Owners Manual

Cummins **Onan**

Performance you rely on.™

Generator Set

DFB (Spec A–F)

English – Original Instructions 6–2010 953–0301 (Issue 2)

OPERATORS MANUAL AND PARTS CATALOG

FOR

Onan®

ELECTRIC GENERATING PLANTS

DFB

SERIES

ONAN 2515 UNIVERSITY AVE. S.E. • MINNEAPOLIS, MINN. 55414

A DIVISION OF STUDEBAKER CORPORATION

IN CANADA: ONAN GENERATORS CANADA LTD., P. O. BOX 652, GUELPH, ONTARIO

953–301 *Price $1.00* 10AF67 Printed in U.S.A.

We mean it.....

.....and this certificate with the Onan electric plant you purchased proves we mean it! When this plant left our factory in Minneapolis it took with it our sincere assurance that it will produce exactly as stated on its nameplate.

The name of ONAN is synonymous with satisfactory performance, certified performance.

GENERAL INFORMATION

This instruction book contains information for the proper installation, operation, and maintenance of your equipment. We suggest that this book be kept handy so that it can be referred to when necessary.

This equipment is the result of proven engineering design, highest quality materials, and expert workmanship. Thorough inspection and testing assures you that this equipment will perform as expected.

If you wish to contact your dealer or the factory regarding this equipment, be sure to supply the complete MODEL and SPEC. NO., and the full serial number of the equipment as shown on the nameplate. This information is necessary to identify the equipment among the many basic and special optional types manufactured.

MANUFACTURER'S WARRANTY

The Manufacturer warrants, to the original user, that each product of its manufacture is free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to the Manufacturer's instructions.

Manufacturer's obligation under this warranty is limited to correcting without charge at its factory any part or parts thereof which shall be returned to its factory or one of its Authorized Service Stations, transportation charges prepaid, within one year after being put into service by the original user, and which upon examination shall disclose to the Manufacturer's satisfaction to have been originally defective. Correction of such defects by repair to, or supplying of replacements for defective parts, shall constitute fulfillment of all obligations to original user.

This warranty shall not apply to any of the Manufacturer's products which must be replaced because of normal wear, which have been subject to misuse, negligence or accident or which shall have been repaired or altered outside of the Manufacturer's factory unless authorized by the Manufacturer.

Manufacturer shall not be liable for loss, damage or expense directly or indirectly from the use of its product or from any other cause.

The above warranty supersedes and is in lieu of all other warranties, expressed or implied, and of all other liabilities or obligations on part of Manufacturer. No person, agent or dealer is authorized to give any warranties on behalf of the Manufacturer nor to assume for the Manufacturer any other liability in connection with any of its products unless made in writing and signed by an officer of the Manufacturer.

DATED August 1, 1963

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT

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The Onan generating plant of the DFB series is a complete unit consisting of a diesel type engine driving an alternating current generator, and such controls and accessories as are specified by the purchaser.

The electrical characteristics of the plant vary according to the particular model, and are noted on the Onan nameplate attached to the unit. The rated power is based on an .8 power factor load. When rated for standby service the plant is intended to serve as an emergency source of electric power, with operation confined to a few hundred hours per year. When the plant is used for standby service, optional controls for starting, load transfer, and stopping may be connected during installation. The plant is designed for normal starting in ambient temperatures of 50°F. or above. Special precautions must be taken if ambient temperatures are low. If it ever becomes necessary to contact a dealer or the factory regarding the plant, be sure to mention the complete Model and Spec. No., and the Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify the plant among the many types manufactured. Refer to the engine nameplate when requesting information from its manufacturer.

The generating plant is given a complete running test under various load conditions and is thoroughly checked before leaving the factory. Inspect the plant closely for any damage that might have occurred in shipment. Any such damage must be repaired before putting the plant in operation.

ENGINE

The engine is a Cummins basic model H-6 and is described in the Cummins manual. The specific engine used may have variations due to optional features of the generating plant, type of cooling, etc., specified by the plant purchaser. Basically, the engine is a 6 cylinder, water cooled, diesel (compression ignition) type. The cylinder bore is 4-7/8 inches, piston stroke 6 inches, and displacement is 672 cubic inches. The engine is rated 160 horsepower at 1800 rpm. The standard oil capacity is 7 U.S. gallons. A 12/24 volt battery system is used for energizing the starting and control circuits. Accessories, safety devices, etc. vary according to the model and purchaser options.

The standard engine cooling system (19.5 gallon water capacity) uses a radiator and pusher fan. Optional cooling systems use "city" or other pressure water supply. When the water supply is very alkaline or is otherwise unsuitable for circulating through the engine, a "heat exchanger" system is recommended. If the water supply can safely be used directly, a "mixing" stand pipe or tempering tank is usually used.

GENERATOR

Models ending with Spec. Letter A. - The generator consists of a 4 pole revolving field type alternator and a direct current generator exciter. The alternator field and the exciter armature are connected to

the engine flywheel and so turn at engine speed.

The exciter current is used to create the magnetic field in the alternator rotor. A separate voltage regulator controls the exciter current according to the demands of the alternator, thus keeping the ac output voltage stable under various load conditions Emergency manual rheostat voltage control is provided for in case of regulator failure.

Models ending with Spec. Letter B or later. - Beginning with models ending with spec. letter B or later, the generator consists of a 4 pole revolving field type alternator and a "static" (stationary) type exciter, with magnetic amplifier voltage regulation. The rotating field is attached to the engine flywheel and so turns at engine speed.

The static exciter - voltage regulator components are mounted on a metal frame attached to the outer end of the generator. The design provides for approximately 2% voltage regulation from no load to full load, with stable operating conditions established within 2 seconds after any change in the load. A rheostat control on the control panel of models ending with spec. letter C or later provides for plus or minus 5% adjustment of output voltage.

Because frequency of the output current is determined by the speed at which the alternator rotor turns, the 60 cycle plant must operate at approximately 1800 rpm and the 50 cycle plant at approximately 1500 rpm.

CONTROLS

The plant control box is mounted on the generator. It contains components for starting, controlling, and stopping the plant. Instruments to indicate engine and generator performance are flush mounted on the operator's panel of the control.

The engine is started through a run-stop switch, a fuel solenoid relay, 2 cycle cranking relays, a pilot relay, a series-parallel solenoid, and a starter motor. Cranking alternates in 10 second cycles until the engine starts or the cranking limiter opens. A start disconnect relay stops the cranking when the engine starts.

Engine performance is indicated by a water temperature gauge, a low oil pressure gauge, and a battery charge ammeter. The engine is protected from high water temperature, low oil pressure, and overspeed, all operating through an emergency latch relay. A latched relay is indicated by a red light on the control panel and by a protruding button which has to be manually reset. There is a terminal block in the control for connecting wires to a remote control switch. Other controls are used in conjunction with accessories specified by the purchaser.

Installation of the generating plant involves its location, connection of fuel source, connection of exhaust system, starting battery installation, connection to the load wiring, and for some special models connection to a source of cooling water. Each installation must be considered individually - use these instructions as a general guide. Typical installations are shown, and by following the principles outlined a proper installation can be made. Local regulations (building code, fire ordinance, etc.) may affect some installation details, and should be carefully checked.

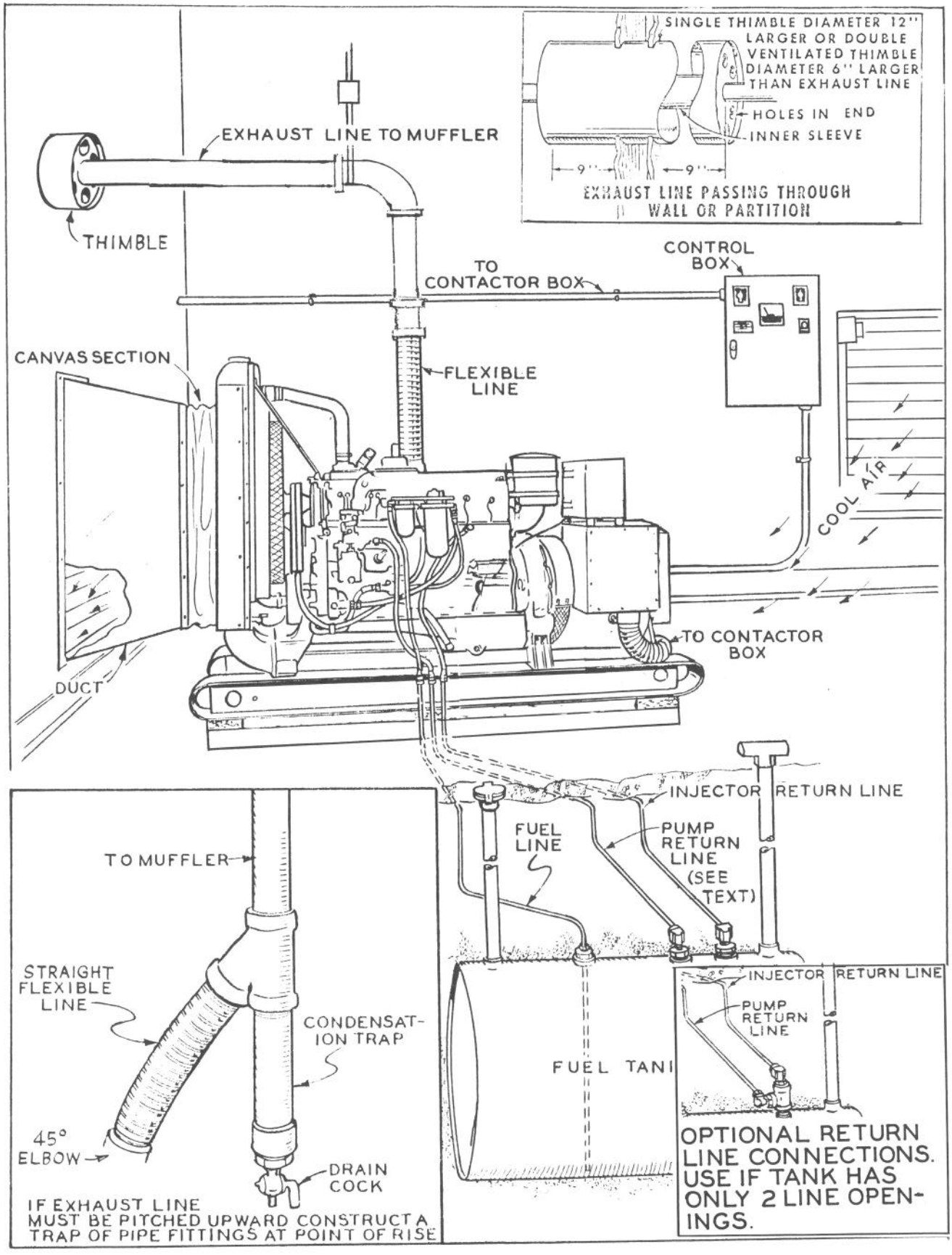
LOCATION. - In the average installation, the location has been pre-selected. For the average standby installation a warm indoor site is usually required. If automatic, unattended starting is required, the ambient temperature must be high enough to assure positive starting. The minimum temperature is usually specified by local regulations at 60°F. or higher. Check the local regulations. The location should be dry, well ventilated, and reasonably dust free. Normally, the plant should be located near the main power line switch. Provide sufficient clearance (at least 24 inches recommended) on all sides for convenience in servicing the plant.

MOUNTING. - Refer to the installation outline drawing. The plant is mounted on a rigid skid base which provides proper support. However if additional vibration dampeners, raised pedestals, etc. are employed it may be necessary to provide special footings or other support as necessary to carry the load.

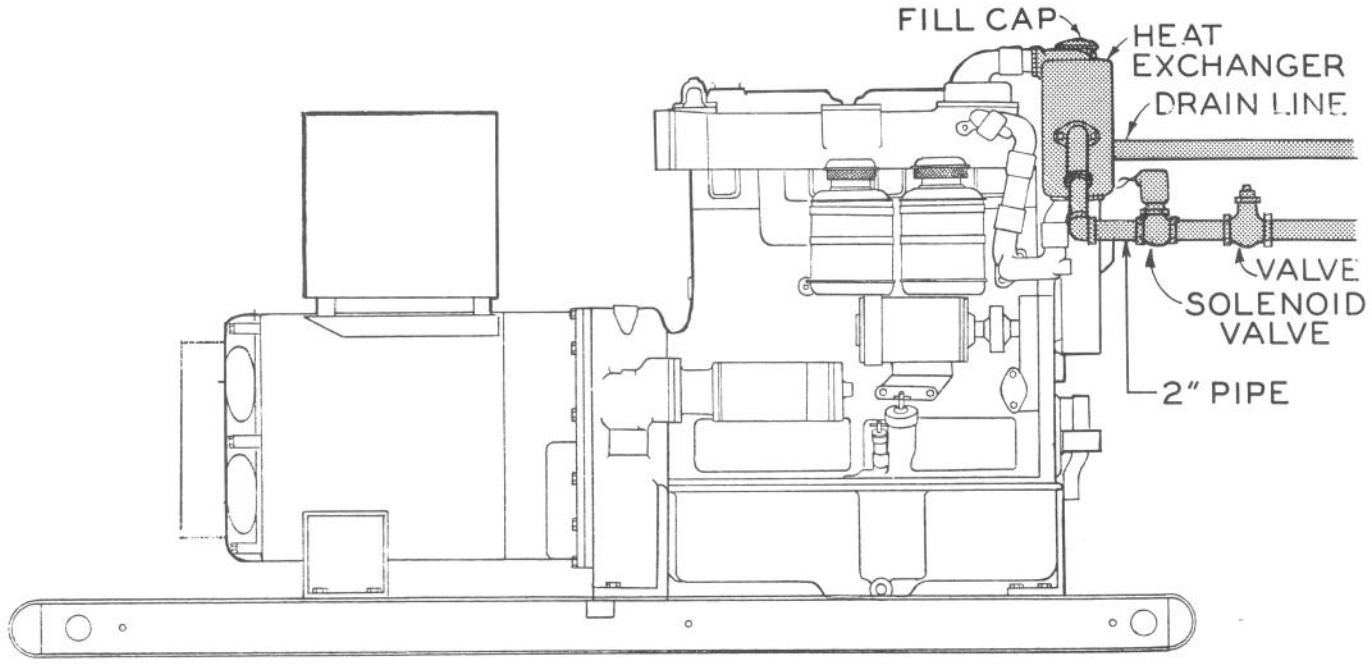
VENTILATION. - For radiator cooled units, proper ventilation is of vital importance. Under normal operating conditions, approximately 14,200 cubic feet of air per minute will provide proper cooling. Instal lation in a small room may require an auxiliary fan connected to operate at any time the plant is running. Separate air inlet and outlet openings are necessary.

