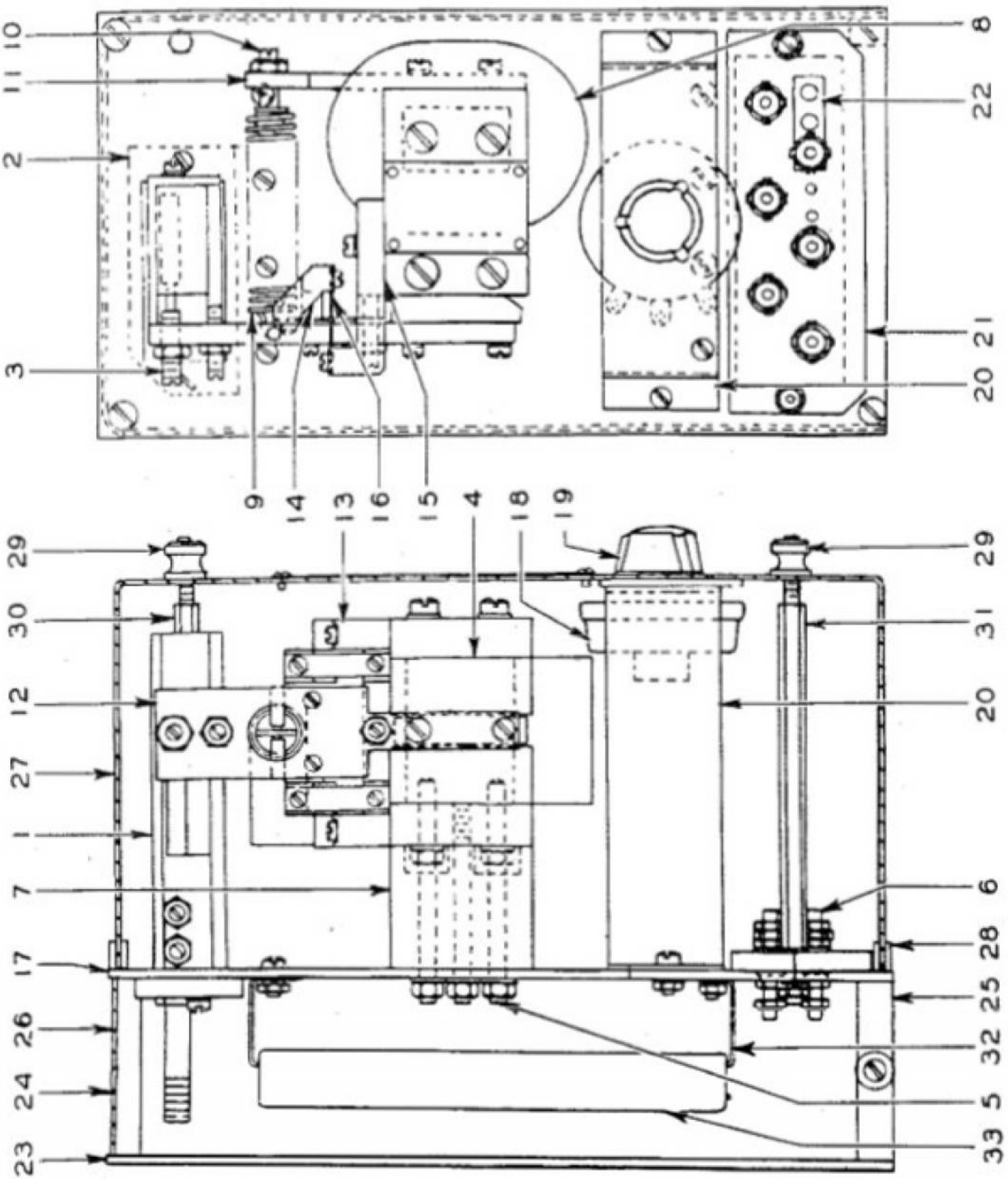

Fig. 68. Cross Section through 12 Volt Voltage Regulator

68. 1700 — Type SRA-1 Voltage Regulator (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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. 76Y414	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	1B8419	J
23		1	Rear plate	1191990	J
24		2	Rear plate post—Upper	1084587	J
25		2	Rear plate post—Lower	1084588	J
26		1	Rear cover, Item 6	1A8864	J
27		1	Front cover	1190739	J
28		1	Gasket for cover, Item 2	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—18.5 ohms	1081595	J
33		1	Regulating resistor tube—31.6 ohms	1081596	J
33		1	Regulating resistor tube—55.8 ohms	1081597	J
33		1	Regulating resistor tube—75.0 ohms	1081598	J
..		1	Damping transformer and Rectox unit	1190741	J
..		1	Damping transformer	1190740	J
..		4	Rectox unit	967282	J

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

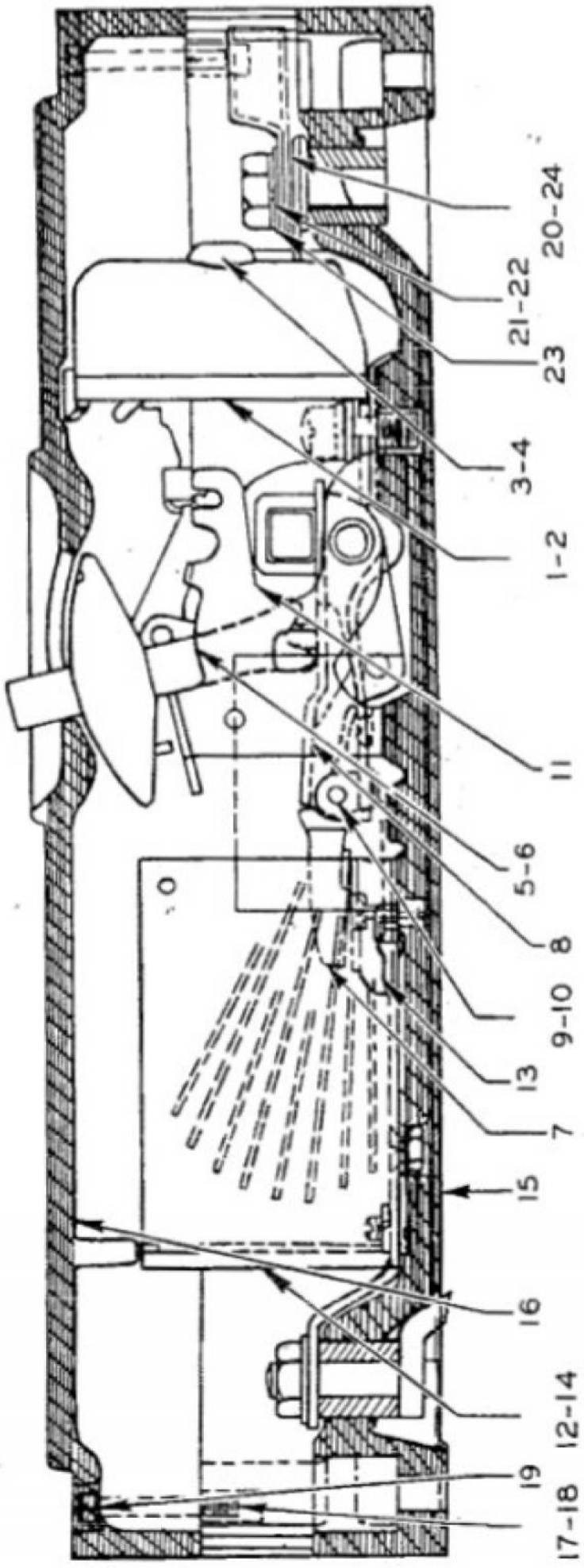

Fig. 69. Cross Section through Circuit Breaker

69. Type AB DE-ION Circuit Breaker

Manually Operated — Automatic Trip — Front or Rear Connected
225 Ampere Frame — 250 Volt A-C — 2 Pole

