SECTION "A"

(A.C. - D.C.)

WAUKESHA DIESEL ENGINATORS

INTRODUCTION AND GENERAL INFORMATION

Waukesha Diesel Enginators were not only designed and developed for railway passenger car installations, but can be used for heater cars, refrigerator cars or any installation requiring a constant source of electrical energy, either direct or alternating current.

The D.C. and A.C. Enginators are comparable in general design characteristics. Both units use the same model heavy-duty diesel engine and fuel system. The major difference is in current, voltage and control. One has slip rings and is designed to produce alternating current. The other has a commutator and produces direct current. Certain electrical items, such as radiator fan motors, are similar to both units except for voltage and current. Both units use the same size and type engine cooling system. The design features of the d.c. generator and the a.c. alternator are comparable. Both are enclosed and sealed to keep out dirt and moisture and have identical internal air cooling systems.

Each unit is a complete packaged power plant, consisting of a 60 hp., six-cylinder, 4-cycle, vertical overhead valve diesel engine. The engine drives the alternator or generator through a balanced type fluid coupling. The alternator or generator, engine, engine radiators, radiator fans and controls are assembled in a welded, pressed steel chassis. The complete unit is supported under the car by means of cushioned trolleys and specially designed tubular mounting tracks. This provides easy roll-out of the unit for maintenance or quick exchange. The units can be operated in full roll-out position for testing and servicing.

The component parts of the control panels are different, due to the methods of controlling a.c. or d.c. current in relation to the Enginator and car electrical demands. Many direct current installations use only small automotive-type starting batteries, similar to those used on a.c. systems. Electrical loads are then connected directly to the d.c. generator. The starting batteries are automatically charged through a small charging panel.

Two or more Enginators of the same voltage may be operated in parallel to provide a power network throughout the train. A common train-line then distributes electric power to all power demands.

The D.C. Diesel Enginator can be used as either a prime power source or used to supplement axle generators as an additional or standby power supply. An adequate supply of electrical energy, regardless of train motion, is becoming more important, due to the ever increasing electrical loads and limitations of battery space on railway passenger cars.

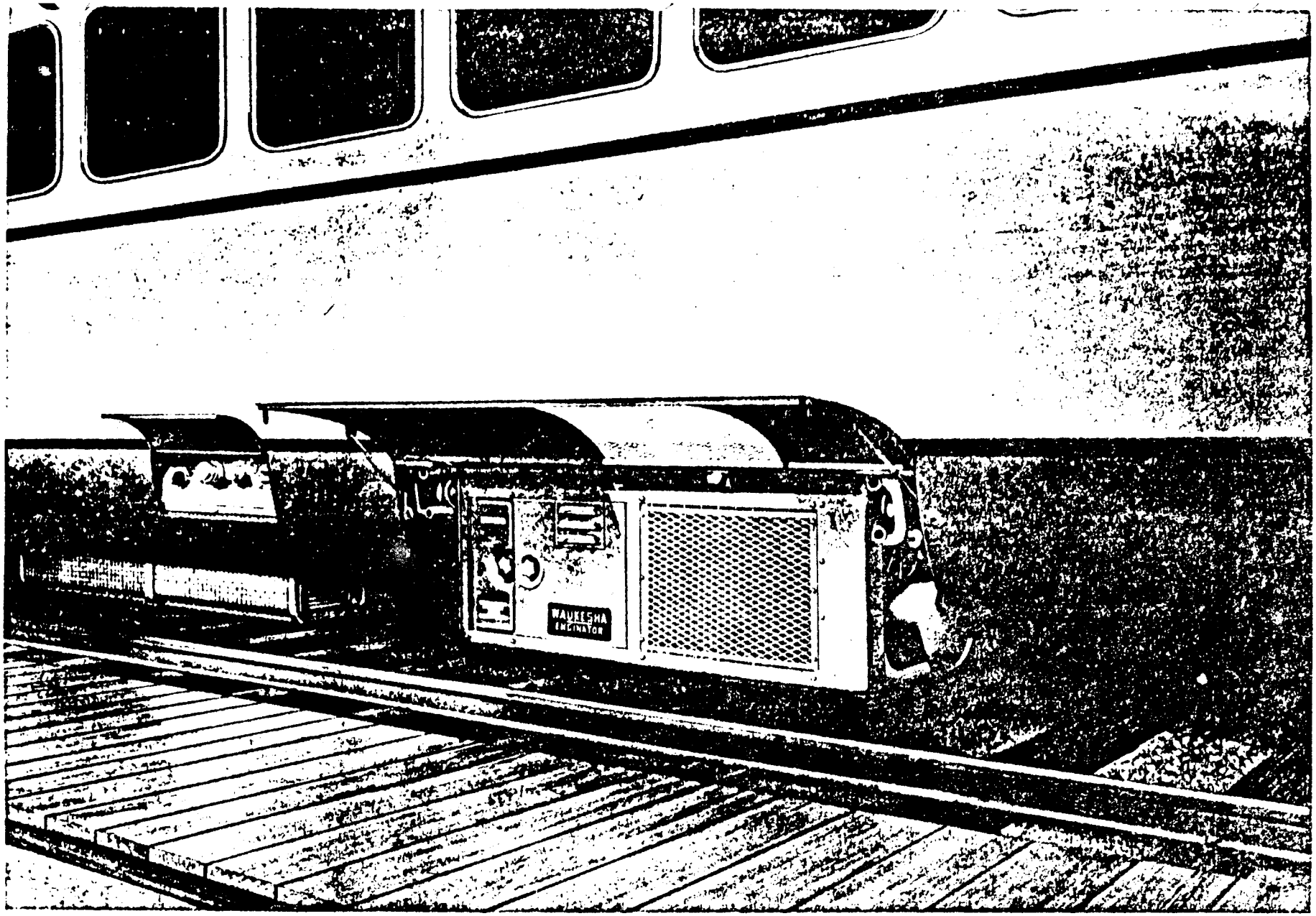


FIG. 49-45 — ENGINATOR AND FUEL TANK UNDER CAR

SECTION "B"

(D.C.)

ENGINATOR OPERATION

STARTING UNIT FOR THE FIRST TIME

After the Enginator is in place and a check has been made to see that all parts are in working order and all car wiring complete, the unit will be ready to start, after the following steps have been taken: (See Figures 54-257, 54-258, and 54-255.)

Lubrication

Fill the engine crankcase with approximately 20 quarts (includes 2-1/2 quarts for two filters and oil cooler) of premium grade, heavy-duty SAE 30 S1 diesel motor oil. After the engine has warmed up, recheck oil and fill only to the level mark on dip gauge stick. Do not overfill. All bearings and fittings have been greased at the factory and require no further greasing or lubrication at this time.

Air Cleaners

Swing out the large intake manifold air cleaner to its service position. Remove bottom cup of this air cleaner. Fill cup to indicated oil level mark with SAE 10 motor oil. Use this weight oil both winter and summer. Remove the smaller crankcase breather which is located on the same side of the engine as the large engine air cleaner. Fill this cup to indicated oil level mark with SAE 10 grade motor oil (winter and summer). If Enginators operate in extreme sub-zero weather, a low pour point oil, such as compressor oil, should be used in both air cleaners. A 50-50 mixture of SAE 10 motor oil and kerosene may also be used. Too heavy an oil, either winter or summer, will decrease the efficiency of the air cleaners.

The preclearer of the large intake air cleaner is enclosed in a sheet metal compartment when the air cleaner is in its operating position. A manually operated damper is located on the right wall (toward the generator) of the enclosure. This damper should be closed for summer operation and open for winter operation. Likewise, the air intake louvers in the engine compartment service door should be open in summer and closed in winter.

Cooling System

Fill the cooling system with approximately 12 gallons of clean, soft water. It is important to add a good rust and scale inhibitor, even if Prestone is used. Filler cap and body assembly are

Cooling System (Continued)

located at the front center of the unit. Open the test pet cock which is located to the left of the water filler body. This test pet cock is used to check the level of the engine coolant and also acts as an air bleed when filling the system. Add coolant only until it starts to drip out of pet cock.

After Enginator is running, recheck level to assure all parts of the cooling system are full and free of air. During cold weather operation, the system should be protected from freezing with anti-freeze solution.

Fuel

Fill the fuel tank with clean diesel fuel oil. See Figure 49-45. The same grade or specification as used in the diesel locomotives is also satisfactory for use in the Waukesha System. Open shutoff valves in the car fuel lines. These valves are usually just ahead of the two long flexible fuel lines at the mounting tracks.

The fuel transfer pump is located on the manifold side of the engine. It is equipped with a hand primer. This can be used to pump fuel from the tank to the injection pump, prior to cranking the engine. An automatic air vent is located at the top of the secondary fuel oil filter and will bleed air from the filter shell to the return fuel oil line and back to the top of the fuel tank. The fuel injection pump sump should clear itself of air after a brief cranking or running period. Pressure on the fuel gauge will indicate solid fuel. Air will cause the engine to misfire and smoke. The inlet fuel line from the fuel tank to the engine must be air tight. In extreme cases, it may be necessary to "crack" the high pressure fuel lines to the injectors, one at a time, with the engine running, to purge the air from the high pressure fuel lines between the pump and injectors.

Steam Connection

If the unit is being started in cold weather, the valve in the steam line to the engine steam heat exchanger should be opened. The manual valve in the steam line to the heat exchanger of the fuel oil tank should also be opened (maximum pressure, 12 lbs.). Never try to start a cold engine if the car has been off steam. Do not attempt to crank the engine until the car is on steam and the engine temperature gauge reads approximately 150° F.

CAUTION: The Enginator can be started and stopped from the inspector's control box at the unit, or from the master control panel in the car electrical locker. When pressing either start button to crank the engine, hold the start button until the Enginator voltage builds up to close the voltage relay which will then maintain control circuit.

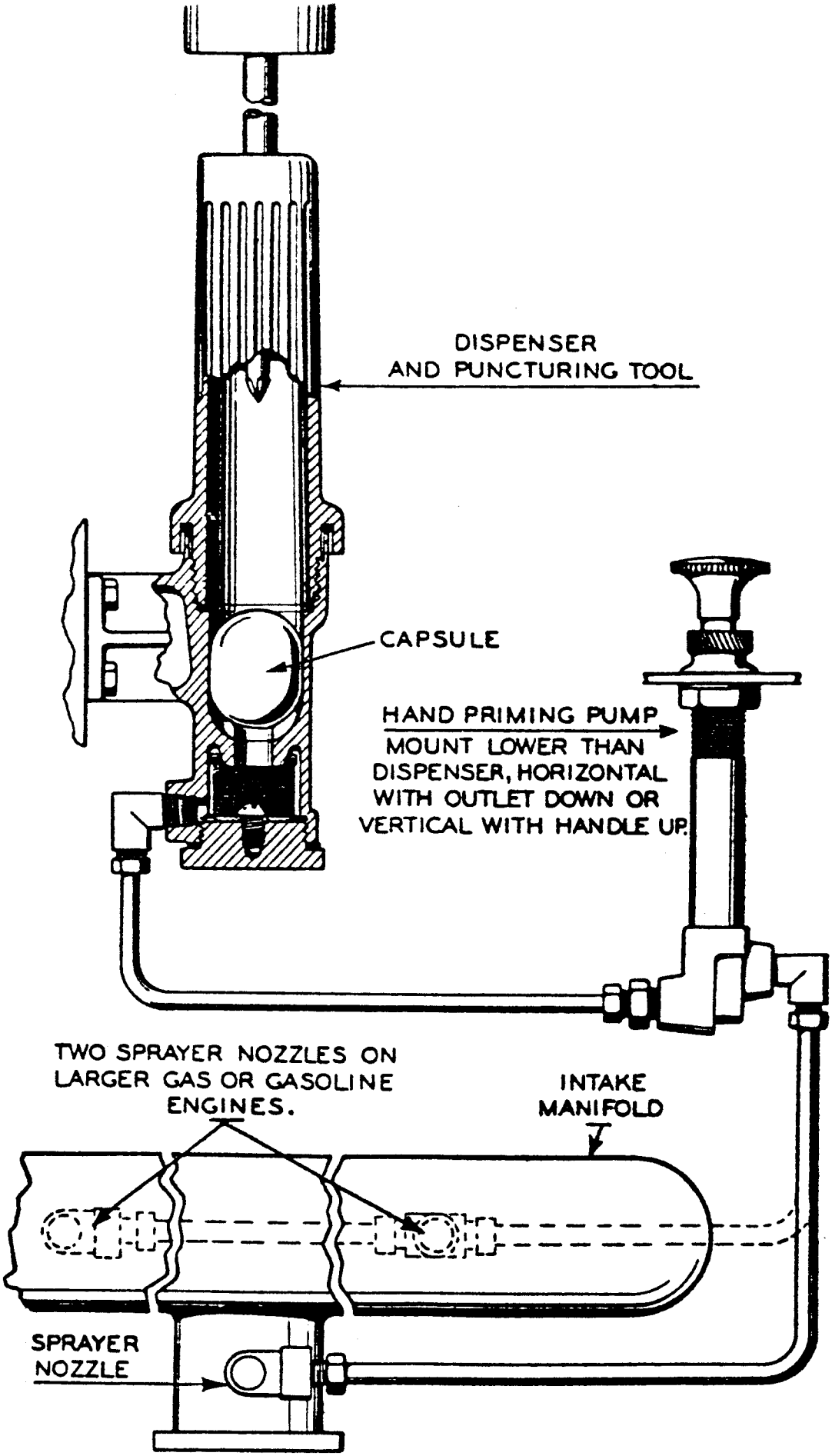


Fig. 64-19 — SECTION OF CHEVRON ETHER STARTER

Emergency Cold Weather Starting

In extremely cold weather, it may be necessary to use the ether primer. The ether capsule dispenser and hand primer pump are conveniently located within the front engine compartment, just to the right of the inspector's control box.

The following suggestions are offered for using the equipment:

1. Unscrew upper chamber of dispenser and pull out handle of puncturing tool as far as possible. Place 7-cc. capsule (Waukesha Part No. 119990) in lower chamber. Two capsules may be needed in extremely cold weather.

2. With the puncturing tool handle still pulled up, screw the upper chamber into the body.

3. Push plunger to bottom. The fluid is now released and ready to be picked up by the priming pump.

4. Press start button in unit control box. Immediately after the engine is being cranked, operate the primer with smooth strokes. When the engine is running and the generator voltage has built up, release the start button, but continue to prime until fluid in dispenser is exhausted. Engine should then continue to run on its normal fuel.

5. Remove the empty capsule and replace the upper chamber firmly, so it will not vibrate loose. Permitting dirt to enter the system may interfere with the primer check valves.

PRECAUTIONS:

1. The starting fluid is more inflammable than gasoline. Treat it with caution. Keep away from fire, flame, and temperatures above 120° F. The gelatin capsules dissolve in water and soften when warm. Do not carry them in your pocket.

2. Avoid priming the engine before starter cranks it over. Too much starting fluid might damage the engine by extreme explosion pressure.

3. Avoid breathing fumes which are toxic and will cause sleepiness.

4. Avoid smoking when opening capsule storage can or handling capsules.

5. Always remove capsule after using, to prevent its melting and blocking the primer system.

6. Avoid cutting hand on barbs of puncturing tool.

PRECAUTIONS: (Continued)

7. In extremely cold weather, warm primer with heat of the hands; it will work easier and smoother.

GENERAL OPERATION OF ENGINATOR

When the Enginator is started, it is important to note the lubricating oil pressure, which should be between 25 lbs. to 35 lbs.

The fuel oil pressure should be between 8 lbs. to 12 lbs. The engine temperature will vary between 150° to 190° F., depending on the outside temperature and load. The three gauges for reading pressures and temperature are located in the upper part of the inspector's control box.

The two radiator fan motors, located directly above the generator, are thermostatically controlled. These thermostats are located in the radiator return (outlet) line, directly behind the engine intake air cleaner. The fans are independently operated, and start and stop according to the control of these thermostats.

INSPECTOR'S CONTROL BOX

A cast aluminum control box is located at the left front side of the Enginator (Figure 54-258). Its cast aluminum gasket-tight cover protects the engine gauges, start-stop control, protective trip switches, generator voltage adjustment, generator voltage test terminals, and the engine hour meter. The fuel oil pressure gauge indicates the fuel pressure on the pressure side (discharge) of the fuel transfer pump. Normal operating pressure may vary between 8 to 12 lbs. The center gauge indicates the temperature of the engine coolant. This temperature will vary somewhat with ambient temperatures and unit loads. The normal operating range is between 150° to 190° F. The third gauge registers the engine lubricating oil pressure. Normal lube oil pressure varies between 25 to 35 lbs.

The manual start-stop switch in the control box is in series with the start-stop switch on the master control panel in the car electrical locker. Enginators can be started and stopped from either up in the car or at the unit. The stop switch in the control box at the unit has a manual lock-out lever which is used when the unit is being serviced. The stop switch on the control panel in the car also has a lock-out feature. When either of these is locked, it opens the control circuit as a safety feature.

The engine is protected against overheating, loss of lubricating oil pressure, and impending depletion of fuel oil by means of thermal stop switches which must be manually reset if tripped. The generator is also protected against overheating by means of similar thermal stop switches. These four trip switches are in the inspector's control box.

INSPECTOR'S CONTROL BOX (Continued)

The engine heat switch is attached to an adapter on the exhaust manifold. A small quantity of the engine coolant circulates through the switch adapter. If this circulation stops due to loss of coolant, the switch temperature rises, closing its contact and energizing the thermal trip switch in the inspector's control box. In approximately 30 seconds, the latter switch opens its contacts which are in series with the control circuit and de-energizes the solenoid on the fuel pump control rack, stopping the unit.

To protect the fuel oil injection system from becoming airbound, in the event of completely depleting fuel oil in the fuel oil tank, a combination switch-gauge is used in the standard Waukesha Diesel Fuel Tank. When the fuel oil level in the tank recedes to an approximate 10-gallon low level, the switch contacts close, energizing the "low fuel" thermal trip switch in the inspector's control box. The contacts of this switch are also in series with the control circuit.

The generator protective heat switch is located in the front heat exchanger loader of the enclosed air cooling system of the generator. If the circulated air temperature within the generator should rise above a safe operating temperature, the contacts of the heat switch will close and energize the generator overheat thermal trip switch in the inspector's control box. The contacts of this switch are also in series with the unit control circuit.

The hour meter registers the actual hours of Enginator operation. This meter takes the guesswork out of hours of operation between lube oil changes, inspection periods, and hours of operation between major overhauls.

The test terminals in the inspector's control box are for the convenience of reading the generator output voltage.

The rheostat in the inspector's control box is for generator output voltage adjustment. This rheostat, being in series with the main coil of the Electronetic Governor Coil, controls the Enginator output voltage.

SPEED CONTROL AND VOLTAGE ADJUSTMENT

The operating speed and output voltage of the direct-current Enginator is controlled by the Electronetic Governor Assembly, which is directly connected to the control rack of the fuel injection pump. The generator field has a fixed external resistor, and the output voltage is maintained by the variation in the armature speed. The electronetic governor coil, being connected across the generator output, causes the engine r.p.m. and armature speed to change according to variations in generator voltage. The Enginator speed increases with an increase in electric load; likewise decreases with a reduction in load. This results in a low or

SPEED CONTROL AND VOLTAGE ADJUSTMENT (Continued)

economical speed with small loads, and higher engine speed (more available horsepower) with heavy electrical loads.

The generator output voltage may be checked at the convenient test terminals located in the inspector's control box on the Enginator. The voltage may be adjusted at the voltage adjustment rheostat, which is located directly below the test terminals.

A mechanical overspeed governor, located at the front gear train of the engine, will control the engine speed in the event the Electronetic Governor should become inoperative. The control speed of this governor is adjustable by increasing or decreasing the governor spring tension. When checking or adjusting the overspeed governor, the Electronetic Governor must be electrically disconnected.

For further details on the Electronetic Governor, refer to Section "E."

CHARGING THE STARTING BATTERIES

Some car installations use standard car lighting batteries connected in the conventional manner across the generator. These are used for control and cranking of the Enginator as well as for supply to the car load in emergencies. They are charged by the generator in the conventional manner, generator voltage and battery condition dictating the amount of charging.

On L-B installations (continuous operation of the D.C. Enginator), small automotive-type batteries are the only ones used on the car. These batteries are for cranking the Enginator and for circuit control use only. These batteries are charged by means of a separate battery charging panel. For further details on this panel, see Section "H."

OVERLOAD RELAYS, CIRCUIT BREAKERS, AND FUSES

ITEM	PROTECTION	LOCATION
Generator	Load Fuse	Control Panel
Generator Field	Cartridge Fuse	On Enginator above Control Box
Radiator Fan Motors	Manual Reset Circuit Breaker	On Enginator on Box at rear of Unit
High Engine Coolant Temperature	Manual Reset Thermal Stop Switch	In Enginator Control Box
Low Lube Oil Pressure on Engine	Manual Reset Thermal Stop Switch	In Enginator Control Box

OVERLOAD RELAYS, CIRCUIT BREAKERS, AND FUSES (Continued)

Generator Overheat	Manual Reset Thermal Stop Switch	In Enginator Control Box
Low Fuel Oil Level in Car Fuel Tank	Manual Reset Thermal Stop Switch	In Enginator Control Box
Enginator Control Circuit	Cartridge Fuses	Control Panel
Generator High Voltage	Manual Reset Thermal Stop Switch	Control Panel
Battery Charging	Cartridge Fuse	Battery Charging Panel

TRAIN-LINING

Cars equipped with Waukesha Diesel Enginators may be train-lined together (operated in parallel) or to any car having the same voltage, regardless of the type of generating equipment.

THE FLUID COUPLING

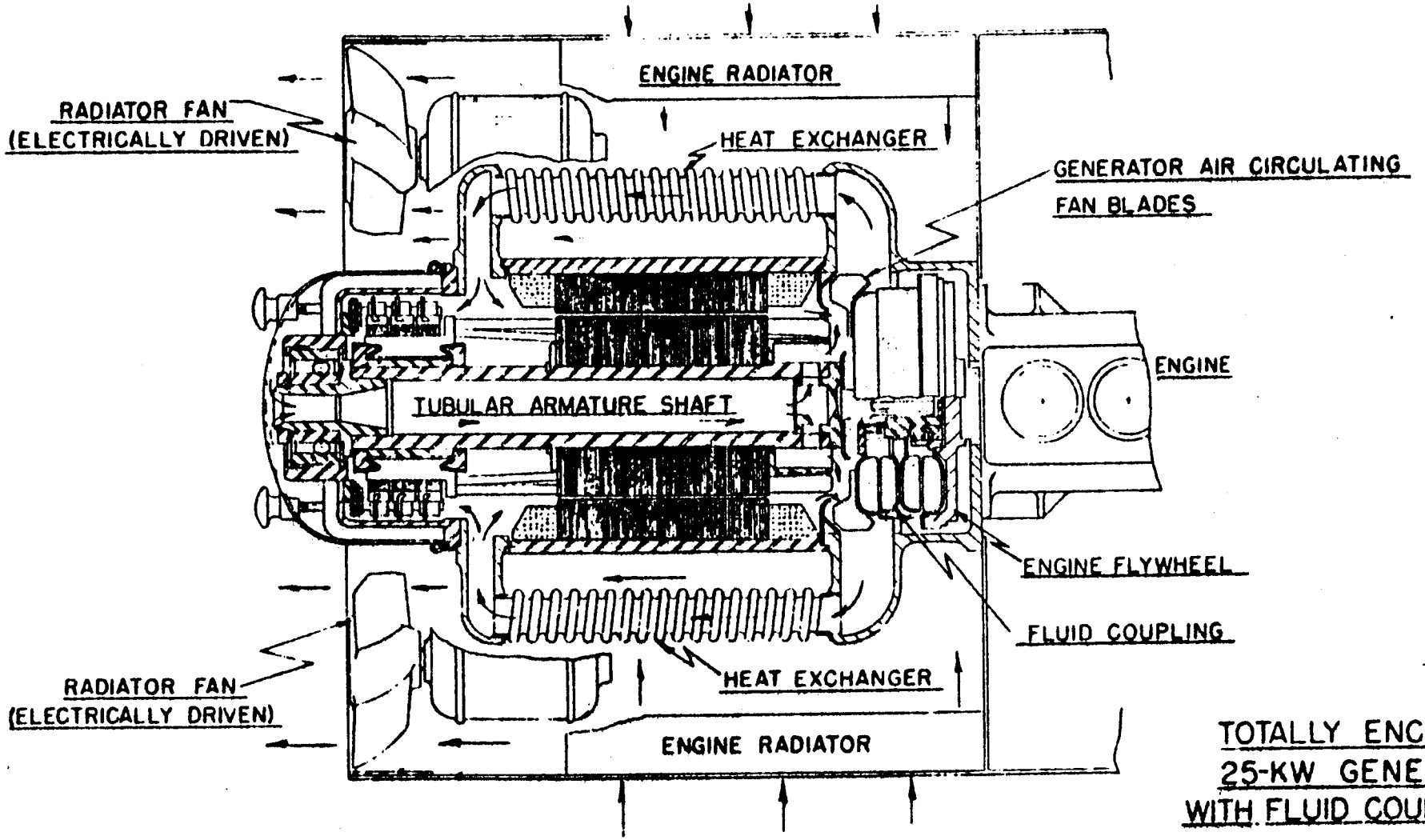
The fluid coupling, between the engine and generator, serves to dampen out torsional irregularities and provide smooth, vibrationless drive. For details, refer to Section "E." This cushioning action absorbs periodic oscillations of the engine crankshaft and eliminates high-frequency vibrations. It allows the engine to maintain governed speed and full-power output when impact loads, such as cross-line starting loads, are applied. This fluid drive, an exclusive Waukesha Enginator feature, operates on the same principle of power transmission used in countless modern automotive and industrial applications. The hydraulic fluid is retained within the coupling shell by a spring-loaded seal, similar to the seal proved by millions of miles of railway operation in Waukesha Ice-Engine Compressors.

THE DIRECT-CURRENT (D.C.) GENERATOR

The direct-current Generators are built with rolled steel welded frames, laminated interpoles, formed wound coils, and insulation throughout meeting Class "H" requirements.

The armature is made of laminated punchings, with skewed slots assembled to a hollow shaft. This hollow shaft is the center cooling air duct of the generator. The hollow armature shaft also facilitates cleaning of the Generator and removal of the armature.

The large, wide-faced, mica-insulated commutator is made from hard-forged, silver-bearing copper segments, slotted for armature coil



TOTALLY ENCLOSED
25-KW GENERATOR
WITH FLUID COUPLING

WAUKESHA MOTOR CO.
WAUKESHA, WIS.

SK-1090

THE DIRECT-CURRENT (D.C.) GENERATOR (Continued)

windings, which are secured with high-temperature silver alloy solder. The sixteen large carbon brushes are carried in four sets of rugged box-type bronze brush holders. The multiple brushes, with coil-type Waukesha Negator brush springs, maintain a constant predetermined, non-variable pressure between brushes and commutator, regardless of the brush length due to wear.

A unique feature is the self-contained internal air cooling system, which permits complete enclosure of the Generator and positive protection against moisture and road dust. Cooling is accomplished by an enclosed air circulating system incorporated within the Generator.

Fan blades, mounted on the fluid coupling, create a recirculating air stream within the Generator, which passes over the brushes, armature, through the windings and the hollow armature shaft. The air stream picks up the internal heat switch, which is then dissipated by the heat exchangers, which consist of six copper cooling tubes with spiral convolutions, externally mounted, three on each side of the generator. Over these heat exchanger tubes, a continuous blast of outside air is forced by two electric cooling fans within the generator compartment of the Enginator chassis. The air within the heat exchanger tubes (not mixed with the outside air) is thus cooled and returns in the closed circuit to the commutator end and repeats the cooling cycle. Please refer to SK-1090.

The armature is driven from the fluid coupling by a replaceable splined shaft. The engine end of the armature shaft is supported by a double-row, self-aligning spherical roller bearing contained in the fluid coupling.

At the opposite end of the armature shaft, a welded steel spider carries the brush rigging and an extra large sealed ball bearing with an ample grease reservoir. The brushes are readily accessible for inspection and servicing by removing a drawn-steel, dome-shaped cover which is held against a synthetic rubber sealing gasket by two bronze hand nuts.

The generator has a gross capacity of 27 K.W. The net capacity is 25 K.W., since 2 K.W. are required for radiator fans. The generator output voltage is controlled by its speed, through the action of the Electronetic Governor. Therefore, the generator speed varies from 1500 R.P.M. at no load to 1800 R.P.M. at full load.

ENGINE COOLING SYSTEM

Maintaining the normal operating temperature of an internal combustion engine at various ambient temperatures and loads is an important factor in engine performance and life. This is especially true of a diesel engine. The Waukesha Enginator Cooling System provides automatic temperature control. It consists of a 48-quart closed system, having two large parallel radiators, gear-driven circulating pump, dual temperature-controlled cooling fans, and a steam heat exchanger.

ENGINE COOLING SYSTEM (Continued)

Coolant is circulated through the system by means of an open-vane-type circulating pump, which is gear driven from the front end gear train. This pump has a ball bearing impeller shaft, a mechanical or packless-type water seal, and is automatically lubricated from the engine full-pressure lubricating system.

After the coolant leaves the water pump, it enters the engine case and is directed about the wet-type cylinder sleeves in an even manner. It then passes upward into the cored passages of the cylinder head. These passages are carefully designed to allow the coolant access to all areas around the vanes and top part of the combustion chambers. The coolant then goes to the radiators and back to the water pump inlet. The engine thermostat (180° F.) is located in a top water manifold casting at the discharge of the cylinder head.

A pressure relief valve maintains approximately 4 to 5 lbs. pressure on the system. This increases the boiling point of the coolant. The pressure relief is located just in back of the coolant level test petcock at the upper right-hand side of the front engine compartment. A copper tube, running from the valve to the bottom of the unit, vents excess pressure to the atmosphere. The cooling system filler pipe and cap are located at the top center of the Enginator.

The two large radiators are made of removable four-row thick heavy-duty cores which are attached by bolts to the top and bottom cast header tanks. These radiators are connected in parallel and are located on either side of the generator. Air for cooling is drawn in through the radiator cores over the six generator copper heat exchangers and is discharged out the generator end of the unit by means of two direct-connected axial flow fans, driven independently by two 1/2 h.p., d.c. electric motors.

The two radiator fan-motor assemblies are located directly above the commutator end of the generator and are independently controlled, to provide a wide range of cooling capacity. Their 1/2 h.p., d.c. motors receive their power from the generator. Engine temperatures, of course, may vary, depending on the ambient temperatures and the generator load.

If the coolant temperature is below 160° F., both fans are idle. At 160° to 165° F., the number one fan starts and runs at approximately 2800 r.p.m. If the coolant temperature rises to 175° - 180° F., the second fan starts and runs at the same speed. Under high ambient and heavy generator load conditions, separate thermostats, located on the radiator fan motor terminal box on the top of the generator field ring, put the fan motors in a higher speed (3200 r.p.m.). If the temperature again lowers, the cycle is reversed. When the fans are on the "off" position, hinged dampers close the fan openings to keep snow, ice, and dirt from entering the generator compartment. When only one fan is running, the second closed damper keeps air from by-passing the radiators. The temperature sensitive adjustable control

ENGINE COOLING SYSTEM (Continued)

switches are located in a cast manifold box in series with the coolant line from the radiators to the pump. The switches operate in "dry sockets" and, therefore, can be replaced without draining the coolant. Each switch or sending unit actuates a small relay mounted in the inside of the manifold cover. Two condensers suppress the relay contacts. The temperature switches have a 10° to 15° differential. They make contact on rising temperature and break contact on lowering temperature.

These switch relays actuate the main fan motor starting relays which are located in a weatherproof control box at the fan end of the unit. Two thermal overload relays (manual reset) are also located in this box.

A test switch on the side of the relay control box can be used by yard maintenance men to check the operation of the relays and fan motors. The Engirator must be operating when this test is made. Closing the test switch "parallels" both temperature switches and energizes both starting relays and fan motors.

STEAM HEAT EXCHANGER

To facilitate starting the diesel engine in cold weather, a steam heat exchanger is interposed in the cooling system. It is located in the rear engine compartment. This heat exchanger maintains a warm crankcase and cylinder head when the Engirator is not running. Steam from a car low-pressure heating loop (maximum pressure, 10 to 12 lbs.) is piped through a flexible steam line to the heat exchanger body or jacket. Inside this jacket is a copper tube coil which is connected to the engine cooling system. Coolant then circulates by thermosyphon through the heat exchanger coil, cylinder block, and head. The closed engine thermostat prevents thermo-syphon action through the radiators.

It is important to have no more than 12 lbs. steam pressure at the flexible steam inlet hose, as high-pressure steam may rupture the flexible line and cause excessive coolant temperatures. A pressure relief valve at the inlet steam line to the heat exchanger opens if the steam pressure exceeds approximately 20 lbs. A steam retarder and trap are piped within the unit to protect the exchanger and flexible line from freezing.

LUBRICATING SYSTEM

All main bearings, idler gear bushings, and rocker arm bearings are pressure lubricated through drilled passages in the crankcase. The lube oil pump is a two-section, gear-type pump, driven from a spiral gear on the camshaft. The upper section pumps oil under pressure (20 to 30 lbs.) to the full pressure feed lubricating system of all the engine's moving parts. The lower section of the dual oil pump circulates the oil through the two large cartridge-type oil filters, and then through a finned tube oil cooler located in front of the inside engine radiator. The lube oil cooler assures normal

LUBRICATING SYSTEM (Continued)

lubricating oil temperature during extreme, high-ambient temperature operating conditions. During cold weather operation, there may be times when the lube oil congeals in the cooler and will not flow freely. A special pressure relief valve, located between the oil lines to the cooler, automatically by-passes the oil cooler coil. Clean and inspect this valve's internal parts and check it to open above 25 to 30 lbs., and fully close below.

Each section of the dual lube oil pump has its own intake oil screen. The upper section has a "Float-O" type oil screen intake. This screen intake floats on top of the oil and draws from the cleaner upper surface of the oil supply.

The oil pressure relief valve is a nonadjustable, spring-loaded, plunger-type valve. It is located to the back of the engine crankcase, at the extreme front, and extends into the main oil gallery. The valve controls the oil pressure by by-passing the excess oil delivered by the pump into the main oil gallery back into the crankcase.