The pusher type fan used forces the cooling air out through the front of the radiator. The usual method of exhausting the heated air is to construct a duct from the front of the radiator to an outside wall. In cold climates, provision must be made to prevent any back-flow of cold outside air during periods of shut down. Automatic, motor controlled shutters for the air inlet and outlet openings may be necessary. If the engine is cooled by city water, using a heat exchanger or stand pipe system, ventilation is seldom a problem. However, air flow of at least 3350 cfm is needed to properly cool the generator and to support combustion in the engine. Water flow requirements are in the appropriate table in this section.

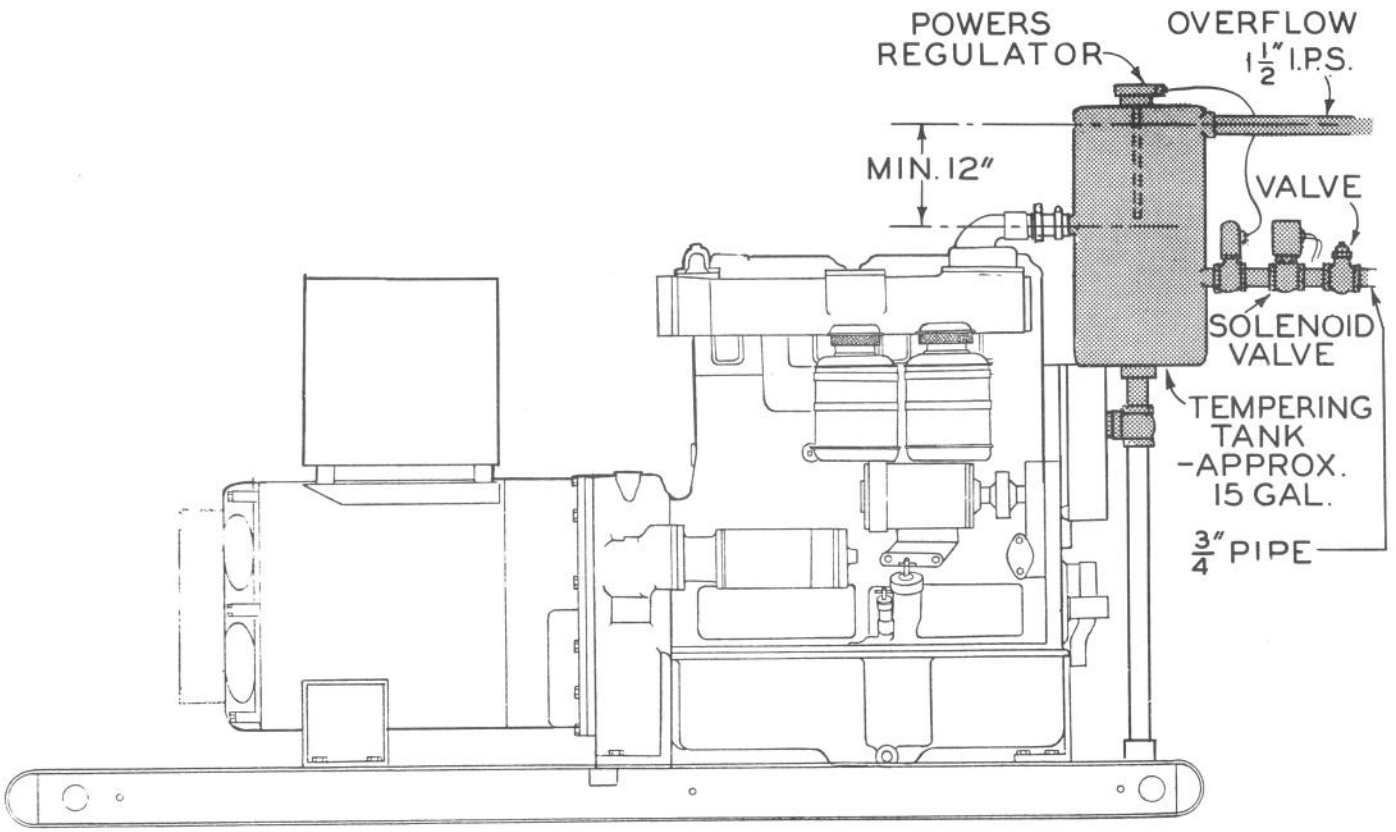
OPTIONAL "CITY" WATER COOLING. - Two types of cooling modifications using a constantly changing water flow are optional in place of the conventional radiator cooling.



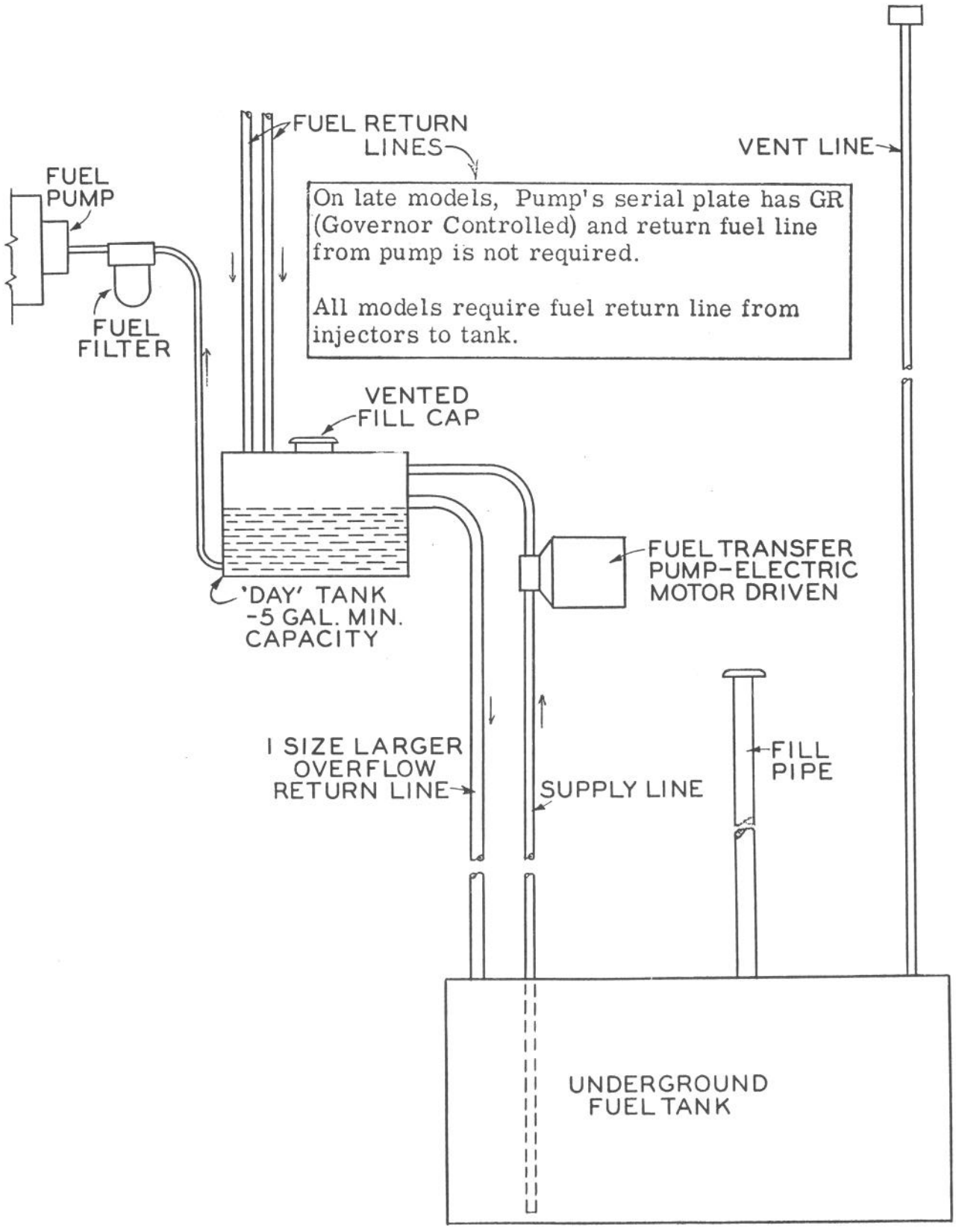
TYPICAL STANDBY INSTALLATION



CITY WATER HEAT EXCHANGER COOLING



CITY WATER STANDPIPE WITH POWERS REGULATOR



'DAY' TANK INSTALLATION

1. Heat Exchanger. - The heat exchanger installation provides for a "closed" engine water system. The engine coolant circulates through a tubed chamber. A separate and constantly changing flow of "raw" or city water surrounds the cooling tubes and is drained off. An electrically operated valve (solenoid type) opens the water flow when the plant is operating, and shuts off the water flow when the plant stops. Connect the solenoid as shown on the engine control wiring diagram. Rate of flow is controlled by either a hand valve or by an optional automatic regulator. If rate of flow is hand adjusted, refer to the water flow table, which shows the approximate minimum water required at the loads listed. Use 2 inch pipe, for connections, as illustrated. The "closed" chamber section must be filled with coolant before operation and serviced the same as a radiator.

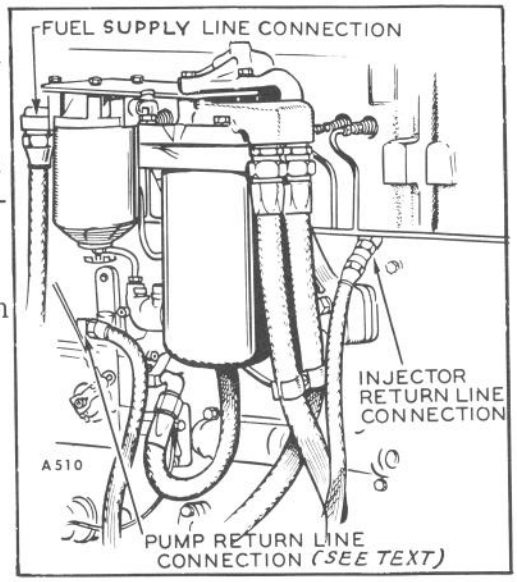
MINIMUM WATER FLOW - HEAT EXCHANGER COOLING

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL./MIN.
75 KW	40°F.	12
	60°F.	18
	80°F.	26
85 KW	40°F.	13
	60°F.	19
	80°F.	27

2. Tempering Tank. - The tempering tank (stand pipe) system uses a mixing or tempering tank. The engine cooling water mixes with a constantly flowing source of cool water. An electric solenoid type valve opens the water flow when the plant is operating, and shuts off the water flow when the plant stops. Connect the solenoid as shown on the engine control wiring diagram. Rate of water flow is controlled by either a hand valve or by an optional automatic regulator. If the rate of flow is to be hand adjusted, refer to the water flow table, which shows the approximate minimum water flow required at full load. Use 3/4 inch pipe for the supply line, and 1-1/2 inch pipe for the over flow line. Pipe the over flow to a convenient drain point.

MINIMUM WATER FLOW - TEMPERING TANK COOLING

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL./MIN.
75 KW	40°F.	6.25
	60°F.	9
	80°F.	12
85 KW	40°F.	9.6
	60°F.	10.9
	80°F.	13.6



FUEL CONNECTIONS. - Use 5/8" tubing for the fuel supply line; the inlet fitting on the fuel filter is threaded for a 5/8" SAE flared fitting. Use 1/2" tubing for the fuel return line from the injector manifold; the fitting in the injector manifold is threaded for a 1/2" SAE flared fitting. A third line is required as a pump drain for units with a pressure-regulator controlled injection pump which is identified by letters PR on the serial plate and a fitting on top the pump. Use 3/8" tubing and connect to the 3/8" SAE flared fitting on the injection pump. The governor controlled type of pump, which has GR on its serial plate and a pipe plug on top, does not require a drain line.

Check local regulations regarding the installation of a fuel supply tank, lines, etc. Lift of fuel should not exceed 8 feet. If the installation requires a greater lift, an auxiliary "DAY" tank of at least 5 gallon capacity will be necessary. An electrically driven fuel transfer pump is then installed to feed the auxiliary tank.

An underground tank usually has connections at the top, requiring a drop or suction tube extending to within an inch or two of the tank bottom. All supply line connections must be air tight to assure that the fuel pump will lift fuel from the tank. The tank must have an approved vent cap. If both return lines must be brought to one return opening, be sure the manifold return line has the most direct route.

NOTE:

In any diesel installation, fuel system cleanliness is of utmost importance and cannot be over emphasized. Make every effort to prevent entrance of any contaminating matter, moisture, etc. Do not use fittings of galvanized material.