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr's. Code*
..		2	Breaker complete		J
1		2	Trip unit complete	807134	J
2		2	Cover for ref. 1	869783	J
3		4	Fil. Hd.I.M. screw for ref. 2 (⅜—40 x ¼")	Std. Hdw.	J
4		4	Washer for ref. 3	3407	
5		2	Breaker frame complete without trip unit	807003	J
6		2	Mechanism complete with contacts operating handle, cross bar and contact holder	809823	J
7		4	Moving contact and shunt	809815	J
8		4	Spring for ref. 7	809814	J
9		4	Hinge pin for ref. 7	706216	J
10		8	Hinge pin washer	807169	J
11		2	Mechanism complete with operating handle cross bar and contact holder	1030034	J
..		2	Operating handle	1020955	J
12		4	Arc splitter complete with stationary contact	807143	J
13		4	Stationary conductor	809914	J
14		4	Arc splitter complete	809915	J
15		2	Base complete	807137	J
16		2	Cover	807139	J
17		8	Fil. hd. I.M. screw for ref. 16 (.190—32 x 1⅝")	Std. Hdw.	J
18		8	Lockwasher for ref. 17 (.190)	Std. Hdw.	J
19		8	Washer for ref. 17	779343	J
20		8	Terminal complete (front connected)	806003	J
21		8	Hex. hd. bolt for ref. 20 (½ x 1")	Std. Hdw.	J
22		8	Lockwasher for ref. 20 (½)	Std. Hdw.	J
23		8	Washer	3223	J
24		8	Terminal—225 ampere	776342	J
..		8	Stud complete (rear connected)	806989	J

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

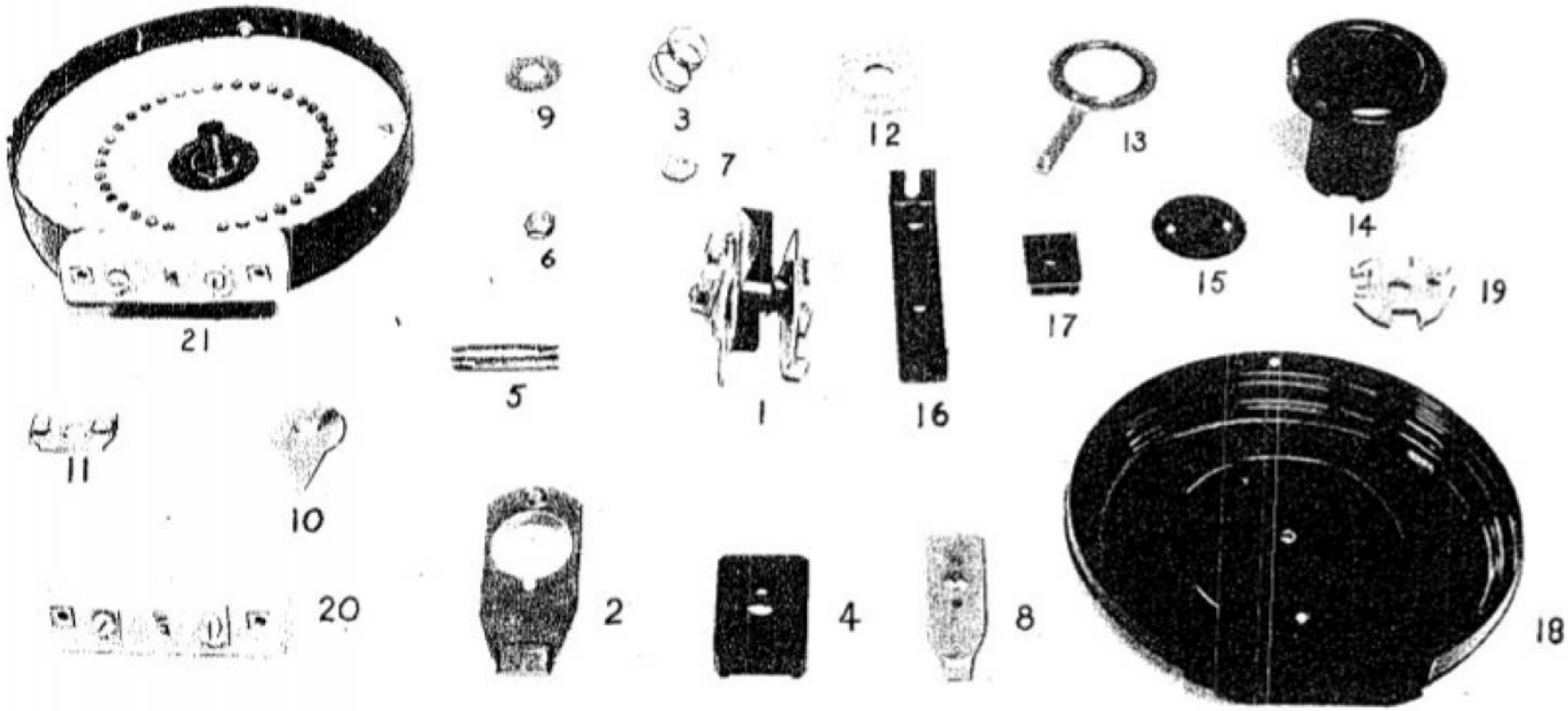

Fig. 70. Field Rheostat and Component Parts

70. Type WL Field Rheostat

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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
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

‡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.

71. Carburetor

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
430		1	Carburetor assy. Zenith #62AJ10	A84-546-3	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 23)	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 (blank)	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 60-1)	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
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