FUEL SYSTEM

The fuel oil for the engine is pumped from the fuel oil tank to the engine through the primary strainer by the fuel transfer pump. This pump is located at the manifold side of the engine, and is driven from the camshaft. It can also be operated manually by the hand primer part of the pump. The fuel oil line from the tank to the transfer pump is on the suction side; therefore any leaks permit air to be taken into the system. From the transfer pump, the fuel is pumped (under pressure) through the secondary filter and to the high-pressure injection pump. From this pump, the fuel goes to the six injectors in the engine cylinder head. Surplus fuel from the injection pump and injectors returns to the fuel tank. A pressure relief valve in the return line regulates the fuel pressure at the outlet of the transfer pump, thus maintaining a constant inlet pressure on the high-pressure injector pump. This pressure is shown or read on the fuel oil pressure gauge in the inspector's control box on the unit.

Figure 24, Page 61, of the Parts List Catalogue, "Fuel Oil Piping," shows a schematic drawing of the fuel system piping.

SECTION "D"

(A.C. - D.C.)

GENERAL SERVICE INSTRUCTIONS AND OPERATING DIFFICULTIES

INTRODUCTION

The service instructions listed in this section are suggestions only. Due to variations in the type of service, length of runs, climatic and road conditions, it may be necessary for the operators to modify these instructions.

As a safety precaution, disconnect all electrical plug connectors at the car receptacles when working on the electrical wiring of the Enginator or car electrical system.

The Waukesha Enginator is equipped with an engine hour meter which is located in the unit control box; therefore, the service procedures may be set up on an hourly basis of engine operation or according to trip schedules.

50-HOUR MAINTENANCE (TRIP)

1. Roll the unit out on extension tracks. Open side doors and remove top and bottom covers. Clean engine compartment with an air hose. (Do not remove generator covers until the unit is blown off.)

2. Blow air through both engine radiator cores. Occasionally, this should be done from the inside out, to clean the dirt from the generator heat exchanger cooling tubes.

3. Remove the dome service cover of the generator or alternator. The armature shaft is hollow. Before turning on the air, insert rubber air hose into the armature shaft at the rear of the generator and then turn on the air. This will clean the assembly from the rear to the front. Air clean the brush holders, commutator or slip rings, coils, etc. The inside of the dome cover should be washed and wiped dry.

4. Inspect the brushes, brush holders, and commutator or slip rings. Brushes should be replaced when they wear to 7/8" on the low side. Brush holders should be spaced 1/8" above commutator or slip rings.

5. Check level of engine lubricating oil. Add oil if necessary. Use heavy-duty detergent diesel oil S.A.E. 30, S-1. The same oil should be used both winter and summer. Do not fill over the full level mark on dip stick.

50-HOUR MAINTENANCE (TRIP) (Continued)

6. Check engine coolant level and add if necessary. Use the test pet cock and do not overfill. Check the level when unit is warm and car is level; also check with unit running.

7. Remove bottom cup of air cleaner. Clean and refill with S.A.E. 10 motor oil to indicated level. If Enginators operate in extreme sub-zero weather, use a low pour point oil such as compressor oil, or 1/2 kerosene and oil can be used.

8. Remove the steel mesh separator ring of the air cleaner and clean with solvent and air. This is located just above the bottom oil cup, and is removed by giving it a slight twist to the left to unlock it.

9. Remove and clean air cleaner precleaner cup.

10. Remove and clean crankcase air breather cup. Refill with S.A.E. 10 oil to indicated level.

11. Start engine and observe operation. Check operation of radiator fans.

12. Remove and clean air intake filter of static exciter unit. (On alternating-current units only.)

13. Remove bottom door and blow out static exciter cabinet and rectifier plates. Be careful not to touch plates with air hose nozzle. (On alternating current units only.)

14. Replace and close all covers. Roll Enginator under car, remove track extensions and tighten wheel stops in place.

300-HOUR MAINTENANCE (MONTH)

1. Roll Enginator out on track extensions.

2. Complete servicing as listed under every 50-hour servicing.

3. Remove and clean the dry felt type breather located on the top side of alternator field frame between the radiator fan motors.

4. Remove the top precleaner cup holder and wash and clean the center air cleaner tube with solvent.

5. Change secondary fuel oil filter element (Part No. 952746). Always use new cover gasket. After new element is installed, purge air from filter shell by operating fuel transfer pump by means of hand plunger until a steady fuel pressure is shown on fuel pressure gauge in control box.

6. Clean the mesh strainer of the primary fuel filter. Drain water and sediment from filter body. Always use new cover gasket, Part No. 952345.

300-HOUR MAINTENANCE (MONTH) (Continued)

7. Drain engine lubricating oil. Refill with approximately 22 quarts of premium grade heavy-duty diesel motor oil S.A.E. 30, S-1. Do not overfill.

8. Replace elements (Part No. 951745) in both lubricating oil filters. It is important to use a waste-packed element and new cover gaskets.

9. Inspect Protectoseal vent on fuel oil tank. Remove wing nuts and washers from studs of the weather cap. (Clean internal filter plates and cap.)

10. Check bottom of fuel tank for accumulation of water and dirt. "Crack open" the small 3/4" fuel oil drain plug in bottom of tank. Bleed tank until clear fuel oil starts to flow. Use a glass jar to take samples, to determine the condition of the fuel oil by visual inspection.

    It is also possible to check for the water content in the fuel tank by using a special water detector test. This may be accomplished by coating a measuring rod or stick with a substance called "Detex Water Finder." It is bluish in color and will turn red in the presence of water. For further details, contact the Waukesha Motor Company, Railway Division, Waukesha, Wisconsin.

3000-HOUR MAINTENANCE (SIX MONTHS)

1. Complete 50- and 300-hour inspection steps.

2. Check engine intake and exhaust valve clearances:

    Intake valve (cold) - .010

    Exhaust valve (cold) - .020

    CAUTION: Be sure to securely tighten the locking nuts on tappet adjusting screws.

3. Drain oil in fluid drive coupling and refill with a premium grade S.A.E. 30, S-1 lube oil winter and summer. To check for normal oil level, remove rectangular inspection cover on top side of flywheel housing in alternator compartment. Remove square head pipe plug in flywheel housing at front of inspection cover. Turn flywheel by hand until Allen head oil level plug in fluid coupling is up. Remove this plug and turn coupling so oil level plug can be seen through opening where square head inspection hole plug was removed. The hex head plug in the oil filler opening of the coupling should now be top center. Remove this plug. Oil is at the proper level if it just starts to run out of oil level hole. Capacity of this coupling is approximately 11 pounds, 13 ounces.

3000-HOUR MAINTENANCE (SIX MONTHS) (Continued)

4. Check engine cylinder compressions with compression gauge and special adapter. Normal compression pressure should read approximately 400 lbs. at 200 rpm engine speed, or 450 lbs. at 400 rpm.

   NOTE: Compression gauge can be obtained according to the following specification:

   Kiene Diesel Pressure Indicator
   Model K-120 — 0-1500 lbs.
   Adapter to fit Bosch injector
   nozzle ADN-4-SD-20 - Nozzle
   holder AKB-35-S - 1738-A.

   Purchase from:

   Kiene Diesel Accessories, Inc.
   10352 Pacific Avenue
   Franklin Park, Illinois

5. Check spray pattern of each injector nozzle. This is easily done with a Bosch injector test stand. Refer to bulletin on test stand and its use. Proper cleaning of carbon and dirt particles should be the limit of field maintenance.

   IMPORTANT: Read warning instructions on fuel injector.

6. Inspect the starting motor as follows:

   a. Cover

   The cover band should be removed and the brushes and commutator inspected. Examine the inside surface of the cover band for thrown solder which indicates the starter has been overheated. If this condition is found, the starting motor should be removed from the unit for shop repair. Blow the dust and dirt out of the motor.

   b. Brushes

   Inspect the brushes and replace when found to be worn to half their original length. Brushes must move freely in holders and make good firm contact with the commutator. Do not "snap" brush holder levers down on brush, because this may break them. Too short or sticking brushes, and insufficient brush spring pressure, or wrong adjustment, may cause high temperature arcing between the brushes and the commutator. Do not change the position or location of the brush rigging.

3000-HOUR MAINTENANCE (SIX MONTHS) (Continued)

c. Commutator

Inspect the commutator. If found to be glazed or dirty, it may be cleaned by holding a piece of "00" sandpaper against it by means of a flat piece of wood or fiber. Do not use emery on commutator. If the commutator is rough, out of round, has high mica, or is extremely dirty, the starting motor should be removed from the unit for shop repair.

d. Lubrication

Put several drops of clean lubricating oil in each cup at each monthly inspection of the Enginator.

To lubricate the bearing in the Bendix housing, it is necessary to remove the starting motor. Then remove the slotted threaded plug and saturate the felt wick with a high-grade parrafin-base petroleum oil. At this time, the screw shaft on which the pinion moves, may be cleaned and coated with a thin film of light oil. Avoid excessive lubrication.

6000-HOUR OVERHAUL (YEAR)

Unit should be removed from the car and completely overhauled. This overhaul should follow the standard pattern generally practiced on internal combustion engines and generators. Six thousand hours represents approximately 240,000 truck miles. For major overhaul instructions, refer to that section of the manual.

SUGGESTED SERVICE CHECK LIST

Item No.	Maintenance	50-Hour (Trip)	300-Hours (Monthly)
1	Record Hour Meter Reading and Date	X	X
2	Roll out Unit and Clean	X	X
3	Inspect and Clean Generator	X	X
4	Service Generator Breather		X
5	Check Engine Oil Level - Record	X	X
6	Change Engine Oil - Record		X
7	Renew Lub. Oil Filter Elements		X
8	Renew Secondary Fuel Oil Filter Element		X
9	Service Primary Fuel Strainer	X	X

SUGGESTED SERVICE CHECK LIST (Continued)

Item No.	Maintenance	50-Hour (Trip)	300-Hours (Monthly)
10	Bleed Fuel System of Air	X	X
11	Check Coolant Level	X	X
12	Service Crankcase Breather	X	X
13	Service Air Cleaner	X	X
14	Clean Air Cleaner Center Tube		X
15	Check Fuel Pressure, Lubricating Oil Pressure, Engine Temperature	X	X
16	Check Radiator Fan Motors		X
17	Check Enginator for Lubricating Oil, Fuel Oil and Coolant Leaks	X	X
18	Inspect Control Panels	X	X
19	Inspect L-B Battery Charging Panels (D.C. Units Only)	X	X
20	Record Irregularities and Repairs	X	X

COMMENTS TO SERVICE CHECK LIST

Item 1 Record Hour Meter Reading

The hours of operation should be recorded on the check card at both terminals. If, by chance a unit stops en route, then the serviceman can tell how long the unit ran and about where it stopped.

Item 2 Roll Out Unit and Clean

It is important that the unit be rolled out each 50 hours for cleaning with air and for general inspection. At each 300-hour period, the engine and Enginator frame, front and bottom, should be washed with a solvent and air gun to clean off the oil, etc.

Item 3 Inspect and Clean Generator or Alternator

After the unit is blown off, the generator or alternator dome cover should be removed and cleaned with solvent and dried. The generator or alternator should be blown out. The armature shaft is hollow. Before turning on the air, insert the air hose into the shaft to the rear of the generator and then turn on the air. This will clean the assembly from the rear to the

COMMENTS TO SERVICE CHECK LIST (Continued)

front. Air clean the brush holders, commutator or slip rings, field coils, etc.

Make sure all brushes are free in the holders and have uniform tension. When the brushes reach about 7/8" on the low side, they should be replaced. Brush boxes should be 1/8" from the commutator or rings. Commutator or slip rings should be dressed if necessary. Make sure the armature bearing lock nut is tight and locked.

Item 4 Service Generator or Alternator Breather

This is located on top of generator, just below and in the center of the radiator fan motors. Remove cover and blow off the dust from the felt element.

Item 5 Check Engine Oil Level - Record

If oil is added, it is important to use only heavy-duty diesel motor oil, S.A.E. 30, S-1, winter and summer.

It is very important that the exact amount of oil added be accurately recorded. Oil consumption is an indication of the internal engine condition. It is closely related to preventive maintenance.

Item 6 Change Engine Oil

The lubricating oil system holds about 22 quarts when both filter elements are changed. Fill only to full mark on the dip stick. Do not overfill. Be sure drain valve is seated.

Items 7 and 8 Renew Filter Elements

Use only waste-pack filter elements in both the fuel oil and lubricating oil filters. Part number of the fuel filter is 951746, and part number of the lubricating oil filter element is 951745.

After the unit is running and the oil is warm, recheck all filters for possible leaks around cover gaskets, etc. Always use new gaskets furnished with each element.

Item 9 Service Primary Fuel Strainer

This is the large strainer in the inlet fuel line just ahead of the fuel filter. The strainer element is made of a fine mesh screen and can be cleaned. Occasionally, it may be necessary to replace this strainer with a new one, Part No. 952207. The filter or strainer body acts as a water trap. Open pet cock in bottom of body and drain.

COMMENTS TO SERVICE CHECK LIST (Continued)

Item 10 Bleed Fuel System of Air

After the primary strainer and secondary filter have been serviced, it is important to bleed off the air at the top of the waste-pack secondary filter. Manually pump the fuel at the primary fuel pump until fuel pressure is read at gauge. Close bleed hole and continue to pump for several seconds.

Item 11 Check Coolant Level

We suggest coolant level be checked with unit running. Fill until coolant comes out of test pet cock. Cooling system holds 48 quarts.

Item 12 Service Crankcase Breather

Clean and refill cup to indicated level with S.A.E. 10 oil.

Items 13 and 14 Service Air Cleaner

The condition of the air cleaner reflects in the engine life. It is important to service these cleaners 100%. The top precleaner cup should be emptied and wiped out, and the bottom oil cup washed in solvent and refilled to indicated level with S.A.E. 10 oil.

The steel mesh separator ring should be removed and cleaned with solvent and air. This is located just above the bottom cup and can be removed by giving it a slight twist to the left to unlock it.

At each 300-hour check, the top precleaner cup holder should be removed and the center tube or neck washed with solvent.

Air inlet damper should be open for winter operation, so air to air cleaner comes from warm generator compartment. This will maintain more uniform oil density in bottom cup of air cleaner.

Item 15 Check Fuel Pressure, Lubricating Oil Pressure, Engine Temperature

Record on check card.

Item 16 Check Radiator Fan Motors

Remove the inspection band covers and blow out motors with air. Make sure the brushes are clean and free in the holders. Check commutator, etc. Check ball bearings for wear or excessive end play. Check starting

COMMENTS TO SERVICE CHECK LIST (Continued)

relays, circuit breakers, and cut-in temperature of the fans. Grease bearings of a.c. motors, using Silicone DC-44, every 3000 hours.

Item 17 Check Enginator for Lubricating Oil, Fuel Oil, and Coolant Leaks

All leaks should be repaired.

Item 18 Inspect Control Panels

This consists of just visual inspection. Start and stop Enginator from panel.

Item 19 Inspect L-B Battery Charging Panel (D.C. Units)

This consists mostly of visual inspection. Make certain panel is charging. If battery voltage is normal, a slight deflection of charge meter needle will be noticed when test button is pressed.

ENGINATOR OPERATING DIFFICULTIES AND TROUBLE SHOOTING

The following procedures for recognizing and correcting various operating difficulties are suggested to serve as a guide:

1. Enginator does not crank:

   a. Check control circuit fuses on control panel.

   b. Check "stop" button at both unit control box and control panel in car. They should be released (unlocked).

   c. Check battery switch, fuse and battery voltage.

   d. Check all protective switches in control box on unit.

2. Enginator cranks, but does not start:

   a. Check the fuel pressure on the gauge in unit control box. Pressure should indicate when cranking unit. If there is no pressure, operate the manual pump on fuel transfer pump, located on the manifold side of the engine. If there is still no fuel pressure, check fuel filters for restriction or air leak in suction line (inlet). Be sure there is sufficient fuel in the fuel tank.

   b. If Enginator cranking speed is slow, check the battery voltage. Train-line, if possible, to raise the cranking voltage.

3. Enginator cranks and starts, but stops when "start" button is released:

   a. Do not release "start" button until Enginator voltage builds up to normal. Hold "start" button at least five (5) seconds after Enginator fires and runs.

b. If Enginator still stops, check the alternator circuit breaker (a.c. units) at control panel, to make certain it is closed.

c. Check the normally open holding contact (parallels the "start" buttons) of the voltage relay on the control panel. It may not be making contact.

4. Enginator smokes excessively:

a. Check Enginator for possible overload.

b. Check air cleaner and air intake manifolding for restriction.

c. Oil level in inlet air cleaner too high or too heavy.

d. Check fuel system for air or restrictions.

e. Check fuel injectors for correct and consistent firing.

f. Check engine lubricating oil for proper level and lubricating oil condition.

g. Check cylinder compression and valve adjustments.

h. Check fuel injection pump timing.

i. Check grade and quality of fuel oil.

j. Check exhaust manifolding, muffler and piping for possible restrictions.

k. Enginator speed too low.

5. Enginator speed is excessive:

a. Most likely, unit is being governed by the mechanical overspeed governor.

b. Check Electronetic Governor for open circuit or plunger binding. If found to be inoperative or sluggish, replace Electronetic Governor as an assembly.

6. Enginator stops or stalls:

a. Loss of fuel oil pressure due to air in fuel, out of fuel, or transfer pump failure.

b. Water in fuel.

c. Protective switches tripped. Check to determine cause of trip.

d. Overload circuit breaker or load fuse open.

ENGINATOR OPERATING DIFFICULTIES AND TROUBLE SHOOTING (Continued)

e. Control fuse open.

f. Overload on Enginator.

g. Air inlet to Enginator restricted.

h. Exhaust restricted.

i. Enginator compression low.

j. Incorrect fuel pump timing.

k. Incorrect valve timing.

7. Low lubricating oil pressure (below 15 lbs.):

a. Defective lubricating oil pressure gauge.

b. Plugged line to gauge.

c. Defective pressure relief valve.

d. Worn lubricating oil pump.

e. Low lubricating oil level in crankcase.

f. Lubricating oil dilution.

g. Lubricating oil viscosity too low.

h. Lubricating oil leaks.

i. Excessive clearances on engine bearings.

8. Low fuel oil pressure (below 5 lbs.):

a. Defective fuel oil pressure gauge.

b. Plugged line to gauge.

c. Air in fuel system.

d. Plugged or restricted filters.

e. Low fuel oil level in tank.

f. Valves in transfer pump stuck.

g. Leaks in fuel oil piping.

h. Filter gaskets leaking air.

i. Defective check valve in return line.

9. Abnormally high coolant temperature:

   a. Defective temperature gauge.

   b. Low coolant level.

   c. Radiator fans inoperative.

   d. Plugged or dirty radiators (inside or out).

   e. Defective engine thermostat.

   f. Engine overloaded.

   g. Air into radiators restricted.

   h. Radiator fan exhaust air being drawn back through radiators.

10. Excessive crankcase pressure

   a. Crankcase breather plugged.

   b. Improper viscosity oil or high oil level in crankcase breather.

   c. Crankcase ventilator stack on gear cover or line to intake manifold restricted or plugged.

   d. Thermostat in crankcase air inlet line defective - stuck closed.

   e. Excessive blow-by at pistons and rings.

   f. Poor compression on engine.

11. Excessive lubricating oil consumption

   a. Too high lubricating oil level in crankcase.

   b. Lubricating oil leaks.

   c. Oil too thin.

   d. Too many hours on lubricating oil.

   e. Do not mix lubricating oil of different brands and specifications.

   f. Worn pistons and rings.

12. Excessive fuel oil consumption

   a. Enginator overloaded.

ENGINATOR OPERATING DIFFICULTIES AND TROUBLE SHOOTING (Continued)

b. Fuel oil leaks.

c. Defective injectors - poor combustion.

d. Defective engine valves, valve setting or timing.

e. Improper fuel pump timing.

f. Poor compression on engine.

13. Enginator will not stop

a. AVR/EVR relay (control panel) not opening when its coil is de-energized. Check for stuck contacts, mechanical binding or grounded coil.

b. Fuel rack solenoid "Pull-In" or "Hold-In" coil remaining energized from grounds, incorrect wiring connections, etc.

c. Fuel rack solenoid not operating due to mechanical binding of the plunger or lever, or broken spring on the connecting lever to the pump fuel rack.

d. Fuel rack travel restricted by the manual shutoff lever on the Electronetic Governor being stuck or incorrectly adjusted.

e. Fuel rack travel restricted by the binding or breaking of the inner spring on the Electronetic Governor plunger or armature.

f. "Start" switch contacts stuck closed at either unit control box or control panel in the car electrical locker.

PURGING THE ENGINATOR FUEL SYSTEM OF AIR

It is important that the Diesel Fuel System be free of air. The purpose of the low fuel shutoff protective switch, actuated by the float in the fuel tank, is to shut down the Enginator before the fuel supply becomes low enough to permit air to be drawn into the lines. Restricted filters or valves in the fuel line may cause the fuel oil to evaporate or "gas off," which appears and acts similar to air.

The fuel oil line from the tank to the Enginator transfer pump is on the suction side of the system and should, therefore, be air tight. When servicing fuel filters, it is very important that the covers have good gaskets and are properly tightened. Air in the fuel system results in irregular Enginator speed and can cause smoke. The following is the procedure for purging air from the Enginator Fuel System:

1. Purging the Transfer Pump

The primary part of the fuel system, including the fuel tank, fuel inlet strainer, and fuel line through the primary filter

to the fuel transfer pump, may be purged by manually operating the transfer pump until solid pressure is indicated by the fuel oil pressure gauge in the control box. The air is automatically vented through the restricted line connecting the top of the secondary fuel filter to the return fuel oil line to the fuel tank.

2. Purging the Injector Pump

To purge the high-pressure lines connecting the injector pump to the injectors, it is recommended that the Ermetto fittings at the injectors be loosened while the Enginator is cranking or running. When solid liquid is observed coming out of these lines, retighten the Ermetto nuts. Do not overtighten these lines. Do not remove or disconnect the high-pressure lines; merely loosen them. Be careful that the high-pressure fuel oil does not strike the hands, face or eyes. If engine is running, loosen only one or two lines at a time.

FLUID COUPLING REPAIR (Continued)

When removing or replacing the bearing, use care to prevent dirt from entering the bearing, and always be sure to apply pressure directly to the race in contact with the surface from which it is being removed. Never apply the pressure indirectly through the bearing rollers.

When the coupling has been disassembled, it is well to flush it internally to remove any abrasive material or residue from the coupling oil. It is important that the oil in the coupling be clean at all times, inasmuch as dirty oil will damage the bearing and cause the seal to leak.

The coupling oil should be changed each 3000 hours of operation, and clean, fresh SAE-30, S-1 heavy-duty diesel engine oil, the same as recommended for the crankcase of the engine, should be used.

To change coupling oil, remove the cover plates in the top and bottom of the flywheel housing. Rotate the coupling until the large hex head plug (11) is at the bottom, and then remove the plug. Remove the 5/16-24 socket head cap screw (17), which will be approximately at the top of the coupling, to vent the coupling and facilitate draining. When the oil is thoroughly drained, replace the hex head plug (11) and the 5/16-24 socket head cap screw (17). Rotate the coupling until the hex head plug (11) is in the vertical position. Remove socket head cap screw plug (9). This plug is related to the position of the filler, so that when the correct amount of oil is added to the coupling, it will just begin to run out at this opening. It will require approximately 11 lbs., 13 oz. of S.A.E. #30 oil to fill to this point.

Note: A loss of coupling oil will cause the coupling to "slip" excessively, producing extreme heat and resulting in inadequate generator speed. To assure checking the oil to the proper level, do this when the fluid is cooled.

GENERATOR (D.C.)

The electrical resistance of the insulation to ground is thoroughly checked for an infinity reading on all Enginators before leaving the factory.

Carbon dust, resulting from brush wear, should be blown from the generator windings and cooling system at frequent intervals. It is recommended that the generator be thoroughly blown out every hundred hours of operation, and that the brushes also be inspected at this time.

To clean the armature and the internal portions of the generator, insert an air hose in the hollow armature shaft and permit the air to thoroughly blow out the internal parts of the cooling system.

It is important that the six (6) heat exchanger tubes be cleaned both inside and out. These can be removed by telescoping the spring end of the heat exchanger tube into the adapter casting against the compression spring and then sliding the opposite end of the tube out of position. On older installations where the tubes cannot be telescoped and do not have the compression springs, it is necessary to remove the adapter castings at the coupling end of the generator.

GENERATOR (D.C.) (Continued)

During the cleaning operation, the dome cover should be thoroughly blown out and washed with a solvent, to keep it free from accumulations of carbon dust and oil.

Carefully inspect the commutator to be sure it is smooth and concentric. Inspect for high mica. The brushes should be replaced with the proper grade and type, when the short side is 3/4" long or less. Seat the new brushes for maximum contact with the commutator. This can be done by wrapping a piece of 4/0 sandpaper at the circumference of the commutator and retaining it temporarily with plastic electrical tape, and then rotate the armature by hand, with brushes down in contact with the sandpaper, until satisfactory contact surface is obtained.

If it is necessary to reface the commutator, this can be done by removing the armature and placing the entire assembly in a suitable lathe. It is important that the commutator be concentric within a total indicator reading of .002". The minimum diameter to which the commutator may be turned is 7-3/4" - maximum diameter is 8¼".

GENERATOR LUBRICATION

The grease reservoir of the generator ball bearing is lubricated at the factory with DC-44 Silicone grease. Under normal operating conditions, this lubrication is sufficient for 6000 hours operation. If there is any question concerning the amount of lubrication in the bearing, as indicated by a loss of lubricant to the adjacent parts of the generator, it is recommended that an inspection be made by removing one of the bearing seals. If, upon removing the grease seal, there is no apparent darkening of the lubricant and the reservoir is approximately 1/2 full, it may be operated for another 6000-hour period without further attention. If the lubricant is excessively black, it should be removed from the bearing by washing the complete bearing in a petroleum solvent, such as hot water-free kerosene. It is important to keep the bearing clean. If the bearing passes inspection, repack with DC-44 Silicone grease 1/2 to 2/3 full. Do not exceed this amount. Always use DC-44 Silicone Grease - do not substitute.

GENERATOR REPAIR

Removing the Armature

If it is necessary to remove the armature, this can be readily done in the following manner: Remove the brushes and at the same time the armature leads. Remove the spanner nut on the armature shaft and the eight (8) socket head cap screws holding the bearing support to the field ring. Use a puller to remove the bearing support with the bearing from the armature shaft. Protect the end of the armature shaft from pressure of the wheel puller.

GENERATOR REPAIR (Continued)

Removing the Armature (Continued)

The armature is now ready to be taken from the field frame assembly. A long, round bar is then inserted in the hollow armature shaft as far as possible, and a fulcrum point is established for the bar at the outer end of the armature shaft, by a sling hanging from an overhead tackle or by some other means of support from the ground or floor. The armature assembly is then balanced by applying weight to the outer end of the bar and simultaneously moving the fulcrum point and the armature from the generator field frame assembly. If the spline hub on the fluid coupling end of the armature shaft shows excessive wear, it should be replaced. When making a spline replacement, care should be used to be certain that the new spline flange seats squarely against the armature shaft. If facilities are available, the spline should be indicated to determine the runout, which should not exceed .001" total indicator reading. The dowels in the flange of the splined hub are tight fitting and prevent relative movement between the hub and the armature shaft. Be sure these dowel pins do not shear small shavings of metal in the assembly process, which may prevent the hub from seating properly.

Rewinding

If it is necessary to rewind the armature or field coils, only Class "H" insulation and Silicone varnish should be used. Individual parts, sub-assemblies or complete assemblies which can be purchased are listed in the parts section of this manual. Be sure the armature is balanced within two (2) ounce inches.

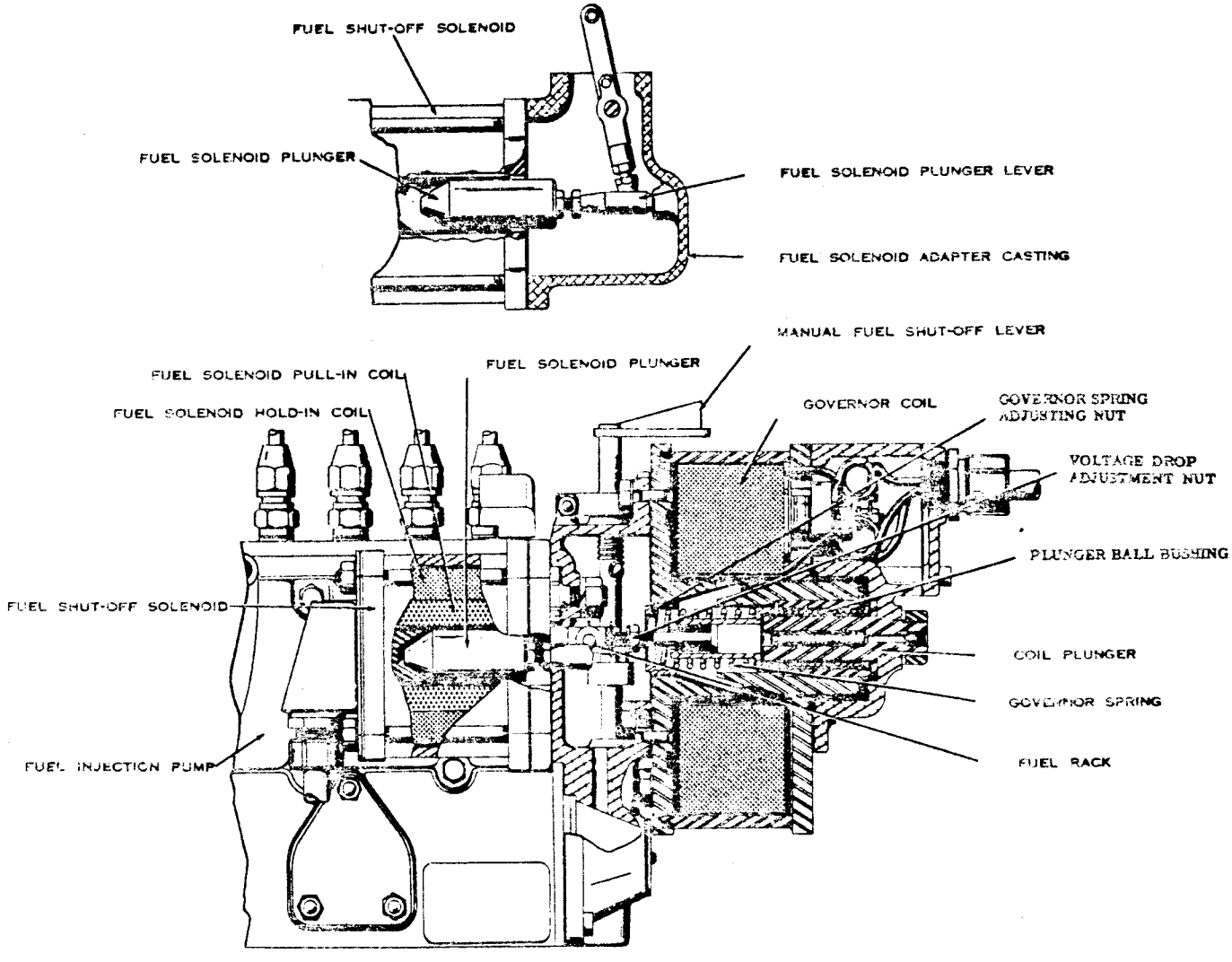
Armature Commutator Replacement

When the armature commutator has been turned or worn to 7-3/4" diameter, it must be replaced. Further details on armature rebuilding may be obtained by writing the Railway Division, Waukesha Motor Company, Waukesha, Wisconsin, requesting them. Be sure to state voltage of generator and name plate data of Enginator.

ELECTRONETIC GOVERNOR (D.C.)

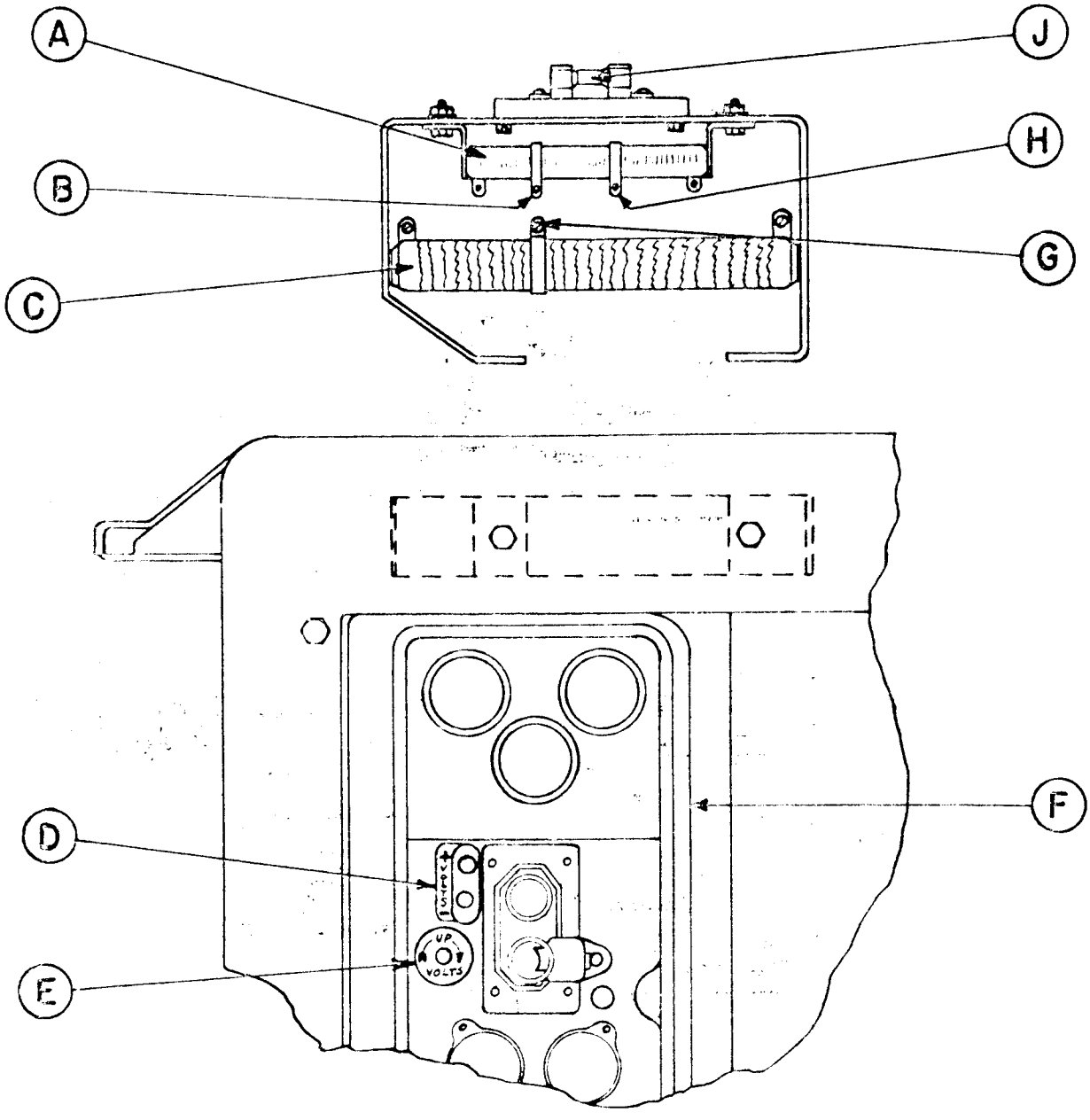
The Waukesha Electronetic Master Governor, used on the D.C. Diesel Enginators, provides prompt, simple speed and voltage control for the unit. See cross section of Electronetic Governor, Figure 1-G. The engine speed is modulated in direct proportion to the load on the unit, giving maximum speed (and horsepower) with heavy electrical loads and graduating down to lower speed with lighter electrical loads.