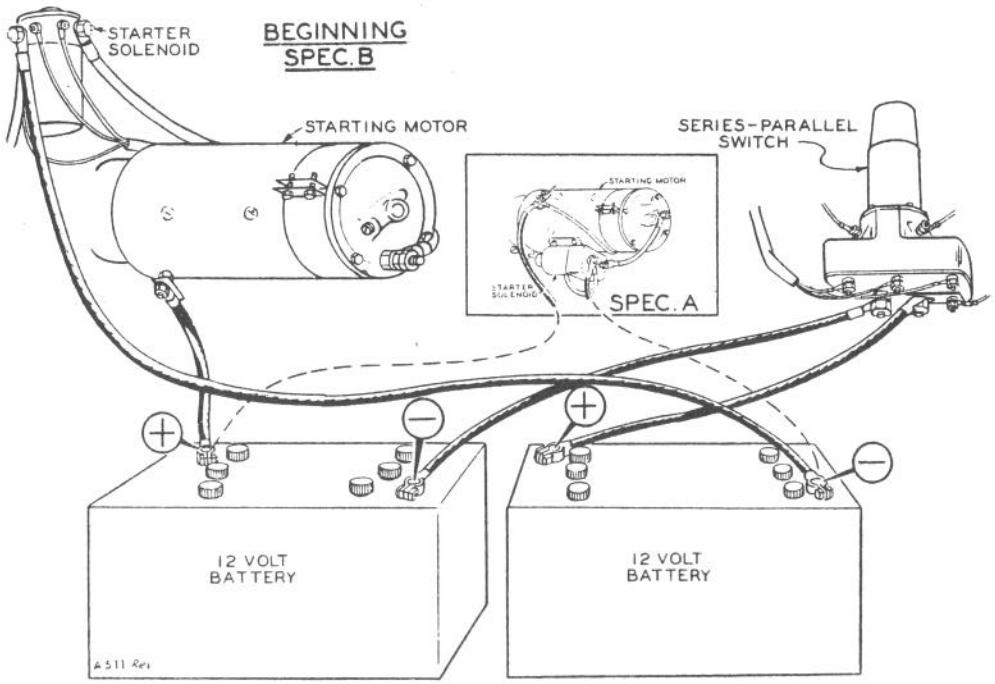
EXHAUST. - Pipe the exhaust gases outside any enclosure. Use pipe at least as large as the 2-1/2 inch pipe size outlet of the engine exhaust. Increase the pipe diamter one size for each additional 10 feet in length. Use a flexible connection to the engine exhaust manifold. Avoid using sharp elbow turns — use sweeping type elbows to keep back pressure to a minimum. If the exhaust line runs upward at any point, install a condensation trap at the low point, with provision for periodic draining. Shield or insulate the line if there is danger of personnel contact. Protect walls and partitions through which the exhaust line passes with a thimble like the one shown in the typical installation illustration. Install a suitable muffler.

WATER JACKET HEATER (Optional). - The water jacket heater keeps the engine coolant warm during periods of shut down, thus promoting easier starting when the ambient temperature is low. Connect the heater to a normally energized power source, making sure that the line voltage is correct for the rated voltage of the heater. Refer to the heater nameplate.

BATTERY CONNECTIONS. - The plant uses 12/24 volt battery current. An automatic series-parallel switch provides the necessary 24 volt circuit for starting, and 12 volt circuit for charging and control purposes.

Two 12 volt, type 8D batteries are recommended for normal installations. If 6 volt batteries are used, connect the batteries in pairs to form two 12 volt units, using a jumper cable to connect the positive post of one battery to the negative post of a second battery for each 12 volt unit.

The following instructions apply to units with a separate series-parallel switch and starter solenoid (prior to Onan serial number 661047).



PRIOR TO ONAN SERIAL NUMBER 661047

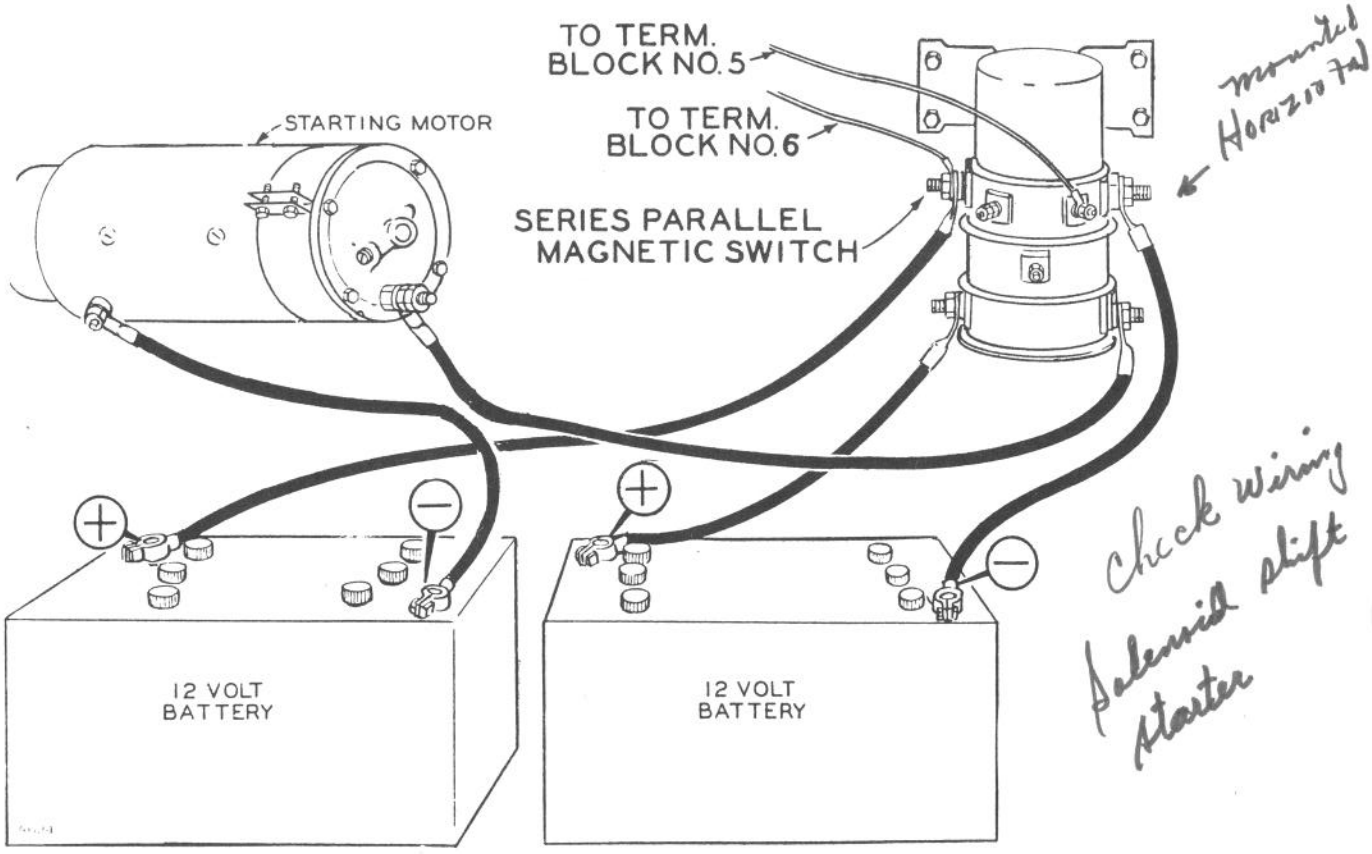
1. Connect the positive post of one 12 volt battery to the forward terminal of the series-parallel switch.

2. Connect the negative post of the same battery to the grounded terminal of the start solenoid.

3. Connect the positive post of the second 12 volt battery to the terminal on the side of the engine starting motor.

4. Connect the negative post of the same battery to the rear terminal of the series-parallel switch.

The following instructions apply to units with a combination series-parallel magnetic switch (effective Onan serial number 661047).



EFFECTIVE ONAN SERIAL NUMBER 661047

1. Connect the positive terminal of one battery to the lower left terminal on the series-parallel magnetic switch.

2. Connect the negative terminal of the same battery to the upper right terminal on the series-parallel magnetic switch.

3. Connect the positive terminal of the second battery to the upper left terminal on the series-parallel magnetic switch.

4. Connect the negative terminal of the second battery to the starter ground terminal.

5. Connect the lower right terminal on the series-parallel magnetic switch to the field terminal on the starter.

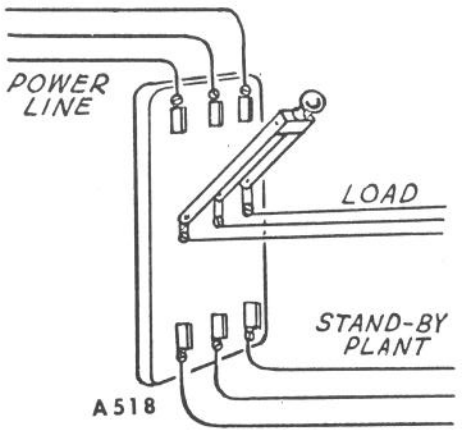
Service the batteries as necessary.

Infrequent use of the plant (as in emergency standby service) may allow the batteries to self discharge to the point where they cannot start the plant in an emergency. If using a load transfer switch assembly that does not include a trickle charge circuit, a separate trickle charger should be installed.

ELECTRICAL CONNECTIONS. - Most local regulations require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. Be sure that wiring meets requirements of electrical codes in effect at the installation site.

When the plant is used for standby service, a double throw switch must always be used. This switch (either manual or automatic type) must be connected so that there is no possibility for the generator current to be fed into the normal source of power lines, nor for the normal source and generator to be connected at the same time.

It is assumed that personnel connecting the generator to the load, either directly or through a transfer switch, are fully qualified and understand the problems involved in balancing the circuits, grounding the plant, etc.

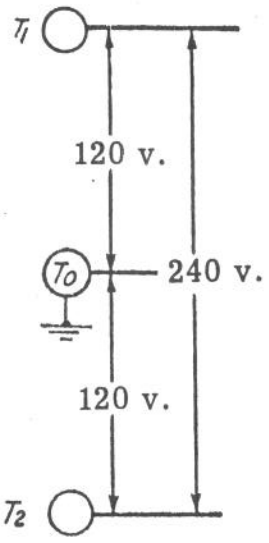


BASIC LINE CONNECTIONS

Load transfer and automatic demand controls operate through the plant control to start, control, and stop the plant as demanded by the application. Wiring instructions are in the manuals supplied with these automatic controls. Connections at the remote control terminal block are shown on the plant control wiring diagram. The GND terminal is for a customer-supplied alarm at a remote location to warn of high water temperature, low oil pressure, and overspeed. For plants prior to Spec **D**, connections are to a 4 place terminal block designated B +, 1, 2, and 3; B+ is for voltage to the control, 1 is for ground, 2 is for stopping, and 3 is for starting.

CONNECTING THE LOAD WIRES. - The ac output terminals are located inside a sheet metal enclosure at the side of the generator. Knock out openings are provided. The terminal studs are marked as designated on the output control wiring diagram.

120/240 VOLT, SINGLE PHASE, 3 WIRE PLANT

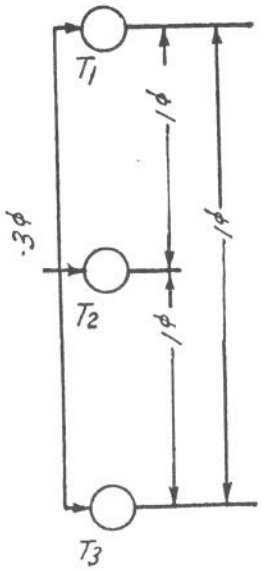


The terminal post marked "T0" is grounded. For 120 volt current, connect the "NEUTRAL" (white) load wire to the "T0" terminal. Connect the "hot" (black) load wire to either the "T1 or "T2" terminal. Two 120 volt circuits are thus available, with not more than one half the rated capacity of the plant available on each circuit. Balance the load as closely as possible between the two circuits.

For 240 volt current, connect one load wire to terminal "T1" and the other load wire to terminal "T2", leaving terminal "T0" unused.

If both 120 and 240 volt current are used at the same time, use care not to overload either side of the circuit.

3 PHASE, 3 WIRE PLANT

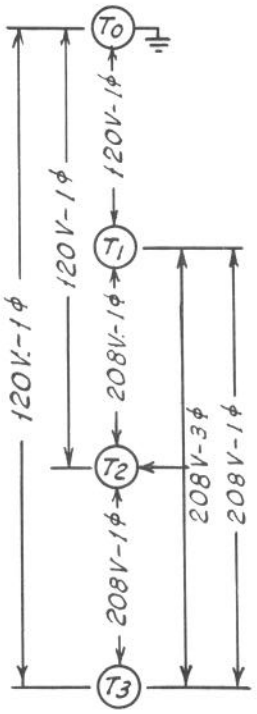


No terminal is grounded. For three phase current, connect separate load wires to each plant terminal "T1", "T2", and "T3", one wire to each terminal. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. If phase sequence is important, be sure to check the phase sequence before connections are completed.

To obtain single phase current, connect separate load wires to each of any two plant terminals. Three single phase circuits are thus available, with not more than 1/3 of the plant rated capacity for each circuit. Balance the load as closely as possible among the circuits.

If both single phase and three phase current is to be used at the same time, use care not to overload any one circuit. Subtract the amount of the 3 phase load from the rated capacity of the plant. Divide the remainder by 3, and this is the maximum load that can be taken from any one circuit for single phase current use. For example, a 50, 000 watt plant is used, with a 20, 000 watt 3 phase load connected. This leaves 30, 000 watts available for single phase use. Divide the 30, 000 watts by 3, giving 10, 000 watts available on each single phase circuit. Do not attempt to take all 30, 000 watts in this example off one circuit, as over-loading of the generator will result.

120/208 VOLT, 3 PHASE, 4 WIRE, WYE-CONNECTED PLANT



The terminal marked "T0" is grounded. For 120 volt, single phase current, connect the "neutral" (white) load wire to the "T0" terminal. Connect the "hot" (black) load wire to any one of the other three terminals, "T1", "T2", "T3". Three separate 120 volt, single phase circuits are thus available. Do not attempt to take more than 1/3 the rated capacity of the plant from any one circuit. Balance the load as closely as possible between the three circuits.

For 208 volt, three phase current, connect a separate load wire to each of the plant terminals "T1", "T2", and "T3", leaving the "T0" terminal unused. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. If phase sequence is important, check the phase sequence before making final connections.