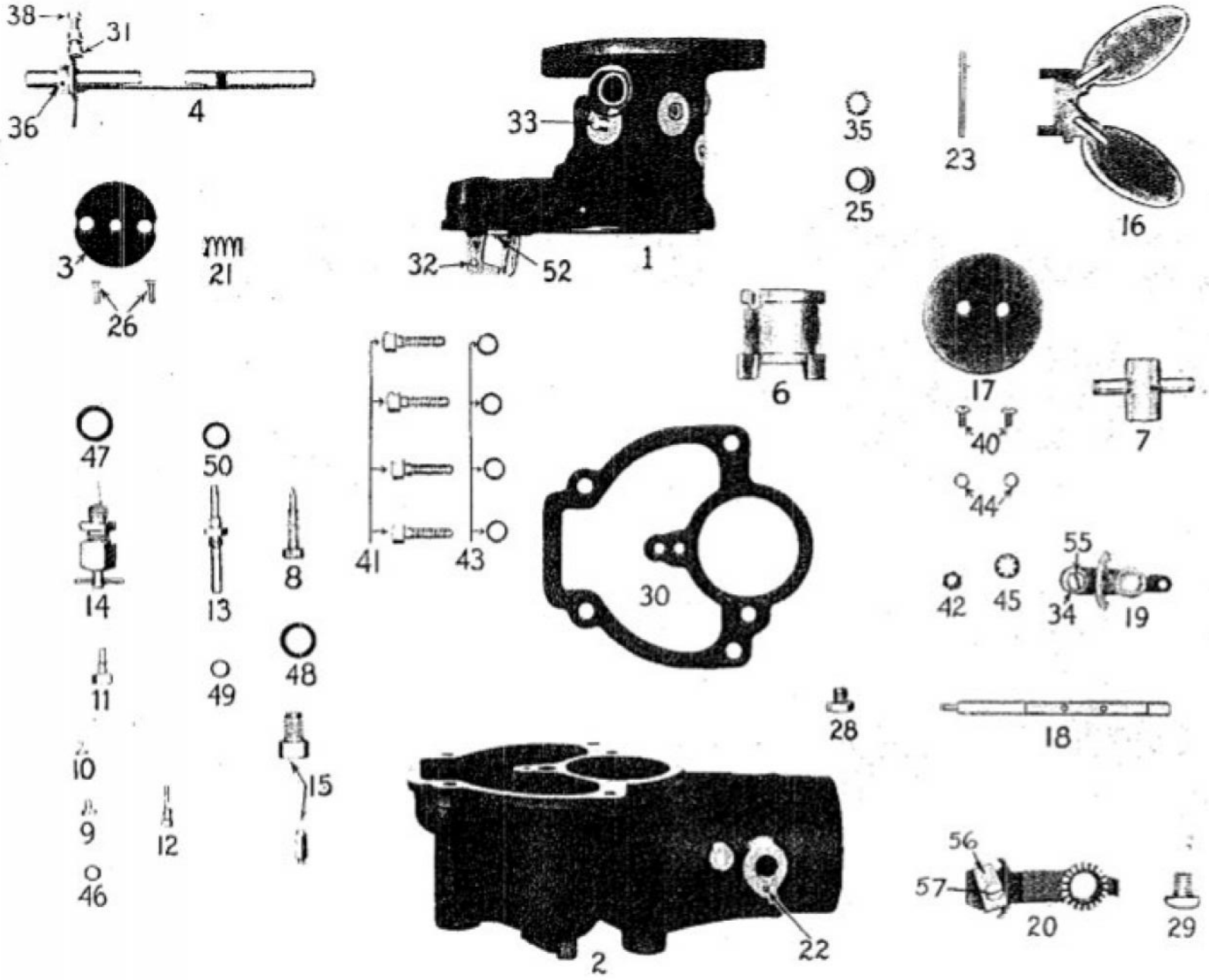

Fig. 71. Carburetor and Component Parts

71. Carburetor (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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
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

72. Fuel Pump

..	3H4574/P25	1	Fuel Pump assy.—A. C. #1523019	AS1-99-4	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

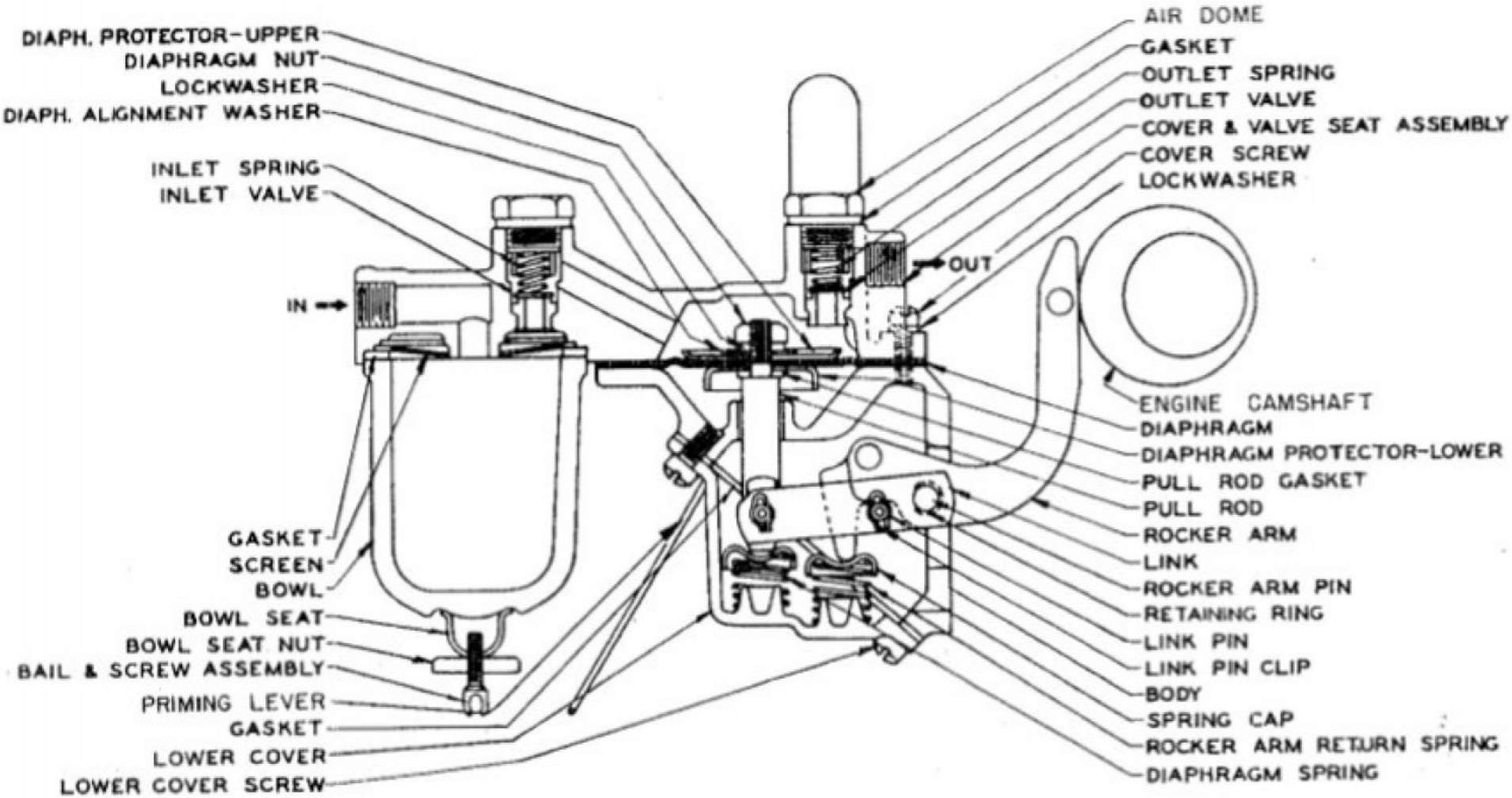

Fig. 72. Cross Section through Fuel Pump

72. Fuel Pump (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
..		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. 16-921-1)	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
..		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