The engine speed is governed to maintain the desired generator output voltage when load changes occur. An external fixed resistance in series with the generator field and the controlled armature speed provide the necessary voltage control.



CROSS SECTION of THE ELECTRONETIC GOVERNOR
and
CUT AWAY SECTION of THE FUEL RACK SOLENOID

Fig. 1 G



(DIRECT CURRENT)

A-GOVERNOR RESISTOR

B-THERMISTOR TAP

C-GENERATOR FIELD RESISTOR

D-VOLTAGE TEST TERMINALS

E-VOLTAGE ADJUSTOR

F-INSPECTORS CONTROL BOX

G-GENERATOR FIELD SLIDE ARM

H-VOLTAGE TAP

J-GOVERNOR AND FIELD FUSE

ELECTRONETIC GOVERNOR SPEED AND VOLTAGE ADJUSTMENT	SK 1474

OPERATING INFORMATION ON THE ELECTRONETIC GOVERNOR - D.C.

The D.C. Diesel Enginator Electronetic Governor attaches directly to the Fuel Injector Pump. An electric solenoid is employed to close the fuel rack to permit stopping the engine.

The main body of the Electronetic Governor consists of a voltage coil connected across the generator output terminals. The magnetic field of this coil produces a mechanical force that acts directly on a floating plunger (armature). This plunger is connected through a spring-loaded inner plunger directly to the fuel rack.

A coil spring forces the floating plunger back (away from the pump) and causes the fuel rack to move towards "full open position." The magnetic pull of the coil (which is connected across the generator output) pulls the floating plunger in the opposite direction and tends to close the fuel rack. The point where the two opposing forces balance is the fuel rack position necessary to maintain a generator speed sufficient to produce the desired output voltage. Therefore, an increase in governor coil voltage reduces the engine speed by closing the fuel rack, and a decrease in governor coil voltage permits the spring to open the fuel rack and increase the engine speed.

A second mechanical governor, located in the engine gear case and driven from the gear train, assumes speed control should the Electronetic Governor become inoperative, thereby providing full protection or speed control. For details of this governor, refer to Page E-23 and Figure 52-336.

The generator field has a series adjustable resistor (Item "C," Figure SK-1474) located on the Enginator Unit immediately above the control box. The field resistor for 40-volt D.C. Enginators is 3.5 ohms, 375 watts, and for 80-volt D.C. Enginators is 15 ohms, 375 watts. The field fuse (Item "J") is located on the field resistor bracket above the control box. It is rated at 10 amps. for 80-volt systems and 20 amps. for 40-volt systems. The governor resistor (Item "A") is located on the same bracket with the field resistor above the control box. The rating of this resistor is 20 ohms, 100 watts for 40-volt D.C. units, and 48.5 ohms, 160 watts for 80-volt D.C. Units. In series with the governor coil is a second voltage resistor in the form of a rheostat (Item "E"), which is located in the unit control box. It has a total resistance of 3 ohms, 25 watts for the 40-volt unit, and 6 ohms, 25 watts for the 80-volt unit. The Electronetic Governor Coil for both 40- and 80-volt D.C. Enginators has a resistance value at room temperature of approximately 11 ohms.

A thermistor assembly is located in the governor junction box immediately behind the governor coil housing. This thermistor reflects the temperature rise of the governor coil and compensates the generator output voltage for variable temperature conditions.

The fuel rack shutoff solenoid is attached to the governor adapter housing and actuates through a center hinged, spring-loaded, shutoff lever, to permit the fuel rack of the injector pump to "close" for stopping the engine and "open" for starting. The direct opening and closing of the fuel rack by operation of this fuel rack solenoid is the basic operating control of the Waukesha Diesel Enginator.

OPERATING INFORMATION ON THE ELECTRONETIC GOVERNOR - D.C. (Continued)

NOTE: Manual Fuel Shutoff: A lever is provided for the manual shut-off of the fuel rack. It is located on the Electronetic Governor. The fuel rack is fully closed when this lever is held forward or to the left. An adjusting screw on this lever provides the smoke limit stop adjustment for the maximum travel of the fuel rack. The total travel of the fuel rack from closed to wide open should be 7/16", measured on the front end of the pump rack at the front of the engine within the gear cover.

SERVICE SUGGESTIONS FOR THE ELECTRONETIC GOVERNOR

Field Check

For voltage checking convenience, there are two test post terminals located in the inspector's control box on the unit. Enginator output voltage may be read at this point, as this is directly across the generator (generator output voltage). The acorn nut immediately below the test posts should be removed to uncover the adjusting slot of the rheostat-type governor voltage resistor. As indicated by the directional arrow, turning to the right (clockwise) raises the generator voltage, and to the left (counterclockwise) lowers the generator voltage.

Electronetic Governor Adjustment

The Electronetic Governor is entirely enclosed. For normal operation, the internal parts must be kept clean. Therefore, it is important that the governor be in good condition, the solenoid plunger ball bearing fit smoothly and move smoothly on its pilot shaft, and lubricated lightly to actuate with minimum friction. Be sure all terminals, resistor slide bands, and wire splices are tight. Check the generator brushes to see that they are making maximum contact and are well seated, and that the commutator is in good condition. Be sure generator and governor coil are warm and equalized before adjustments are made. The operating current of the governor coil is approximately 1.4 amperes. Turning the brass governor spring adjusting nut "in" (towards the governor) increases this current; turning it "out" decreases the current draw of the governor coil. The approximate adjustment of this adjusting nut is so that it is turned in until only two or three threads are visible. If an ammeter is not used in making this adjustment, the following procedure may be used. The variable rheostat in the control box should be set at the midway position. Then adjust the large brass governor spring adjusting nut until the desired generator output voltage (no load) is obtained.

The speed (RPM) of the armature is adjusted by varying the amount of external resistance to the generator field. The average setting of the resistor (Item "C") is to have 3/4 of its resistance in the circuit. With no load on the generator, the speed should be approximately 1500 rpm. Adjust the slide of the field resistor until this speed is obtained. Increasing the resistance will increase the armature speed; likewise, less field resistance will decrease the armature speed.

SERVICE SUGGESTIONS FOR THE ELECTRONETIC GOVERNOR (Continued)

Electronetic Governor Adjustment (Continued)

The Enginator speed droop, no load to full load, should be approximately 300 rpm; therefore, with a 1500 rpm no load speed, the full load speed should be approximately 1800 armature rpm. It is important to have at least 1800 rpm at full load. To increase this speed droop, shift the generator brush holder with the direction of armature rotation. Likewise, to decrease the droop, shift the generator brush holder against the direction of armature rotation. Be sure the brush holder adjusting screws are tightened after adjustment is made. The normal position of the brush holder to obtain the 300 rpm speed droop is approximately 1/8" to 1/4" from the electrical neutral in the direction of rotation of the armature. Excessive movement of the brush holder away from the neutral point will result in brush sparking and should be avoided.

The speed checks and final adjustments should be made with the generator warm. The speeds given are armature speeds. Therefore, if engine rpm is read, allowance should be made for the slip of the fluid drive coupling. At no load, the engine and armature speed are about the same; however, at full load, the approximate 3% coupling slip will result in an increased engine speed of approximately 100 rpm.

CHECKING AND ADJUSTING FUEL INJECTION PUMP TIMING TO THE ENGINE

The following are instructions for checking the injection pump timing to the engine. Please refer to Figures 1, 2, and 3 of SK-1395.

1. Remove inspection cover at the top of the flywheel housing (J - Fig. 1) located in generator compartment. Also remove the front sheet metal frame piece at the gear cover end of the unit.

2. Remove the engine rocker arm cover. Turn engine over at the flywheel in direction of normal rotation until No. 1 cylinder is on compression stroke (both valves closed). The flywheel turns anti-clockwise when facing generator end of the unit.

   Note: When No. 1 cylinder piston is on top dead center, the timing pointer (H) should be in line with the dead center (D.C.) mark on flywheel.

3. The timing mark F.P. 22° stamped on the flywheel (L) will show up 22° before the top dead center mark. To check the exact pump timing in relation to the timing pointer (H) and the flywheel timing mark, turn flywheel back at least a quarter turn.

4. Disconnect the low pressure flexible inlet fuel line (A) at the opposite end from injection pump inlet fitting.

CHECKING AND ADJUSTING FUEL INJECTION PUMP TIMING TO THE ENGINE (Continued)

5. Cleanliness is very important in this step. Disconnect high pressure fuel line at No. 1 pump cylinder (F - Fig. 1) and remove delivery valve holder (M). Remove delivery valve spring (N) and delivery valve (O - Fig. 2).

6. Replace delivery valve holder (M) and connect the Ermetto nut of test line (B), Part No. A-952467, to valve holder. Submerge open end of test line into small glass jar of fuel oil or light engine oil.

7. Open fuel injection pump rack manually or electrically. Do not permit starting motor to crank the engine.

8. Slowly turn the engine over at the flywheel in the direction of normal rotation (see arrow on top view sketch of engine and flywheel housing) and at the same time have someone blow on the flexible inlet fuel hose (A) to pump. Bubbles will appear in the jar (C). It may be necessary to clear the lines of fuel oil before the air will come through the test line (B).

9. When No. 1 fuel injection pump piston (S) closes fuel port (R), air can no longer be blown through pump to test line and bubbles will stop at test jar. This point is the beginning of the fuel injection or pressure stroke and should occur as the timing pointer is in line with the 22° mark on the flywheel. If by mistake the engine is turned beyond this point, back it up at least a quarter revolution to pick up any gear lash and then again turn engine over until the bubbles just stop. At this point, if the 22° timing mark on the flywheel is "back" of the pointer, the timing is advanced and should be retarded. If the 22° mark is past the pointer, the timing is late and should be advanced.

ADVANCING OR RETARDING THE TIMING

1. Remove the overspeed governor housing cover. Drain coolant to a low level and disconnect 3/8" copper tube between water pump and top cylinder block. Remove overspeed governor housing assembly (Fig. 3).

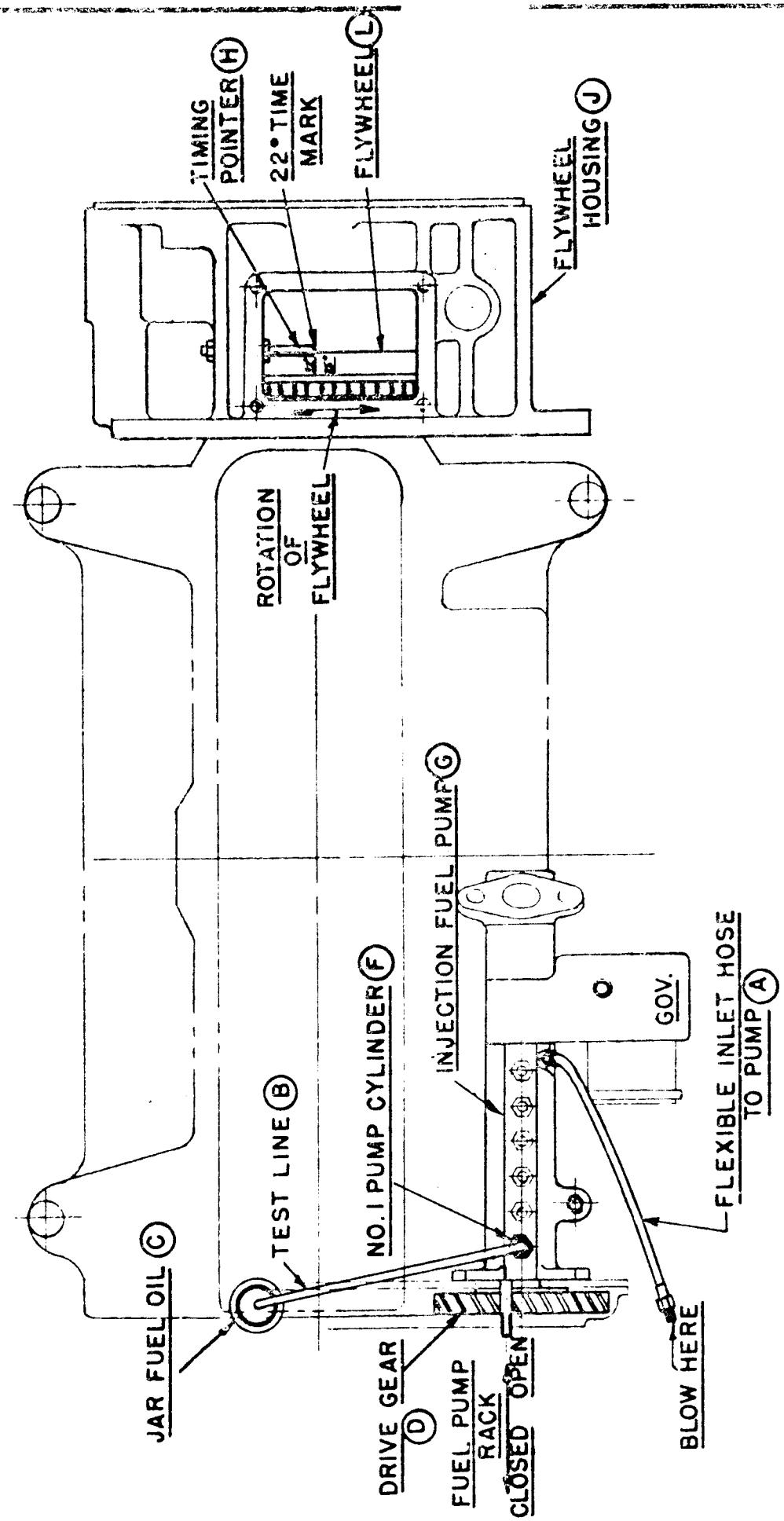
2. Remove safety wire from the two cap screws (Q) holding pump driven coupling to drive gear (D).

3. If timing is to be advanced, move the two cap screws (Q) in a clockwise direction to the next holes in the drive gear. This will move the injection pump driven coupling. The drive gear will not move. If timing is to be retarded, move the two cap screws anticlockwise. Changing the cap screw positions one hole advances or retards the timing approximately 2-1/2° to 3°..

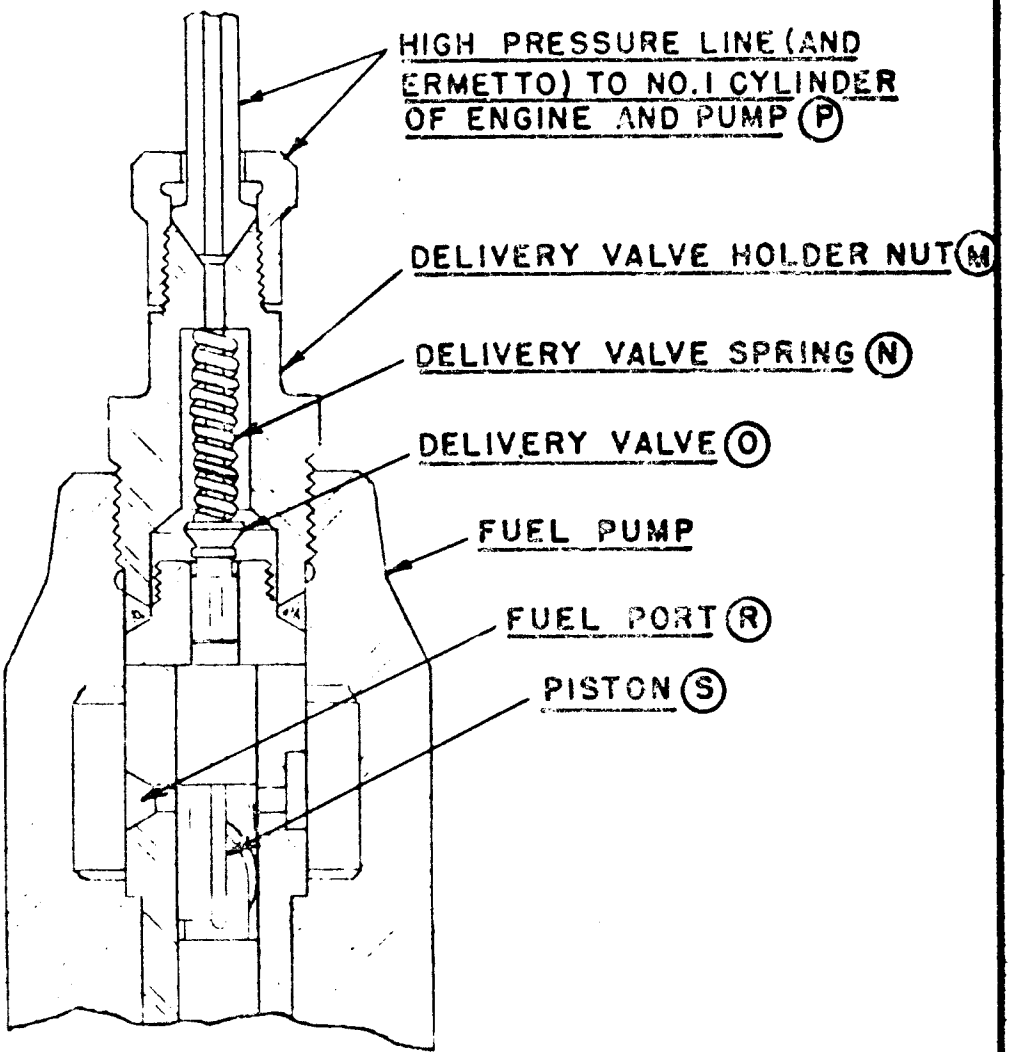
ADVANCING OR RETARDING THE TIMING (Continued)

4. Recheck timing as outlined in steps 8 and 9. If timing is 22° before top dead center, the unit can be reassembled. Be sure to replace the safety wire at cap screws (Q).

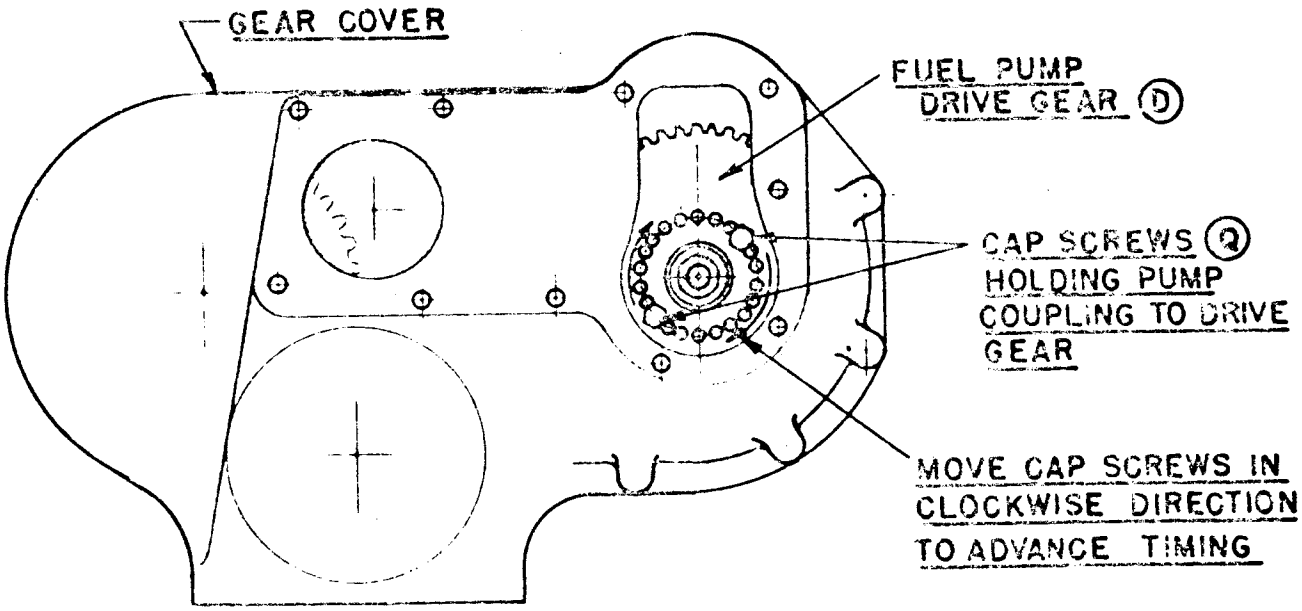
   Note: If for any reason it is necessary to remove the crankshaft and camshaft gears during overhaul of the engine, the timing of the camshaft is easily accomplished at assembly. This is done by matching the tooth marked "C" on the crankshaft gear with the "C" on the camshaft gear.



TOP VIEW OF ENGINE
WITH FLYWHEEL HOUSING COVER REMOVED



CROSS SECTION OF NO.1 CYLINDER FUEL INJECTION PUMP DELIVERY VALVE ASSEMBLY



FRONT VIEW OF GEAR COVER WITH OVERSPEED GOVERNOR HOUSING REMOVED

WAUKESHA MOTOR CO. WAUKESHA, WIS.	TITLE– INSTRUCTIONS FOR CHECKING & ADJUSTING FUEL INJECTION PUMP TIMING OF WAUKESHA DIESEL ENGINATOR		SK 1395

CRANKSHAFT OIL SEAL (Continued)

2. If a new flywheel housing is being applied, it may be necessary to loosen the crankcase oil pan cap screws to prevent the pan from interfering with the lining up of the flywheel housing.
3. Refer to Waukesha Drawing No. SK-1441. The flywheel housing must line up with the crankshaft flange. Use locating tool for this.
4. Both dowel pins through the housing and case should be removed. Be sure cap screws are not too tight to permit housing to shift as necessary. Locate housing with equal fit on all sides of the locating tool.
5. Tighten down all flywheel housing cap screws.
6. Ream both dowel pin holes .5000" - .5005" diameter and insert new dowel pins.
7. Retighten oil pan cap screws.
8. Place oil slinger over crankshaft flange.
9. Place "O" ring over crankshaft flange next to slinger.
10. Apply new "O" ring to housing seal sleeve. Run pencil or the like around under ring to even up the ring and remove all twists. Lubricate with white lead or equivalent. Push sleeve into flywheel housing by hand. Do not drive or pull into place with the cap screws to prevent shearing the "O" ring. Put sleeve holding cap screws in place, but do not tighten.
11. Assemble seal rings to seal retainer with an expanding tool as these rings can be sprung out of round if not handled correctly.
12. Engage seal retainer puller tool to seal retainer and heat both in hot oil to about 275° F.
13. Place seal mounting sleeve in position; be sure it is seating securely and evenly against the seal housing sleeve.
14. Position the heated and expanded seal retainer and puller tool into sleeve and firmly drive on to the crankshaft flange. After the ring has cooled sufficiently to be tight on the shaft again, drive it into place against the slinger.
15. Use a .006" feeler gauge to check clearance between sleeve and seal retainer. If the .006" feeler gauge will not go all around, a small misalignment can be corrected by prying between the sleeve flange and the flywheel housing until gauge is free all around.

CAUTION: All seal parts must be handled with care so as not to mar or bend in anyway. Hands and tools should also be kept clean.

WATER PUMP ASSEMBLY

The water pump is located at the extreme front end of the engine and is bolted and doweled directly to the engine gear cover. The pump is gear-driven directly from the crankshaft gear; therefore, these gears are lubricated by the oil spray off the main gear chain from the crankcase oil supply. A raw hide leather seal around the pump gear, seals in the oil. The sealed double-row ball bearing and shaft assembly is grease-packed.

WATER PUMP ASSEMBLY (Continued)

The shaft is the inner bearing race. Do not attempt to take this bearing and shaft assembly apart. The bearing and shaft assembly is fastened in the pump body by a spring retaining clip. The rotating half of the coolant seal fits closely around the pump shaft and has a spring loaded carbon face that seats against a machined and polished face of the body casting. It is suggested that the coolant water pump be completely overhauled at each engine overhaul. Refer to Drawing No. A-191160-B. The following procedure should be followed when disassembling the pump:

1. Remove pump cover (Item 9).

2. Remove bearing retaining clip (Item 7).

3. Press out the old shaft and bearing assembly (Item 2) from the impeller end. The impeller blades will "bottom" on the pump body. The shaft and bearing assembly are not to be taken apart as the shaft represents the bearing inner race.

4. Remove the water pump seal assembly (Item 3) from the impeller body.

5. Press out the shaft and bearing assembly from the pump gear (Item 6). Note: There are no shaft keys at the gear or impeller hubs.

6. Remove the old oil seal (Item 5) from the pump body.

7. Wash, clean and check the gear, pump body, impeller and cover.

8. As the stationary member of the water pump seal is a machined and polished face in the body casting, this face can be cleaned and polished with No. 500 garnet paper and a wood block, keeping the face "square." If the face is badly scored, a new body should be used.

When reassembling the pump, use new oil seal, water seal, shaft and bearing assembly and new gaskets, and proceed as follows:

1. Press the new water pump seal into the impeller body. Apply pressure to the outer drive sleeve of the seal when assembling to prevent damaging the rotating carbon seal face.

2. Press the oil seal (Item 5) into the pump body in position as shown on drawing.

3. Press the shaft and ball bearing assembly into the pump body. This is a light press fit. The 1-7/8" end of the shaft takes the impeller. Apply pressure only against the outer bearing race and not on the end of the shaft. Press in until the locking clip groove of the bearing is centered in bottom 1/8" slot-out of pump body. (See section B-B of drawing.)

NOTES:

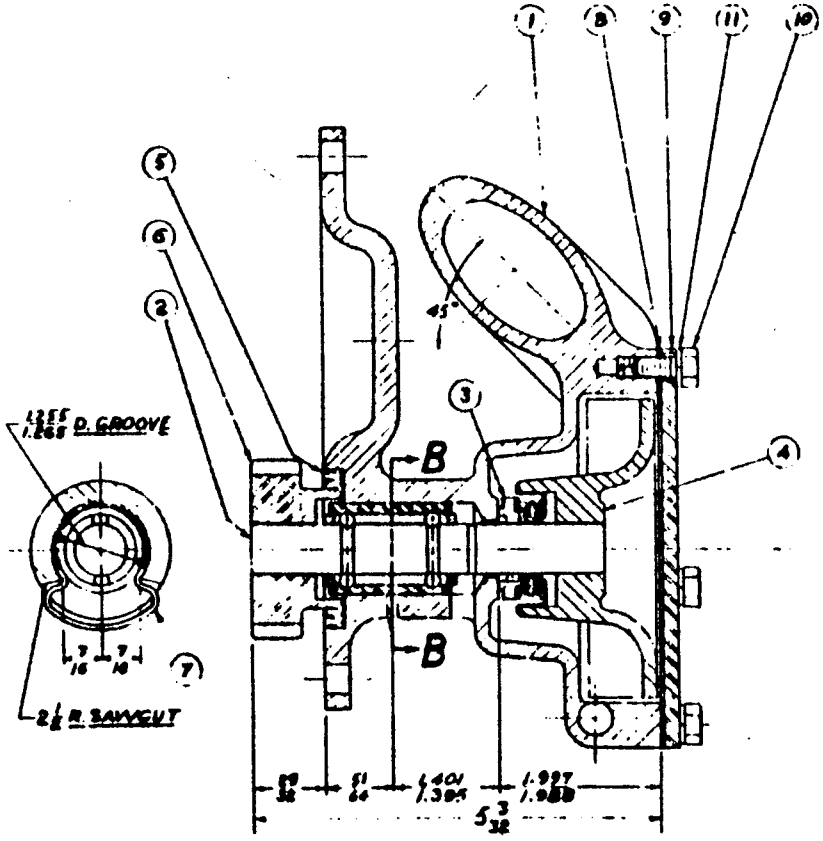
APPLY CHEMICAL SEAL (OTHER THAN RUBBER) TO OUTER RACE WHEN ASSEMBLING THE BEARING AND SHAFT ASSEMBLY INTO THE HOUSING.

APPLY PRESSURE TO THE DRIVE SLEEVE OF W.P. SEAL WHILE ASSEMBLING IT TO IMPELLER TO PREVENT RUPTURING THE SEAL.

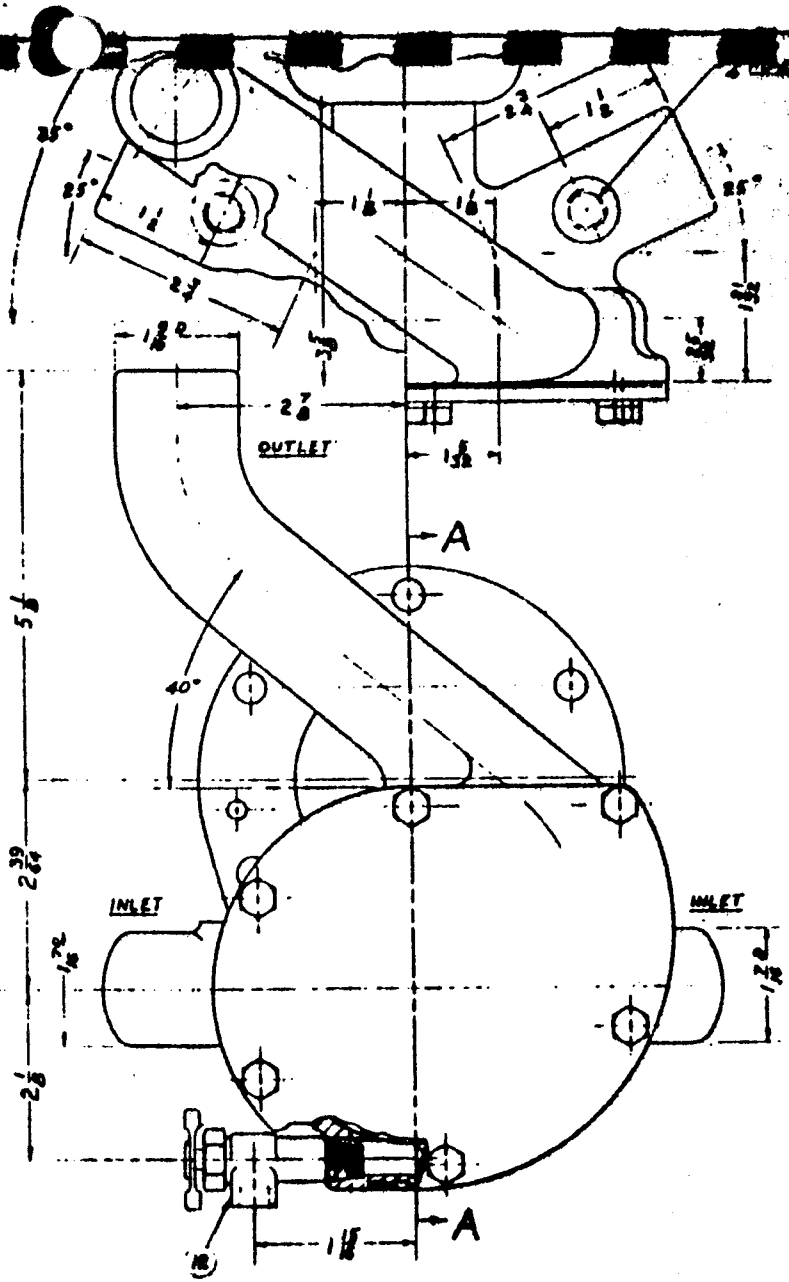
WHILE ASSEMBLING GEAR AND IMPELLER TO SHAFT, SUPPORT SHAFT TO PREVENT PRELOADING OF BEARINGS.

LOCATE W.P. GEAR AND IMPELLER FLUSH WITH ENDS OF SHAFT.

ITEM	PART NO.	QTY	NAME
1	[illegible]-B	1	WATER PUMP BODY
2	[illegible]	1	W.P. SHAFT AND BRG. ASM.
3	120320	1	WATER PUMP SEAL
4	100063	1	WATER PUMP IMPELLER
5	95128-A	1	OIL SEAL
6	118683	1	WATER PUMP GEAR
7	76939	1	RETAINING CLIP
8	117718	1	WATER PUMP COVER GASKET
9	117715	1	WATER PUMP COVER
10	21274	6	HEX HD. BOLT 1/4-20 x 1
11	21536	6	LOCK WASHER
12	73059	1	ANGLE SHUT-OFF



SECTION B-B



SECTION A-A

WATER PUMP ASSEMBLY

A-101160-B

WATER PUMP ASSEMBLY (Continued)

4. Apply the retaining clip (Item 7)

5. Be sure the oil seal face diameter of the drive gear is clean and smooth. Using the impeller end of the shaft as a support, press on the drive gear until it is flush with the end of the shaft.

6. Using the gear end of the shaft as support, press on the impeller and seal assembly until the impeller hub is flush with the end of the shaft.

7. Turn pump gear by hand to be sure all parts are free to rotate. There should be no end play. It may take a short running period for the seal to seat itself or wear in. Excessive seal leakage will be noticed by coolant at the bottom drain hole.