For 208 volt, single phase current, connect a separate load wire to each of any two terminals "T1", "T2", or "T3". Do not use the "T0" terminal. Three separate single phase circuits are available: "T1" and "T2", "T1" and "T3", "T2" and "T3". Do not attempt to take more than 1/3 the rated capacity of the plant from any one circuit. Balance the load as closely as possible between the three circuits.

If both single and three phase current is used at the same time follow the principles of load distribution as given for the 3 phase, 3 wire plant.

220/380 VOLT, 3 PHASE, 4 WIRE PLANT
277/480 VOLT, 3 PHASE, 4 WIRE PLANT

Follow the principles of connection as given for the 120-volt, single phase 120/208-volt, 3-phase, 4-wire plant.

120/240 VOLT, 3 PHASE, 4 WIRE, DELTA-CONNECTED PLANT

This type of generating plant is specially designed so that two types of loading can be applied to the generator: standard 240 volt, 3 phase, 3 wire operation only, or in combination with 120/240 volt, 1 phase, 3 wire operation.

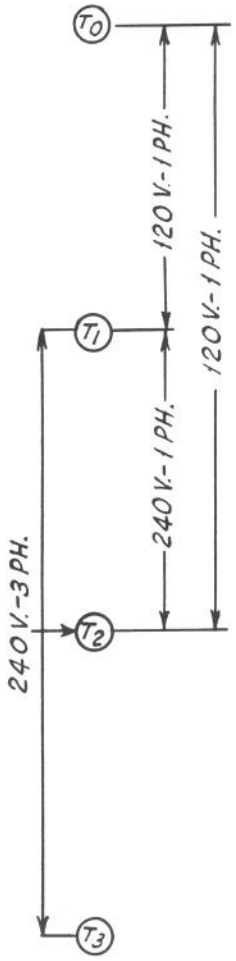
The load terminals are marked T1, T2, T3 and T0. The T0 terminal is the generator center tap between T1, and T2. The T0 terminal of the generator is not grounded.

For 240 volt 3 phase 3 wire operation connect the three load wires to the three terminals T1, T2, T3, one wire to each terminal post. For 3 phase 3 wire operation the T0 terminal is not used and is normally not grounded.

If it is desired to use combination single phase and three phase loads simultaneously connect such single phase loads as follows:

For 120/240 volt, 1 phase, 3 wire operation, terminals T1 and T2 are the "hot" terminals; the T0 terminal is the neutral (which can be grounded if desired). For 120 volt service, connect the "hot" (black) load wires to the T1 and T2 terminals, and the neutral (white) wire to the T0 terminal. Two 120 volt circuits are thus obtained. The two black wires connected to T1 and T2 will give one 240 volt circuit.

Any combination of single phase and three phase loading can be applied to the generator simultaneously as specified above as long as no terminal current exceeds the rated NAMEPLATE current of the generator.



GENERAL. - After a plant is properly installed, several preliminary services are necessary to prepare the plant for operation. Do not attempt to operate the plant until preliminary servicing has been completed.

CRANKCASE OIL. - Refer to section 3 of the Cummins engine manual. Note that for average operating conditions, MIL-L-2104A (military specification) oil is recommended. Most oil suppliers market such an oil for heavy truck service. Many oils designated for MS or DG service meet requirements of MIL-L-2104A.

The capacity of the engine oil pan is 7 U.S. gallons. However, an extra amount may be required for the oil filter or other accessories. Check the level after 10 to 15 minutes of the initial run.

Use oil of the recommended viscosity according to the ambient temperature. Do not use a multi-viscosity oil, such as 10W-30, or other oils designated for ordinary automotive use. Do not mix brands (nor grades of the same manufacturer) of lubricating oil.

GOVERNOR OIL. - The standard engine is equipped with the hydraulic governor. Be sure the governor case is properly filled to the full mark on its dip stick gauge. Use the same viscosity and quality oil as that used in the crankcase.

AIR CLEANER. - Service the air cleaner according to the type supplied. If the cleaner is of the oil bath type, fill to the level indicated with oil of the same viscosity as that used in the crankcase. However, a non-detergent (straight mineral) oil is recommended.

BREATHER AIR CLEANER. - The standard engine is equipped with a small air cleaner at the oil fill opening, as a crankcase breather. Service in the same manner as the main oil bath type.

COOLANT. - For units which use a radiator, fill the cooling system with clean soft water. The standard radiator and block capacity is 19.5 U.S. gallons. Use a good rust and scale inhibitor. If there is any possibility of a radiator cooled plant being exposed to freezing temperatures, use antifreeze solution in the proper proportion. On the initial run check the coolant level several times and add coolant if necessary to compensate for any air pockets which may have formed during filling.

If the plant is equipped for "city" water cooling, either heat exchanger or tempering tank type, see that the water supply is turned on. If the plant has the heat exchanger type cooling, be sure the "closed" chamber portion is properly filled with clean soft water. A fill cap is provided at the top of the chamber.

FUEL. - Refer to section 3 of the Cummins engine manual for fuel oil specifications. Check with the fuel supplier for assurance that the fuel supplied meets the specifications. Make every effort to keep the fuel supply clean. Ordinarily no preliminary priming or "bleeding" of the fuel system is necessary.

STARTING. - During the initial run have the field circuit breaker OFF so the unit can run at no load. To start the unit, move the run-stop switch to the RUN position and leave it there. The unit will run as long as the switch is at that position. The cranking motor will be disconnected by the start disconnect relay when the engine comes up to speed. If the unit fails to start within about 10 seconds, the cycle cranking relay will interrupt cranking for about 10 seconds, and then the unit will automatically crank again.

CHECKING OPERATION. - As soon as the engine starts, check the oil pressure gauge and the battery charge ammeter. As the engine warms up, check the water temperature gauge. When the engine reaches operating temperature, as indicated by the oil pressure and water temperature gauges, energize the generator by moving the field circuit breaker to ON. Then check the voltmeter for the correct output voltage. A voltage adjustment of 5% can be made with the rheostat on the control panel. If a voltage adjustment is necessary, wait until the voltage decays to a stable level. Should the voltage tend to wander from the stable point, a governor sensitivity adjustment may be required. Operating instructions for a load transfer or an automatic demand control are in separate manuals.

WATER FLOW. - If the plant is city water cooled and has a manual flow valve, check the rate of water flow. At the time of installation, an adjustable valve was connected in the water supply line. With the key provided, adjust the valve for a flow of water sufficient to keep the water temperature within the range of 165 to 185°F. Excessive water flow is expensive and wasteful. Insufficient water flow will cause a rise in coolant temperature and the engine to stop through the high water temperature safety switch. To avoid unauthorized tampering after proper adjustment, remove and store the adjusting key.

STOPPING. - If operating conditions permit, disconnect the electrical load and allow the plant to run at no load to prevent an excessive temperature rise. To stop the plant, move the run-stop switch to the STOP position.

NORMAL OPERATING FUNCTIONS

SAFETY STOPPING DEVICES. - In addition to the field circuit breaker, which will not stop the plant, the plant is equipped with safety devices that stop the engine under conditions that could cause severe damage.

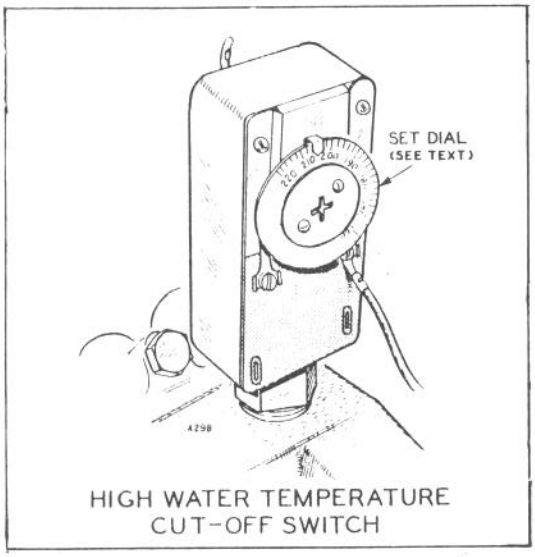
NOTE

If one of the safety stopping devices operates to stop the plant, the Emergency Latch Relay PUSH TO RESET button must be reset before the plant can be restarted.

Special plants may be equipped with warning circuits instead of or in addition to stopping devices. When such circuits are used. they operate through the GND terminal on the remote terminal block.

1. Low Oil Pressure Cut-Off. - A pressure operated switch mounted on the engine stops the plant if the engine oil pressure drops dangerously low. The switch is not adjustable.

2. High Water Temperature Cut-off. - A thermostatic switch on the engine closes to stop the engine if the coolant temperature rises to near its boiling point. The switch opens to permit restarting after the coolant temperature has fallen about $10^{O}F$. There are 2 types of switches — (1) on early models, an adjustable switch was used. Its dial setting determined at what temperature the switch would close. When it left the factory, the switch was set at $205^{O}F$. Lower the setting $3^{O}F$ for each 1000 feet above sea level. Set the dial below the boiling point of the coolant but above operating temperature; (2) later models have a non-adjustable switch fixed to close at about 202 plus or minus $2^{O}F$.



HIGH WATER TEMPERATURE
CUT-OFF SWITCH

(EARLY MODELS ONLY)

3. Overspeed Cut-off Switch. - A centrifugal weight type switch is attached to the outer end of the generator shaft. The switch operates to stop the plant if the engine speed should accidentally rise to a dangerous point.

OIL PRESSURE GAUGE. - The oil pressure gauge indicates the engine oil pressure while the engine is operating. Normal oil pressure at operating temperature is within a range of 30 - 75 psi. Pressure will be high until the engine warms up.

WATER TEMPERATURE. - The panel temperature gauge indicates the coolant temperature during operation. Normal operating temperature is $165^{O}F$. to $185^{O}F$.

CHARGE AMMETER - The small dc ammeter indicates the battery charging current. An automatic regulator controls the charge rate, and it will vary according to the charge condition of the batteries. The charge rate will be comparatively high when the plant first starts, but should fall gradually to almost zero as the batteries become fully charged.

EMERGENCY LATCH RELAY. - The emergency latch relay is energized by battery voltage when a ground is provided by one of the engine safety devices. A red light comes on and a button protrudes from the control panel to indicate a latched relay.

RUN-STOP SWITCH. - A SPDT. center off switch, it functions as a manual control for starting and stopping and as a selector when a switch is installed for remote control.

CIRCUIT BREAKER. - The circuit breaker protects the generator from damage in case of an extreme overload. The circuit breaker can be used as a connect-disconnect output switch. If the breaker trips automatically from an over load condition, it must be reset manually after correcting the over load condition that caused it to trip.

METER SELECTOR SWITCH. - The position of the switch handle indicates which phase of the generator output is shown on the ac ammeter and voltmeter. Turn the handle to the desired position. Single phase models are not equipped with the switch.

VOLTAGE REGULATOR RHEOSTAT. - The voltage regulator rheostat provides for adjusting the ac output voltage under normal operating conditions. Turn clockwise to increase the voltage - counterclockwise to decrease the voltage. For models with spec. ending with letter A, the voltage regulator rheostat has no effect if the combination field rheostat and voltage regulator switch is not at its extreme counterclockwise position. For models ending with spec. letter B, refer to MAINTENANCE.

COMBINATION FIELD RHEOSTAT AND VOLTAGE REGULATOR SWITCH. - The (Applies only to models with spec. ending with letter A) combination field rheostat and switch is provided for emergency manual voltage control, in case of accidental voltage regulator failure. When the rheostat is turned to its extreme counterclockwise position, a built-in switch provides for voltage regulator operation. When the rheostat is turned slightly clockwise, the switch cuts out the voltage regulator and output voltage must be manually controlled. Any substantial change in the electrical load will require a readjustment of the field rheostat. Turn the rheostat clockwise to increase voltage, counterclockwise to decrease voltage.

RUNNING TIME METER. - The running time meter registers the total number of hours, to 1/10th, that the plant has operated. Use it to keep a record of periodic service, etc.

AMMETER. - The ac ammeter indicates the amount of load connected to the phase indicated by the position of the selector switch. Single phase models have two ammeters and no selector switch.

VOLTMETER. - The voltmeter measures the output voltage of the generator. On 3 wire generators, the voltmeter is connected to indicate only the higher nameplate voltage. On 4 wire generators, it's connected through a selector switch to measure voltage on each phase of the generator.

FREQUENCY METER (Optional). - The frequency meter indicates the frequency of the output current in cycles per second. Vibrating reed indicators show the exact frequency.

TACHOMETER (Optional). - The tachometer indicates the engine operating speed in revolutions per minute.

EXERCISE PERIOD. - If the plant is used infrequently, as in standby service, it should be started and operated at least once a week. Operate long enough (15 to 30 minutes) to thoroughly warm up the engine. Such an exercise period will help to keep oil distributed on engine parts, fuel system full, etc., and promotes easier starting and longer engine life.

BATTERIES, HOT LOCATION. - Batteries will self discharge very quickly when installed where the ambient emperature is consistently above 90°F., such as in a boiler room. To lengthen battery life, dilute the electrolyte from its normal 1.275 specific gravity reading at full charge to a 1.225 reading. The cranking power is reduced slightly when the electrolyte is so diluted, but if the temperature is above 90°F. this should not be noticed. The lengthened battery life will be a distinct advantage.

1. Fully charge the battery.
2. With the battery still on charge, draw off all the electrolyte above the plates in each cell. DO NOT ATTEMPT TO POUR OFF! Use a hydrometer or filler bulb. Avoid skin or clothing contact with the electrolyte, and dispose of it in a safe manner.
3. Refill each cell with approved water, to the recommended level.
4. Continue charging for 1 hour at a 4 to 6 ampere rate.
5. Test each cell. If the specific gravity is still above 1.225, repeat steps 2, 3 and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

PARALLEL OPERATION. - If the plant is to be operated in parallel with another plant, special equipment and operating procedures are necessary. Parallel operation demands that the operator clearly understands the many requirements and proper procedure.

Plants designed for parallel operation usually have a special control panel with synchronizing lights, governor speed control, cross current compensating circuit, etc. Plants not originally so equipped may be altered as necessary. Consult the factory for specific information.