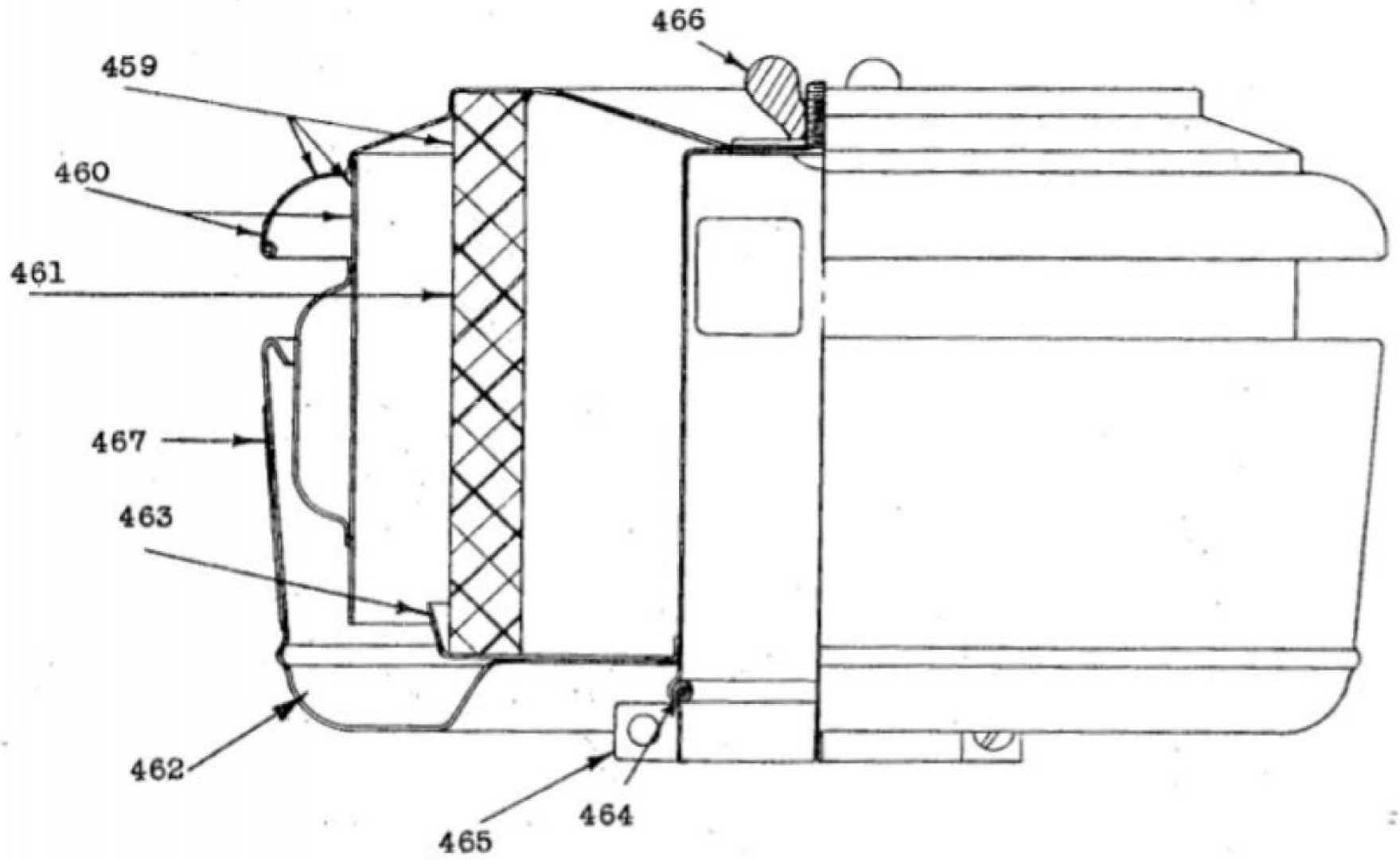

Fig. 73. Cross Section through Air Cleaner

73. Air Cleaner

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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, ⅜—16 x ¾" 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

74. 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, ⅜"—16 hex.	04-103	A
...		2	Lockwasher—For #04-103, ⅜"	05-51	A
955	3H4574/C102	1	Cap Assy.—For fuel tank	A4-129	A
...		1	Drain plug—Brass, ¼" square head	011-252	A
...		1	Nipple, ¼" brass, close	33-546	A
...	3H4574/E16	1	Reducing elbow, ¼ x ⅛"—90°	33-547	A
...	3H4574/N34	3	Nipple, ⅛" brass, close	35-544	A
...	3H4574/L30	1	Fuel line—Tank to valve, titeflex—11¾"	A55-643-3	A
...	3H4574/L31	1	Fuel line—Fuel pump to valve, titeflex—23"	A55-643-4	A
...	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

74. Fuel Tank, Lines, E Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
...	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

75. Governor Assembly

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 ½"	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 1¼" hex.	02-21	A
...		4	Lockwasher, 5/16"	05-50	A
1		1	Servo 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
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

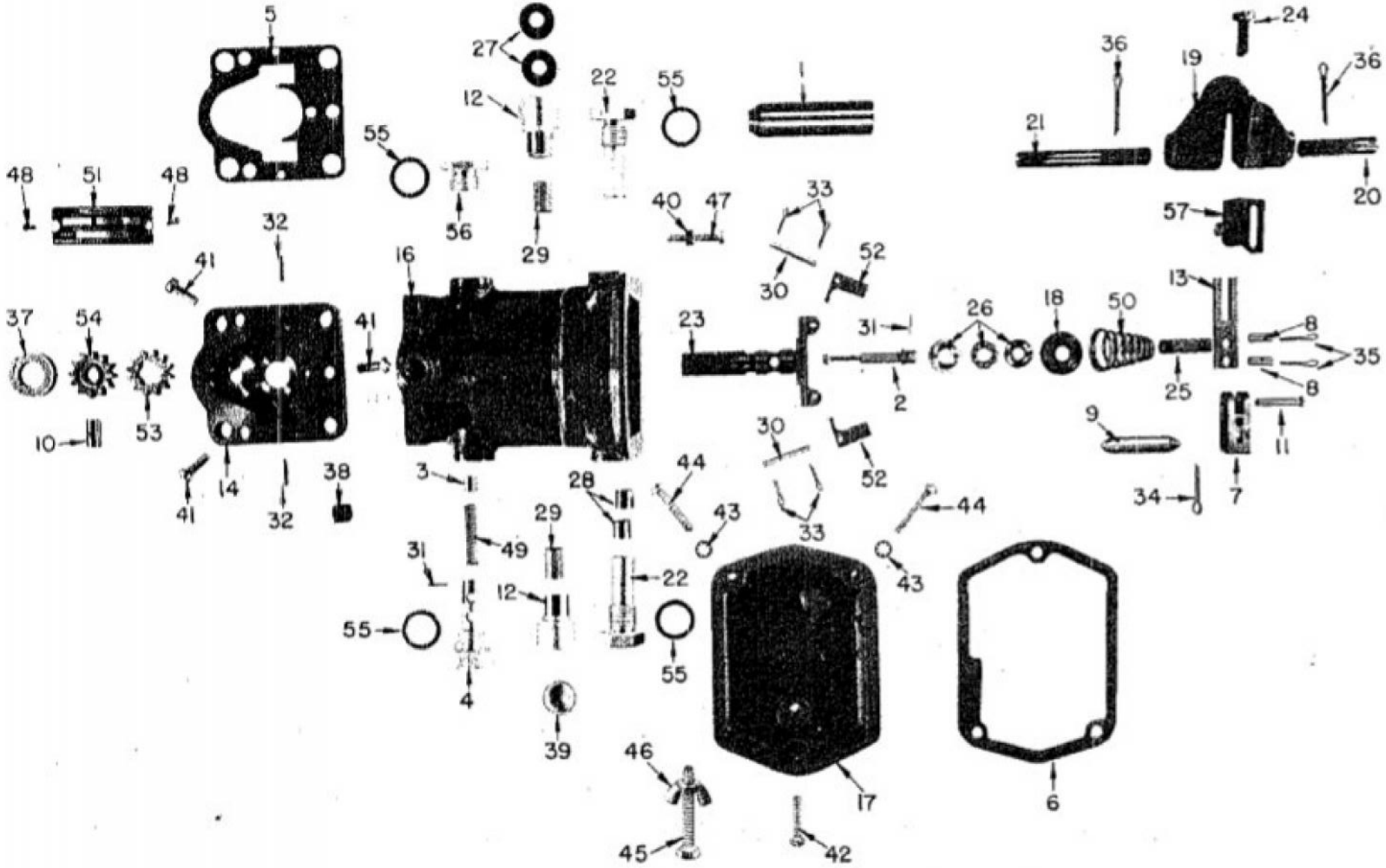

Fig. 74. Governor and Component Parts

75. Governor Assembly (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
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