The two bottom 1-7/16" O.D. side connections are the inlet lines to the pump. The one top 1-9/16" O.D. connection is the pump outlet.

DUAL OIL PUMP

The dual oil pump has two inlet screens which should be inspected and cleaned with solvent. The pumps should be checked for free rotation and oil delivery. The pump parts are made with close tolerances. If it is necessary to renew the bottom cover gaskets, be sure to use standard Waukesha gaskets of the correct thickness.

GEAR COVER AND GEAR TRAIN

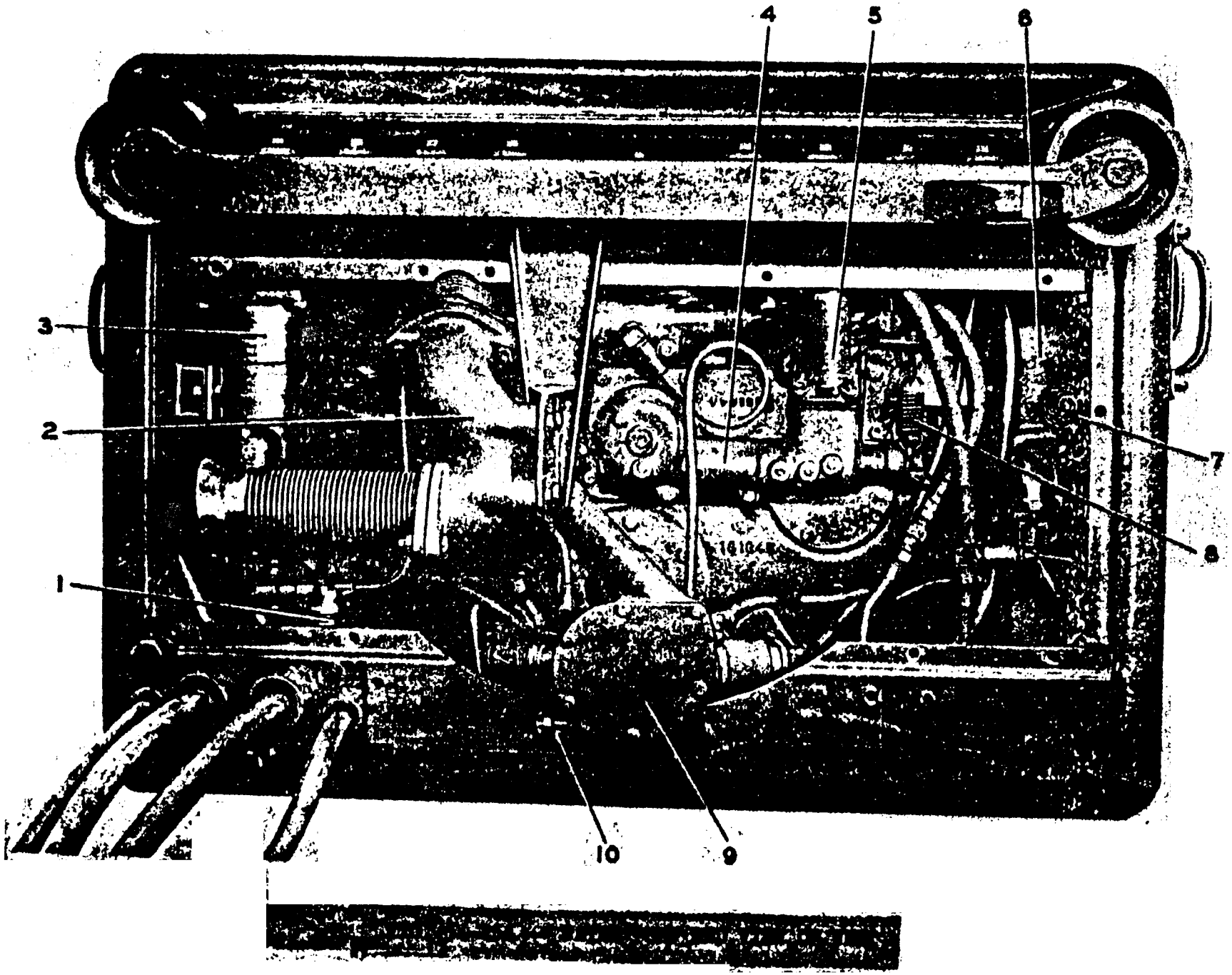
The cast iron gear cover, supports the engine coolant pump and the mechanical overspeed governor housing. The governor overspeed housing is fastened to the gear cover with the cap screws visible from the front and also by the long cap screw on the inner flange of the fuel injector pump. When removing this cover, be careful that the overspeed governor parts do not slip out of place. Likewise, when reassembling, be sure the governor weights, shifter and control yoke are in their correct relative positions.

Care should be taken to locate and note all visible timing marks on the gear train and remesh the gears exactly as indicated by those marks. All gears should be thoroughly cleaned and inspected for cracked or chipped teeth before reassembly. It is generally desirable to replace all gears when one or more require replacement. When excessive running clearance (back-lash) is found, the bushings should be checked to determine their condition.

All gears are made in varying sizes and marked accordingly. The letter "S" on the gear rim means "standard." Gears ranging larger and smaller on their pitch diameter are marked "2L," "4L," or "2S" and "4S" respectively on the rim. The cam gear is a press fit on the camshaft. When reassembling the gear covers, be sure all the cap screws and washers are in their correct locations. Cap screws that are too long might interfere with the

ITEMS IDENTIFIED ON FIG. 54-254

ITEM NUMBER	NAME
1.	Steam Heat Exchanger Drain Petcock
2.	Enginator Exhaust Connection
3.	Steam Heat Exchanger
4.	Overspeed Governor
5.	Crankcase Breather
6.	Inspector's Control Box
7.	Damper Coil To Fuel Oil Gauge
8.	Overspeed Governor Spring
9.	Coolant (Water) Pump
10.	Coolant Pump Drain Petcock


4
5
6
3
2
7
8
1
10
9

ITEMS IDENTIFIED ON FIG. 54-255

ITEM NUMBER	NAME
1.	Alternator Breather
2.	Lubricating Oil Cooler
3.	Lubricating Oil Cooler Pressure Relief Valve
4.	Lubricating Oil Filters
5.	Ether Starting Connection to Intake Manifold
6.	Primary Fuel Oil Filter (Screen Element)
7.	Air Eliminator Restricted Outlet
8.	Engine High Temperature Protective Switch
9.	Secondary Fuel Oil Filter (Waste Element)
10.	Fuel Oil Transfer Pump
11.	Fuel Oil Hand Primer
12.	Steam Heat Exchanger
13.	Engine Exhaust Connection
14.	Steam Line Connection (Low Pressure)
15.	Fuel Oil Connections
16.	Steam Heat Pressure Relief Valve
17.	Steam Trap
18.	Retarder (Steam)

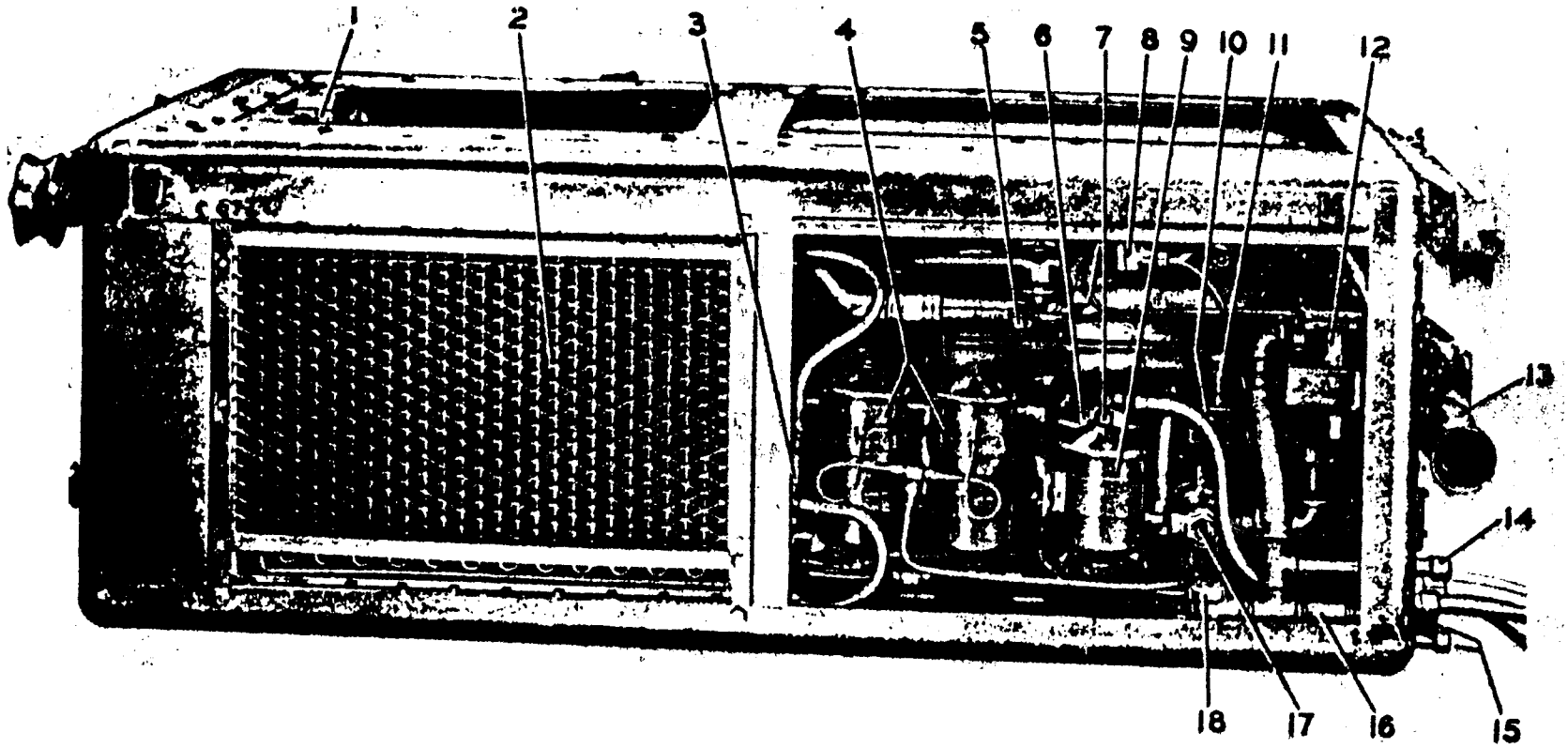


FIG. 54-255 — REAR VIEW OF UNIT

ITEMS IDENTIFIED ON FIG. 54-257

ITEM NUMBER	NAME
1	Control Box
2	Crankcase Breather (Oil Bath)
3	Ether Primer
4	Lubricating Oil Filler Cap
5	Radiator Fan Motor Control Thermostat Box
6	Lubricating Oil Level Dip Stick
7	Lubricating Oil Drain Valve
8	Intake Manifold Air Cleaner (Oil Bath)
9	Air Inlet Precleaner
10	Coolant Radiator
11	Generator Breather
12	Radiator Filler Cap
13	Radiator Level Test Petcock
14	Starting Motor
15	Electronetic Governor
16	Engine Rocker Arm Cover
17	Thermostat Housing
18	Fuel Shut-Off Solenoid
19	Manual Fuel Shut-Off Lever

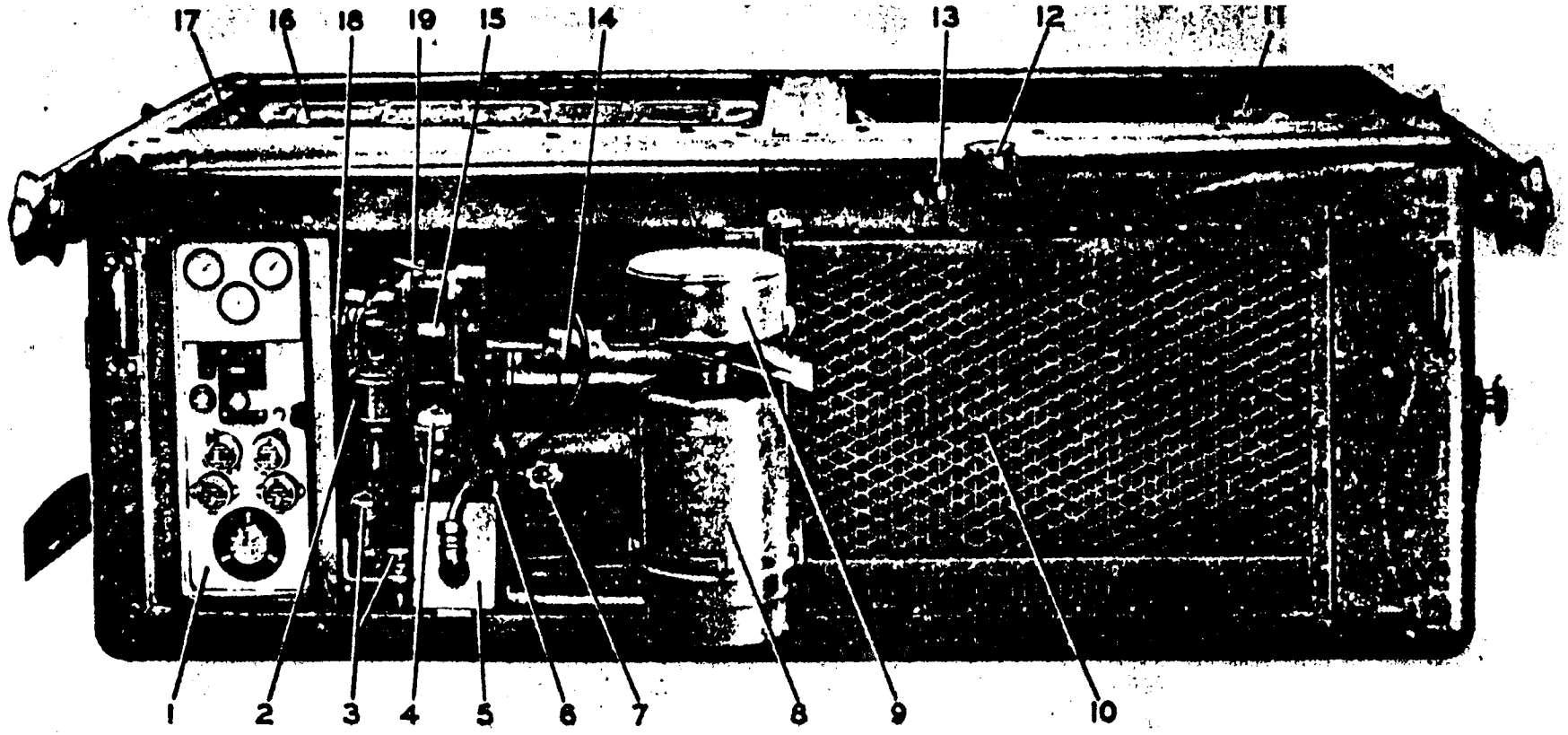


FIG. 54-257 — FRONT VIEW OF EXCITATOR

ITEMS IDENTIFIED ON FIG. 54-258

ITEM NUMBER	NAME
1	Engine Hour Meter
2	Ether Primer
3	Radiator Fan Motor Control Thermostat Box
4	Lubricating Oil Drain Valve
5	Lubricating Oil Filler Cap
6	Crankcase Breather (Oil Bath)
7	Electronetic Governor
8	Lubricating Oil Pressure Gauge
9	Engine Temperature Gauge
10	Fuel Oil Pressure Gauge
11	Engine Start Button
12	Engine Stop Button
13	Generator Overheat Protective Switch
14	Engine Overheat Protective Switch
15	Low Fuel Protective Switch
16	Low Lubricating Oil Pressure Protective Switch

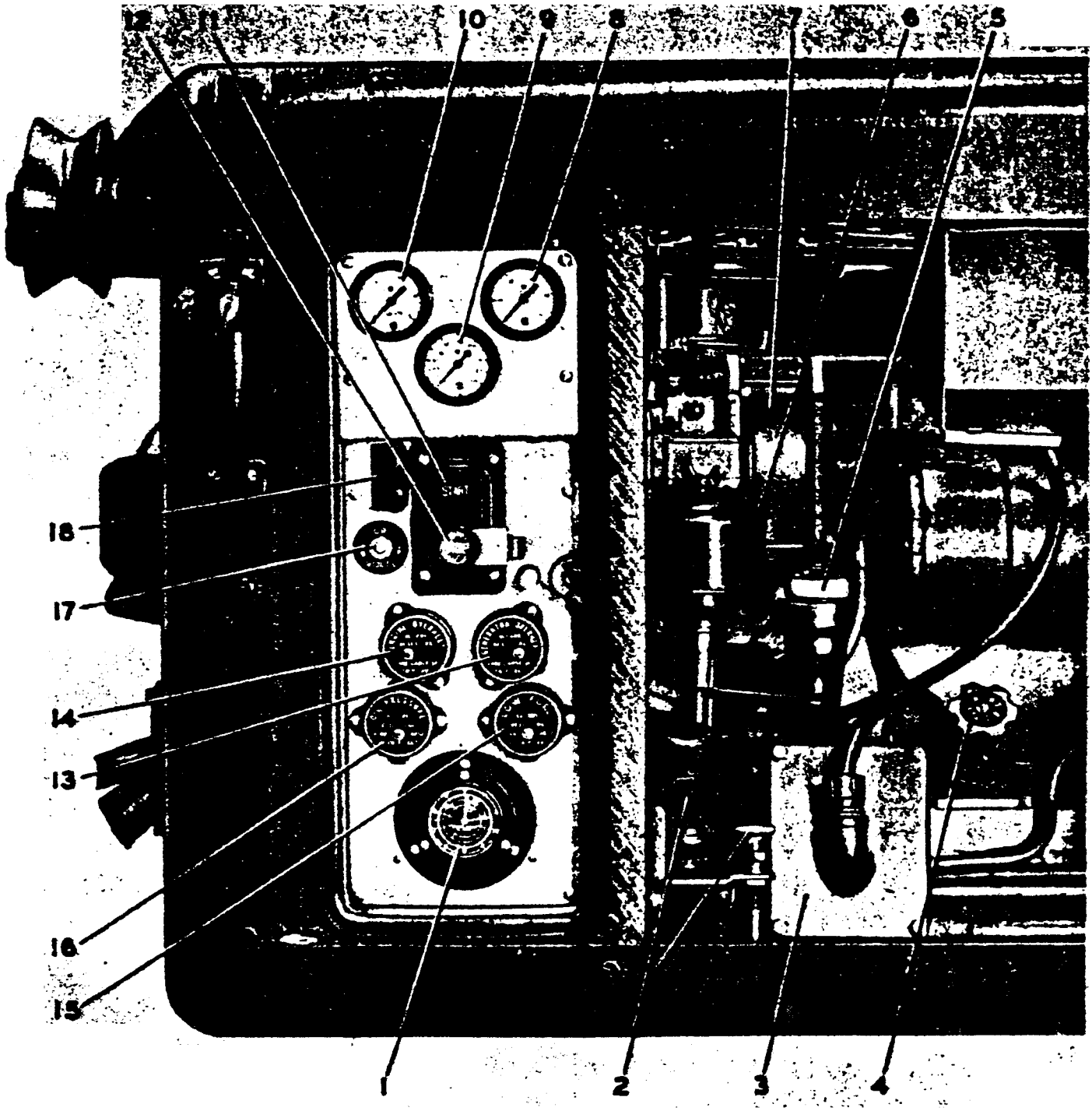


FIG. 54-258 — INSPECTOR'S CONTROL BOX

ITEMS IDENTIFIED ON FIG. 53-465

ITEM NUMBER	NAME
1	Mounting Wheels for Unit Roll Out
2	Radiator Fan Dampers
3	Cushion Mountings
4	Generator Inspection Cover
5	Radiator Fan Motor Relay and Circuit Breaker Box
6	Radiator Fan Motor Manual Test Switch
7	Safety Strike for Mounting Track Latch

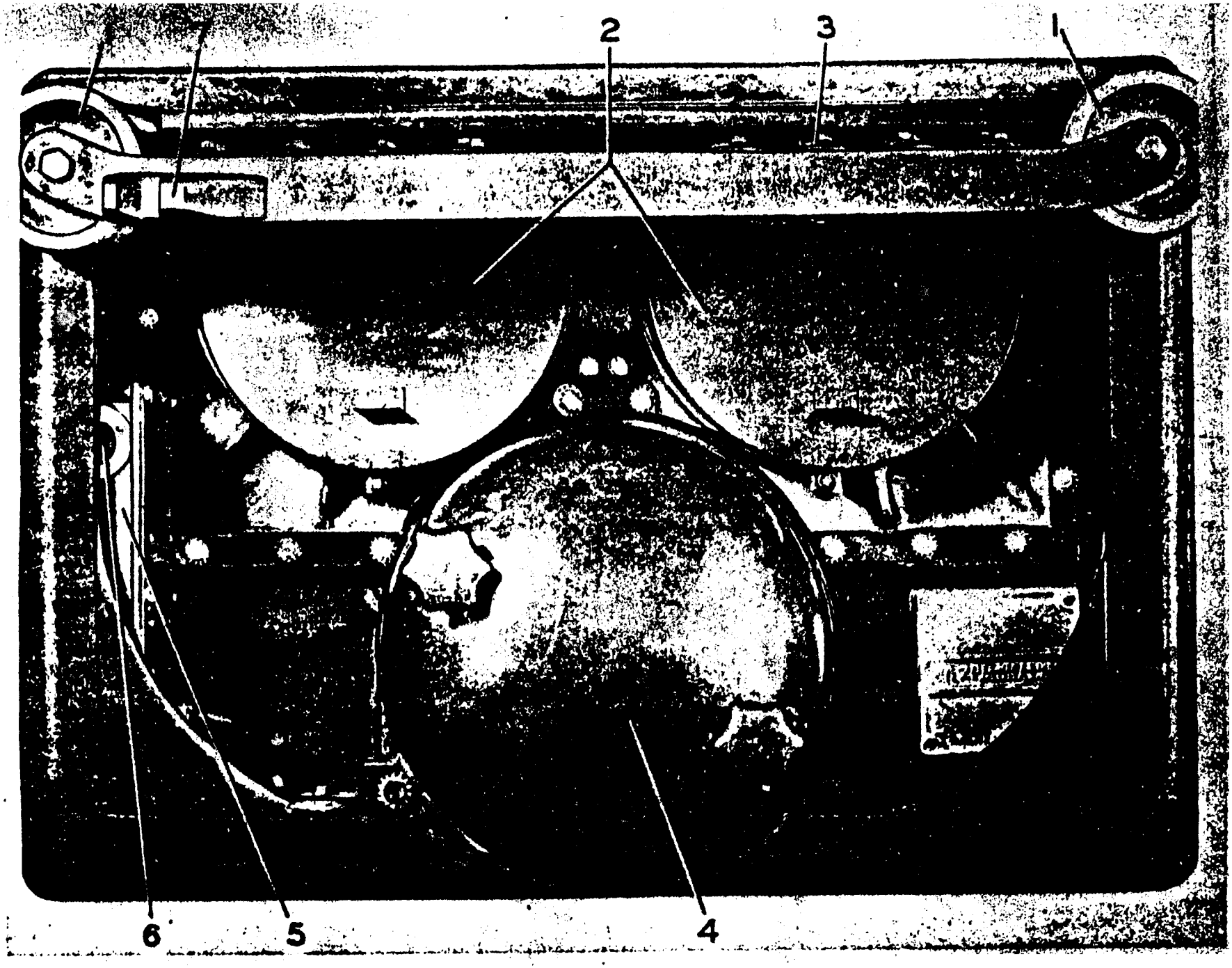


FIG. 53-465 — RADIATOR FAN AND GENERATOR END OF UNIT

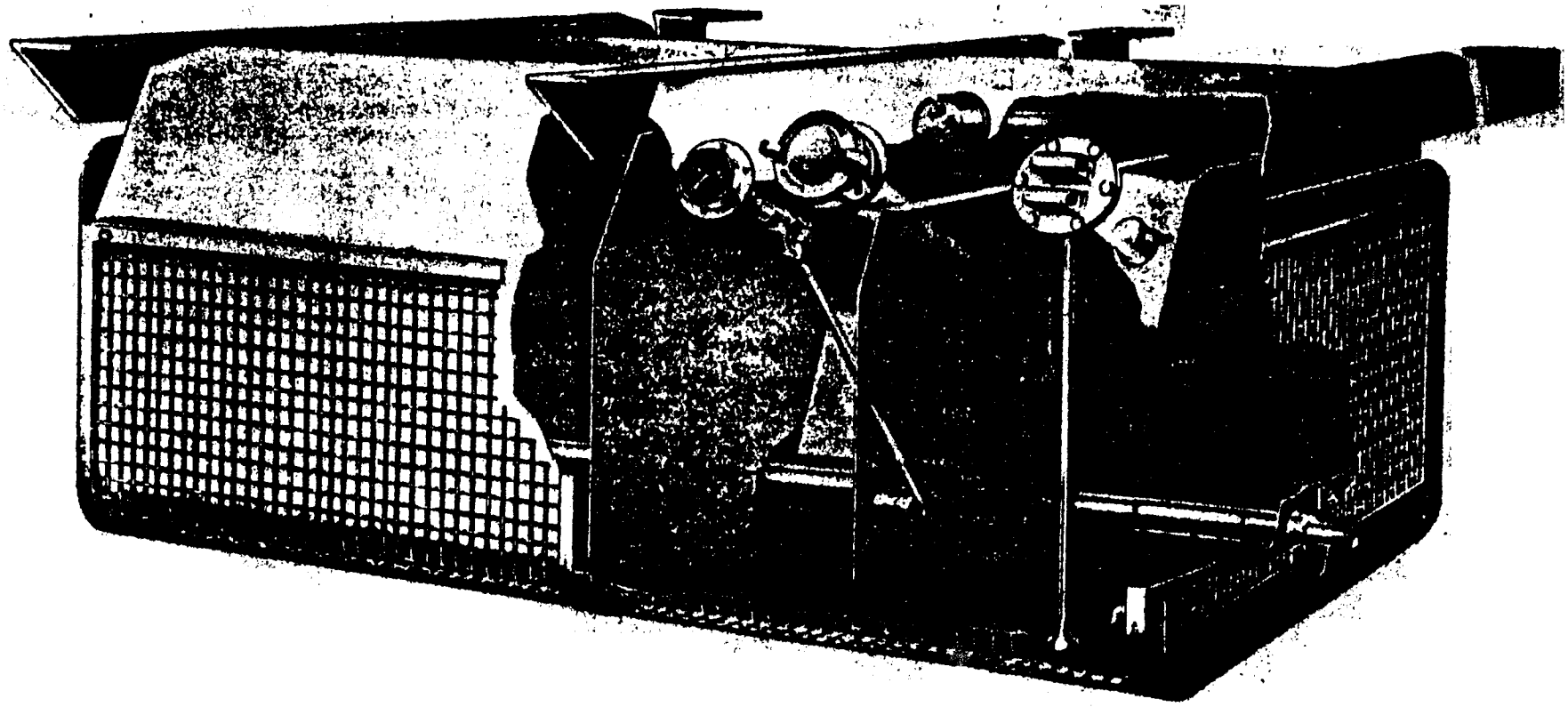


FIG. 27-53 — DIESEL FUEL OIL TANK

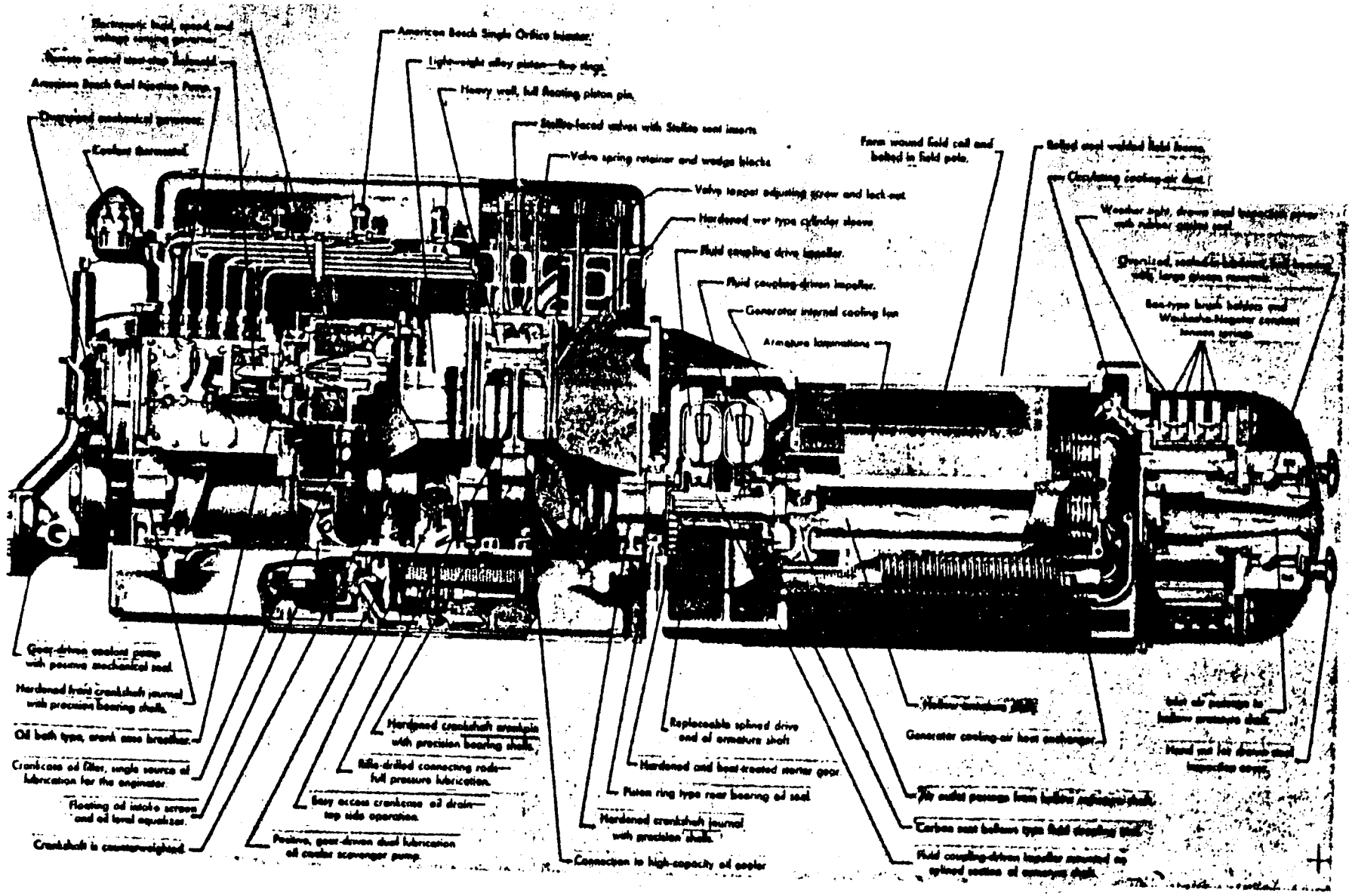
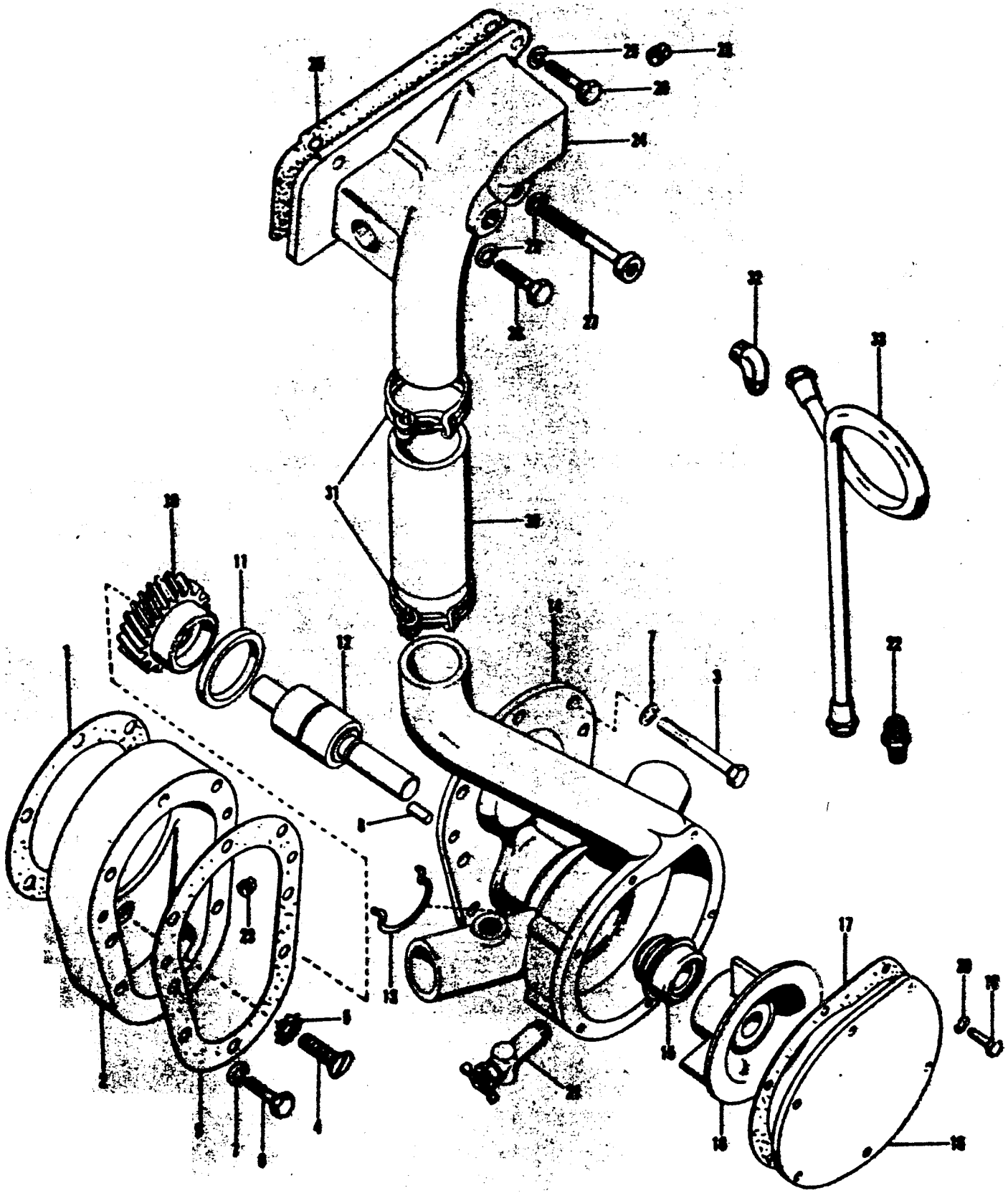