GENERAL. - Follow a definite schedule of inspection and service. Use the running time meter to keep a record of service operations. Service periods are based on normal service and operating conditions. For continuous heavy duty, extreme temperatures, etc., service more frequently. For light duty, periods of little use, etc., service periods can be lengthened accordingly.

ENGINE. - Refer to the Cummins engine manual for details of service operations.

BATTERIES. - Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of grease or asphalt paint will retard corrosion at terminals. Keep the electrolyte level at the proper level above the plates by adding clean water that is satisfactory for battery use.

AC GENERATOR. - In addition to the engine service operations scheduled under the "C" column in the Cummins engine manual, check the condition of the ac generator.

Replace the brushes if worn to 1/2 inch in length, or if damaged. DO NOT LUBRICATE. Refer to Generator Maintenance.

It is normal for the slip rings to acquire a dark brown glossy surface. Do not attempt to keep a bright metallic appearance. Clean with a dry, lint free cloth. Slight roughness can be remedied by light sanding with #00 sandpaper.

The generator bearing is pre-lubricated and sealed. It requires no additional lubrication during its service life.

GOVERNOR. - Basic principles of governor adjustment are given in the Cummins manual. The purpose of the governor is to control the engine speed, under various load conditions, to keep the generator output current stable.

The governor should control the engine speed so that the frequency at full load is within 2 to 3 cycles of the no load frequency. A momentary surge beyond the 3 cycle limit is normal when the load is changed, but the frequency should stabilize within a few seconds. Normal frequency at no load is approximately 61 cycles for a 60 cycle plant, but may be as high as 63 cycles if necessary to obtain the correct voltage. The frequency at full load should not drop below 59 cycles.

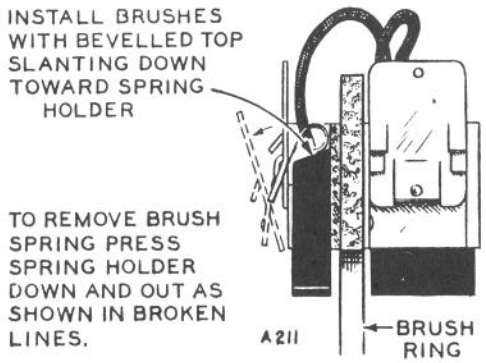
MAINTENANCE

ENGINE MAINTENANCE. - Refer to Cummins model H-6 manual for detailed instructions on engine maintenance. Refer to the Onan wiring diagram for information and data relating to generator and engine controls and instruments.

GENERATOR MAINTENANCE. - The generator normally requires little maintenance other than periodic service. Inspection during periodic service should indiacte when the slip ring brushes must be replaced..

To examine the brushes, brush springs, and slip rings, remove the exciter cover. Note that the exciter assembly mounts on a hinged plate. Remove the screws from the left side of the exciter plate and swing the assembly outward. Openings in the alternator end bell permit access to the brush rig.

Brushes should be replaced when worn to approximately 1/2 inch long, or when the top of the brush is below a point midway between the outer and inner end of its guide. Order replacement brushes by part number. A physical description does not fully identify a brush. Be sure the brush is installed so the short side of its taper is toward the spring and its bracket. Do not attempt to remove the brush without first removing its spring and bracket as shown. Never bend a spring bakc over its bracket - doing so will put a kink in it and require replacement.



The generator bearing is pre-lubricated and sealed. It requires no service.

The exciter contains no moving parts. Occasionally blow out any dust, etc. Check thoroughly to assure that all components are mechnically secure, and that all electrical connections are tight.

GENERATOR TESTS. - If the generator does not function properly, a few simple tests with the plant off may isolate the cause.

1. Temporarily disconnect the leads from exciter terminals E1, E2, AF1 and AF2. Check the exciter wiring diagram for input voltage to the exciter, and temporarily connect and alternate source (such as commercial line) of AC power with the same voltage rating to exciter terminals E1 and E2.

   Check the voltage across terminals AF1 (+) and AF2 (-). If there is no dc voltage, the exciter is not functioning.

2. If dc voltage at terminals AF1 and AF2 is 25- volts or higher, check the alternator for a grounded or open circuit, etc.

3. No terminal of the exciter should show a grounded circuit.

4. CHECKING STATIC EXCITER. - Troubles are listed in advancing order, from no output voltage to a rated but fluctuating output voltage. The relationship between trouble and cause is not always consistent from model to model, so the following information must be used as a guide, not an absolute rule. The column entitled "step" indicates the step for testing a standard component. When the word "None" appears in that column, all the information needed to complete the check is given in the column headed "Corrective Action". Use a multimeter to check continuity, voltage, and resistance as indicated in the tests.

Note: It is imperative that the testing procedures are completely understood by the serviceman before attempting to perform corrective maintenance. Use caution when working on an operating plant.

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Generator will not build up voltage.	Circuit breaker in "off" or "tripped" position	Reset and close breaker	None
	Open in circuit breaker	Stop plant and check breaker continuity	None
	No AC power to Magneciter	Check AC voltage at E1-E2 with the plant operating. Voltage should be five per cent of the rated voltage. If not, check continuity from E1-E2 back to the generator	None
	Partial loss of residual in Rotor	With plant operating jumper from E2 to heat sink of field rectifier Z until voltage begins to build-up. Then remove.	None
	Pair of field Rectifiers (either W & Z or X & Y) open	Test rectifiers and replace if defective	
	Both Field Rectifiers X and Y shorted	Test rectifiers and replace if defective	

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Output voltage slow to build up. Circuit breaker opens in about five seconds	Either Field Rectifier X or Y shorted	Test rectifiers and replace if defective	5
Output voltage slow to build up and five per cent below rated voltage after build up. Voltage regulation poor.	Either Field Rectifier W or Z shorted	Test Rectifier and replace if defective	5
Output voltage slow to build up and higher than rated voltage after build up	Open circuit in one or more Control Rectifier	Test rectifier and replace if defective. Check soldered connections to rectifiers	5
Output voltage slow to build up and ten to twenty percent above rated voltage after build up	Open in one Field Rectifier	Test rectifiers and replace if defective	5
	Open circuit in Gate winding G1-G2 of Reactor A or B	If Field Rectifiers Y and Z check okay, check continuities of Gate windings G1-G2	6
Output voltage builds up normally but less than rated voltage after build up	Shorted winding in Control Reactor	Test Control Reactor and replace if defective	7
Output voltage builds up normally with slightly less than rated voltage at no load and low voltage at full load	Compound winding S1-S2 installed backward or has open circuit.	Check wiring diagram for polarity of Compound windings through Reactors A and B and test for continuity	None
Output voltage builds up normally but 20 percent above rated voltage after build up. Voltage regulation poor.	Compound winding S1-S2 installed backward through one Reactor (A or B)	Check wiring diagram for polarity of Compound winding through Reactor A or B	None
Output voltage builds up normally but is twenty five percent above rated voltage after build up	Open circuit in Control Rectifier bridge	Check continuity from the junction of Control Rectifiers	None

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Output voltage builds up normally but 125 to 150-percent above rated voltage after build up	Shorted turn in gate winding G1-G2 of Reactor A or B	Test Reactors A and B for shorted turns and replace if defective	6
Output voltage builds up normally but 150 to 200-percent above rated voltage after build up. No regulation possible	Control winding C1-C2 of Reactor A or B polarized incorrectly	Check circuit connections of both Reactors A and B	None
	Shorted turn in Control winding C1-C2 of Reactor A or B	Test Reactors A and B for shorted turn and replace if defective	6
	Open in Control Circuit	Check continuity from E1 to E2 through Control Circuit	None
Generator Voltage fluctuating while engine running at constant speed	Incorrect setting on the Stabilizing Resistor	Check resistance and reset.	8

5. Checking Rectifiers. Disconnect one lead from, or remove, each rectifier for its individual test.

CAUTION

Note carefully the DIRECTION OF MOUNTING of any rectifier removed. It must be remounted in its original direction.

a. Connect the ohmmeter across the rectifier contacts and observe the meter reading.

b. Reverse the connections and compare the new reading with the first reading.

c. If one reading is considerably higher than the other reading, the rectifier can be considered satisfactory. However, if both readings are low, or if both indicate an "open" circuit, replace the rectifier with a new identical part.

6. Checking Reactors "A" and "B".

   a. Set the resistance range selector on the meter to the resistance range.

   b. Isolate one Gate winding by disconnecting either end of Gate winding G1-G2 from its point of connection; for example, disconnect G1 at E2. Measure the resistance in the Gate winding across G1-G2. Should be 0.30.

   c. Isolate one Control winding by disconnecting either lead C1 or C2 from the terminal block. Measure the resistance in the Control winding across C1-C2. Should be 8.5.

   d. Connect one meter lead to the disconnected Gate winding lead and the other meter lead to the disconnected Control winding lead and check for continuity.

   Results:

   1. REACTOR IS SERVICEABLE if resistance is within 20 percent either way of the value listed and there is no continuity between the Control and Gate windings.

   2. REACTOR IS DEFECTIVE if there is an open circuit in either the Gate or the Control windings. Continuity between the Gate and the Control windings is also an indication of a defective Reactor. In either case, the Reactor should be replaced.

7. Checking Control Reactor.

   a. Isolate the Control Reactor by disconnecting common lead "C" from its point of connection and carefully measure the resistance from this lead to the numbered lead on the Control Reactor. Should be 18.0.

   Results:

   1. CONTROL REACTOR IS SERVICEABLE if resistance is within 10 percent of the value specified.

   2. CONTROL REACTOR IS DEFECTIVE if no continuity is indicated between the common lead "C" and the numbered lead, indicating the presence of an open circuit.

8. Checking Resistors:

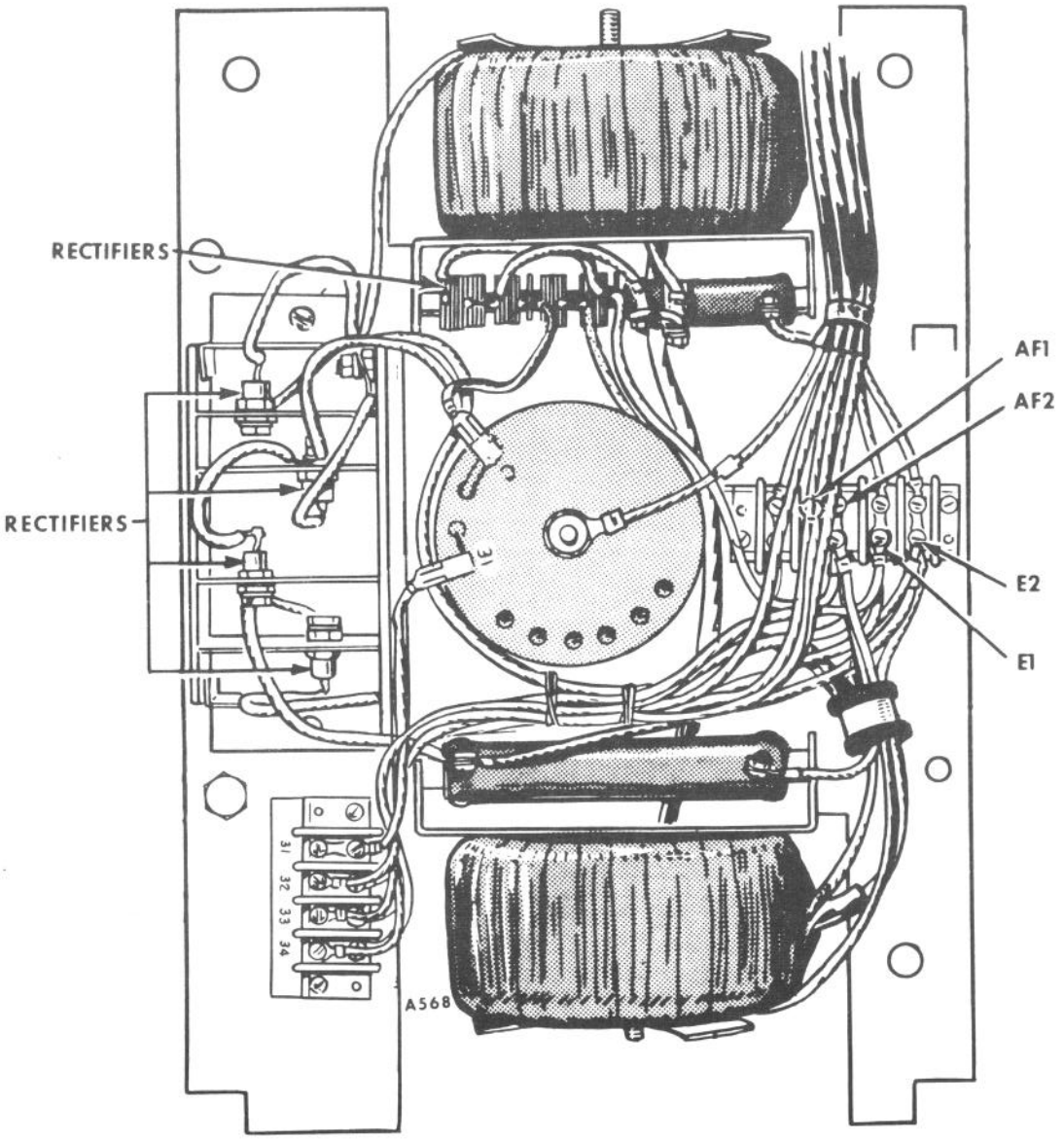
   The resistors must be checked with a multimeter adjusted to the appropriate range of resistances. See wiring diagram for correct values.

   a. Isolate the Resistor by disconnecting one end from its point of connection and carefully measure the resistance.

Results:

1. RESISTOR IS SERVICEABLE if the measured resistance falls within 20-percent of the value specified in the wiring diagram.