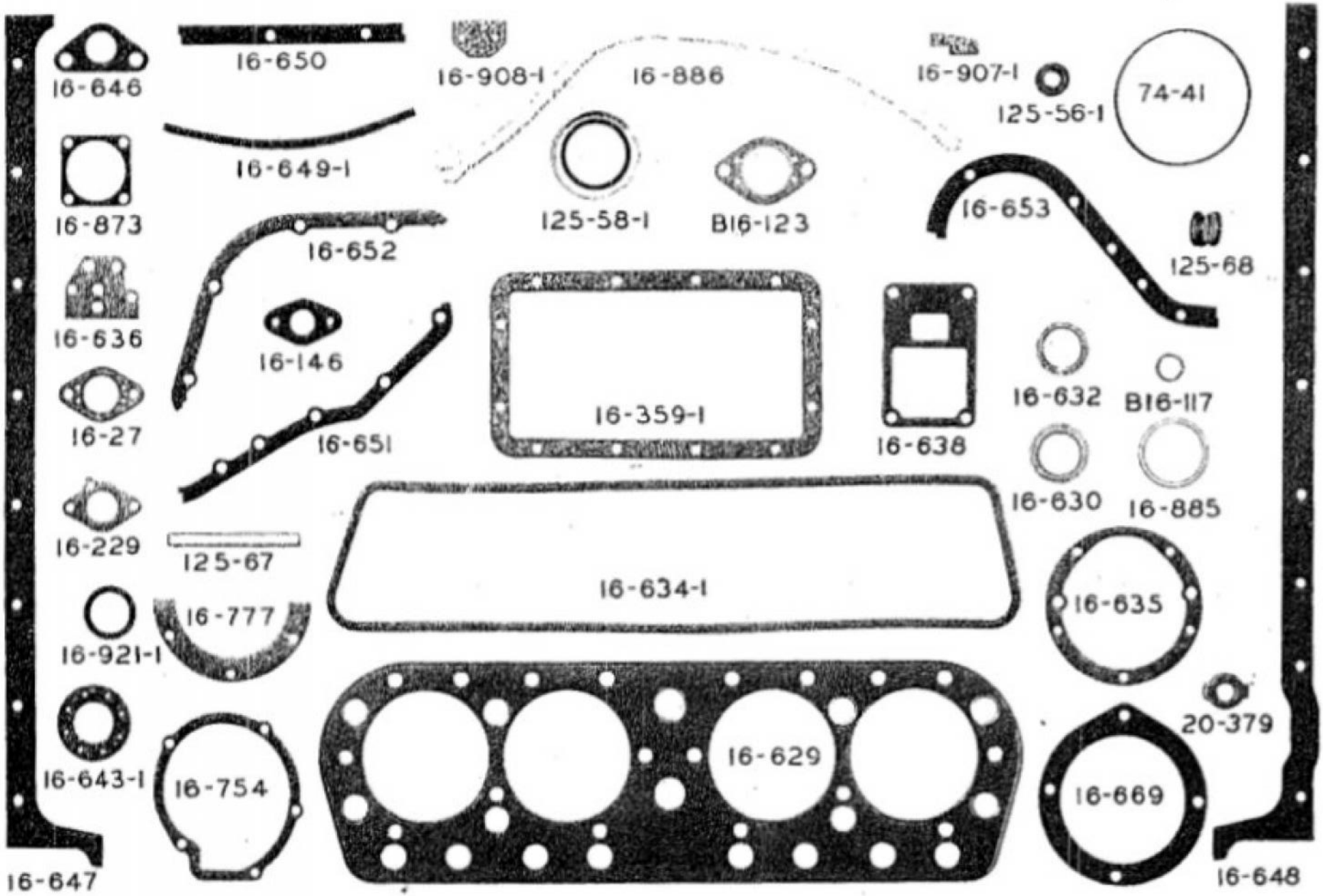

Fig. 75. Gasket List

76. Spare Parts, Tools and Supplies

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Function	Mfgr's. Part No.	Mfgr's. Code
		1	Metal tool box		119-123-1	A
..		2	Nut, ½"—20		04-605	A
..		2	Lockwasher, ½"		05-53	A
		1	Padlock		A178-14	A
			Parts in Bottom of Box			
..	3H4574/H7	1	Service Cyl. Hd. Assembly		3A2-149-3	A
..	3H4574/R25	1	Push Rod		99-72	A
..		1	Conn. Rod and Piston Assembly		5A7-74	A
..	3H4574/S15	1	Cyl. Sleeve, 4½"		175-6-1	A
..		1	Gasoline Line, 10 Ft. Lg		55-643-7	A
..	3H4584D/32	10	Oil Filter Elements		A77-180-1	A
..		1	Oil Pressure Hose, 10 Ft. Lg		55-642-16	A
..		1	Exciter Brush Holder, Westinghouse, No. 1124998		174-18	A
			Tray No. 1			
..		1	Magneto		A85-99-4	
..	3H4574/B53	1	Fuel Pump Sediment Bowl, A. C., No. 854004		184-2	A-G
..		1	Carburetor		A84-546-3	A
..	3H4574/P25	1	Fuel Pump, Complete		A81-99-4	A
..		1	Voltage Regulator, Delco Remy, No. 5897		116-85	A-F
..		1	Oil Can, 8 Oz.		88-227	A
..		1	Oil Can Holder		39-1404	A
..		1	5 Lb. Can of Grease		204-4	A
..	3H4584A/P29	24	Spark Plugs, No. 83AC		86-9-6	A-G
..		1	Generator Brush Holders, Westinghouse, No. 884027		174-19	A-J
..	3H4574/V8	4	Exhaust Valves		15-201-1	A
..	3H4574/V2	4	Intake Valves		15-200	A
..	3H4574/S11	4	Valve Springs		B24-26	A
..	3H4584A/R4	4	Valve Spring Retainer Washers		20-278	A
..	3H4574/W6	8	Valve Spring Lockwashers		20-279	A
..	3H4584A/A1	1	Rocker Arm Assembly		A98-19-3	A
..		1	Funnel		88-236	A

76. Spare Parts, Tools and Supplies (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
..	3H4574/H3	2	Radiator Hose	73-5-14	A
..	3H4574/H13	2	Radiator Hose	73-5-20	A
..	3H4584A/C25	8	Hose Clamps	83-93	A
..	3H4574/C69	2	Hose Clamps	83-92	A
..	3H4574B/B3	2	Seal Bellows Assembly, Water Pump	125-68	A
..	3H4574B/F3	1	Fitting, Titeflex	182-163	A
..	3H4574B/F4	1	Fitting, Titeflex	182-164	A
..	3H4574/F1	1	Fitting, Titeflex	182-165	A
..	3H4574/F2	1	Fitting, Titeflex	182-180	A
..	3H4584A/R7	12	Piston Rings, Comp., 4½ x 3/16"	18-233	A
..	3H4584A/R8	4	Piston Rings, Oil, 4½ x 3/16"	18-114	A
..		1	Battery Generator Ball Bearing, Delco, No. 903203	181-180	A-F
..		1	Battery Generator Bushing, Delco, No. 812823	21-363	A-F
..		1	Starting Motor Bushing, Delco, No. 810620	21-364	A-F
..		1	Starting Motor Bushing, Delco, No. 35048	21-365	A-F
..		1	Starting Motor Bushing, Delco, No. 1839345	21-366	A-F
..		1	Container of Gasket Shellac	204-1	A

Tray No. 2—Lower Compartment

..	3H4574/G25	2	Gasket (Water Outlet Conn.)	16-146	A
..	3H4574/G11	2	Carb. Flange Gasket	16-27	A
..	3H4574/G10	2	Fuel Pump Flange Gasket	16-229	A
..	3H4574/G2	8	Water Outlet Conn. Gasket	16-646	A
..	3H4574/G38	4	Retainer Parting Gasket	16-907-1	A
..	3H4584A/G7	2	Air Cleaner Brkt. Gasket	16-908-1	A
..	3H4574/G77	2	Gasket for Sed. Bowl, A. C., No. 854003	16-921-1	A-G
..	3H4574/G3	2	Rad. Inlet Conn. Gasket	B16-123	A
..	3H4574/G39	2	Oil Pump, Body to Cover Gasket	16-636	A
..	3H4574/G15	4	Gov. Flange to Drive Body Gasket	16-873	A
..	3H4574/G8	2	Water Pump Brkt. Gasket	16-638	A
..	3H4574/G21	2	Breather Gasket	16-643-1	A
..		4	Rear Oil Seal	125-67	A

76. Spare Parts, Tools and Supplies (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
..	3H4574/G27	2	Crankcase Retainer Gasket	16-777	A
..	3H4574/P1	16	Cyl. Sleeve Packing	74-41	A
..		1	Diaphragm, Fuel Pump, A. C., No. 855389	186-9	A-G
..	3H4574/G9	2	Water Pump Body Gasket	16-754	A
..	3H4574/G24	2	Oil Pump Cover Flange Gasket	16-635	A
..	3H4574/G19	2	Gear Cover Gasket (Upper)	16-650	A
..	3H4574/G14	2	Gov. Drive Body to Crankcase Gasket	16-669	A
..	3H4574/G16	2	Gear Cover Gasket (Magneto Side)	16-653	A
..	3H4574/G17	2	Gear Cover Gasket (Lower)	16-652	A
..	3H4574/G18	2	Gear Cover Gasket (Manifold Side)	16-651	A
..	3H4574/G1	8	Oil Pan Cover Gasket	16-359-1	A
..	3H4574/G5	2	Oil Pan Rear Gaskets	16-649-1	A
..		2	Generator Belts	41-229	A
..	3H4584A/B1	2	Fan Belts	41-235	A
..	3H4574/G7	2	Oil Pan Flange Gasket (Carb. Side)	16-647	A
..	3H4574/G6	2	Oil Pan Flange Gasket (Magneto Side)	16-648	A
..	3H4574/G20	6	Cyl. Hd. Cover Gasket	16-634-1	A
..	3H4574/G22	6	Cyl. Hd. Gaskets	16-629	A
..		1	Instruction Book		
..	3H4574/H14	1	Hose, ¾ x 11½"	73-29-8	A