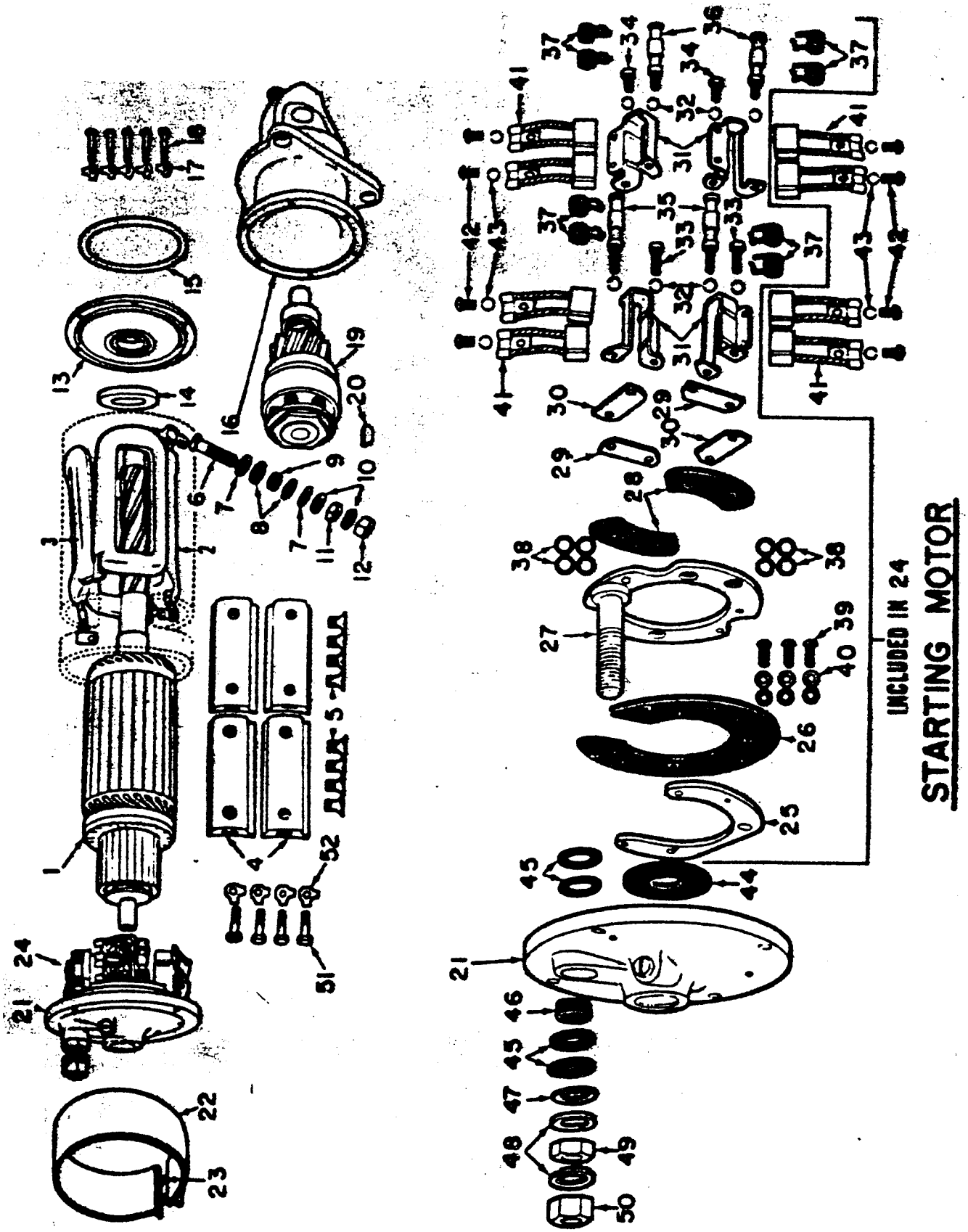
FIG. 52-323 — CROSS SECTION OF ENGINATOR



WATER PUMP
FIG. 10

WATER PUMP, ADAPTER AND WATER PUMP INLET ELBOW

Ref.	Part Number	Description	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	41482	Water Pump Adapter Gasket	1	1	1	1
[illegible]	117714	Water Pump Adapter	1	1	1	1
3	21322	Hex Head Cap Screw	5	5	5	5
[illegible]	21340	Flat Head Screw	6	6	6	6
[illegible]	26143	Shakeproof Lock Washer	1	1	1	1
6	21314	Hex Head Cap Screw	3	3	3	3
7	21538	Lock Washer	8	8	8	8
[illegible]	B-1883	Dowel Pin	4	4	4	4
9	117713	Water Pump Flange Gasket	1	1	1	1
	A-191160-B	Water Pump Assembly	1	1	1	1
[illegible]	118623	Water Pump Gear	1	1	1	1
[illegible]	951281-A	Oil Seal	1	1	1	1
.2	0190056	Water Pump Shaft & Bearing Assembly	1	1	1	1
[illegible]	76939	Retaining Clip	1	1	1	1
[illegible]	191160-B	Water Pump Body	1	1	1	1
.5	120320	Water Pump Seal	1	1	1	1
.6	190063	Water Pump Impeller	1	1	1	1
[illegible]	117712	Water Pump Cover Gasket	1	1	1	1
[illegible]	117715	Water Pump Cover	1	1	1	1
.9	21274	Hex Head Cap Screw	6	6	6	6
[illegible]	21536	Lock Washer	6	6	6	6
	73059	Angle Shut Off Valve	1	1	1	1
	B-5526	Half Union (In Pump Elbow)	1	1	1	1
[illegible]	78282-C	Sq. Head Pipe Plug	1	1	1	1
[illegible]	191064-C	Water Inlet Elbow	1	1	1	1
5	116247	Water Inlet Elbow Gasket	1	1	1	1
6	21349	Hex Head Cap Screw	2	2	2	2
7	21544	Socket Head Cap Screw	1	1	1	1
8	21366	Hex Head Cap Screw	1	1	1	1
.9	21052	Lock Washer	4	4	4	4
[illegible]	Y-18676-D	Rubber Hose	1	1	1	1
[illegible]	Y-6502	Hose Clamp	2	2	2	2
2	B-1687	Half Union Elbow	1	1	1	1
[illegible]	0951423-A	Copper Tube Assembly	1	1	1	1



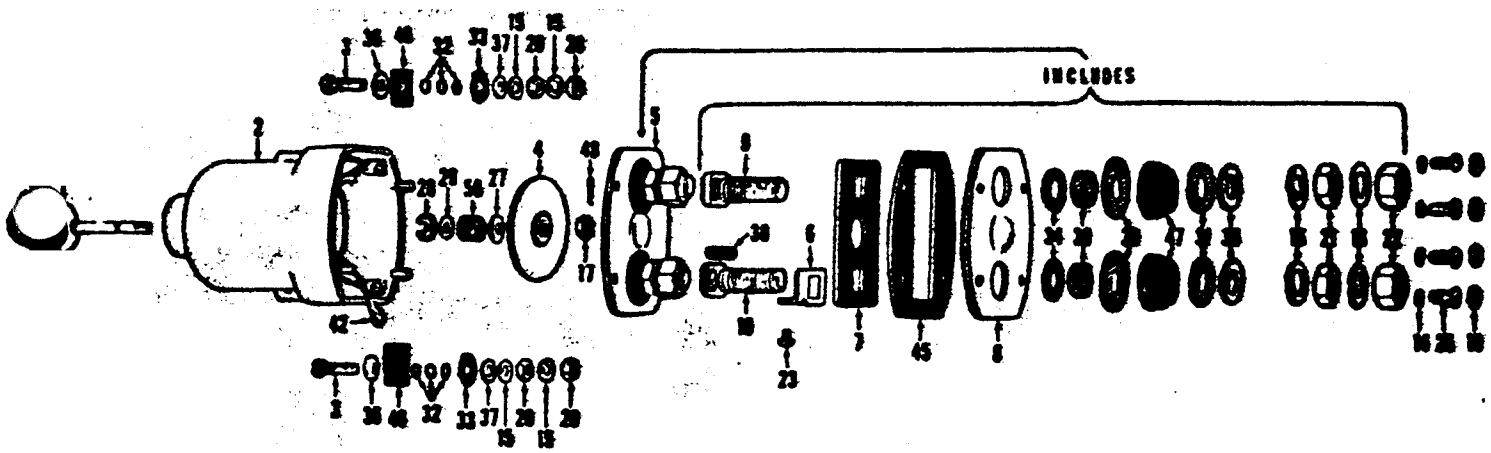
STARTING MOTOR 32 VOLT
FIG. 25

STARTING MOTOR - 32 VOLT

Part Number	Description				
952453	Starting Motor	1		1	
960001	Armature	1		1	
960002	Field Coil	4		4	
	Not Used				
960007	Pole Shoe	4		4	
960008	Pole Shoe Screw	8		8	
960009	Stud - Field Terminal	1		1	
960010	Washer - Terminal Stud Plain	2		2	
960011	Washer - Terminal Stud Insulation 7/8 O.D.	2		2	
960012	Washer - Terminal Stud Insulation 1 13/16 O.D.	2		2	
960013	Bushing Terminal Stud Insulation	1		1	
960014	Lock Washer - Terminal Stud	2		2	
960015	Nut - Terminal Stud	1		1	
960016	Nut - Terminal Stud	1		1	
960017	Center Bearing Plate	1		1	
960018	Oil Seal	1		1	
960095	Bushing	1		1	
960019	Collar Armature Center Bearing Plate	1		1	
960020	Gasket Center Bearing	1		1	
960021	Drive Housing	1		1	
960022	Pipe Plug	1		1	
960023	Oil Wick	1		1	
960024	Lock Washer	5		5	
960025	Screw	5		5	
960026	Drive Assembly	1		1	
960027	Woodruff Key	1		1	
960028	Frame - C.E.	1		1	
960029	Bushing C.E.	1		1	
960030	Plug Expansion C.E.	1		1	
960022	Plug Pipe C.E.	1		1	
960031	Wick Oil C.E.	1		1	
960032	Band Cover	1		1	
960033	Screw Cover Band	2		2	

STARTING MOTOR - 32 VOLT

Ref. No.	Part Number	Description			
24	960034	Plate Assembly Less Brush	1		1
25	960035	Plate-Support	1		1
26	960036	Brush Plate Insulator	1		1
27	960037	Plate and Stud	1		1
28	960038	Brush Holder Insulator	2		2
29	960039	Space Insulator Holder Plate	2		2
30	960040	Stud Plate Spacer	2		2
31	960041	Brush Holder	4		4
32	960042	Lock Washer	8		8
33	960043	Screw Brush Holder Insulator	2		2
34	960044	Screw Brush Holder Ground	2		2
35	960045	Screw Insulated Holder	2		2
36	960046	Screw Grounded Holder	2		2
37	960047	Spring Brush	8		8
38	960048	Washer Brush Holder Screw	8		8
39	960049	Screw Brush Plate Assembly - Attaching	3		3
40	960050	Lock Washer Brush Plate - Attaching Screw	6		6
41	960051	Brush	8		8
42	960052	Screw Brush Lead Attaching	8		8
43	960053	Lock Washer Brush Lead Screw	8		8
44	960054	Washer-Brake C.E.	1		1
45	960011	Washer Terminal Stud Washer	4		4
46	960013	Bushing Terminal Stud	1		1
47	960010	Washer Terminal Stud	1		1
48	960014	Lock Washer - Terminal Stud	2		2
49	960015	Nut - Terminal Stud	1		1
50	960016	Nut - Terminal Stud	1		1
51	960055	Screw - C.E. Frame Attaching	4		4
52	960024	Lock Washer - C.E. Frame	4		4



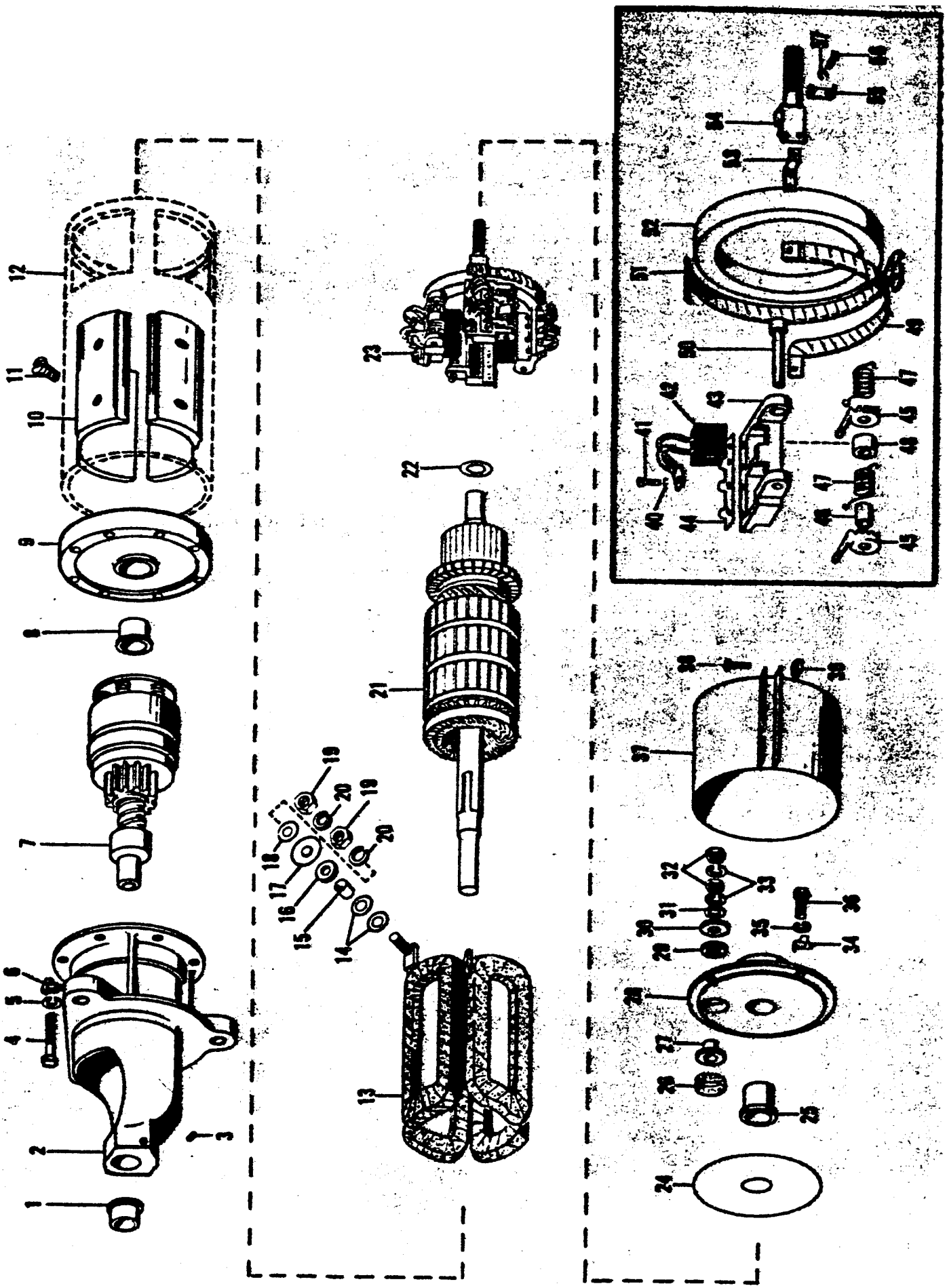
STARTING MOTOR SOLENOID
FIG. 26

STARTING MOTOR SOLENOID

Ref. No.	Part Number	Description	# 2	# 3	# 5
	951132	Solenoid Assembly	1		1
	951140	Solenoid Assembly		1	
			1	1	1
1	960056	Plunger	1		1
2	960057	Case & Coil Assembly		1	
	960058	Case & Coil Assembly	2	2	2
3	960059	Terminal Stud	1	1	1
4	960060	Contact Disc	1	1	1
5	960061	Plate Assembly			
6		Not Used	1	1	1
7	960062	Insulator	1	1	1
8	960063	Terminal Plate	1	1	1
9	960064	Battery Terminal	1	1	1
10	960064	Motor Terminal Stud	1	1	1
11	960065	Return Spring	1	1	1
12	960066	Cup Retainer	1	1	1
13	960067	Boot	4	4	4
14	960042	Lock Washer	4	4	4
15	960068	Lock Washer Terminal Stud 1/4	1	1	1
16	960014	Lock Washer Terminal Stud 1/2			
17	960069	Contact Attaching Nut	4	4	4
18		Not Used	4	4	4
19	960070	Terminal Plate Attaching Nut	2	2	2
20	960071	Terminal Nut	2	2	2
21	960072	Terminal Nut			
22	960073	Terminal Nut			
23		Not Used			
24		Not Used			
25		Not Used			
26		Not Used	1	1	1
27	960074	Contact Spring Reg. Cup Washer	1	1	1
28	960075	Contact Spring Retainer - Cupped & Slotted Washer	1	1	1
29	960076	Contact Spring Plain Washer			
30		Not Used			
31		Not Used	6	6	6
32	960077	Terminal Insulation Washer	2	2	2
33	960078	Terminal Insulation Washer	1	1	1
34	960079	Terminal Insulation Washer			
35		Not Used	2	2	2
36	960080	Terminal Plain Washer	2		2
37	960081	Terminal Plain Washer	2	2	2
38	960082	Terminal Plain Washer	1	1	1
39	960083	Terminal Plate Attaching Nut Plain Washer	1	1	1
40	960084	Terminal Plate Attaching Nut Rubber Washer			

STARTING MOTOR SOLENOID

Part Number	Description	220 32 Volt AC	220 24 Volt AC	32 Volt DC	24 Volt DC
	Not Used				
960085	Insulated Terminal Stud Bushing	2	2	2	2
	Not Used				
	Not Used				
960086	Terminal Clip		1		1
	Not Used				
960087	Plunger Cover Gasket	1		1	
960088	Plunger Cover Gasket		1		1
960089	Terminal Plate Gasket	1	1	1	1
960090	Terminal Insulator	2	2	2	2
960091	Terminal Stud Insulator	2	2	2	2
960092	Contact Nut Cotter Pin	1	1	1	1
960093	Plunger Spring Cotter Pin	1	1	1	1
960094	Contact Cushion Spring	1	1	1	1
	Not Used				



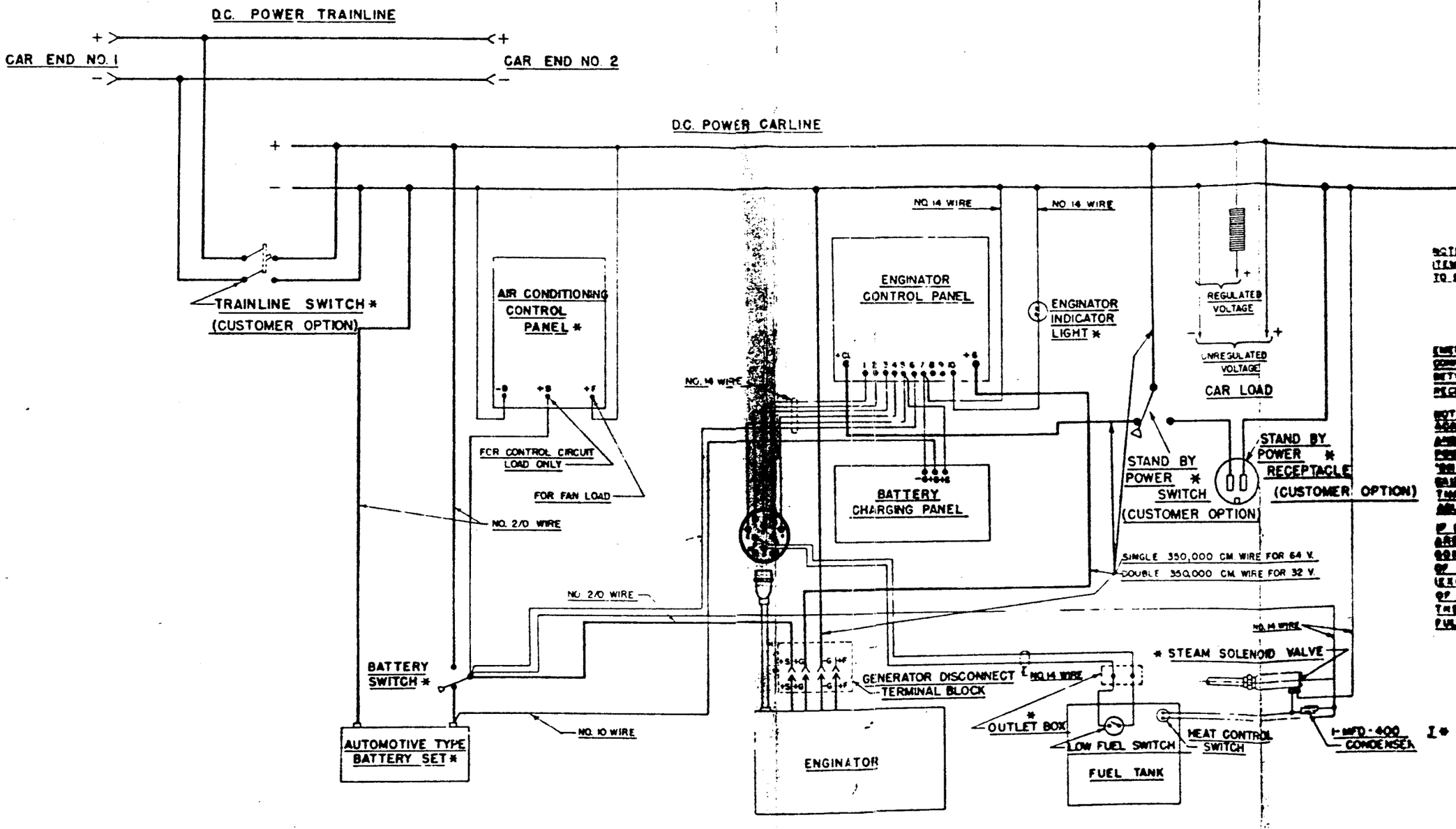
STARTING MOTOR 64 VOLT
FIG. 27

STARTING MOTOR (64 VOLT)

No.	Part Number	Description					
	952076	Starting Motor		1			1
	952556	Drive Housing Bushing		1			1
2	952555	Drive Housing with Bushing		1			1
	952557	Drive Housing Pipe Plug		2			2
	21289	Hex Head Cap Screw		8			8
5	26108	Lock Washer		8			8
	960477	Tapped Washer		8			8
	952571	Bendix Drive		1			1
8	952553	Intermediate Bushing		2			2
	952552	Drive End Housing		1			1
	952554	Intermediate Bushing Oilers		2			2
10	960478	Pole Piece		4			4
11	21753	Pole Piece Screw		8			8
	952566	Field Frame Assembly		1			1
13	952567	Field Coil (Set)		1			1
14	960479	Insulation (Inner)		2			2
	960480	Insulation Bushing		1			1
	960481	Insulation Washer		1			1
17	960482	Insulation Washer		1			1
	960483	Guard Washer		1			1
	960484	Hex Nut		2			2
	Y-19390-B	Lock Washer		2			2
	952568	Armature Assembly		1			1
	960487	Shim Washer		1			1
25	952560	Brush Rigging Assembly		1			1
24	952559	Insulation Washer		1			1
	952551	Bushing (C.E. Housing)		1			1
	960485	Insulation		1			1
27	952569	Insulation Bushing		1			1
	952549	Housing (C.E.)		1			1
	960481	Insulation Washer		1			1
30	960482	Insulation Washer		2			2
31	960483	Guard Washer		1			1
	960484	Hex Nut		2			2
33	Y-19390-B	Lock Washer		2			2
34	[illegible]	Tabbed Lock Washer		4			4
	[illegible]	Lock Washer		4			4
	[illegible]	Hex Head Cap Screw		4			4
37	[illegible]	Band Assembly		1			1
	[illegible]	Screw		2			2

STARTING MOTOR (64 VOLT)

Ref No.	Part Number	Description	[illegible]	[illegible]	[illegible]
39	26511	Nut		2	
40	26000	Lock Washer		4	
41	960486	Screw		4	
42	952534	Brush		8	
43	952561	Brush Holder		4	
44	960488	Plate Lock		2	
	960489	Plate Lock		2	
45	960490	Brush Lever		8	
46	960491	Lever Spacer		4	
47	960492	Brush Spring		8	
48	960493	Spring Spacer		4	
49	952564	Jumper Assembly		1	
50	960494	Brush Spring Pin		4	
51	952563	Jumper Assembly		1	
52	952562	Brush Holder Bracket		1	
53	960495	Jumper		1	
54	960496	Terminal Screw		1	
55	960497	Lock Plate		1	
56	960498	Sq. Head Screw		2	
57	26000	Lock Washer		2	



NOTE:
ITEMS MARKED WITH AN ASTERISK (*) ARE TO BE SUPPLIED BY CUSTOMER.

EMERGENCY SHUT-DOWN SWITCH MAY BE CONNECTED IN THE NO 2 CONTROL LEAD BETWEEN CONTROL PANEL AND CONTROL RECEPTACLE — (CUSTOMERS OPTION).

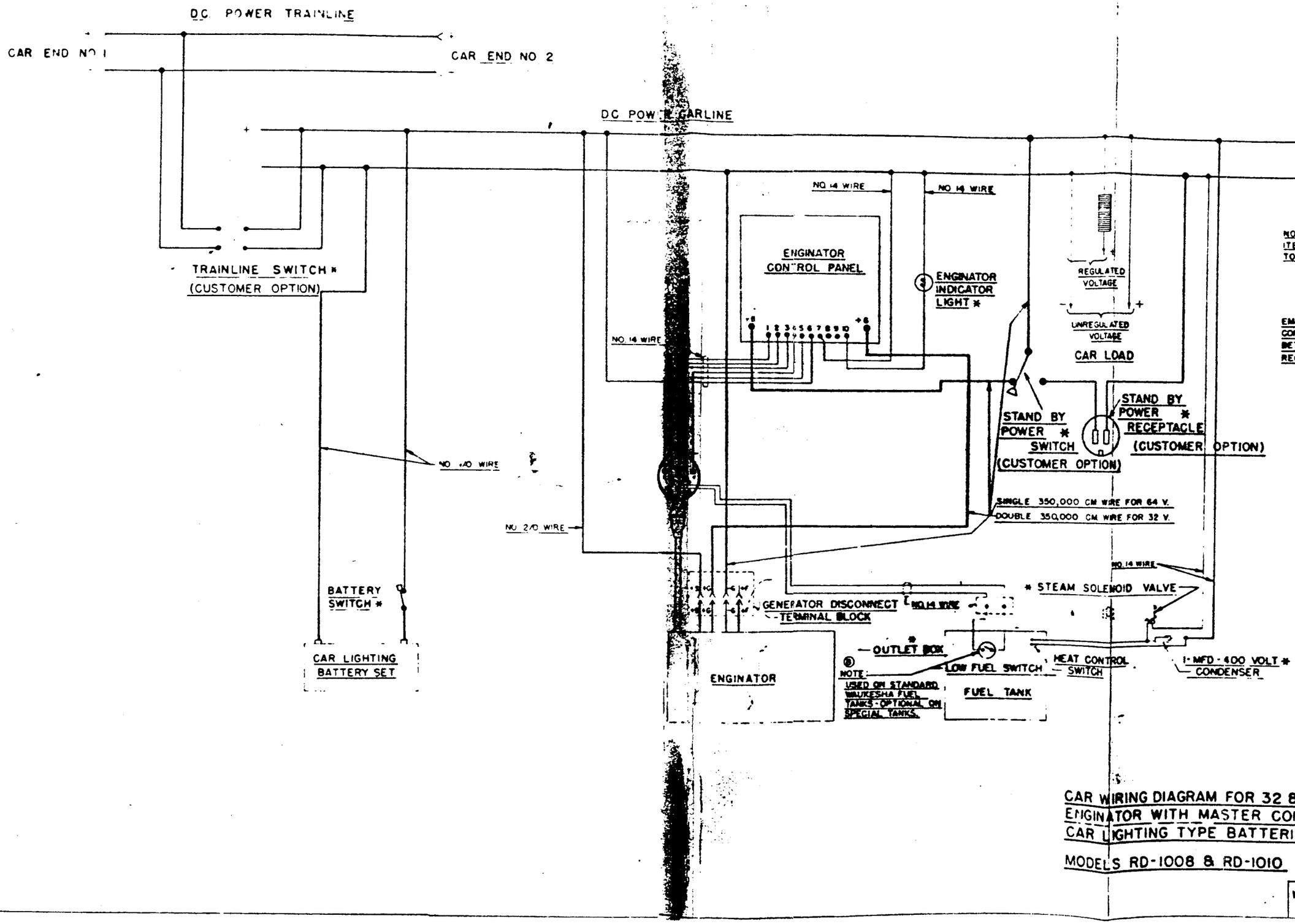
NOTE
ACROSS THE LINE STARTING OF LAR AND SMALL (EXCEPT FRACTIONAL HO POWER) ELECTRIC MOTORS WHICH CYC 'ON' AND 'OFF' OCCASIONALLY, MAY CAUSE VARIATIONS IN LIGHT INTENS THAT MAY BE CONSIDERED OBJECTI ABLE FOR SOME APPLICATIONS.

IF MINIMUM LIGHT INTENSITY VARIATI ARE DESIRED, IT IS RECOMMENDED CONSIDERATION BE GIVEN TO THE U OF SEQUENCE STARTING OF ALL MOT (EXCEPT FRACTIONAL HORSEPOWER) A OF MOTOR STARTERS WHICH WILL LI THE STARTING CURRENT TO 150% O FULL MOTOR LOAD.

CAR WIRING DIAGRAM FOR 32 & 64 VOLT DC DIESEL-ENGINATOR WITH MASTER PANEL AND "L-B" BATTERY CHARGING SUB-PANEL USING AUTOMOTIVE TYPE BATTERIES.

MODELS RD-1008 & RD-1010

WAUKESHA MOTOR CO. SK-154



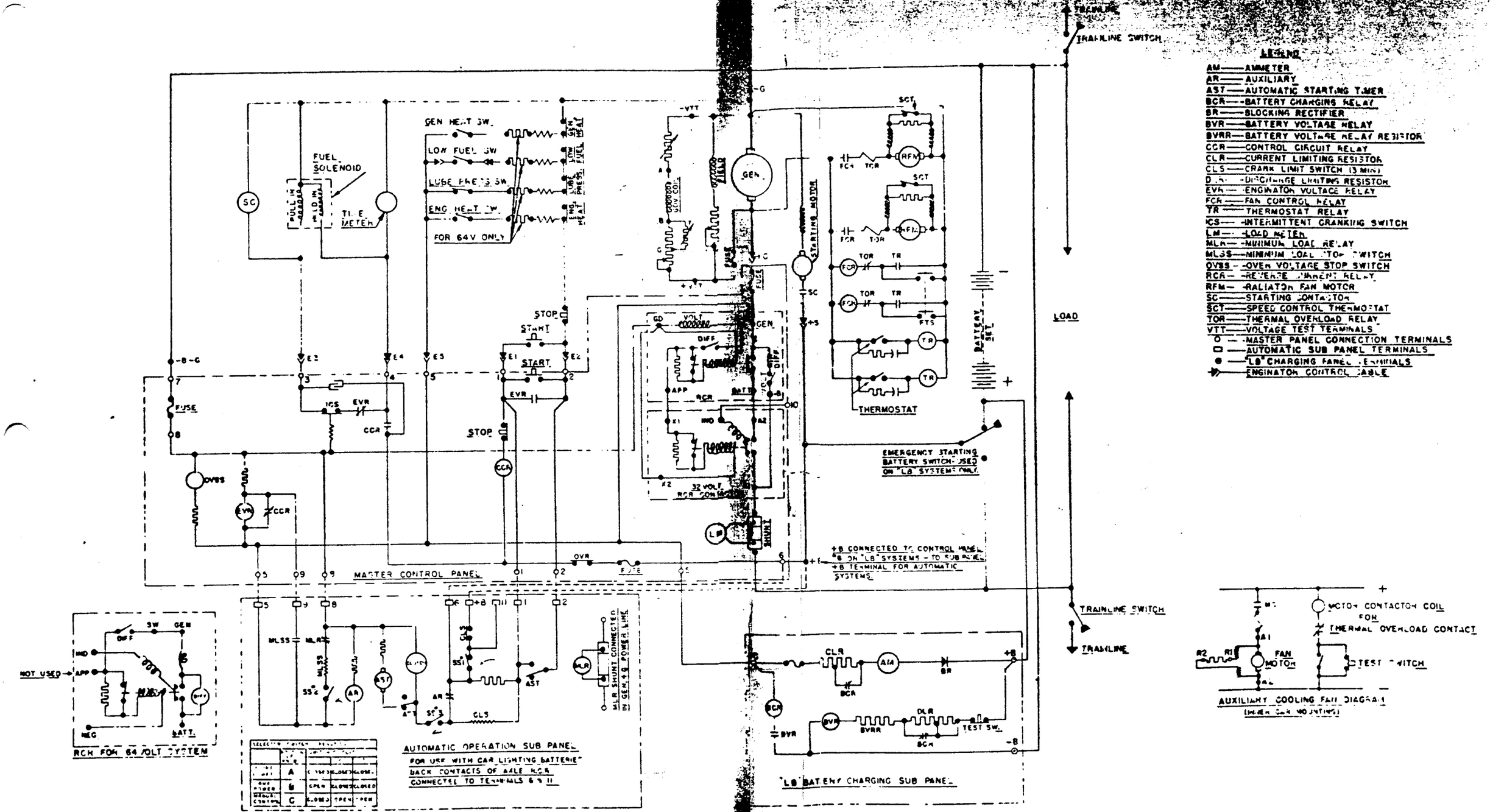
NOTE:
ITEMS MARKED WITH AN ASTERISK (*) ARE TO BE SUPPLIED BY CUSTOMER.