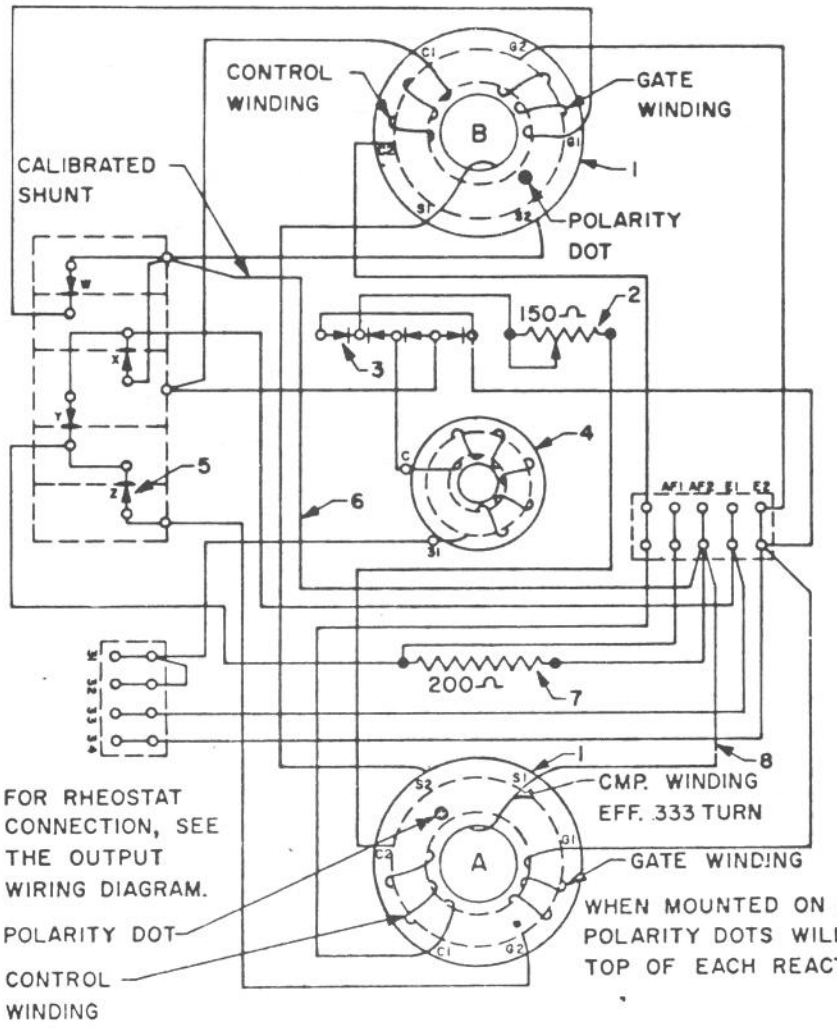
2. RESISTOR IS DEFECTIVE if there is no indication of continuity through the resistor. If the measured resistance exceeds the percent limits either way, the Stabilizing Resistor can be adjusted to bring the resistance within the required limits.



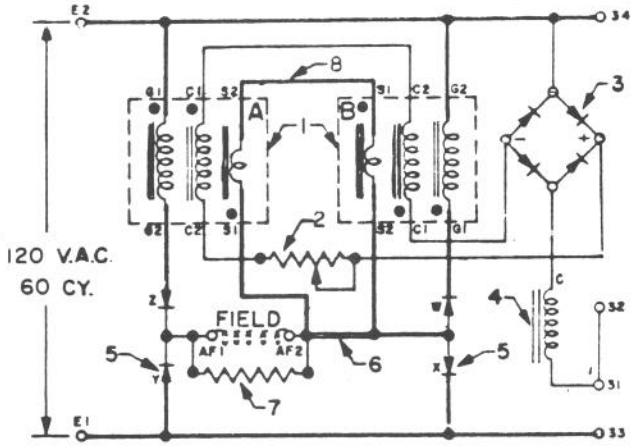
STATIC EXCITER

625A257

PICTORIAL



SCHEMATIC



ITEM	QTY	DESCRIPTION
8	1	NO. 14 WIRE, 27" LG.
7	1	RESISTOR-DAMPING
6	1	NO. 14 WIRE, 13½" LG.
5	4	RECTIFIER-FIELD
4	1	REACTOR-CONTROL
3	4	RECTIFIER-CONTROL
2	1	RESISTOR-STABILIZING
1	2	REACTOR-GATE

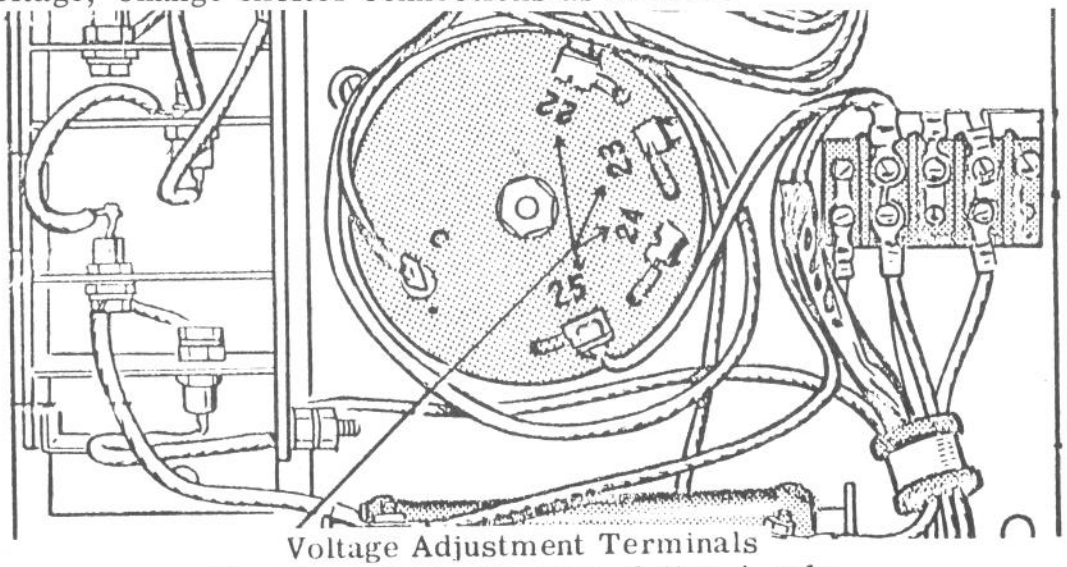
PARTS LIST

NAME: STATIC EXCITER WIRING DIAGRAM 120 V.A.C. 60 CY.

MODEL: 102SXINIB

DWG. NO: 625A257

Output Voltage (Models ending with spec. letter A, only). - The exciter was connected for rated output during the factory test run. Ordinarily if the engine is operating properly and at approximately the nameplate indicated speed, the generator output voltage will be correct. However, if some local condition requires a slight change in the voltage, change exciter connections as follows:



Voltage Adjustment Terminals
Models ending with spec. letter A only.

1. Be sure the engine is operating properly, and that the governor is properly adjusted for correct current frequency (speed), sensitivity, stability, etc.

2. Stop the plant and remove the exciter cover.

3. Note a disc shaped terminal block at the center, with a lead connected to a terminal marked C, and a second lead connected to one of the terminals marked 22, 23, 24 or 25. Moving the second lead to an adjacent terminal (from 25 to 24, etc.) will change the generator output approximately 5-percent.

FIELD RECONNECTING ONAN 12-LEAD GENERATORS

IMPORTANT

BEFORE ATTEMPTING TO RE-CONNECT A GENERATOR-CONTACT THE ONAN FACTORY FOR REQUIRED INSTRUMENT CHANGES, NEW WIRING DIAGRAMS, NEW PLANT NAMEPLATE WITH PROPER SPECIFICATION NUMBER AND VOLTAGE.

When shipped - the generators are connected to deliver the voltage specified on the order. The plant nameplate will show *only* the single specified voltage for which the generator is connected. The output instruments on the plant (such as voltmeters, ammeters, transformers, frequency meters, and running time meters) are intended for use with the specific nameplate voltage.

Some plants may include an optional re-connection terminal block which allows safe and simple voltage changes. The generator leadwires terminate at the optional re-connection block or in the junction box on the generator side. The junction box also contains the ammeter current transformers (some plants have the current transformers in the control box) which may require replacement when changing to different output voltages. Instruments, which may require changes per new output voltages, are accessible by tipping out the control box front panel.

The generator is a basic coded type (either 2X, 5X, 6X) as identified by the generator data number on the plant nameplate.
Each type can be connected for output voltages shown in Table 1.

All generator wires have wire tags for identification. The output leads to load are T0, T1, T2, T3. The generator winding leads, which are joined to form the output leads, are marked 1 through 12. See Figure 1 wiring diagrams for 10 to 85 KW. All numbered leads are joined in various combinations to the output leads for the different voltages.

Instruments and their related parts may require changes because of different voltages and current. New instruments are selected by the new voltage and current ratings of the plant. Refer to Table 2 for voltage rated instruments and select according to the new voltage output. Always size the instrument so the plant output will not exceed instrument rating.

To determine if current rated instruments (ammeters and current transformers)must be changed,refer to Table 3 and find the correct ampere rating of the plant after re-connection. After determining current rating, refer to Table 4 for the proper size ammeter and current transformers.

Instrument wiring is essentially the same for all plants. Connect new instruments in the same manner as the old ones were connected. Wiring diagrams, supplied by ONAN after the re-connection registration, provide additional instructions and part numbers required to complete the plant wiring.

WARNING

SEVERE DAMAGE WILL RESULT IF LEADS ARE INCORRECTLY CONNECTED OR IMPROPERLY INSULATED. USE EXTREME CARE IN CHECKING LEADS TO ASSURE PROPER CONNECTIONS.

TABLE 1 (10-85 KW ONLY)

CODE	VOLTAGE	OUTPUT
	"2X" GENERATOR	
4R	120/208	3ph Wye
7XR	240/416	3ph Wye
5DR	120/240	3ph Delta (Note 2)
	240/480	1ph "Zig-Zag" (Note 1)
7R	220/380	3ph Wye "Dog-Leg"
	"5X" GENERATOR	
7XR	240/416	3ph Wye
5R	240	3ph Delta
6DR	240/480	3ph Delta (Note 2)
	240	1ph Delta (Note 1)
	"6X" GENERATOR	
4XR	277/480	3ph Wye
	138/240	3ph Wye
7XR	240/416	3ph Wye "Dog-Leg"

NOTE 1: Usable output is 2/3 of normal 3ph. rating.

NOTE 2: Delta-one phase center tapped. If no 3ph output is being used, usable 1ph output is up to 2/3 of normal 3ph rating but, 1ph output must be balanced between the two output legs.

TABLE 2. VOLTAGE RATED INSTRUMENTS

AC VOLTMETER VOLTAGE	RESISTOR	METER PART NO.
150	None	302P420
300	None	302P421
600	None	302P422
750	None	302P423
RUNNING-TIME METER		
120-240 (1ph)	None	302P465
120-208 (3ph)	None	302P465
220-380 (3ph)	None	302P466
277-480 (3ph)	None	302P467
FREQUENCY METER		
120	None	302P213
208	None	302P221
240	None	302P221
240 (5R connection	304A125	302P213
220-380 (3ph)	304A125	302P213
277-480 (3ph)	304A305	302P213
480	304A305	302P213

TABLE 3. CURRENT RATED INSTRUMENTS

AC AMMETER CURRENT (AMPS)	CURRENT TRANS.	METER PART NO.
30	None	302P418
50	None	302P419
80	None	302P458
100	302P78	302P408
150	302B79	302P410
200	302B106	302P411
300	302B107	302P413
500	302B372	302P414
750	302B385	302P415

TABLE 4 NOMINAL AMPERE RATINGS OF DIFFERENT SIZE ALTERNATORS

ALWAYS USE KVA RATINGS WHEN SHOWN OR KNOWN			SINGLE PHASE		THREE PHASE				
		ONAN CODE	-1	-3	-4	-5 -5D	-7	-4X -6	-9
POWER FACTOR									
80%		UNITY	120-V	120/240-V	120/208-V	240-V 120/240-V	220/380-V	480-V 277/480-V	600-V
KW	KVA	KW/KVA	AMP	AMP	AMP	AMP	AMP	AMP	AMP
60.0	75.0	75.0	625	313	209	181	114	90	72
65.0	81.25	81.25	677	339	226	196	124	98	78
70.0	87.5	87.5	730	365	244	210	133	105	84
75.0	93.75	93.75	782	390	261	226	143	113	90
80.0	100.0	100.0	834	417	278	240	152	120	96
85.0	106.25	106.25	885	443	295	256	162	128	103
90.0	112.5	112.5	936	468	312	271	171	135	108