Tray No. 2—R. H. End Compartment

..	3H4584A/S56	2	Oil Seal for Gov. Drive Body	125-56-1	A
..	3H4574/R6	2	Oil Seal for Gear Cover	125-58-1	A
..	3H4574/E16	1	Brass Reducing Ell, ¼ x ⅛"—90°	33-547	A
..	3H4574/E17	1	Brass Street Ell, ⅛"—45°	33-543	A
..	3H4574/C48	1	Brass Nipple, Close, ⅛"	33-544	A
..	3H4584A/T5	1	Brass Tee, ⅛ x ⅛ x ⅛"	33-554	A
..	3H4574/E18	1	Brass Street Ell, ⅛"—90°	33-542	A
..		1	Brass Nipple, ⅛ x 2"	33-545	A
..	3H4574/N15	1	Brass Cross, ⅛"	54-101	A
..	3H4574/W77	2	Seal Washer, Water Pump	20-379	A
..	3H4574/G23	2	Oil Relief Plug Gasket	B16-117	A

76. Spare Parts, Tools and Supplies (Cont'd)

Ref. No.	*S. C. Stock No.*	*No. Req'd*	*Name and Description*	*Mfgr's. Part No.*	*Mfgr's. Code*
..	3H4784A/N40	4	Spark Plug Terminal Nuts	188-21	A
..	3H4574/G13	4	Intake Manifold Gaskets	16-630	A
..	3H4574/G29	4	Exhaust End Gaskets	16-632	A
..	3H4574/G28	2	Exhaust Center Gaskets	16-885	A
			Tray No. 2—L. H. End Compartment		
..	3H4574/P4	2	Asbestos Packing	16-886	A
..	3H4574/B12	3	Battery Generator Brushes, Delco Remy, No. 809637	174-14	A-F
..		4	Generator Brushes, Westinghouse, No. 777889	174-20	A-J
..	3H4574/B24	6	Starter Brushes, Delco Remy, No. 38367	174-15	A-F
..		4	Exciter Brushes, Westinghouse, No. 782740	174-17	A-J
			Tray No. 3		
..		1	Gas Pliers	88-230	A
..		1	Feeler Gauge	88-10	A
..		1	Screwdriver (Large)	88-74	A
..		1	Screwdriver (Small)	88-229	A
..		1	Crescent Wrench, 8"	88-235	A
..		1	Pin Punch, 5/32"	88-233	A
..		1	Pin Punch, 1/32"	88-232	A
..		1	Pin Punch, 1/32"	88-231	A
..	3H45842/W20	1	Socket Wrench, Spark Plug	88-224	A
..		1	Valve Lifter	88-48	A
..		1	Hammer	88-228	A
..		1	Wrench, Open End, 3/8 and 7/16"	88-11	A
..		1	Wrench, Open End, 1/2 and 9/16"	88-9	A
..		1	Wrench, Open End, 9/16 and 5/8"	88-234	A
..		1	Wrench, Open End, 11/16 and 13/16"	88-85	A
..		1	Wrench, Open End, 3/4 and 7/8"	88-138	A
..		1	Box Socket Wrench, Double End, 3/4 and 3/4"	88-21	A
..		1	Adjustable Auto Wrench, 11"	88-72	A

76 Spare Parts, Tools and Supplies (Cont'd)

Tray No. 3 (Cont'd)

Ref. No.	S. C. Stock No.	No. Req'd	Name and Description	Mfgr's. Part No.	Mfgr's. Code
..		1	Combination pliers, 6"	88-73	A
..		1	Box of Assorted Cotter Pins	204-2	A
..		1	Spool Wire	204-3	A
..		2	Sheets No. 00 Sandpaper	204-5	A
..		1	Wrench for Allen Socket Screw	88-239	A
..		1	Spanner Wrench	88-252	A

Tray No. 4

..		2	Main Bearing Shells	21-349	A
..		2	Center Main Bearing Shells	21-347	A
..		2	Front Main Bearing Shells	21-348	A
..		8	Conn. Rod Bearing Shells	21-350	A
..	3H4584D/B10	8	Piston Pin Bushings	21-334	A
..	3H4584A/W1	4	Rear Main Bearing Thrust Washers	20-370	A
..		4	Wrist Pins	B17-17	A

Additional Items in Box, Not Classified as "Spare Parts, Tools and Supplies"

Tray No. 1

..		1	Exhaust pipe nipple	33-178-23	A
..	3H4574/P4	1	Muffler packing	16-886	A
..		1	Muffler packing retainer	31-426	A
..	3H4574/C51	1	Reducing coupling, 1 x ¼" I.P.T.	33-548	A

Tray No. 2—Lower Compartment

..	3H4584A/H4	1	Flexible gasoline hose, 35 feet long	73-253-8	A

77. Standard Parts List

Quantity	Size	Length	Thread	Description	Where Used
20	¼"	½"	20	Hex. head capscrew	Magnetic switch mounting Rubber mountings
6	¼"	⅝"	20	Hex. head capscrew	Oil pump
2	¼"	2"	20	Hex. head capscrew	Control bracket
1	⅝"	½"	18	Hex. head capscrew	Bed plate
14	⅝"	¾"	18	Hex. head capscrew	Camshaft Oil pump Water pump and fan Fuel pump mounting
3	⅝"	⅜"	18	Hex. head capscrew	Crankcase
2	⅝"	1"	18	Hex. head capscrew	Generator
6	⅝"	1¼"	18	Hex. head capscrew	Oil pump Governor flange
5	⅝"	1¾"	18	Hex. head capscrew	Water pump and fan
5	⅜"	½"	16	Hex. head capscrew	Cooling group Control box
6	⅜"	⅝"	16	Hex. head capscrew	Bell housing
13	⅜"	¾"	16	Hex. head capscrew	Bell housing Generator Battery ground Conn. to cyl. block
6	⅜"	⅜"	16	Hex. head capscrew	Radiator support
15	⅜"	1"	16	Hex. head capscrew	Outlet conn. to manifold Cranking motor mounting Carburetor mounting Supports
18	⅜"	¾"	16	Hex. head capscrew	Engine base flange Magneto mounting
2	⅜"	1½"	16	Hex. head capscrew	Gear cover
11	⅜"	1¾"	16	Hex. head capscrew	Gear cover
2	7/16"	¾"	14	Hex. head capscrew	Cooling group Inlet connection
6	½"	1¼"	13	Hex. head capscrew	Bell housing Cyl. hd. water connection to manifold
2	½"	1½"	13	Hex. head capscrew	Crankshaft support
4	⅝"	1¾"	11	Hex. head capscrew	Support
2	⅝"	1½"	11	Hex. head capscrew	Radiator
6	¾"	2"	10	Hex. head capscrew	Engine to base
4	¾"	2¾"	10	Hex. head capscrew	Generator to base
1	¾"	½"	28	Hex. head capscrew	Fuel line

77. 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

77. 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	3/8"			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	5/8"			Lockwasher	Cooling group
					Support