EMERGENCY SHUT-DOWN SWITCH MAY BE CONNECTED IN THE NO. 2 CONTROL LEAD BETWEEN CONTROL PANEL AND CONTROL RECEPTACLE — (CUSTOMERS OPTION).

CAR WIRING DIAGRAM FOR 32 & 64 VOLT D.C. DIESEL-ENGINATOR WITH MASTER CONTROL PANEL USING CAR LIGHTING TYPE BATTERIES.

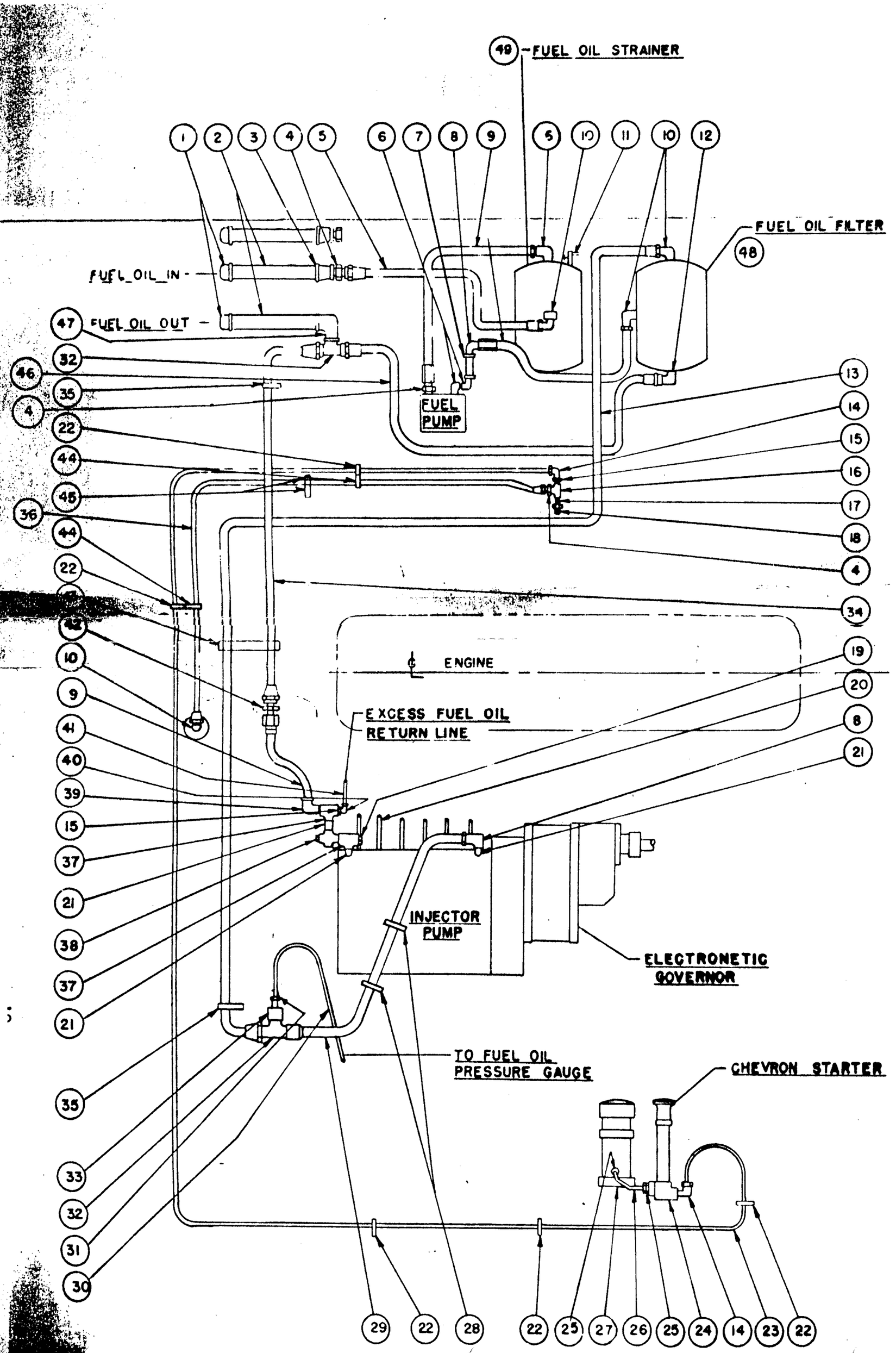
MODELS RD-1008 & RD-1010

WAUKESHA MOTOR CO. | SK-1532

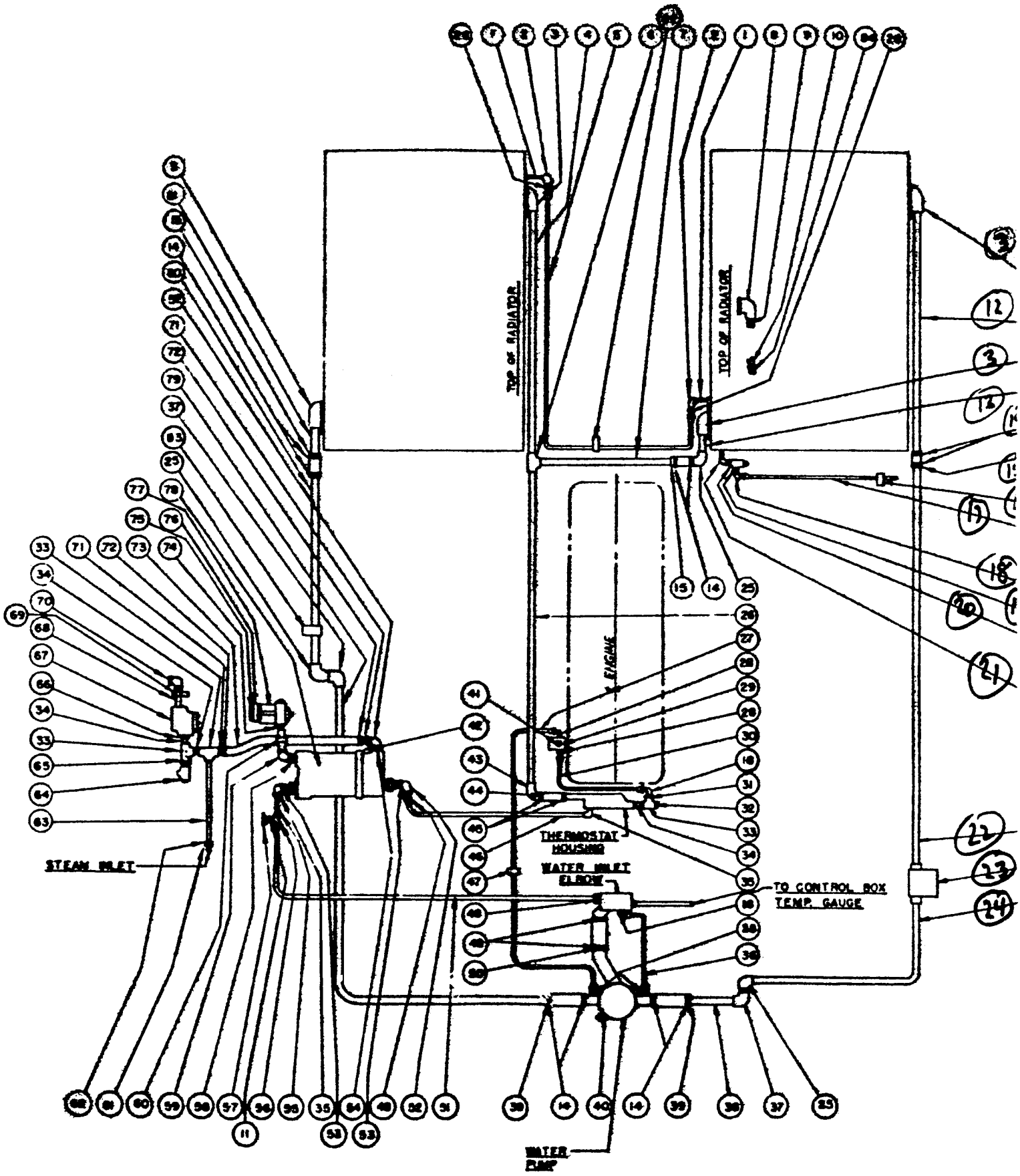


D.C. ENGINATOR UNIT LINE WIRING DIAGRAM
32-64 VOLT SYSTEM

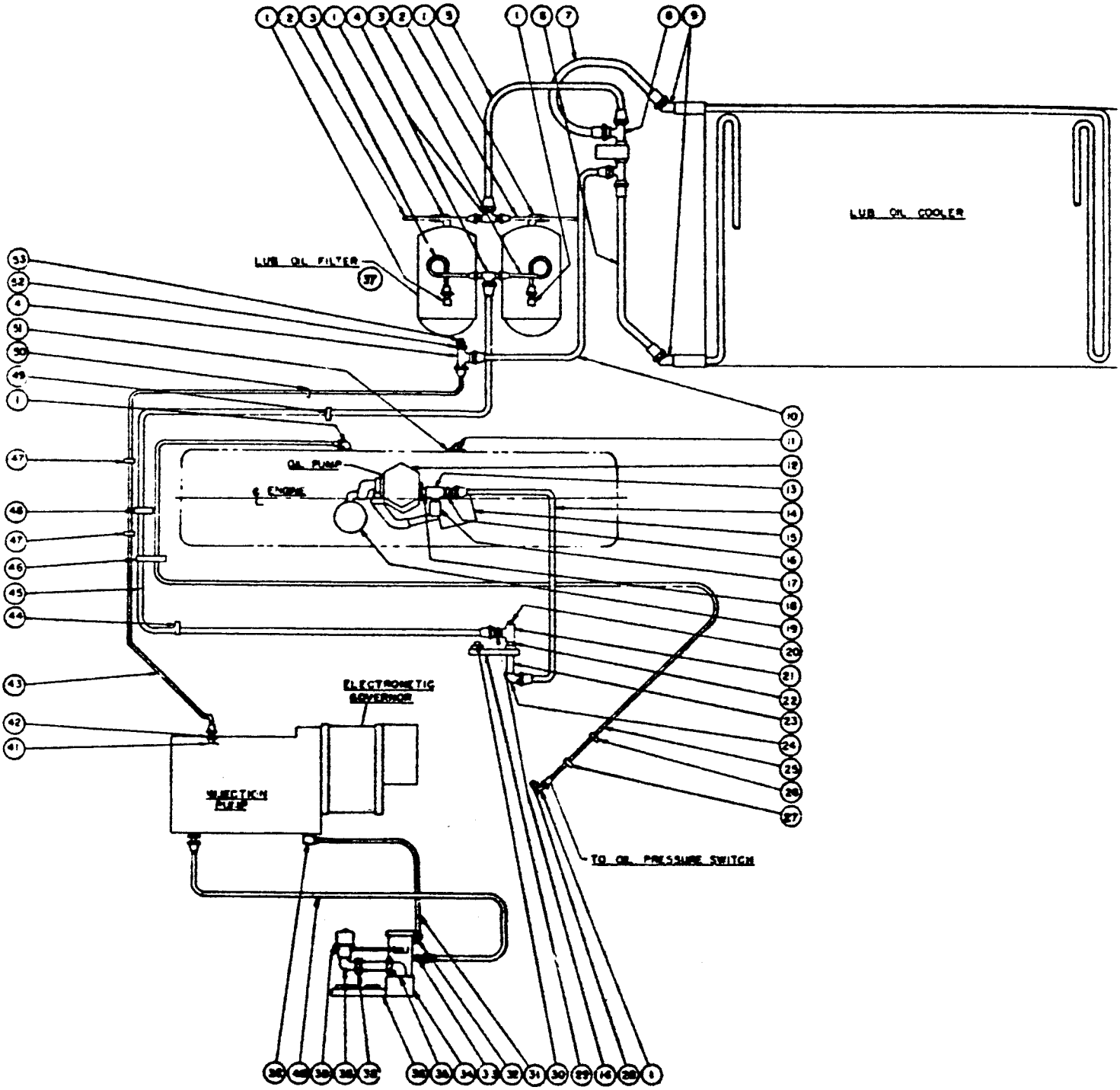
WAUKESHA MOTOR CO. SK-1560-B



FUEL-OIL PIPING
FIG. 24

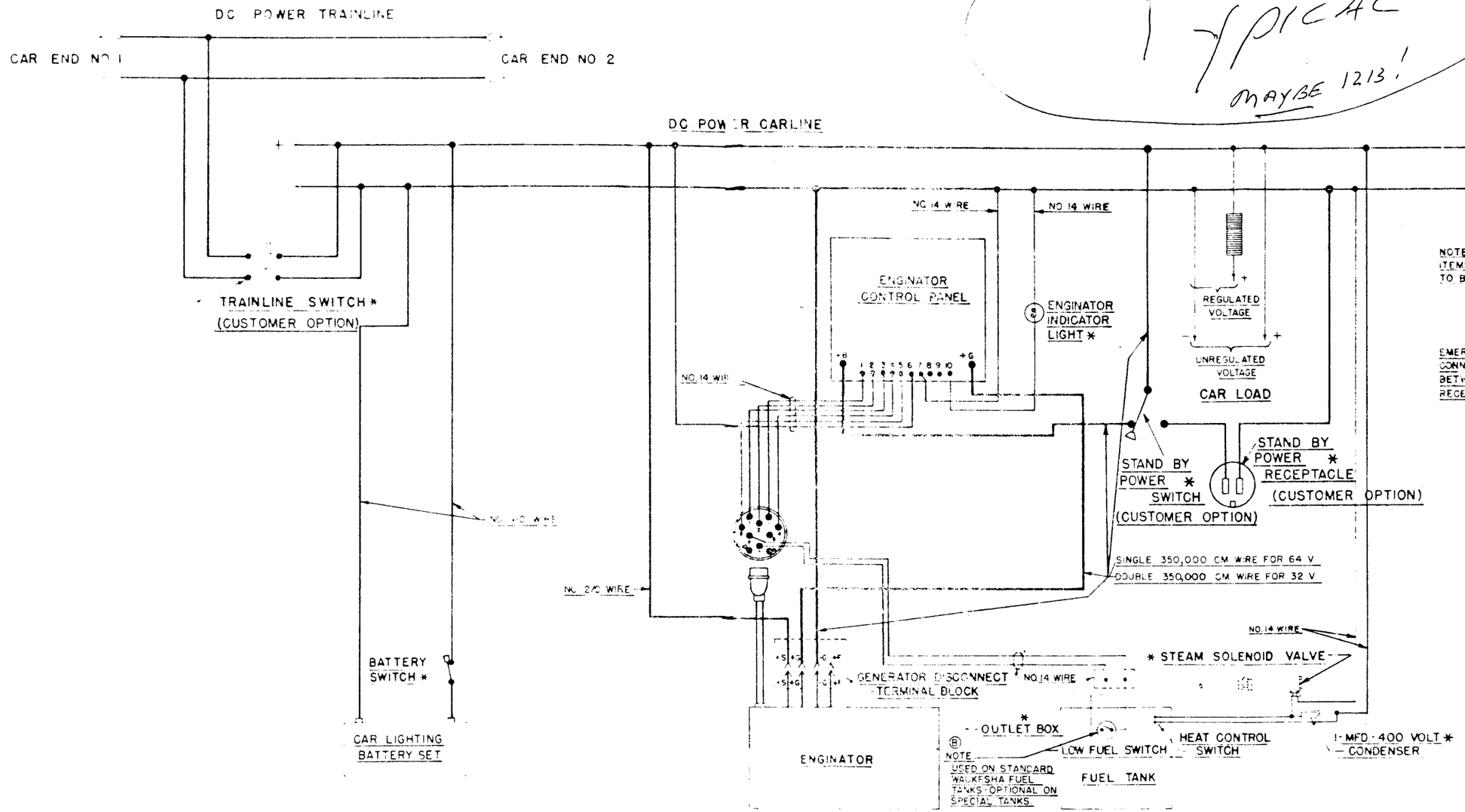


WATER LINES - HEAT EXCHANGER
FIG. 22



LUBRICATING OIL PIPING
FIG. 23

"Typical"
maybe 1213!



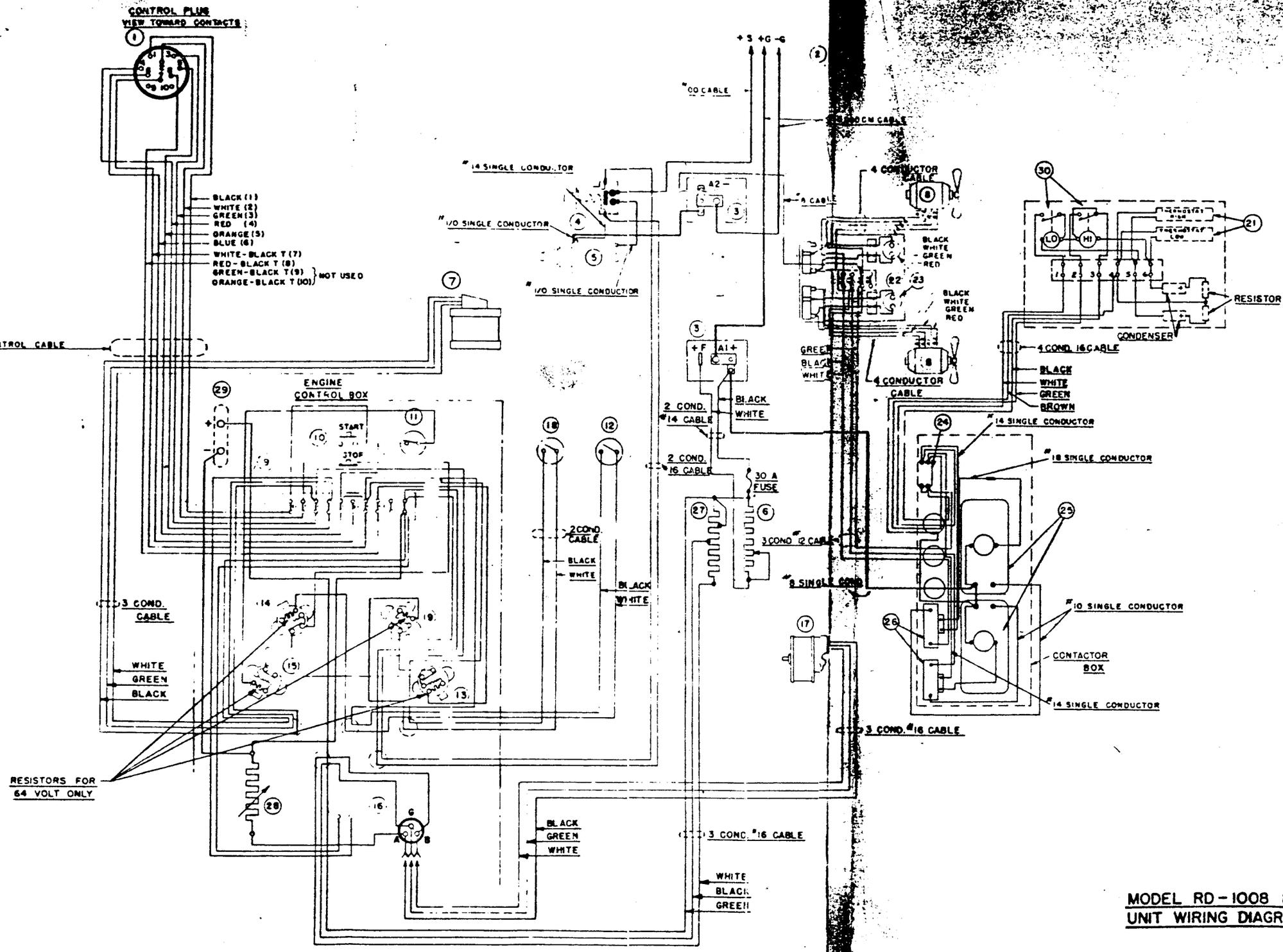
NOTE:
ITEMS MARKED WITH AN ASTERISK (*) ARE TO BE SUPPLIED BY CUSTOMER.

EMERGENCY SHUT-DOWN SWITCH MAY BE CONNECTED IN THE NO. 2 CONTROL LEAD BETWEEN CONTROL PANEL AND CONTROL RECEPTACLE — (CUSTOMERS OPTION).

CAR WIRING DIAGRAM FOR 32 & 64 VOLT D.C. DIESEL-ENGINATOR WITH MASTER CONTROL PANEL USING CAR LIGHTING TYPE BATTERIES.

MODELS RD-1008 & RD-1010

WAUKESHA MOTOR CO. | SK-1532



LEGEND

1. ENGINE CONTROL CABLE PLUG
2. GENERATOR & STARTER CABLE TH
3. GENERATOR TERMINALS
4. MAGNETIC STARTING SWITCH
5. STARTING MOTOR
6. FIELD RESISTOR
7. FUEL RACK SOLENOID
8. ENGINE RADIATOR FAN MOTORS
9. ENGINE CONTROL TERMINAL BOA
10. ENGINE "START-STOP" SWITCH
11. LUBE PRESSURE SWITCH
12. ENGINE HEAT SWITCH
13. LOW FUEL STOP SWITCH
14. ENGINE HEAT STOP SWITCH
15. LUBE PRESSURE STOP SWITCH
16. TIME METER
17. ELECTRONETIC GOVERNOR
18. GENERATOR HEAT SWITCH
19. GENERATOR HEAT STOP SWITCH
20. FAN SPEED CHANGING RESISTOR
21. RAD TEMP THERMOSTAT
22. FAN MOTOR TERMINAL STRIP
23. SPEED CONTROL THERMOSTAT
24. FAN MOTOR TEST SWITCH
25. FAN MOTOR CONTACTOR
26. THERMAL OVERLOAD RELAY
27. GOVERNOR RESISTOR
28. GOVERNOR RHEOSTAT
29. VOLTAGE TEST TERMINAL
30. THERMOSTAT RELAY

MODEL RD-1008 & RD-1010 D.C. ENGINATOR
UNIT WIRING DIAGRAM FOR 32 & 64 VOLT SYST

SPEC. D WAUKESHA MOTOR CO. SK-14

SECTION "F"

(A.C. - D.C.)

TESTING AND ADJUSTING OVERHAULED UNIT

GENERAL TEST DATA

After the Enginator Unit has been overhauled in the shop and each of the components of the unit has been gone over, it is recommended that the unit be tested as a complete unit. Provisions should be made for this test which would consist of a control station, starting batteries or line, and a load bank of sufficient capacity.

The newly overhauled Enginator should be operated for at least one to two hours at no load. During this run-in period, the necessary adjustments should be made, such as engine speed, voltage, radiator fan motor control, etc. The unit should be checked for fuel and lubricating oil and coolant leaks.

The Enginator load should be added in gradual steps so that after about four hours, full-rated load is being carried.

The following suggestions are offered on checking or testing the Enginator and may be used as a guide in establishing a procedure:

1. Use a Megger between ground and all plug contacts (minimum of 5 megohms).

2. To check the smoke limit stop setting of the fuel injector pump rack, remove the crankcase breather casting from front of the gear cover and adjust the manual shutoff lever set screw to provide a total fuel rack travel of 7/16" from the closed position. This measurement should be taken at the gear cover end of the fuel pump rack.

3. To set the overspeed governor, disconnect the Electronetic Governor plug and set the overspeed governor for a maximum engine speed of 2100 rpm at no load. This adjustment is made by increasing or decreasing the tension of the external governor spring.

4. The following steps should be followed in making adjustments and checking the Electronetic Governor:

    a. Read d.c. generator voltage at test terminals in inspector's control box.

    b. With voltage adjustment rheostat that is in inspector's control box set in its center (midway in its range) position, generator output voltage at no load on the unit should read approximately the normal operating voltage of the unit. This permits voltage

GENERAL TEST DATA (Continued)

adjustment both ways by the rheostat when in service. If the voltage adjustment rheostat is out of range, please refer to paragraph on Electronetic Governor, Section "E" in this manual.

5. The crankcase lubricating oil pressure should be 25 to 30 pounds with a warm engine. This pressure can be read at the lubricating oil pressure gauge in the unit control box.

6. The radiator fan motor controls should be checked. Both fan motors should operate when the fan control test switch is manually closed. This test switch is located immediately beneath the rubber diaphragm on the relay box at the generator end of the unit. Each fan motor is controlled by a thermostat switch located in the coolant line from the radiator. These switches are enclosed in the box immediately behind the engine air cleaner on the control box side of the unit. It is recommended that the fans be set to operate at different temperatures. The d.c. radiator fan motors, in addition to the intermittent operation, also have two speeds. The motor speed increase is controlled by thermostat switches located on the terminal box in the generator compartment. Whenever the ambient temperature above the generator within the generator compartment is above 175° F., the radiator fan motor speed is increased by these switches. When the contacts (normally closed) of these switches open at 175° F., more resistance is placed in the motor field circuit, resulting in an increased motor speed. The fan motor speed should be approximately 2800 rpm at low speed and 3200 rpm at high speed. Be sure that the manual reset thermal circuit breakers in the motor circuit operate. They should open when a locked rotor condition exists.

7. The fluid coupling slip is the difference between the armature rpm and the engine rpm. At full load, the slip should not exceed 100 rpm.

8. The total slip ring/commutator runout should not exceed .002". The brush holder springs should automatically exert approximately 2-1/2 pounds pressure on the brush. The gap between the brush holders and the slip ring/commutator should be adjusted to 1/8".

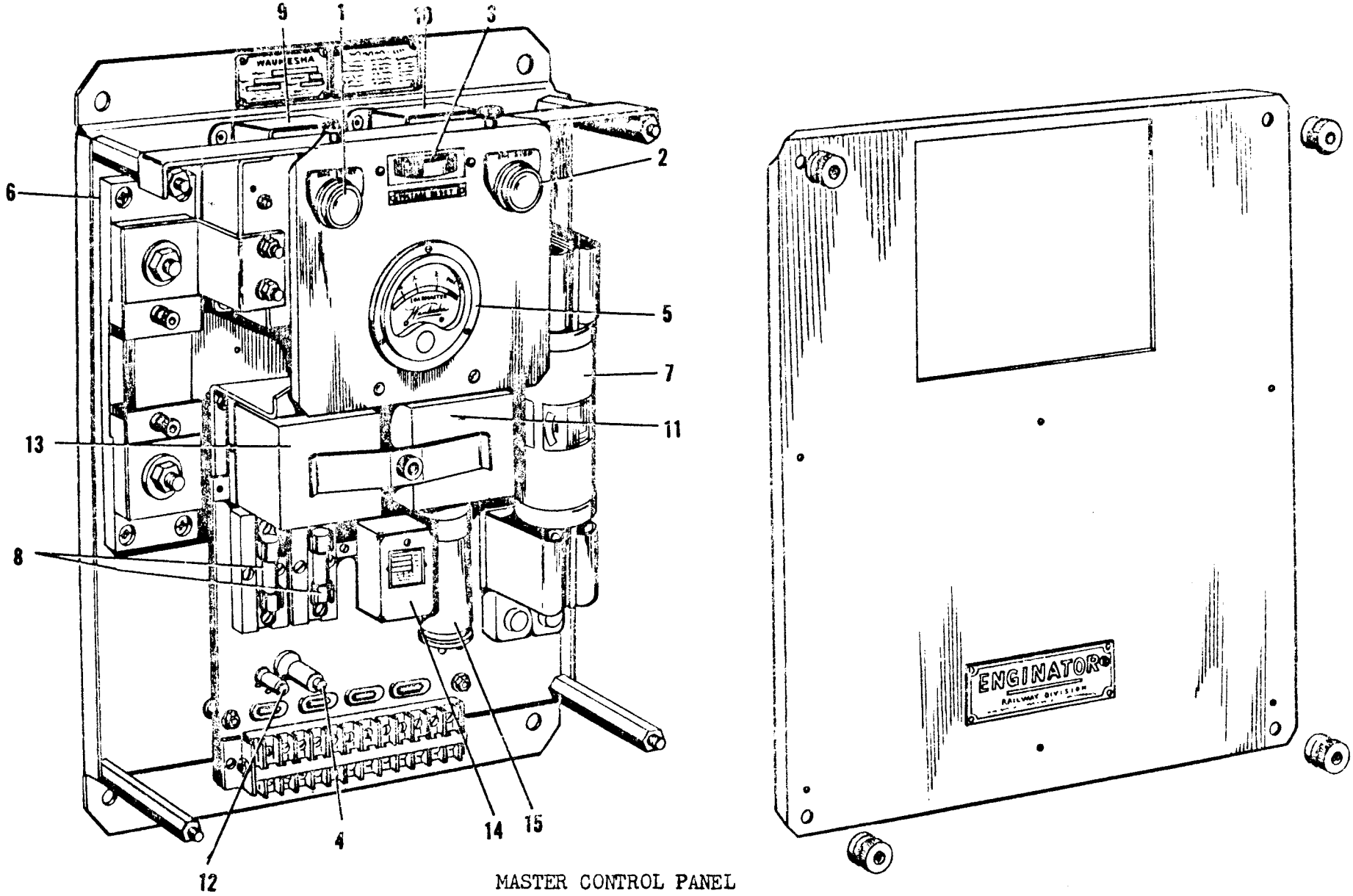
9. The cooling system pressure relief valve should maintain about 4 to 5 pounds pressure on the system. This valve should be bench tested with air.

10. Thoroughly blow out the generator end of the Enginator after test is completed.

11. After the final test, check the air gap between the armature and the field poles. Use a .044" feeler gauge, 3/8" to 1/2" wide, to check this gap.

ITEMS IDENTIFIED ON FIG. 100

ITEM NUMBER	NAME
1	Enginator Start Switch
2	Enginator Stop Switch
3	Overvoltage Stop Switch (OVSS)
4	Overvoltage Stop Switch Resistor
5	Load Meter
6	Load Meter Shunt
7	Generator Power Fuse (G+)
8	Control Circuit Fuses
9	Reverse Current Contactor
10	Reverse Current Relay (64-volt only)
11	Enginator Voltage Relay (EVR)
12	Enginator Voltage Relay Resistor
13	Control Circuit Relay (CCR)
14	Intermittent Cranking Switch (ICS)
15	Intermittent Cranking Switch Condenser



MASTER CONTROL PANEL

FIGURE 100

SECTION "H"

(D.C.)

MASTER CONTROL PANEL

GENERAL DESCRIPTION

The Master Control Panel is located in or near the car electrical locker. This panel is used for all D.C. Enginator installations and consists of all the necessary controls for manual operation of the Enginator. If automatic start and stop control of the Enginator is desired, an automatic sub-panel in conjunction with the Master Control Panel is required. See Section "J."

MASTER CONTROL PANEL COMPONENTS

The Master Control Panel consists of the following components: (Please refer to Figure 100. The paragraph numbers correspond to the figure item numbers.)

1. Enginator Start Switch

   This is the push button switch on the upper left side of the control panel (Item 1). It is a normally open, manually operated switch. The Enginator may be started from this control station in the car, or at the inspector's control box at the unit. All protective switches on the Enginator and both stop switches must be closed to provide continuity to the control circuit. When starting the Enginator from either station, always hold the start button in until the Enginator reaches operating speed and voltage.

2. Enginator Stop Switch

   This is a normally closed, manual control (Item 2) for stopping the Enginator from the car. It may be locked in the "open" position by a slight right turn of the knurled rim of the switch. It must be unlocked to permit the switch contacts to close for operation of the Enginator. There is also a similar stop switch at the unit.

3. Overvoltage Stop Switch (O.V.S.S.)

   This is a manual reset circuit breaker type switch (Item 3) located on the top front of the sub-panel of the Master Control Panel. The purpose of this overvoltage relay is to protect against prolonged periods of Enginator over-voltage. The switch "trips" on 64-volt systems at approximately 88 volts; and, on 32-volt systems, trips at approximately 44 volts. Both have a time delay (delayed opening) of 45 to 180 seconds to minimize false operation. The terminals marked "relay" are the heater element connections

MASTER CONTROL PANEL COMPONENTS (Continued)

3. Overvoltage Stop Switch (O.V.S.S.) (Continued)

and are connected across the Enginator output voltage. The terminals marked "line" and "load" are the switch connections and are connected in series with the positive side of the control circuit. When tripped open, the control circuit relay coil is de-energized. This opens the set of contacts that are in series with the "hold-in" coil of the fuel rack solenoid. The fuel is then shut off by the closing of the fuel pump rack, thus stopping the Enginator.

4. Overvoltage Stop Switch Resistor

This resistor (Item 4) is in series with the heater element of the overvoltage stop switch. Adjustment of the slide band will vary the Enginator overvoltage required to actuate the overvoltage trip switch. The rating of this resistor is 200 ohms, 10 watts for 32-volt systems; and 400 ohms, 25 watts for 64-volt systems.

5. Load Meter

This load meter (Item 5) is located in the front center of the sub-panel. It indicates the per cent of load on the Enginator from no load to full load.

6. Load Meter Shunt

The load meter shunt (Item 5) is in series with generator positive (G+) and indicates the millivolt drop to the load meter.

7. Generator Power Fuse (G+)

The large fuse (Item 7), located on the right-hand side of the panel is the generator load fuse. It protects the generator from excessive overload and external short circuits. The links are renewable. The 64-volt system generators are fused at 300 amperes and the 32-volt system generators at 600 amperes.

8. Control Circuit Fuses

The control circuit fuses (Item 8) are 10-ampere for both 64- and 32-volt systems. Both positive and negative sides of the control circuit are fused.

9. Reverse Current Contactor (R.C.C.)

The reverse current contactor (Item 9) is in series with the Enginator load (G+) and operates in conjunction with the reverse current relay (Item 10). It connects and disconnects the Enginator output to the car-line or load. Its contacts are normally open, closing when Enginator voltage exceeds line

MASTER CONTROL PANEL COMPONENTS (Continued)

9. Reverse Current Contactor (R.C.C.) (Continued)

voltage and opening when Enginator voltage is less than line voltage.

10. Reverse Current Relay (R.C.R.)

The reverse current relay (Item No. 10) is in series with the Enginator load (G+) and actuates the reverse current contactor to connect and disconnect the Enginator output to the car-line or load. It is used only on the 64-volt systems and acts as a pilot relay for the reverse current contactor. On 32-volt systems, the contactor and relay are included in one assembly. Its contact closes when the Enginator voltage exceeds line voltage and opens when the line voltage drops below the output voltage of the Enginator. It has normally open contacts.