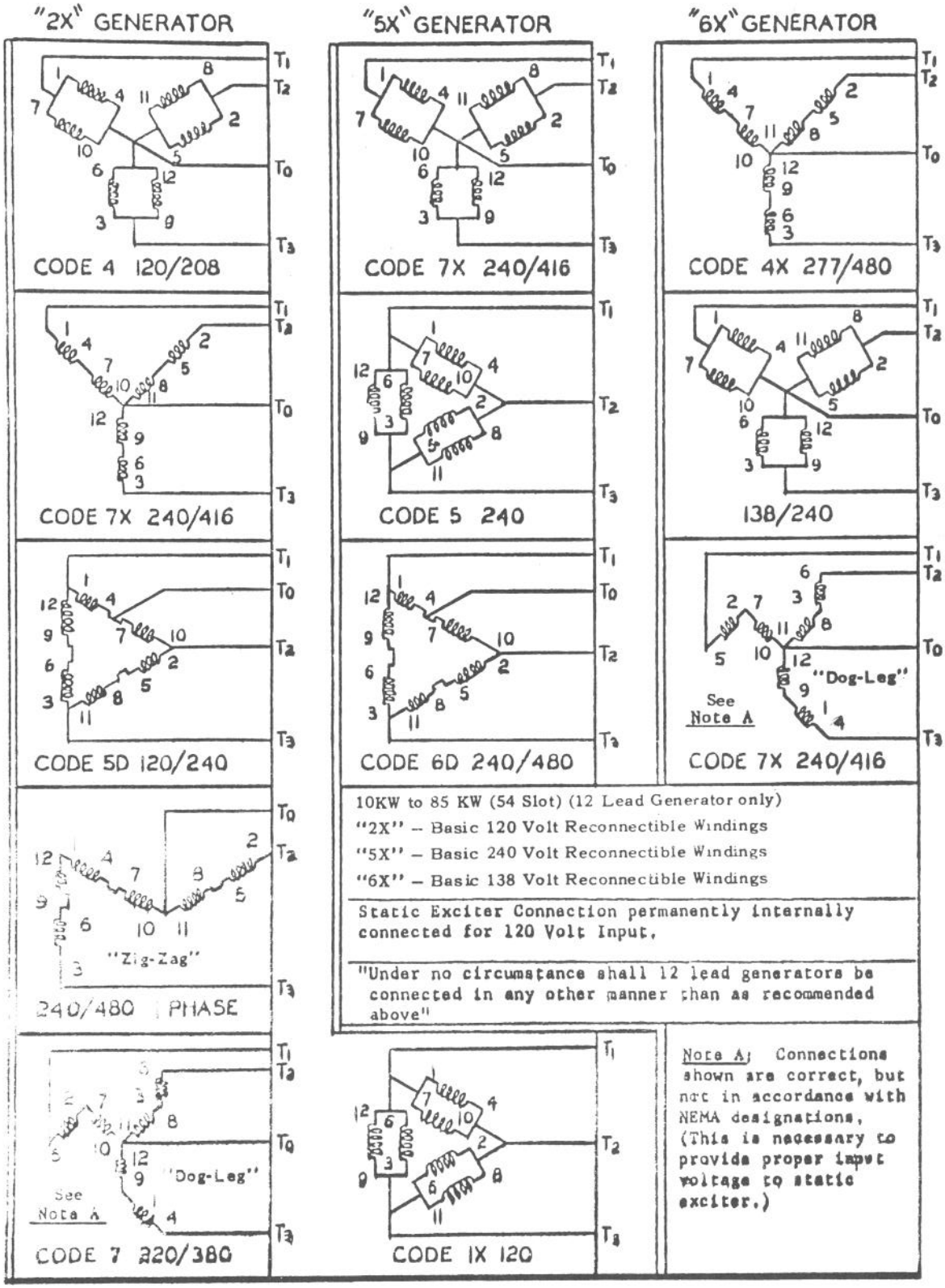


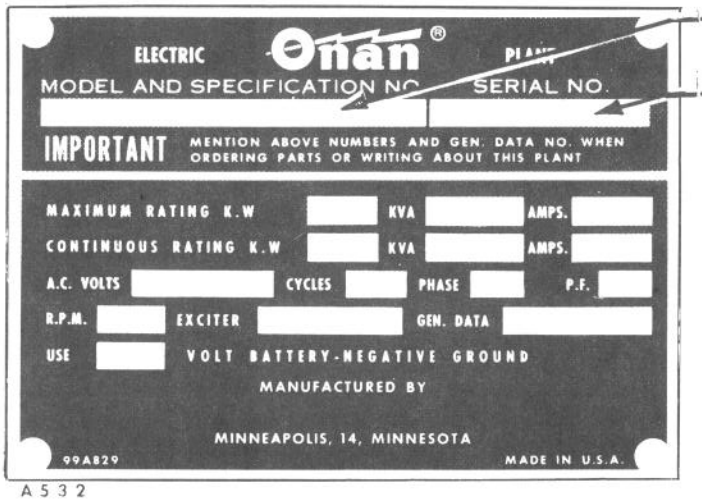
FIG. 1. RE-CONNECTION DIAGRAMS

INSTRUCTIONS FOR ORDERING REPAIR PARTS

ONAN PARTS

ALL PARTS IN THIS LIST ARE ONAN PARTS. FOR ONAN PARTS OR SERVICE, CONTACT THE DEALER FROM WHOM YOU PURCHASED THIS EQUIPMENT OR REFER TO YOUR NEAREST AUTHORIZED SERVICE STATION.

TO AVOID ERRORS OR DELAY IN FILLING YOUR PARTS ORDER, PLEASE FURNISH ALL INFORMATION REQUESTED. REFER TO THE ONAN NAMEPLATE ON YOUR PLANT. ONAN NAMEPLATE IS LOCATED ON THE UPPER RIGHT SIDE OF THE FLYWHEEL HOUSING. ALWAYS GIVE THE COMPLETE:



A532

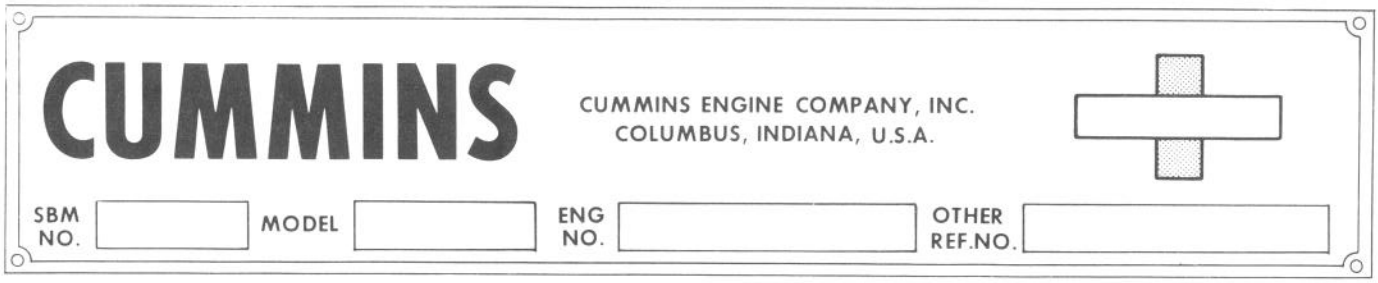
MODEL & SPEC NO.
and
SERIAL NO.

CUMMINS PARTS

ALL CUMMINS PARTS MUST BE ORDERED FROM THE CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA OR THEIR NEAREST AUTHORIZED CUMMINS DISTRIBUTOR OR DEALER.

REFER TO THE CUMMINS ENGINE NAMEPLATE LOCATED ON THE GEAR COVER ON THE RIGHT SIDE OF THE ENGINE AS VIEWED FACING THE RADIATOR END.

WHEN ORDERING PARTS OR REQUESTING SERVICE INFORMATION, SUPPLY CUMMINS WITH ALL INFORMATION STATED ON THE ENGINE NAMEPLATE.



PARTS CATALOG

DFB SERIES

This parts catalog applies to the standard ONAN DFB Series electric generating plants. They are powered by a Cummins Model H-6 engine which is more completely described in the Cummins manual. Basically, the engine is a 6 cylinder, water cooled, diesel (compression ignition) type. The cylinder bore is 4-7/8 inches, piston stroke is 6 inches, and displacement is 672 cubic inches.

Cummins Engine parts must be selected from the appropriate Cummins parts list and parts must be secured from the Cummins Engine Company or their authorized distributor or dealer.

"Right" and "Left" sides of the Generator and Controls are determined by FACING the Radiator (Front) End.

Parts in this catalog are illustrated in groups and have reference numbers which correspond to the like number in the list for that group. Parts illustrations are typical and should not be construed to represent a particular part number.

Compare your ONAN plant nameplate MODEL and SPEC with the Plant Data Table. The Plant Data Table contains all descriptive information pertinent to this list, such as: voltage, phase, etc. which appears in the description of some parts that differ between basic models.

UNLESS OTHERWISE MENTIONED IN THE PARTS DESCRIPTION, PARTS ARE INTERCHANGEABLE BETWEEN ALL MODELS LISTED IN THE PLANT DATA TABLE.

PLANT DATA TABLE

MODEL & SPEC NO.†	ELECTRICAL DATA				
	WATTS	VOLTS	CYCLES	PHASE	WIRE
85DFB-3R8/	85, 000	120/240	60	1	3
85DFB-4R8/	85, 000	120/208	60	3	4
85DFB-4XR8/	85, 000	277/480	60	3	4
85DFB-5DR8/▲	85, 000	120/240	60	3	4
85DFB-6R8/	85, 000	480	60	3	3
85DFB-7R8/	85, 000	220/380	60	3	4
85DFB-9R8/	85, 000	600	60	3	3

† - The NUMBER after the diagonal line (/) signifies standard or optional features (1 is Standard). The LETTER ending the Model and Spec. No. is the Spec Letter and will advance with manufacturing changes. (A to B, B to C, etc.).

▲ - This is a delta-wound 240 volt model with one phase center-tapped. A limited amount of 1 phase 120/240 volt power can be utilized together with 3 phase power as long as no terminal current exceeds the rated nameplate current.