77. Standard Parts List (Cont'd)

Quantity	Size	Length	Thread	Description	Where Used
9	¼"			Flat washer	Cooling group
1	5/16"			Plain washer	Oil pump
2	⅜"			Plain washer	Magneto mounting
2	¼"			Plain washer	Bed plate
4	⅜"			Plain washer	Bed plate
1	7/16"			Plain washer	Rocker arm bracket stud
2	⅜"			Plain washer	Cooling group
3	1/16"	1/16"		Cotter pin	Governor controls
26	3/32"	1"		Cotter pin	Bell housing Connecting rod Bed plate
4	#6	½"		Woodruff key	Oil pump drive gear Oil pump gear Magneto coupling
2	#A	⅜"		Woodruff key	Crankshaft
1	#13	1"		Woodruff key	Camshaft gear
1	⅝"	2½"		Square key	Alternator
1	#2	1"		Taper pin	Oil pump drive gear
2	#3	1¼"		Taper pin	Governor drive gear
1	#4	1"		Taper pin	Fan hub
1	#4	1½"		Taper pin	Impellor hub
2	#000	½"		Taper pin	Coupling for operating lever
2	#7	2"		Taper pin	Gear cover
4	#9	3"		Dowel pin	Bed plate
5	⅛"			Square head pipe plug	Crankcase
1	¼"			Countersunk pipe plug	Oil pump
1	⅜"			Countersunk pipe plug	Crankcase
1	¼"			Square head drain plug	Fuel tank
1	¾"	2½"		Oil drain line	Engine base
1	¾"			90° Street ell	Oil drain line—Engine base
1	⅛"			45° Street ell	Water pump and fan
1	¼"			45° Street ell	Cooling group
1	#000		⅛"	Grease cup	Water pump and fan
4	1¼"			Welch plug	Manifold
1	3"			Welch plug	Crankcase
3	¼"		28	Clevis end	Governor rod and spring rod in governor controls
3	¼"			Clevis pin	Governor controls

78. Identification Index to Manufacturers of Accessories and Equipment

Le Roi Part Name	Le Roi Part No.	Manufacturer Name and Address	Manufacturers Model or Type No.
Air Cleaner	A77-145-1	Air-Maze Corporation Cleveland, Ohio	37U-OBF
Alternator	A108-97	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	A84-546-3	Zenith Carburetor Division Detroit, Michigan	62AJ10
Control switch box	A76-176	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	A151-214	Westinghouse Electric & Mfg. Co. Chicago, Ill.	MKZ-24372
Magnetic switch	A76-46	Delco-Remy Div. Anderson, Indiana	1422
Magneto	A85-99-4	American Bosch Corp. Springfield, Massachusetts	MJB4A-314

78. Identification Index to Manufacturers (Cont'd)

Le Roi Part Name	Le Roi Part No.	Manufacturer Name and Address	Manufacturers Model or Type No.
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