11. Enginator Voltage Relay (E.V.R.)

Enginator voltage relay plugs in a polarized receptacle that provides quick removal or replacement. The Enginator voltage relay and the control circuit relay are interchangeable on panels of similar voltage. The coil of the Enginator voltage relay is connected across the generator output ahead of the reverse current contactor. The normally open set of contacts is in parallel with the "start" button switches and provides a holding circuit for the control circuit relay coil when the Enginator is running. The normally closed contacts of the Enginator voltage relay are in series with both the starting motor contactor coil and the "pull-in" coil of the fuel solenoid. When the Enginator voltage builds up and actuates the Enginator voltage relay, these normally closed contacts open, and de-energize these coils, and disengage the starting motor and fuel solenoid "pull-in" coil. The "hold-in" coil of the fuel solenoid remains energized and holds the fuel solenoid plunger, and, therefore, the fuel rack open.

12. Enginator Voltage Relay Resistor

This resistor (Item 12) is in series with the coil of the Enginator voltage relay. Adjustment of the slide band varies the pull-in or actuating point of the relay in relation to Enginator output voltage. The approximate setting of the slide band is one-half of the resistance in the circuit. The ratings of the resistors are 150 ohms, 25 watts for 32-volt systems; and 1500 ohms, 10 watts for 64-volt systems.

13. Control Circuit Relay (C.C.R.)

The control circuit relay plugs in a polarized receptacle and provides quick removal or replacement. The coil of the control circuit relay is across the starting battery in series with the "start" button switches. The normally open set of contacts is in series with the Enginator starting motor solenoid, fuel solenoid, and the time meter. The normally

MASTER CONTROL PANEL COMPONENTS (Continued)

13. Control Circuit Relay (C.C.R.) (Continued)

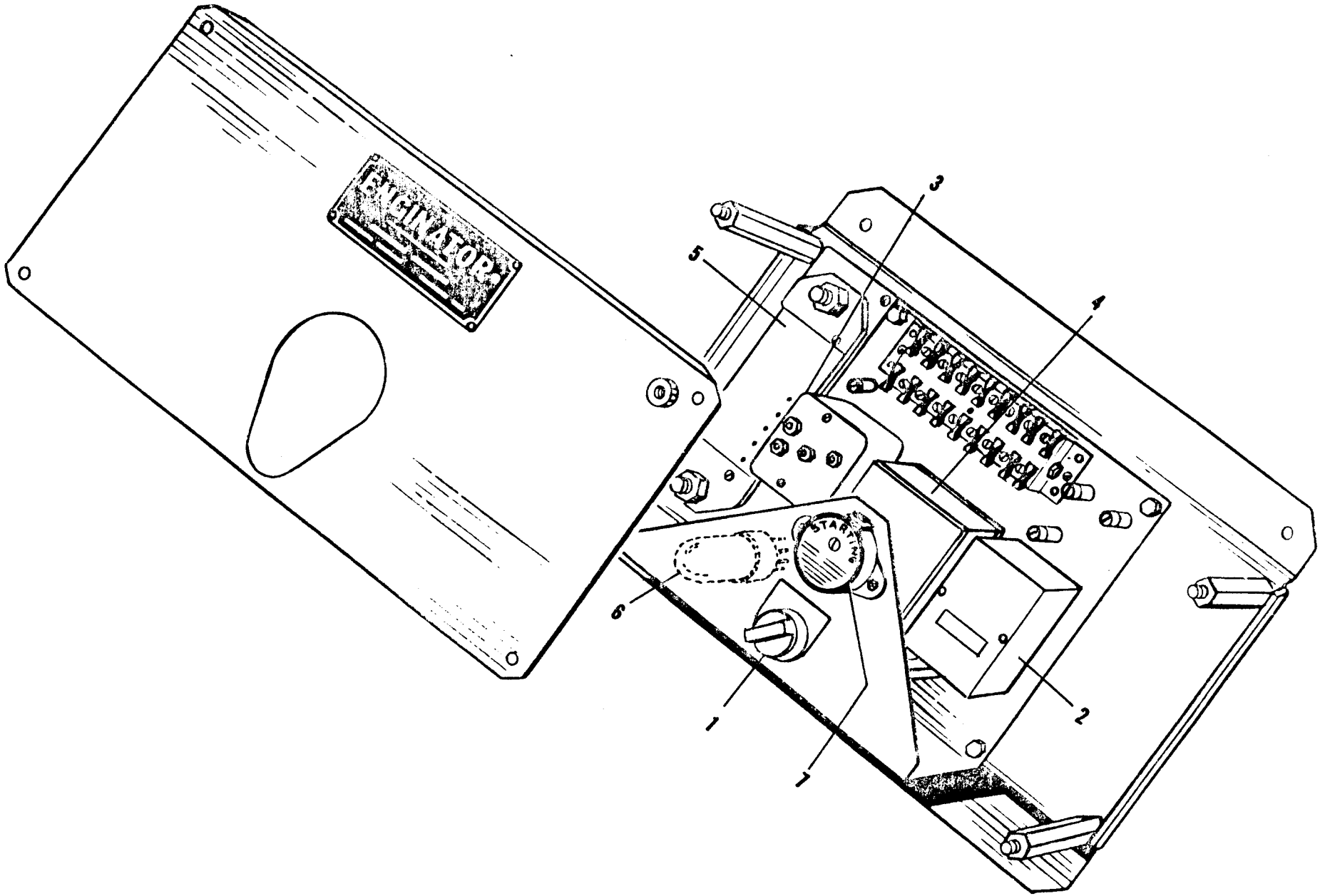
closed set of contacts is in parallel with the Enginator voltage relay coil. When the control circuit relay is de-energized, these normally closed contacts permit the Enginator voltage relay to drop out instantaneously, before the generator output voltage has dropped. The Enginator can, therefore, be stopped by a quick touch on the "stop" switch; otherwise, it would be necessary to hold the "stop" switch open until the generator voltage dropped below the drop-out point of the Enginator voltage relay coil.

14. Intermittent Cranking Switch (I.C.S.)

This switch is located on the right side of the back panel. The normally closed contacts are in series with the diesel starting motor solenoid switch and the "pull-in" coil of the fuel solenoid. The heater circuit of this switch is energized by the d.c. control circuit through the normally closed Enginator voltage relay contacts and the control circuit relay normally open contacts that are closed when cranking. The purpose of the intermittent cranking switch is to limit the cranking time of the starting motor, thereby preventing its overheating and abuse. When used with normal voltage, the approximate cranking time is twenty to thirty seconds (20-30), and the off period is approximately forty to fifty seconds (40-50). The intermittent switch is automatic closing or resetting.

15. Intermittent Cranking Switch Condenser

This is a polarized electrolytic condenser across the contacts of the intermittent cranking switch, the contacts of the control circuit relay and the contacts of the Enginator voltage relay. It provides protection to these contacts.



AUTOMATIC SUB-PANEL

FIGURE 101

ITEMS IDENTIFIED ON FIGURE 101

ITEM NUMBER	NAME
1	Selector Switch
2	Automatic Starting Timer
3	Minimum Load Relay (MLR)
4	Auxiliary Relay
5	Minimum Load Relay Shunt
6	Minimum Load Stop Switch (MLSS)
7	Crank Limit Switch (CLS)

SECTION "I"

(D.C.)

AUTOMATIC CONTROL PANEL

GENERAL DESCRIPTION

When automatic starting and stopping of the Diesel Enginator is required, it is necessary to use an Automatic Sub-Panel in addition to the Master Control Panel. A three-position selector switch provides four methods of control. The method of operation selected depends on the type of car service and the electrical system of the car. The Automatic Sub-Panel is usually located near the Master Control Panel in the car electric locker.

OPERATING CONTROL POSITIONS

There are three positions on the manually operated control selector switch. The Enginator will operate automatically as the prime power source, when the switch is in the "A" position. This control position is used when the Enginator parallels the axle generator, starting, running, and stopping automatically with load conditions.

In the "B" position, the Enginator acts as an auxiliary unit, supplementing axle generators whenever the axle generator is not generating. In the "C" position, the Enginator operates continuously, having only manual start and stop. Each position of the selector switch and method of control are described in the following paragraphs. Please refer to Figure 101, Automatic Sub-Panel for location of items referred to.

CONTROL SELECTOR SWITCH - POSITION "A"

When the D.C. Enginator is the sole, prime source of electrical energy on a car, the selector switch (Item No. 1) is set to the "A" position. This provides for full automatic starting and stopping. The Enginator shuts down when the car electrical load lowers to a predetermined setting of the minimum load stop switch (Item No. 6). The Enginator automatically starts again after a definite "off" time period, determined by the automatic starting timer (Item No. 2), which is adjustable to meet car electrical conditions.

POSITION "A" WITH "AA" TYPE OPERATION

When the D.C. Enginator is required to supplement an axle generator on cars having large electrical loads, the selector switch is set at the "A" position. The Enginator voltage is usually adjusted one to two volts lower than the axle generator. Therefore, the Enginator can parallel the axle generator and will carry the electrical load that is in excess of the actual output of the axle generator. The Enginator automatically starts and stops as described under POSITION "A."

CONTROL SELECTOR SWITCH - POSITION "B"

If the D.C. Enginator is required to carry the car electrical load when the axle generator is not operating (R.C.R. open), the control selector switch should be set at the "B" position. The Enginator then acts as a stand-by power source when the train is standing still or when the axle generator fails to reach the cut-in speed. The Diesel Enginator control circuit is in series with the auxiliary contacts (N.C. back contact) of the reverse current relay of the axle generator. The Enginator will operate only when the axle generator is not generating.

CONTROL SELECTOR SWITCH - POSITION "C"

When it is necessary to operate the Enginator continuously, the selector switch should be set on the "C" position. The Enginator is then manually started and stopped from either master control panel or at the Enginator control box.

AUTOMATIC CONTROL PANEL ADJUSTMENTS AND OPERATION

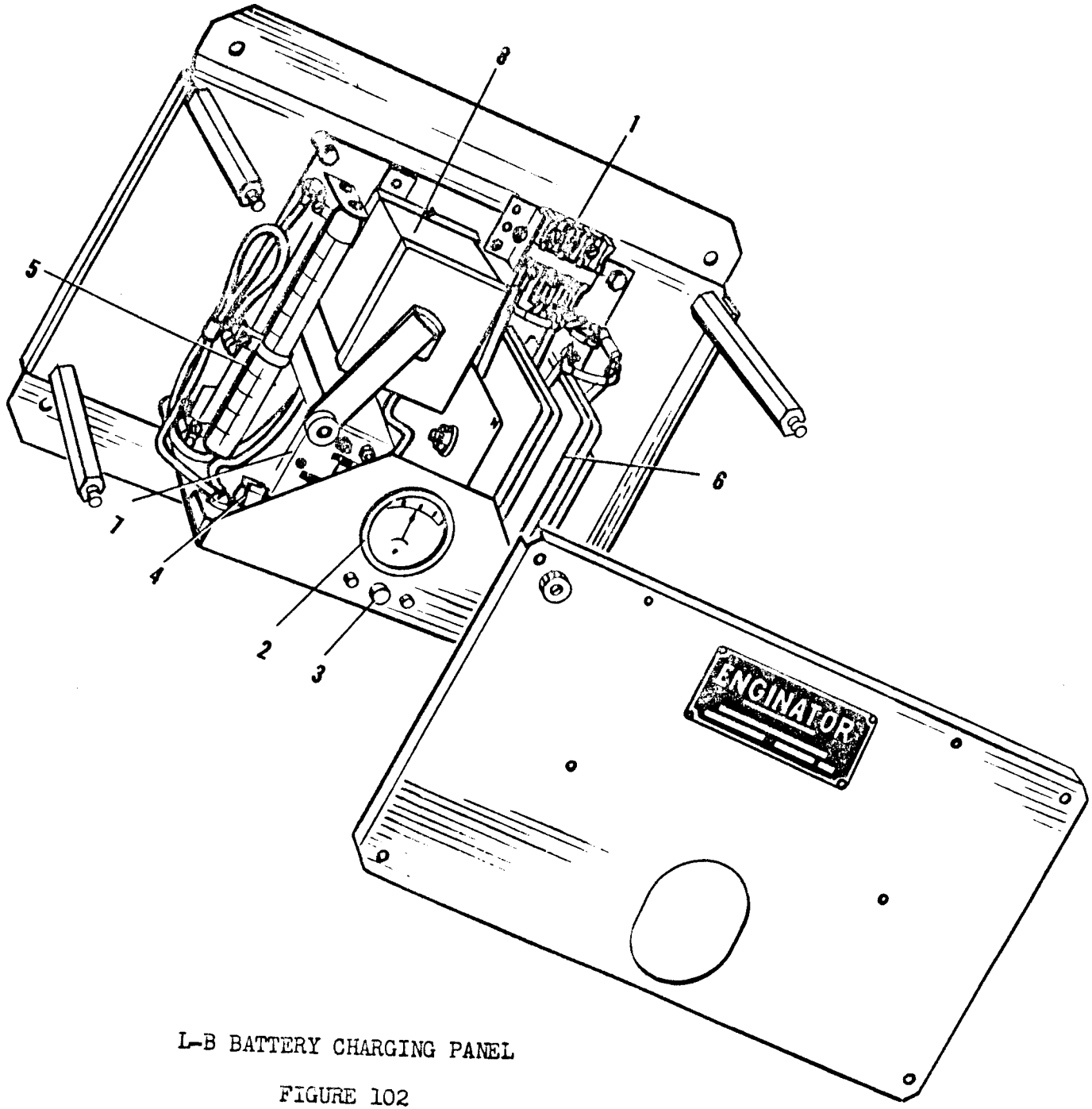
When the Automatic Control Panel is used in conjunction with the Master Control Panel for Enginator operation, the position of the selector switch, as previously described, dictates the operating sequence.

The automatic timer (Item No. 2) may be adjusted to control the "off" period from six to sixty minutes. This adjustment is made by moving the time adjusting hand screw as indicated on the scale within the removable cover.

The Minimum Load Stop Switch (Item No. 6) is actuated by the minimum load relay (Item No. 3). The coil of the minimum load relay is voltage sensitive to the voltage drop across the minimum load shunt (Item No. 5). This load shunt is in series with the "load" or Enginator output. The minimum load relay stops the Enginator when the voltage drop across the shunt is below the drop-out point of the relay coil.

The shut-down or stopping point of the Enginator, as determined by the amount of "load" or Enginator output, is controlled by the adjustment or position of the minimum load relay coil connections to the load shunt. Connecting or adjusting these leads farther apart will keep the Enginator operating or running with less "load," resulting in longer running periods. Therefore, connecting these leads closer together will stop the Enginator while still operating with comparatively more load or Enginator output. The finish rate of the batteries, plus the minimum connected car load, should be considered when adjusting the drop-out point of the minimum load relay.

The Enginator is protected against excessive cranking by the crank limit switch (CLS), Item No. 7. This is a manual reset thermal trip switch in series with the Enginator control circuit.



L-B BATTERY CHARGING PANEL

FIGURE 102

ITEMS IDENTIFIED ON FIGURE 102

ITEM NUMBER	NAME
1	Terminal Block
2	Ammeter
3	Test Switch
4	Fuse
5	Current Limiting Resistors
6	Blocking Rectifier
7	Battery Voltage Relay
8	Battery Charging Relay

SECTION "J"

(D.C.)

BATTERY CHARGING PANEL

INTRODUCTION

On cars using continuous operation Diesel Enginator Systems, conventional car lighting batteries are not used. Standard automotive batteries in series of 30 or 60 volts are used for Enginator starting and system controls only. These small batteries are automatically charged by an automatic battery charging panel. The battery charging panel increases or decreases the rate of charge to the battery, according to the battery state of charge. Operating valves and charging rates are adjustable.

OPERATION

Please see Figure No. 102 for location of item numbers referred to in this section. The ammeter (Item No. 2) indicates the amount of current (charge) the battery is receiving. The charging panel has two charging rates: a high and a low rate. The battery condition determines which rate is in operation. A push button test switch (Item No. 3), located directly below the ammeter, is used to check the operation of the panel. Pressing this test switch will put the charging panel on "high" charging rate. If the state of charge of the battery is up, the charging rate will drop to the low rate as soon as the test push button is released.

The battery charging panel is connected to the car wiring at the terminal block (Item No. 1). The starting battery positive (+) and battery negative (-) connect to terminals B+ and B-, respectively. The car line positive (Enginator voltage) connects to the G+ terminal of the panel. From G+, this circuit in the panel goes to the protective fuse (Item No. 4). A 30-ampere fuse is used on 32-volt systems, and a 15-ampere fuse on 64-volt systems. Next in the circuit are the current limiting resistors (Item No. 5). These resistors may be adjusted to control the amount of current on the "high" charge rate to meet the battery requirements. The circuit then continues through the series ammeter (Item No. 2). The blocking rectifier (Item No. 6) is next in the circuit. This acts as a reverse current relay and prevents a current reverse or feedback from the battery when the Enginator is shut off. From the blocking rectifier, the circuit connects to the terminal block at positive battery (B+).

Connected across the battery terminals on the panel is the Battery Voltage Relay (BVR), Item No. 7. This relay, being sensitive to the battery voltage, controls the operation of the charging rate, depending on the state of charge of the battery. Being connected across the battery, there is voltage across the coil of the "BVR" at all times. At approximately 31 volts (on a 32-volt system) and 62 volts (on a 64-volt system), the armature or plunger of the BVR "drops out," opening its contacts. The opening of the BVR relay contacts de-energizesthe coil of the Battery Charging Relay (BCR), Item No. 8, changing the charging rate from "low" to "high." The "BCR" has two sets of normally-closed contacts. One set of contacts parallels part

OPERATION (Continued)

of the current limiting resistor when the battery is to be charged at the "high" rate. The other BCR contact parallels the discharge limiting resistor (low rheostat) and cuts it in and out of the battery voltage relay (BVR) coil circuit. Increasing the resistance on the "low" rheostat raises the operating point of the BVR relay coil in respect to the battery voltage, so it will "drop out" and open its contacts at a higher battery voltage, changing the charging rate from "low" to "high." Increasing the "high" rheostat resistance will cause the battery charging rate to change from "high" rate to "low" rate, when the battery voltage and gravity is relatively higher. By the same means, decreasing the resistance on the "low" rheostat will permit the battery condition to be comparatively lower before the rate of charging changes from "low" to "high."

Decreasing the resistance of the "high" rheostat will cause the "high" rate to drop to "low" rate, when the battery voltage and state of charge are comparatively lower. The increase of resistance of the "high" rheostat adds to the resistance of the "low" rheostat, as they are both in series with the BVR coil when the BCR contacts are open while in the "low" charge rate position. Therefore, if the starting battery gravity is not being maintained high enough, the "high" rheostat resistance should be increased. By the same token, if the battery is using more than the normal amount of water, the resistance in the "high" rheostat should be decreased.

To summarize the operation and adjustment of the rheostats, use the "high" rheostat to control or adjust the "high" to "low" charge. Use the "low" rheostat to control or adjust the "low" to "high" charge rate change.

MAINTENANCE

Visual inspection should be made periodically of the charging panel, to insure all electrical connections are tight and secure. The battery record or chart will determine if the charging rates are correctly balanced. When it is necessary to make adjustments in the charging rates, be sure to determine the connected loads to the battery under the various operating conditions. For example, a certain part of the car heating or cooling control may offer an intermittent load, which would have a direct effect on determining the finish or low charging rate of the charging panel.

ENGINATOR SPECIFICATIONS

Engine Model	190-DLGR
Displacement	265 Cu. In.
Cylinders	6
Bore	3-3/4 In.
Stroke	4 In.
Compression Ratio	16 to 1
Cycle	Four Stroke Cycle
Horsepower	60
Firing Order	1, 5, 3, 6, 2, 4
Valve Clearance, Cold	Intake .010 Exhaust .020
Injection Pump Timing	22° B.T.D.C.
Injection Pressure (Fuel Oil)	1500 lbs.
Transfer Pump Pressure (Fuel Oil)	6 to 9 lbs.
Lubricating Oil Pressure	20 to 30 lbs.
Lubricating Oil Capacity (Filters and Crankcase)	22 quarts
Lubricating Oil Recommended (Engine)	SAE-30, Heavy-Duty, Supplement No. 1
Fluid Drive Coupling Lubricant	Same as Engine
Fluid Drive Coupling Lubricant Capacity	11 lbs. 13 ozs.
Coolant Capacity	48 quarts
Coolant System Pressure	7 lbs.
Unit Weight — A. C. Enginator	3931 lbs.
Unit Weight — D. C. Enginator	3689 lbs.

Enginator rated Capacity - (A.C.) - Gross 33.75 KVA, PF. 0.9—30.4 KW
Net 31.25 KVA, PF. 0.9—28.1 KW
Gross and net differential of approximately 2 KW required for radiator fans, excitation and battery charging.
Rated voltage 240.

ENGINATOR SPECIFICATIONS (Continued)

Enginator Rated Capacity - (D.C.) - Gross 27 KW at max. speed -- net 25 KW
Gross 17 KW at min. speed -- net 15 KW
Gross and net differential of approximately 2 KW required for radiator fans, battery charging. Rated voltage, 40, 80 and 140.

Voltage (A.C.) (Adjustable)..... 220

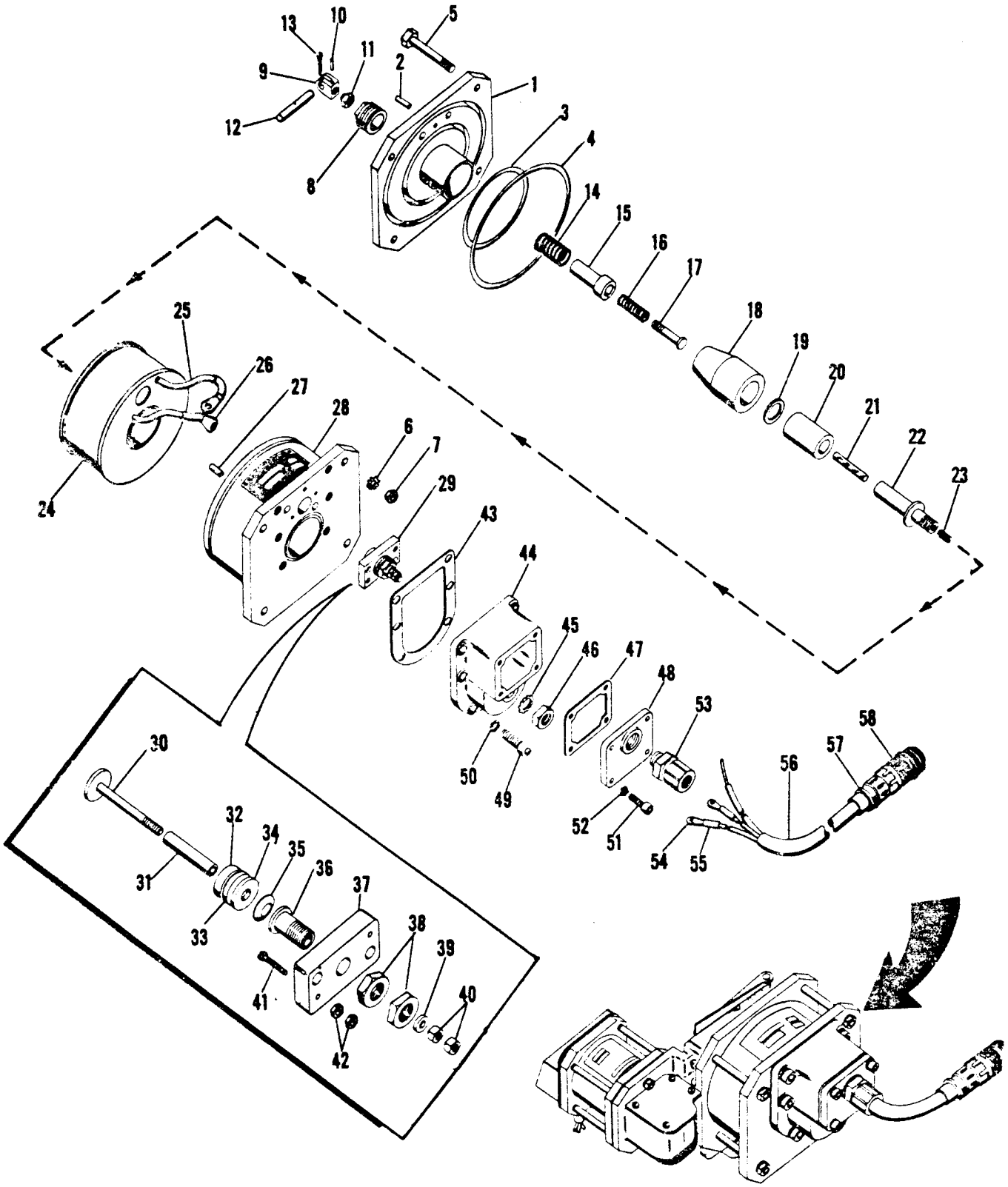
Phase 3

Cycles 60

Control and Excitation (Volts) - Either ..... 32 or 64

Brushes 6

Brush Spring Tension ..... 2-1/4 lbs.



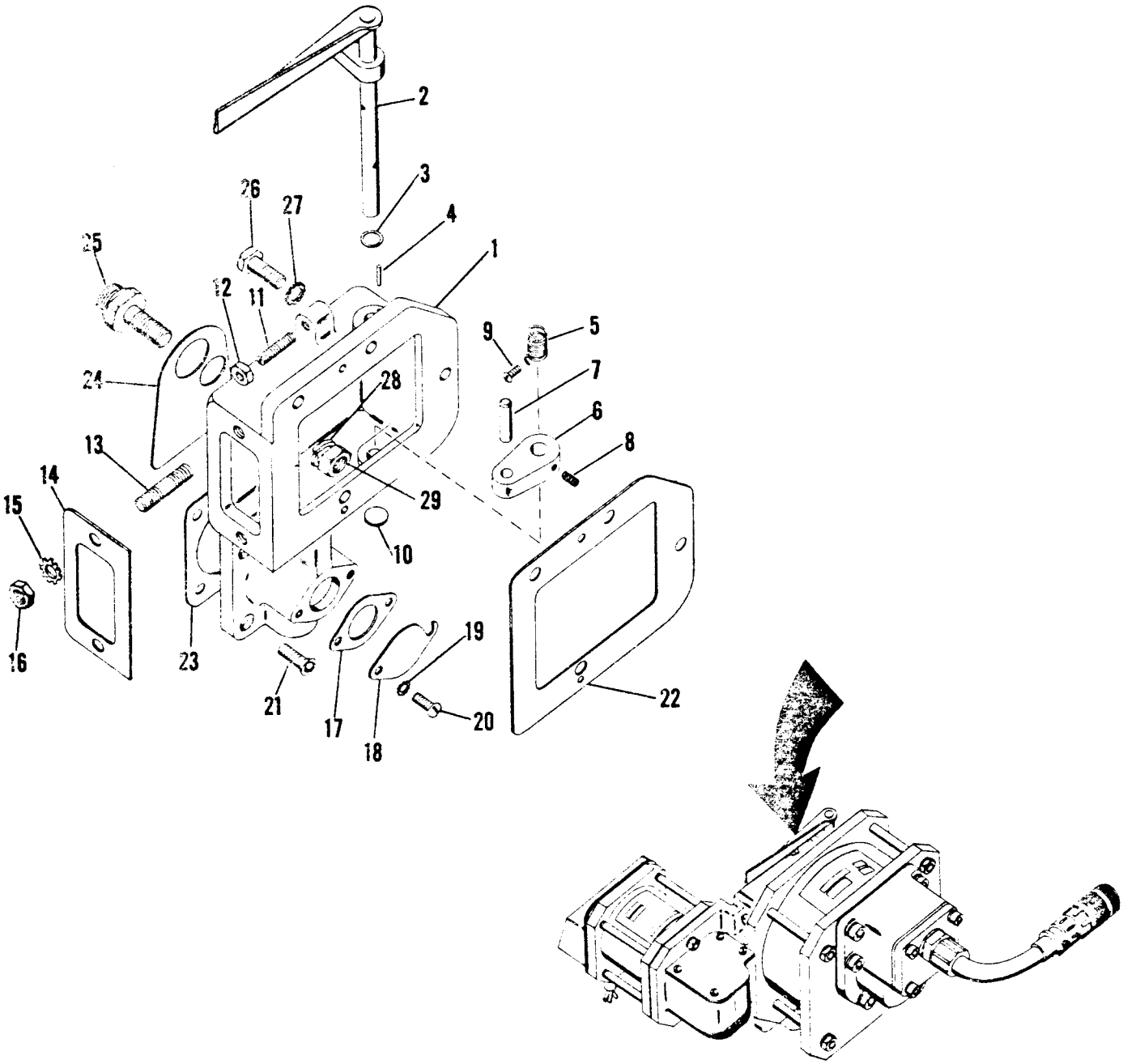
ELECTRONETIC GOVERNOR
FIG. 15

ELECTROSTATIC GOVERNOR

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64 Volt DC
	A-952[illegible]	Electronetic Governor Solenoid Assembly				
	C-952[illegible]	Electronetic Governor Solenoid Assembly				
1	A-952[illegible]	End Plate Assembly Front	1	1	1	1
2	B-6202	Dowel	2	2	2	2
3	74909-A	"O" Ring	1	1	1	1
4	951054-H	"O" Ring	1	1	1	1
5	20602	Hex Head Cap Screw	4	4	4	4
6	20631	Shakeproof Lock Washer	4	4	4	4
7	20632	Hex Nut	4	4	4	4
8	952475	Spring Adjusting Bushing	1	1	1	1
9	952469	Yoke	1	1	1	1
10	26532	Roll Pin	1	1	1	1
11	952[illegible]-A	Elastic Stop Nut	1	1	1	1
12	9[illegible]	Pump Rack Pin	1	1	1	1
13	21561	Cotter Pin	1	1	1	1
14	95[illegible]	Plunger Spring	1	1	1	1
15	9[illegible]	Plunger Spacing Sleeve	1	1	1	1
16	T-[illegible]	Spring	1	1	1	1
17	[illegible]	Yoke Rod	1	1	1	1
18	[illegible]	Solenoid Plunger	1	1	1	1
19	[illegible]	Washer	1	1	1	1
20	[illegible]	Ball Bearing	1	1	1	1
21	[illegible]	Felt Wick	1	1	1	1
22	[illegible]	Plunger Shaft	1	1	1	1
23	2[illegible]	Socket Head Set Screw	1	1	1	1
24	C-[illegible]	Solenoid Coil Assembly	1			
24	D-[illegible]	Solenoid Coil Assembly		1		
25	Y-[illegible]	Sleeve	1	1	1	1
26	[illegible]	Solderless Lug	1	1	1	1
27	[illegible]	Insulating Dowel	1	1	1	1
28	[illegible]	End Plate Assembly (Rear)	1	1	1	1
29	[illegible]	Thermistor Assembly	1	1	1	1
30	[illegible]	Thermistor Screw	1	1	1	1
31	[illegible]	Insulator Tubing	1	1	1	1
32	[illegible]	Thermistor	1	1	1	1
33	[illegible]	Thermistor	1	1	1	1
34	[illegible]	Copper Washer	1	1	1	1
35	[illegible]	Spring Washer	1	1	1	1
36	[illegible]	Screw	1	1	1	1
37	[illegible]	Terminal Block	1	1	1	1
38	[illegible]	Jam Nut	1	1	1	1
39	[illegible]	Insulating Washer	1	1	1	1
40	[illegible]	Hex Nut	1	1	1	1
41	[illegible]	#8 x Head Machine Screw	1	1	1	1
42	[illegible]	Hex Nut	1	1	1	1
43	[illegible]	Shaft Support Gasket	1	1	1	1
44	[illegible]	Plunger Shaft Support	1	1	1	1

ELECTRONETIC GOVERNOR

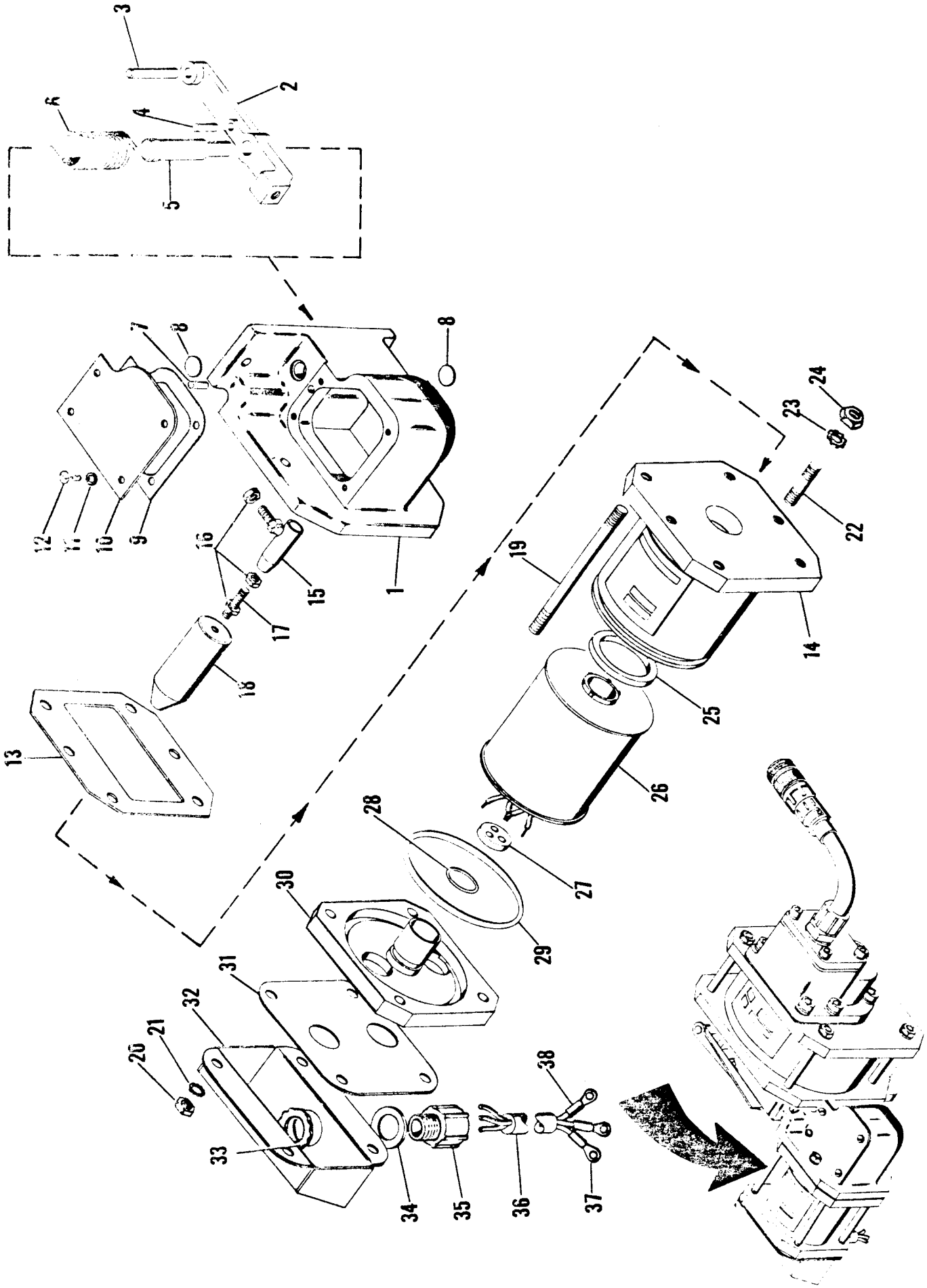
Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64
45	26405	Shakeproof Lock Washer	1	1	1	
46	21228	Jam Nut	1	1	1	
47	952665	Plunger Support Cover Gasket	1	1	1	
48	952664	Plunger Shaft Support Cover	1	1	1	
49	26430	Socket Head Cap Screw	6	6	6	
50	21629	Shakeproof Lock Washer	6	6	6	
51	26478	Socket Head Cap Screw	4	4	4	
52	21625	Shakeproof Lock Washer	4	4	4	
53	Y-6867-A	Cord Grip	1	1	1	
	A-952068	Plug and Cable Assembly	1	1	1	
54	Y-18984-D	Solderless Lug	1	1	1	
	Y-18984	Solderless Lug	2	2	2	
55	Y-19154	Terminal Sleeve	1	1	1	
56	OY-6778-P	Cable Assembly	1	1	1	
57	952069	Cable Clamp	1	1	1	
58	952068	Amphenol Plug				



ELECTRONETIC GOVERNOR
FIG. 15

ELECTRONETIC GOVERNOR

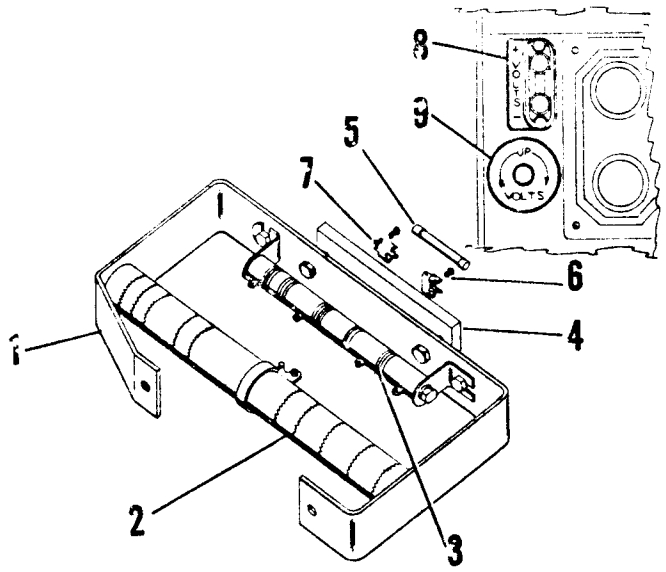
Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64
	A-952455	Governor Support Assembly	1	1	1	
1	952455-A	Governor Support	1	1	1	
2	A-952456	Emergency Stop Lever	1	1	1	
3	B-2336	Spring Anchor Pin	1	1	1	
4	118013-A	"O" Ring	1	1	1	
5	952013-A	Spring	1	1	1	
6	952459	Smoke Limit Lever	1	1	1	
7	952492	Stop Pin	1	1	1	
8	26553	Socket Head Set Screw	1	1	1	
9	26012	Rd. Head Machine Screw	1	1	1	
10	B-536	Expansion Plug	1	1	1	
11	26554	Headless Set Screw	1	1	1	
12	21262	Hex Machine Nut	2	2	2	
13	952751	Stud	1	1	1	
14	952486	Solenoid Support Gasket	2	2	2	
15	21631	Shakeproof Lock Washer	2	2	2	
16	21136	Hex Nut	1	1	1	
17	952490	Cover Plate Gasket	1	1	1	
18	952489	Cover Plate	2	2	2	
19	21625	Shakeproof Lock Washer	2	2	2	
20	21098	Rd. Head Machine Screw	4	4	4	
21	39077	Socket Flat Head Cap Screw	1	1	1	
22	952482	Gasket	1	1	1	
23	118986-A	Gasket	1	1	1	
24	B-9701	Gasket	1	1	1	
25	B-9561-B	Plug Adapter	4	4	4	
26	21308	Hex Head Cap Screw	4	4	4	
27	21631	Shakeproof Lock Washer				



ELECTRONETIC GOVERNOR
FIG. 15B

ELECTRONIC GOVERNOR

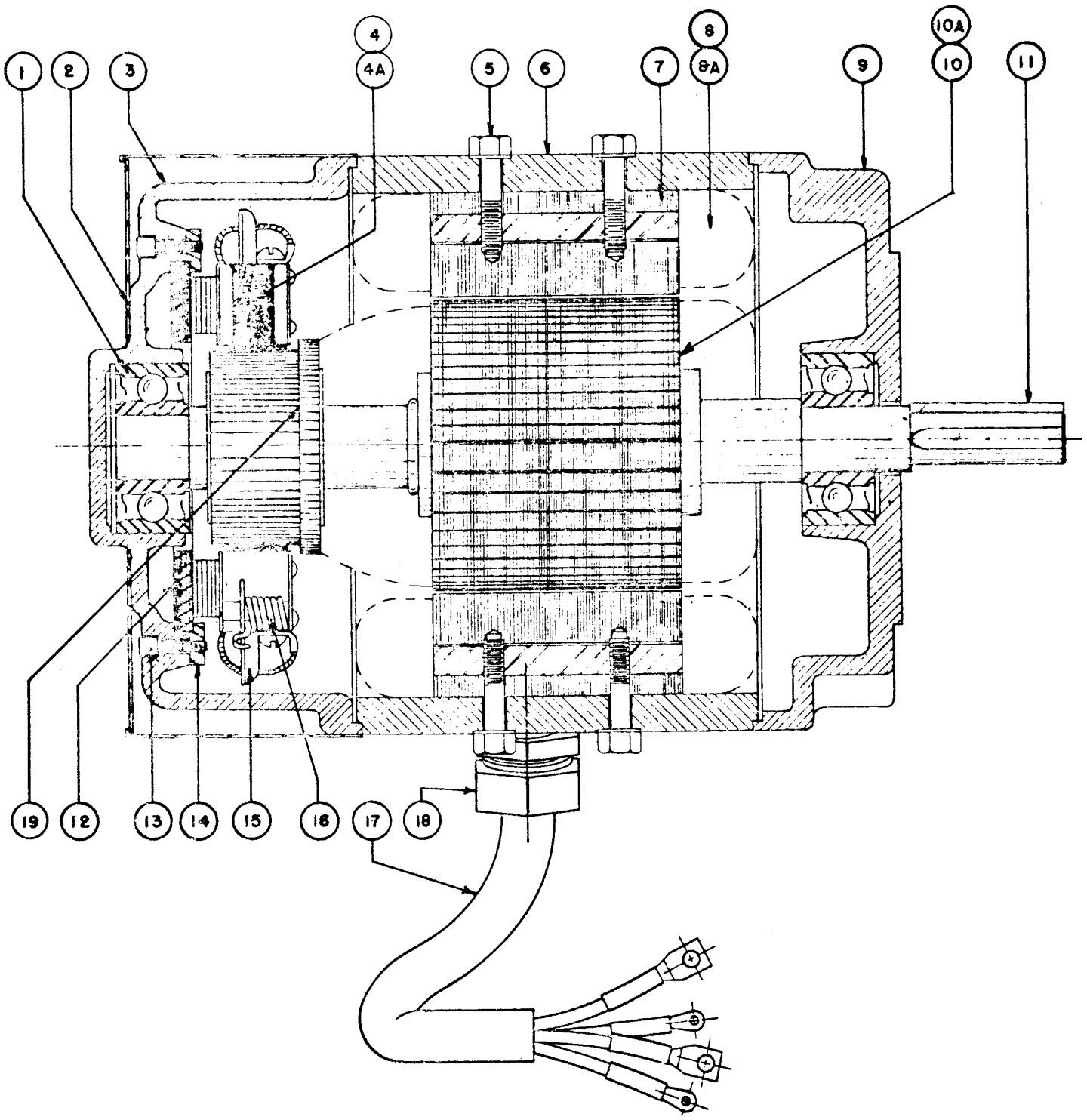
Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64
	A-952479	Shut-Off Solenoid Support Assembly	1	1	1	1
1	952479-A	Shut-Off Solenoid Support	1	1	1	1
2	952480	Shut-Off Lever	1	1	1	1
3	76880	Pin	1	1	1	1
4	B-4481	Pin	1	1	1	1
5	952485	Shut-Off Lever Shaft	1	1	1	1
6	952484	Shut-Off Lever Spring	1	1	1	1
7	117313	Spring Anchor Pin	1	1	1	1
8	B-536	Expansion Plug	2	2	2	2
9	952488	Solenoid Support Cover Gasket	1	1	1	1
10	952487	Solenoid Support Cover	1	1	1	1
11	21621	Shakeproof Lock Washer	4	4	4	4
12	26005	Rd. Head Machine Screw	4	4	4	4
13	952491	Solenoid Gasket	1	1	1	1
	D-952267	Solenoid Assembly				
		Solenoid Assembly				
14	C-952274	End and Name Plate Assembly	1	1	1	1
15	Y-18752	Ball Joint	1	1	1	1
16	21264	Hex Nut	3	3	3	3
17	Y-19148-A	Plunger Rod	1	1	1	1
18	952277	Solenoid Plunger	1	1	1	1
19	952273	Stud	4	4	4	4
20	21629	Shakeproof Lock Washer	4	4	4	4
21	21178	Hex Nut	4	4	4	4
22	952393	Stud	2	2	2	2
23	21629	Shakeproof Lock Washer	2	2	2	2
24	21178	Hex Nut	2	2	2	2
25	952280	Rubber Washer	1	1	1	1
26	952267	Solenoid Coil	1		1	
	952268	Solenoid Coil		1		1
27	952669	Wire Tie Plate Washer	1	1	1	1
28	951054-F	"O" Ring	1	1	1	1
29	951054-G	"O" Ring	1	1	1	1
30	A-952275	End Plate Assembly	1	1	1	1
31	952275	Junction Box Gasket	1	1	1	1
32	952292-A	Junction Box	1	1	1	1
33	Y-6250	Conduit Lock Nut	3	3	3	3
34	B-175	Copper Washer	3	3	3	3
35	Y-6867-B	Cord Grip	3	3	3	3
36	OY-6788-N	Cable Assembly	1	1	1	1
37	Y-18984-D	Solderless Lugs	3	3	3	3
38	Y-19154	Terminal Sleeve	3	3	3	3



RESISTOR ASSEMBLY
FOR
ELECTRONETIC GOVERNOR

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64 Volt DC
	A-952767	Resistor Assembly	1		1	
	C-952767	Resistor Assembly		1		1
1	952767	Mounting Bracket	1	1	1	1
2	952699	Resistor Field	1		1	
	952786	Resistor Field		1		1
3	952788	Resistor Governor	1		1	
	952787	Resistor Governor		1		1
	Y-5393	Cable Clamp Resistor Cam Box	1	1	1	1
	Y-6257	Cable Clamp Gen. Resistor	1	1	1	1
	21272	Hex Hd. Cap Screw	1	1	1	1
	21629	Shakeproof Lock Washer	1	1	1	1
	21174	Hex Nut	1	1	1	1
4	951901	Fuse Block	1	1	1	1
5	951912	Field Fuse	1		1	
	952785	Field Fuse		1		1
6	26051	Rd. Hd. Machine Screw	1	1	1	1
	21262	Shakeproof Lock Washer	1	1	1	1
	21625	Hex Nut	1	1	1	1
7	951755	Binding Post	1	1	1	1
	951763	Binding Post Name Plate	1	1	1	1
	952756	Rheostat (Voltage Control)	1		1	
	952789	Rheostat (Voltage Control)		1		1
	952754	Rheostat Name Plate	1	1	1	1

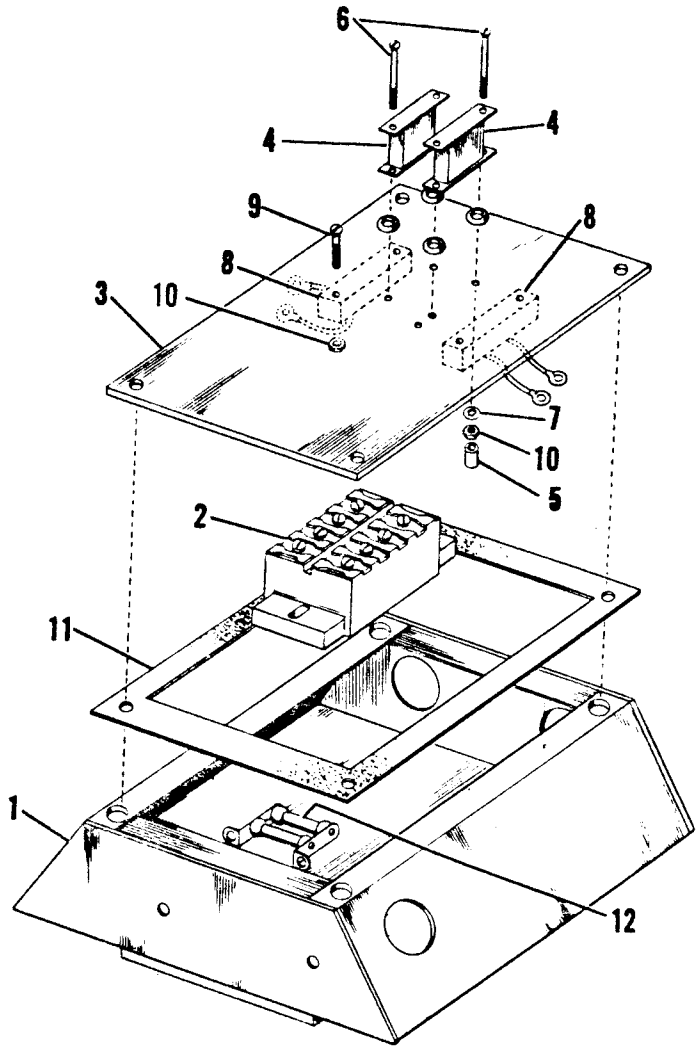
RESISTOR ASSEMBLY FOR ELECTRONETIC GOVERNOR
FIG. 15C



RADIATOR FAN MOTOR BREAKDOWN D.C.
FIG. 19

RADIATOR FAN MOTOR (DC)

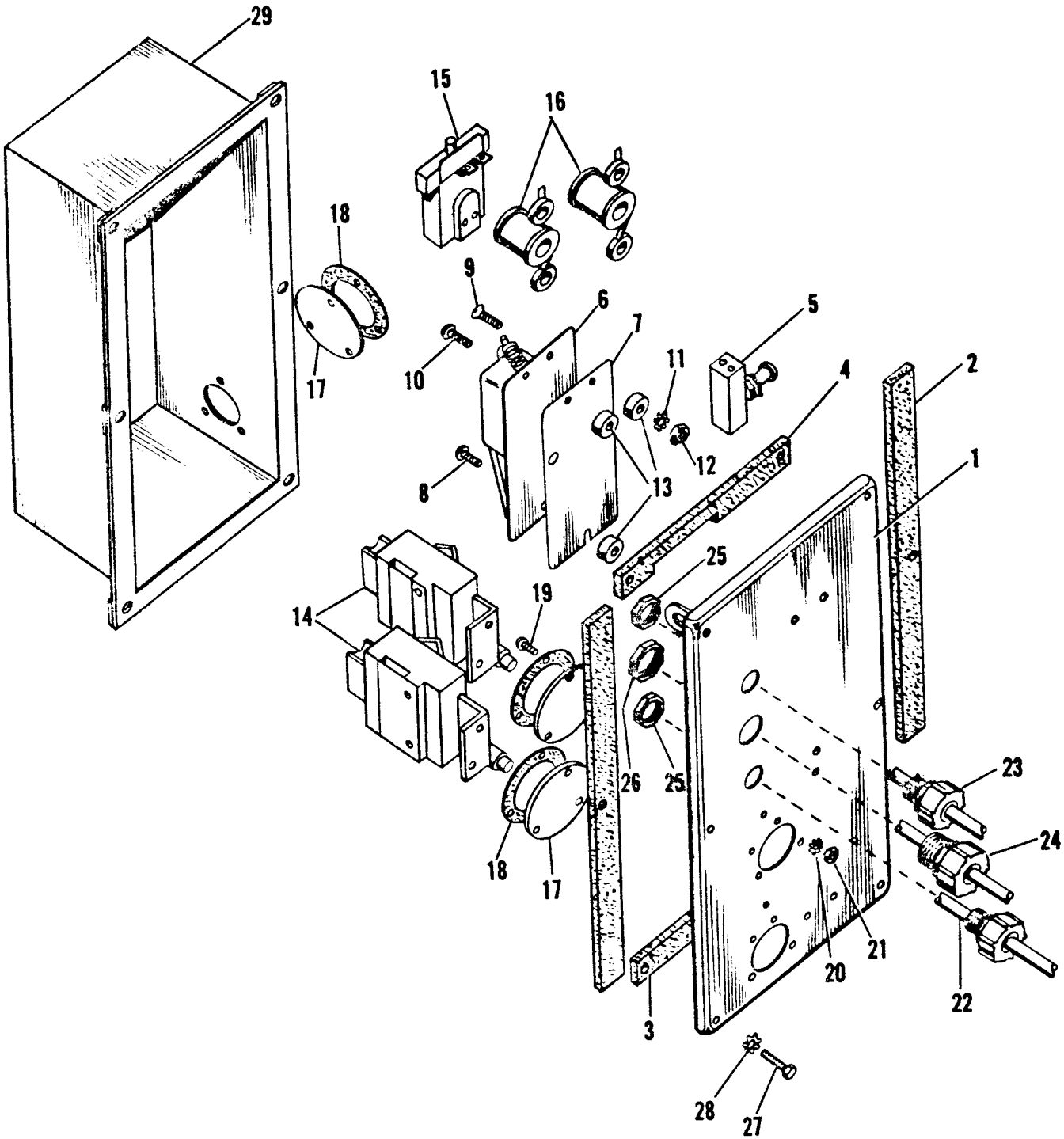
Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC
1	952501	Ball Bearing			2
2	952541	End Bell Shield and Band Assembly			1
3	952499	Commutator End Bell			1
4	952235	Brush			2
4A	952446	Brush			
5	21284	Hex Head Cap Screw			4
6	952497	Frame			1
7	952498	Pole			2
8	952495	Field Coil (Set)			1
8A	952537	Field Coil (Set)			
9	952500	Drive End Bell			1
10	952496	Armature Assembly			1
10A	952539	Armature Assembly			
11	952538	Shaft Key			1
12	952502	Brush Ring and Holder Assembly			1
13	26477	Socket Head Cap Screw			4
14	952540	Brush Ring Holder Clips			4
15	952518	Brush Tension Arm			2
16	952506	Brush Spring			2
17	A-952595	Motor Cable Assembly			1
18	Y-6867-E	Cord Grip			1
19	952513	Commutator			1



FAN MOTOR TERMINAL BOX
FIG. 30

TERMINAL BOX

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64
1	952138-A	Fan Motor Terminal Box			1	1
	X-7296-A	Cord Grip - Fan Motor Cabinet			3	3
	951049-D	Cord Grip			1	1
	Y-6223	Lock Nut			4	4
2	A-952150	Terminal Block			1	1
	26020	Rd. Head Machine Screw			2	2
	21625	Shakeproof Lock Washer			2	2
	21349	Hex Head Cap Screw (Box to Generator Frame)			2	2
	21633	Shakeproof Lock Washer (Box to Generator Frame)			2	2
3	952139-A	Terminal Box Cover			1	1
4	952545	Thermostat			2	2
5	952547	Grommet			4	4
6	26545	Machine Screw			4	4
7	21621	Shakeproof Lock Washer			8	8
8	952477-A	Terminal Strip			2	2
9	21817	Machine Screw			4	4
10	21258	Lock Nut			4	4
	951425-X	Wire			4	4
	952806	Solderless Lug			8	8
11	952140	Cover Gasket			1	1
	21272	Hex Head Cap Screw			3	3
	21274	Hex Head Cap Screw			1	1
	21629	Shakeproof Lock Washer			4	4
	Y-5393	Cable Clamp			1	1
	952448	Resistor			1	
	952450	Resistor				1
	21673	Rd. Head Machine Screw			2	2
	21266	Hex Nut			2	2
	21627	Shakeproof Lock Washer			2	2
	21660	Rd. Head Machine Screw (Resistor)			6	6
	21258	Hex Nut (Resistor)			6	6
	21621	Shakeproof Lock Washer (Resistor)			6	6



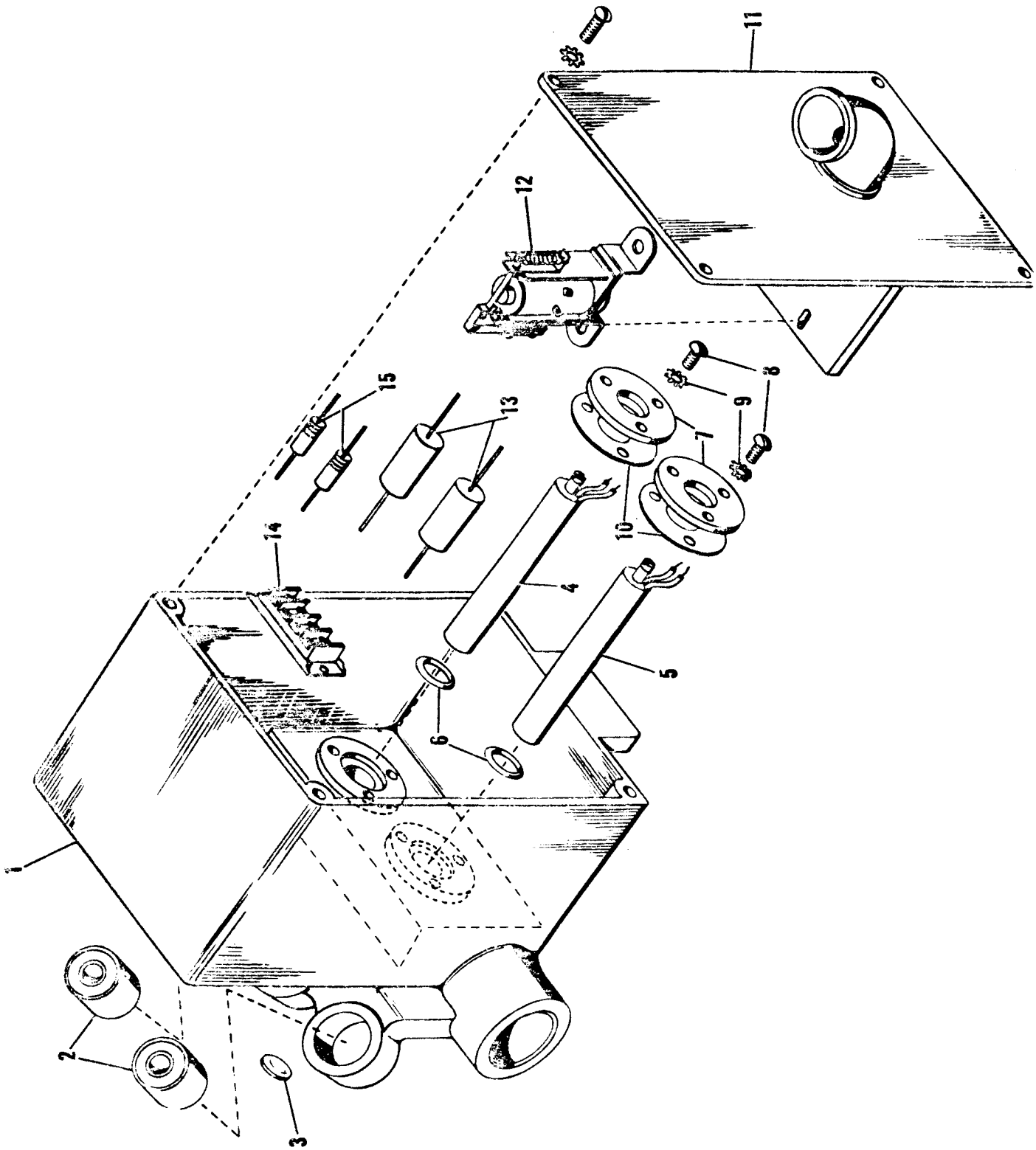
FAN MOTOR CONTACTOR BOX
FIG. 31

FAN MOTOR CONTACTOR BOX

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64
	C-952353-D	Fan Motor Contactor Box Assembly			1	
	D-952353-B	Fan Motor Contactor Box Assembly	1			
	E-952353-B	Fan Motor Contactor Box Assembly		1		
	G-952353	Fan Motor Contactor Box Assembly			1	
	A-952354-D	Contactor Box Cover Assembly				
	C-952354-C	Contactor Box Cover Assembly	1			
	A-952355-B	Contactor Box Cover Assembly		1		
	C-952355	Contactor Box Cover Assembly			1	
1	952354-A	Contactor Box Cover			1	
	952355	Contactor Box Cover	2	2	2	
2	952186-C	Cover Gasket	2	2	1	
3	952186-B	Cover Gasket			1	
4	952186-D	Cover Gasket	1	1	1	
5	952865	Push Button Switch			2	
6	Y-19152-A	Motor Relay	2			
	Y-19152-B	Motor Relay		2		
	952356	Magnetic Switch			1	
	952357	Magnetic Switch	8	8	3	
7	Y-19165	Relay Base Insulator			1	
8	21667	Rd. Head Machine Screw			1	
	26011	Rd. Head Machine Screw			1	
9	26550	Flat Head Machine Screw	8	8	6	
10	26010	Rd. Head Machine Screw	8	8	6	
	26101	Rd. Head Machine Screw			3	
11	21625	Shakeproof Lock Washer			2	
12	21262	Hex Nut			1	
13	950373	Spacer			1	
14	A-952421	Thermal Overload Relay Assembly			1	
	C-952421	Thermal Overload Relay Assembly			1	
	A-952423	Overload Relay Bracket Assembly			2	
	952421	Thermal Overload Relay			2	
	952422	Heater Element			1	
	952427	Heater Element			1	
	21094	Rd. Head Machine Screw			2	
	21604	Shakeproof Lock Washer			2	
	21260	Hex Machine Nut			2	
	952426	Reset Lever			1	
	21878	Washer			2	
	21058	Cotter Pin			1	
	952420	Spring			1	
	952425	Reset Plunger			1	
	21058	Cotter Pin			1	

FAN MOTOR CONTACTOR BOX

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64 Volt DC
15	952358	Circuit Breaker	2	2		
16	952359	Heater Element	2	2		
	26306	Rd. Head Machine Screw	2	2		
	21258	Hex Nut	2	2		
	21621	Shakeproof Lock Washer	2	2		
17	950027	Diaphragm			2	2
18	950028	Diaphragm Ring			2	2
19	21098	Rd. Head Machine Screw			6	6
20	21625	Shakeproof Lock Washer			6	6
21	21262	Hex Nut			6	6
22	Y-6867-A	Cord Grip	4	4	1	2
23	Y-6867-B	Cord Grip			1	1
24	Y-7296-A	Cord Grip			1	1
25	Y-6250	Lock Nut	4	4	2	2
26	Y-6223	Cord Grip			1	1
	952523	Bus Bar			1	1
27	21274	Hex Head Cap Screw	6	6	6	6
28	21629	Shakeproof Lock Washer	6	6	6	6
	A-952353	Contactor Box Assembly	1	1	1	1

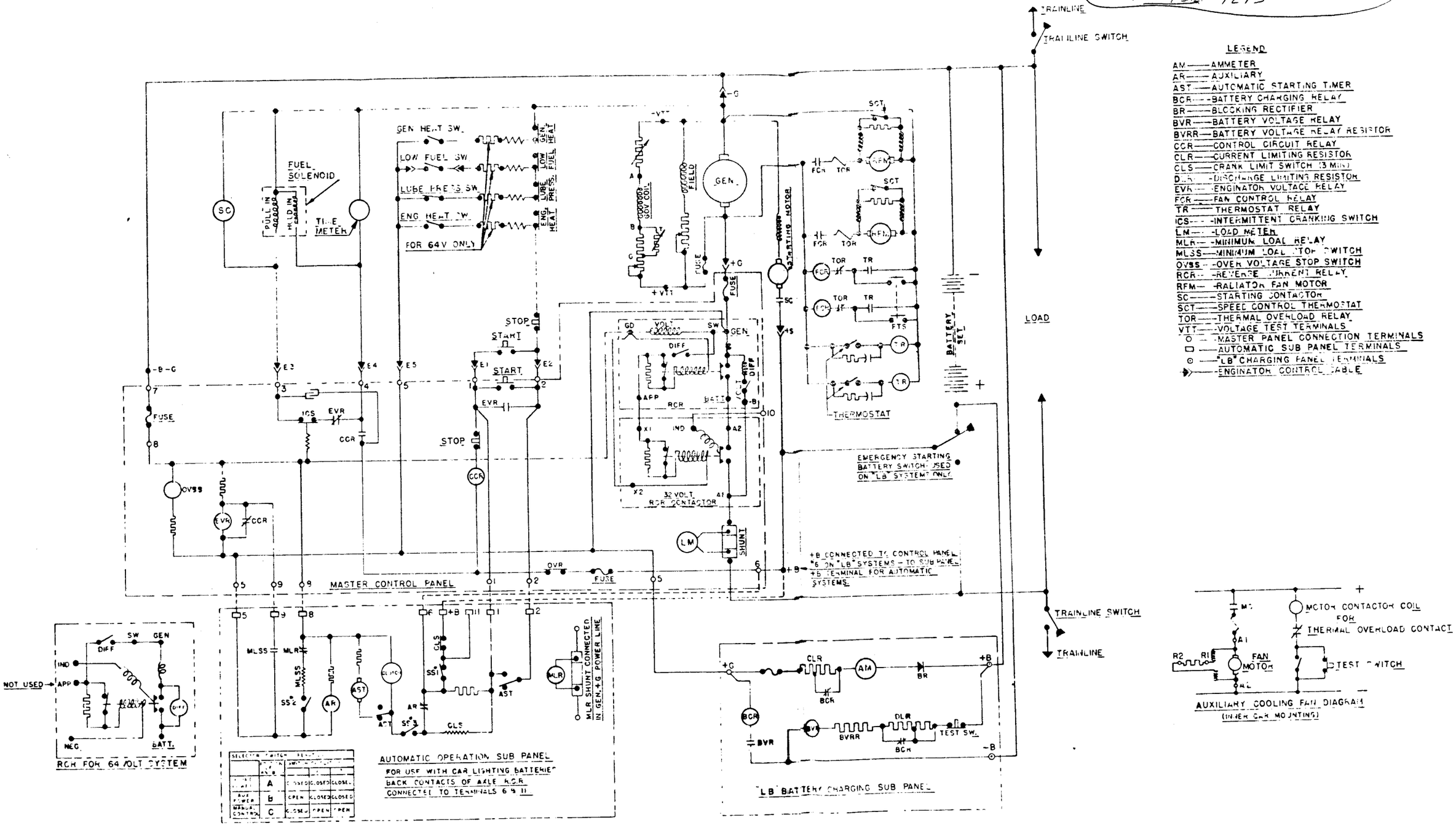


FAN MOTOR SWITCH ASSEMBLY
FIG. 32

FAN MOTOR SWITCH ASSEMBLY

Ref. No.	Part Number	Description	220 32 Volt AC	220 64 Volt AC	32 Volt DC	64 Volt DC
1	A-953018	Thermoswitch Housing Assembly	1	1	1	1
2	28014	Bushing	2	2	2	2
3	B-295-A	Expansion Plug	2	2	2	2
	26033	Hex Head Cap Screw	2	2	2	2
	78892-A	Plain Washer	4	4	4	4
	152452-A	Spacer	2	2	2	2
	21646	Shakeproof Lock Washer	2	2	2	2
	21174	Hex Nut	2	2	2	2
4	953083-B	Thermoswitch	1	1	1	1
5	953083-A	Thermoswitch	1	1	1	1
6	951054-E	"O" Ring	2	2	2	2
7	953084	Thermoswitch Retainer Ring	2	2	2	2
8	26045	Rd. Head Machine Screw	6	6	6	6
9	21625	Shakeproof Lock Washer	6	6	6	6
10	953076	Thermoswitch Gasket	2	2	2	2
11	C-953069	Thermoswitch Cover Assembly	1		1	
	D-953069	Thermoswitch Cover Assembly		1		1
	H-953069	Thermoswitch Housing Gasket	1	1	1	1
	953080	Relay	1		1	
	953087	Relay		1		1
	26005	Rd. Head Machine Screw	4	4	4	4
	21602	Shakeproof Lock Washer	4	4	4	4
13	953082	Capacitor	2		2	
	953088	Capacitor		2		2
	21101	Rd. Head Machine Screw	1	1	1	1
	21625	Shakeproof Lock Washer	1	1	1	1
14	951031-F	Terminal Block	1	1	1	1
	21817	Rd. Head Machine Screw	2	2	2	2
	21621	Shakeproof Lock Washer	2	2	2	2
15	953081	Resistor	2		2	
	953085	Resistor		2		2
	950035-E	Wire	1	1	1	1
	952806	Lug	6	6	6	6
	952805	Solderless Lug	2	2	2	2
	952295-C	Tubing	2	2	2	2

"TYPICAL"
MAYBE 1213



D.C. ENGINATOR UNIT LINE WIRING DIAGRAM
32-64 VOLT SYSTEM