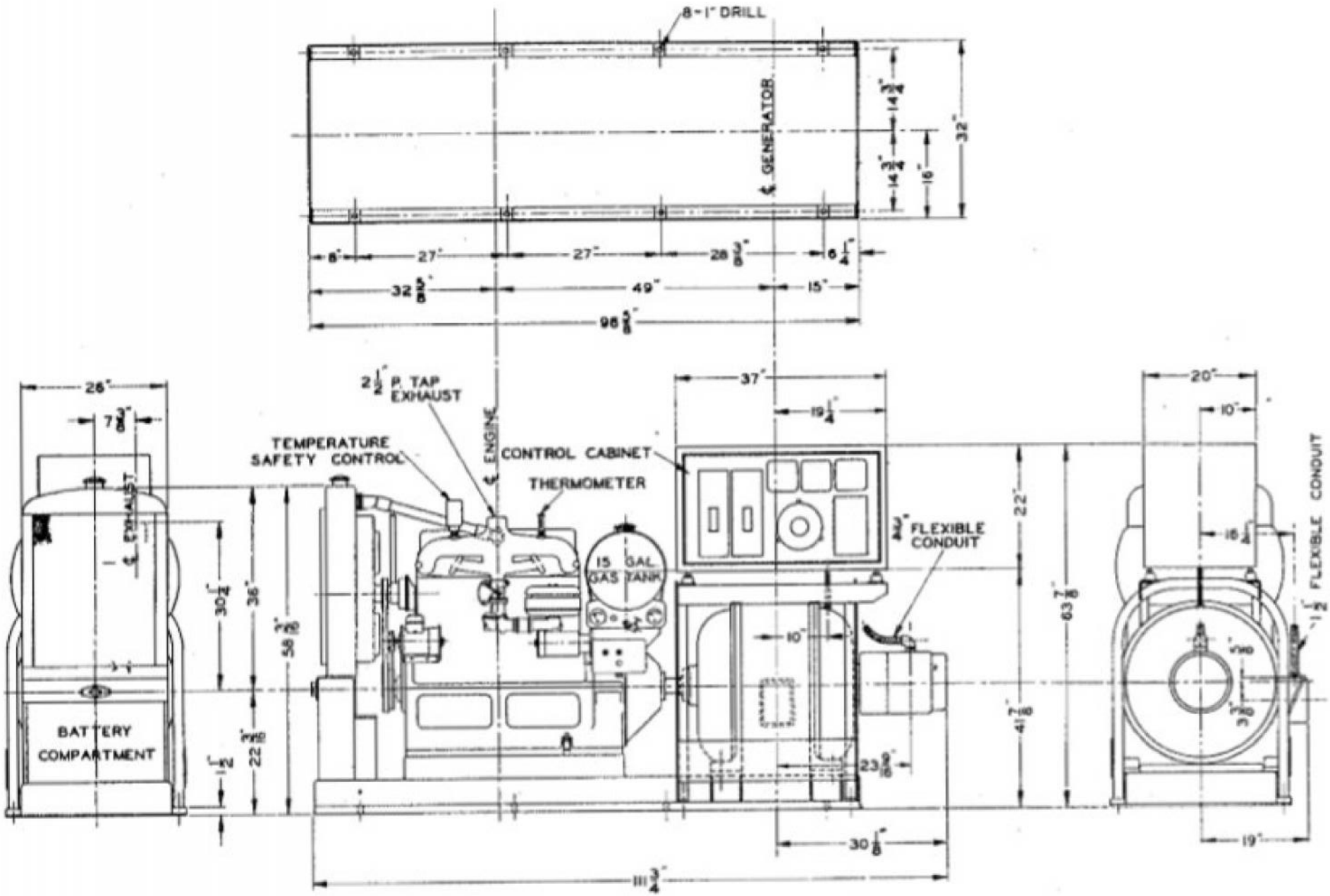

Fig. 76. Installation and Dimensional Drawing of Power Unit

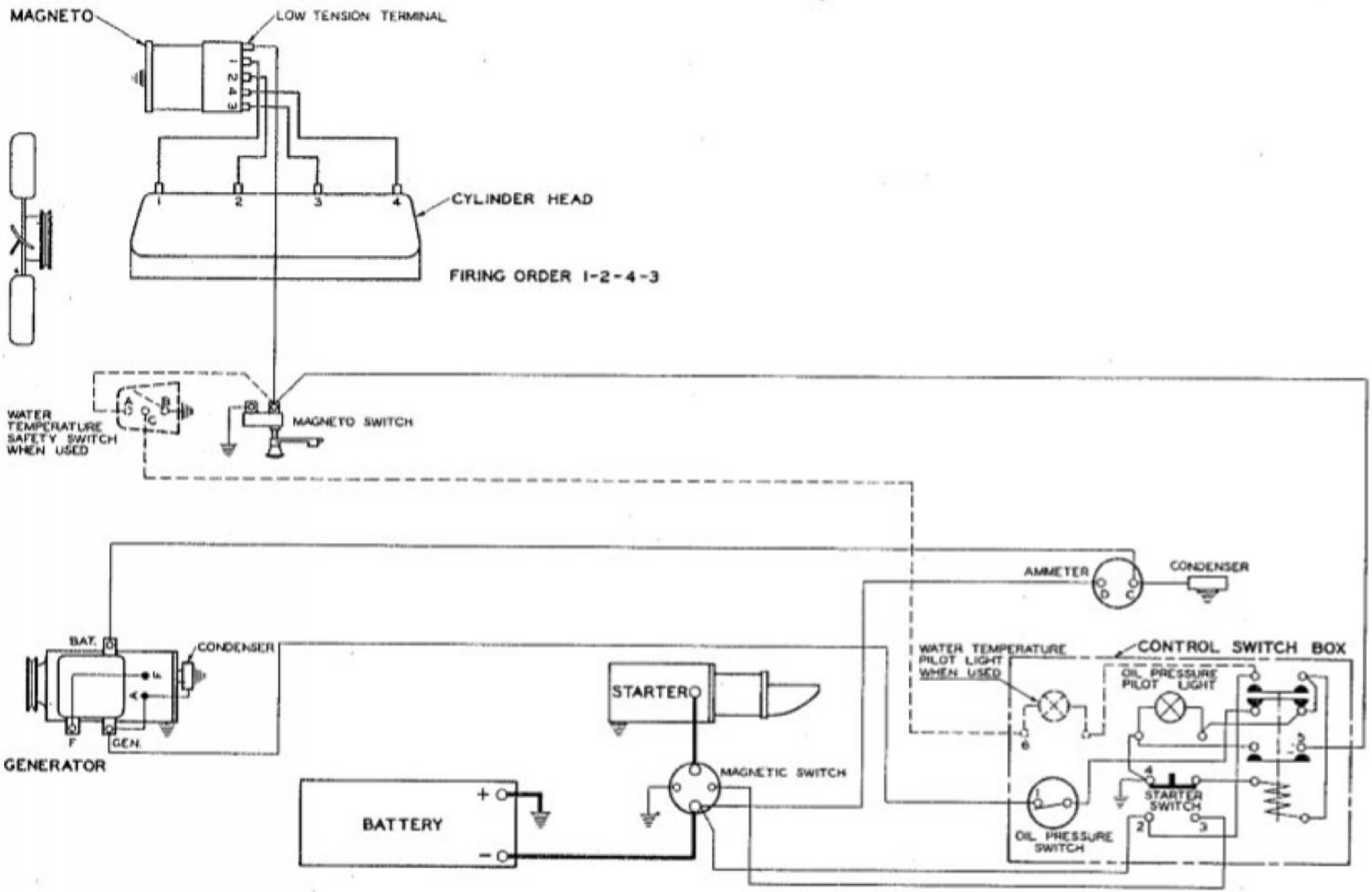

Fig. 77. Wiring Diagram, 12 Volt Electrical System

79. First Aid Instructions for Electric Shock

(From American Red Cross First Aid Text Book)

Symptoms.

In electric shock, the current may pass through the breathing center at the base of the brain and cause this center to stop sending out the nervous impulses which act upon the muscles responsible for breathing. In consequence, breathing stops abruptly. If the shock has not been too severe, the breathing center recovers after a time and resumes the vitally necessary duty of sending impulses to the muscles of breathing, provided that a sufficient supply of air has been furnished the body meanwhile by artificial respiration. Cases are recorded where eight hours work was necessary before the breathing center recovered and the patient began to breathe of his own accord. *Therefore, the ordinary and general tests for death should never be accepted.*

The patient is usually blue, although occasionally he may be very white. The pulse is weak or entirely absent. Unconsciousness is complete. Burns may be present. Occasionally the body becomes rigid or stiff in a very few minutes. This is due to the action of the electricity and is not to be considered "rigor mortis." *This stiffness is not a sign to stop artificial respiration,* as a few of such cases are reported to have been revived.

Resuscitation Procedure.

1. Lay the patient face downwards, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand or forearm so that the nose and mouth are free for breathing. (See Fig. 78.)

2. Kneel straddling the patient's thighs, with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in Fig. 78. In many cases (due to size of the patient) it may be more convenient to straddle only one leg.

Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position and the tips of the fingers just out of sight. (See Fig. 78.)

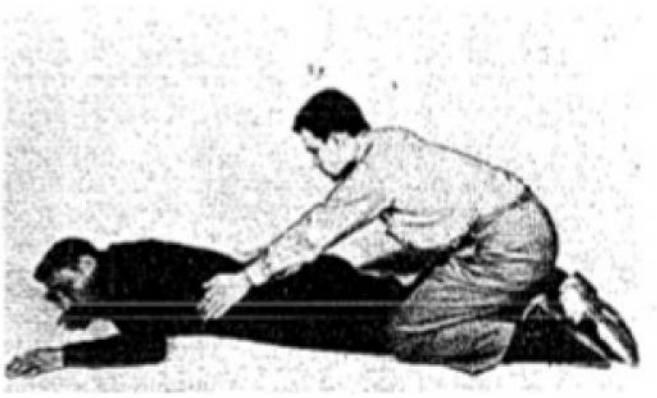

Fig. 78. Artificial Respiration—Ready to Apply Pressure

3. With arms held straight, swing forward slowly, so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. (See Fig. 79.) Do not bend your elbows. This operation should take about two seconds.

Fig. 79. Artificial Respiration—Pressure Applied

4. Now immediately swing backward so as to remove the pressure completely. (See Fig. 80.)

5. After two seconds, swing forward again. Repeat this double movement of compression and release (a complete respiration in four or five seconds) twelve to fifteen times a minute.

6. Continue artificial respiration without interruption until natural breathing is restored (if necessary four hours or longer) or until a physician declares the patient dead.

7. As soon as artificial respiration has been started and while it is being continued, an

Fig. 80. Artificial Respiration—Pressure Released

assistant should loosen any tight clothing about the patient's neck, chest or waist. *Keep the patient warm.* If at all possible, artificial respiration should be performed while the patient is wrapped in a blanket, as shown in Fig. 81. *Do not give any liquids whatever by mouth until the patient is fully conscious.*

Fig. 81. Artificial Respiration—Through a Blanket

8. To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, the patient should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a hot drink of coffee or tea, etc. The patient should be kept warm.

9. Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. He should not be moved from this point until he is breathing normally, of his own volition, and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time he is being moved.

10. A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and if natural breathing stops, artificial respiration should be resumed at once.

11. In carrying out resuscitation it may be necessary to change operators. This change must be made without losing the rhythm of respiration. As pressure is released the operator falls aside while his assistant takes his place. By this procedure no confusion results at the time of change-of-operator and a regular rhythm is kept up.

Explanatory Notes on Resuscitation.

If it is evident that air is not being drawn into the patient's chest, examine the mouth for a possible obstruction, and remove any foreign body such as false teeth, chewing gum, or tobacco. An assistant, if present, should watch the patient's face, and wipe out from the mouth any frothy mucus or saliva that may collect and interfere with respiration.

If the operator is large and the patient is small, then the operator will of course not swing forward until all the weight of his body is brought to bear on the patient, but only until firm resistance is met beneath his hands. *Sixty pounds pressure is sufficient for even a large adult.* Damage has been done by too great pressure.

Treatment During Recovery.

The patient may show no sign of beginning recovery for some time, and then may gradually begin to regain a more normal color, indicating that the blood is getting more oxygen and that the circulation is improving. Then he may show slight muscular effort, such as a slight twitching or a scratching or clutching motion of the fingers. The first attempt to breathe may be a catch of the breath or a faint sign. The operator should watch very carefully at this point so as not to exert pressure as the patient attempts to

take his first spontaneous breath. Artificial respiration should be withheld when the first breathing begins, but may have to be resumed at once if breathing does not continue.

The breathing at first may be very slow —four to six times per minute—but should not be assisted by artificial respiration.

As breathing is resumed the patient may attempt to get up, or even become violent in his semi-conscious efforts to help himself. He must be restrained and kept in the prone position.

A person who has been resuscitated has been through one of the most severe strains that can be experienced. His heart has been under extreme exertion, and the regulation of rhythm and the volume of heart action may not have returned to normal for some time.

The patient must be kept lying down. Permitting him to get up and walk may cause sudden heart failure and death. Shock treatment must be continued long after the patient begins to breathe. He must be carefully watched, as some cases, apparently breathing normally, will suddenly stop breathing and need additional artificial respiration. Never leave a resuscitated person alone until quite sure he is normal again.

[A.G. 062.11 (5-21-43)]

By Order of the Secretary of War

G. C. MARSHALL
Chief of Staff

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J. A. ULIO
Major General
The Adjutant General

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