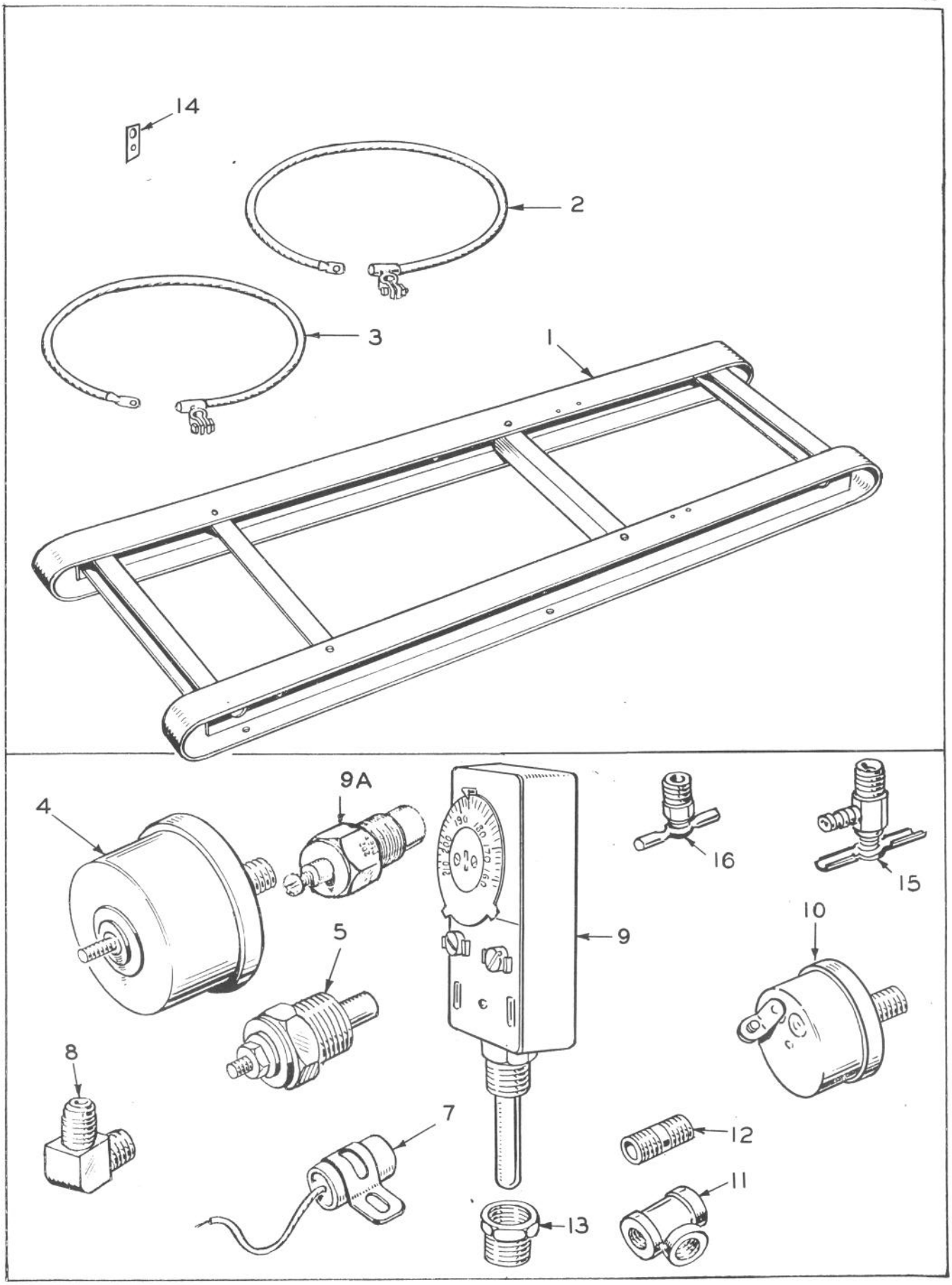


FIG. 1 - MOUNTING BASE, BATTERY CABLES & SENDER GROUP

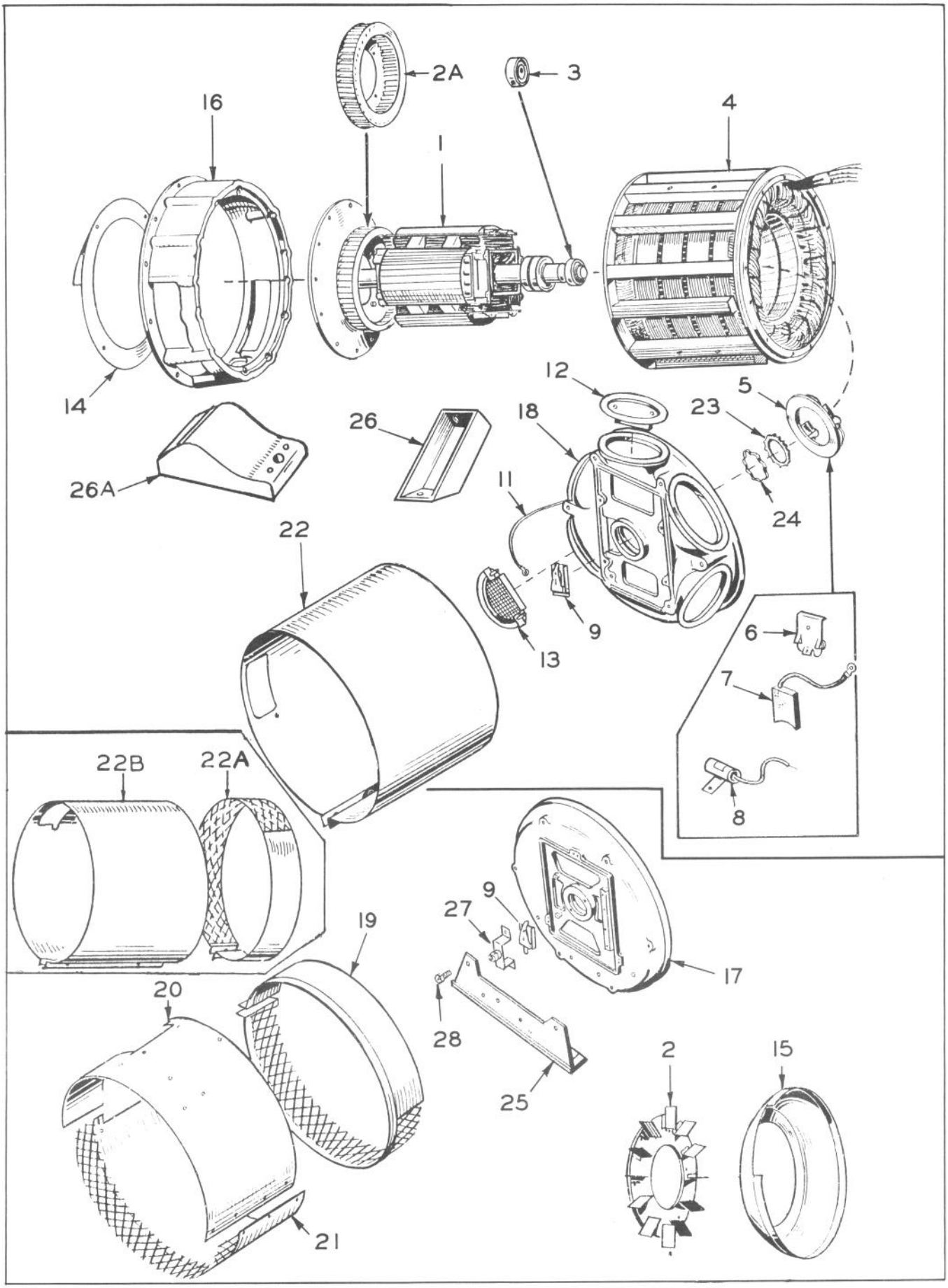


FIG. 2 - GENERATOR GROUP - Alternator Portion

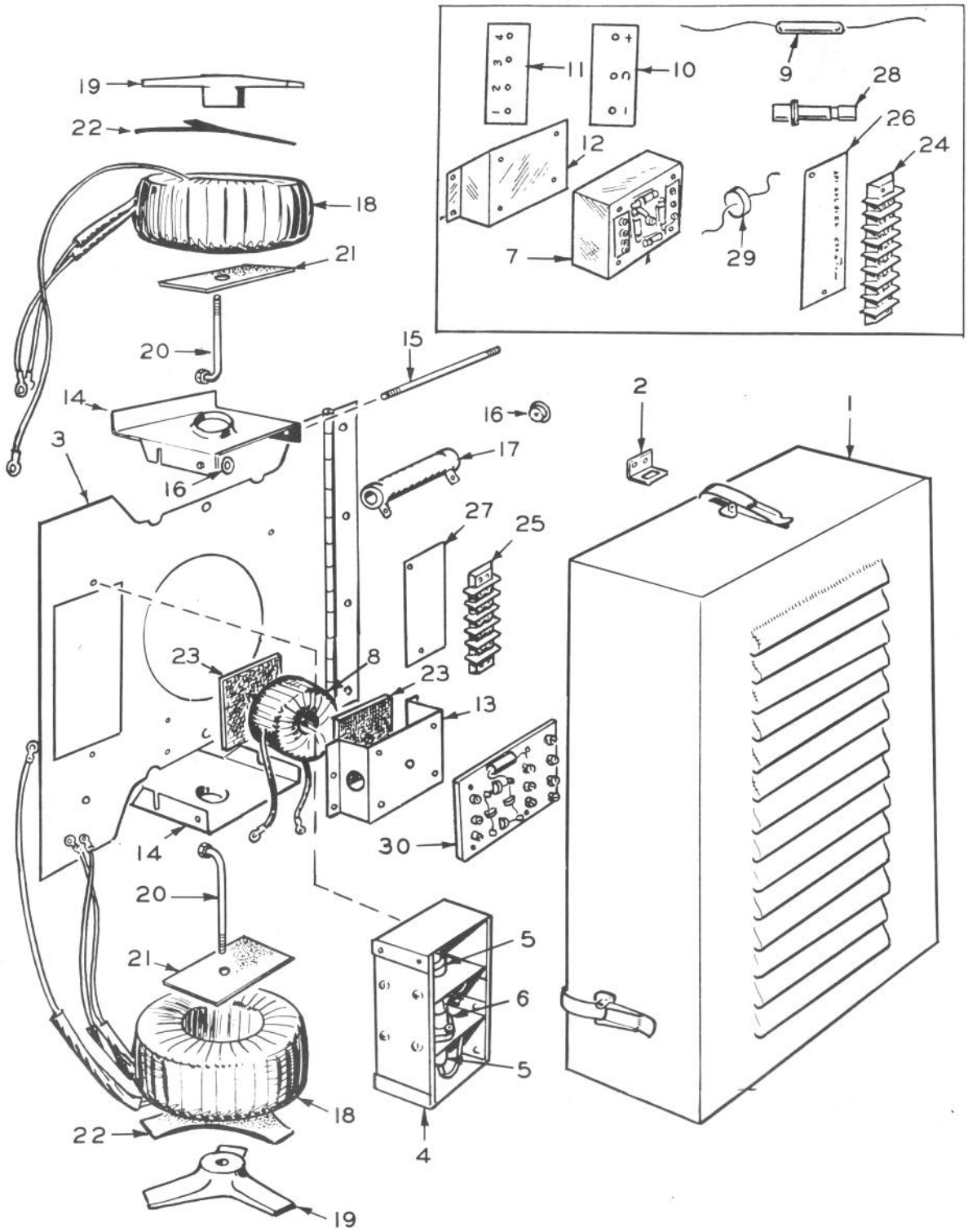


FIG. 3 - GENERATOR GROUP - EXCITER PORTION (SINGLE PHASE)

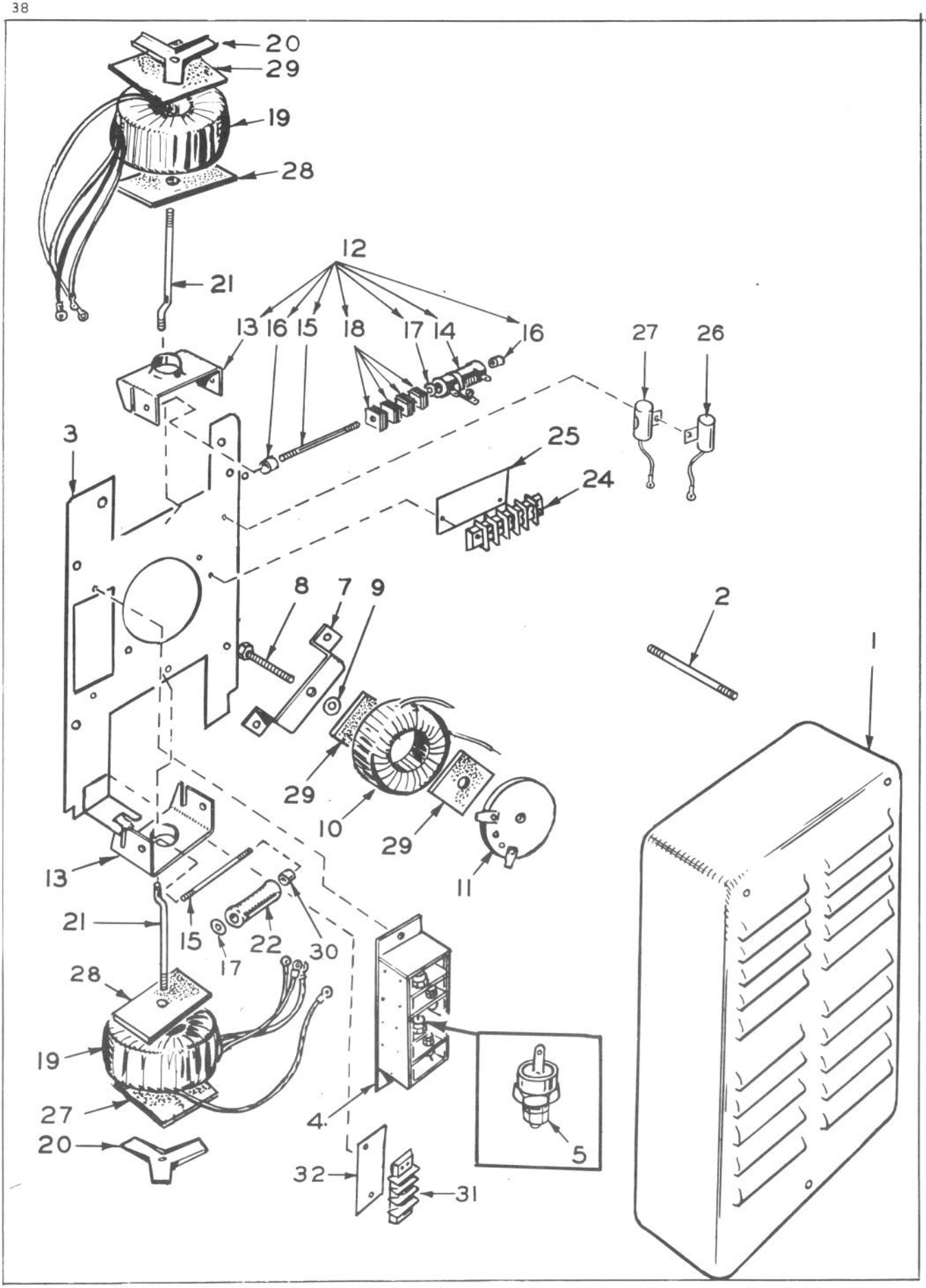


FIG. 4 - GENERATOR GROUP - EXCITER PORTION (THREE PHASE)

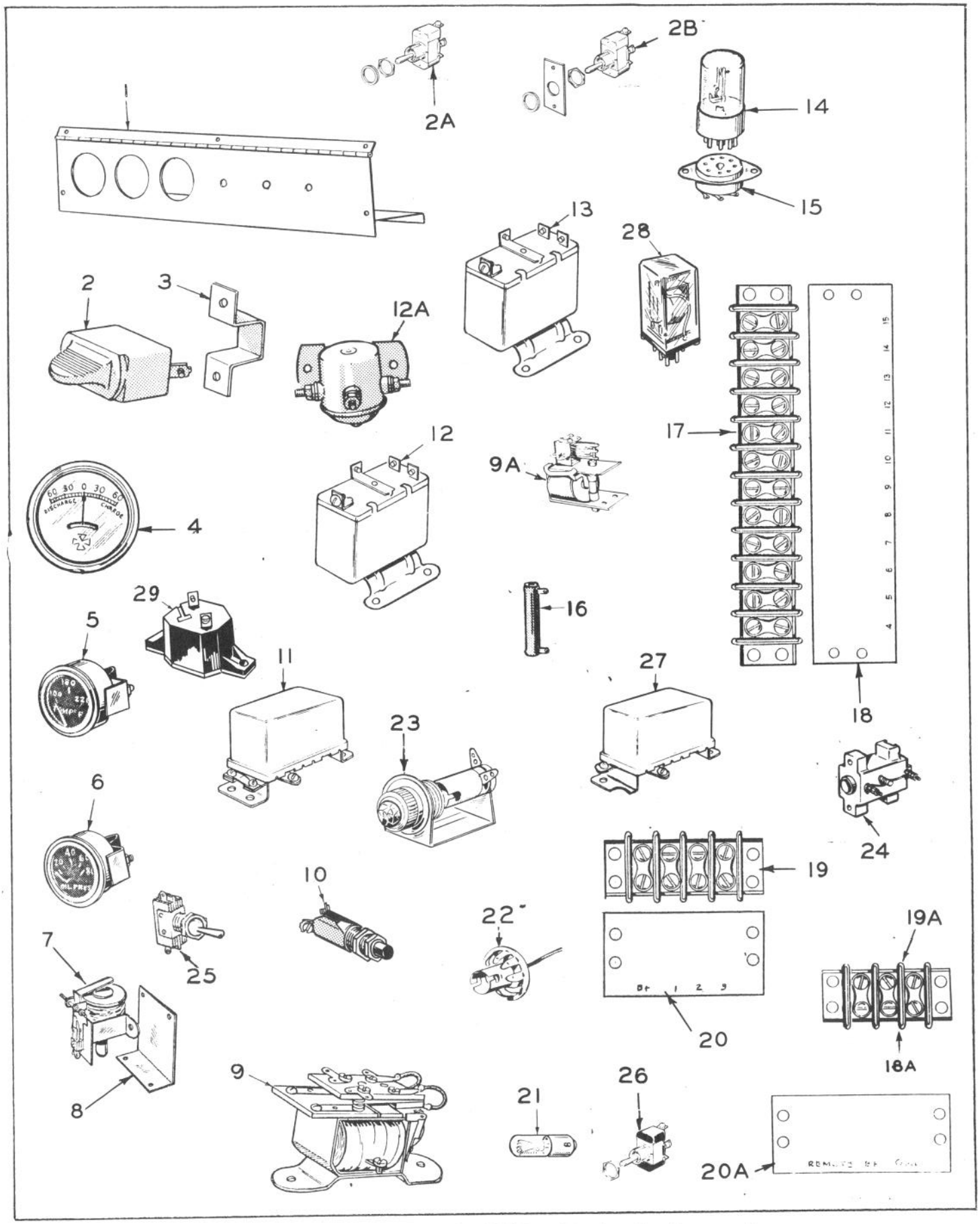


FIG. 5 - CONTROL GROUP - Engine Instruments

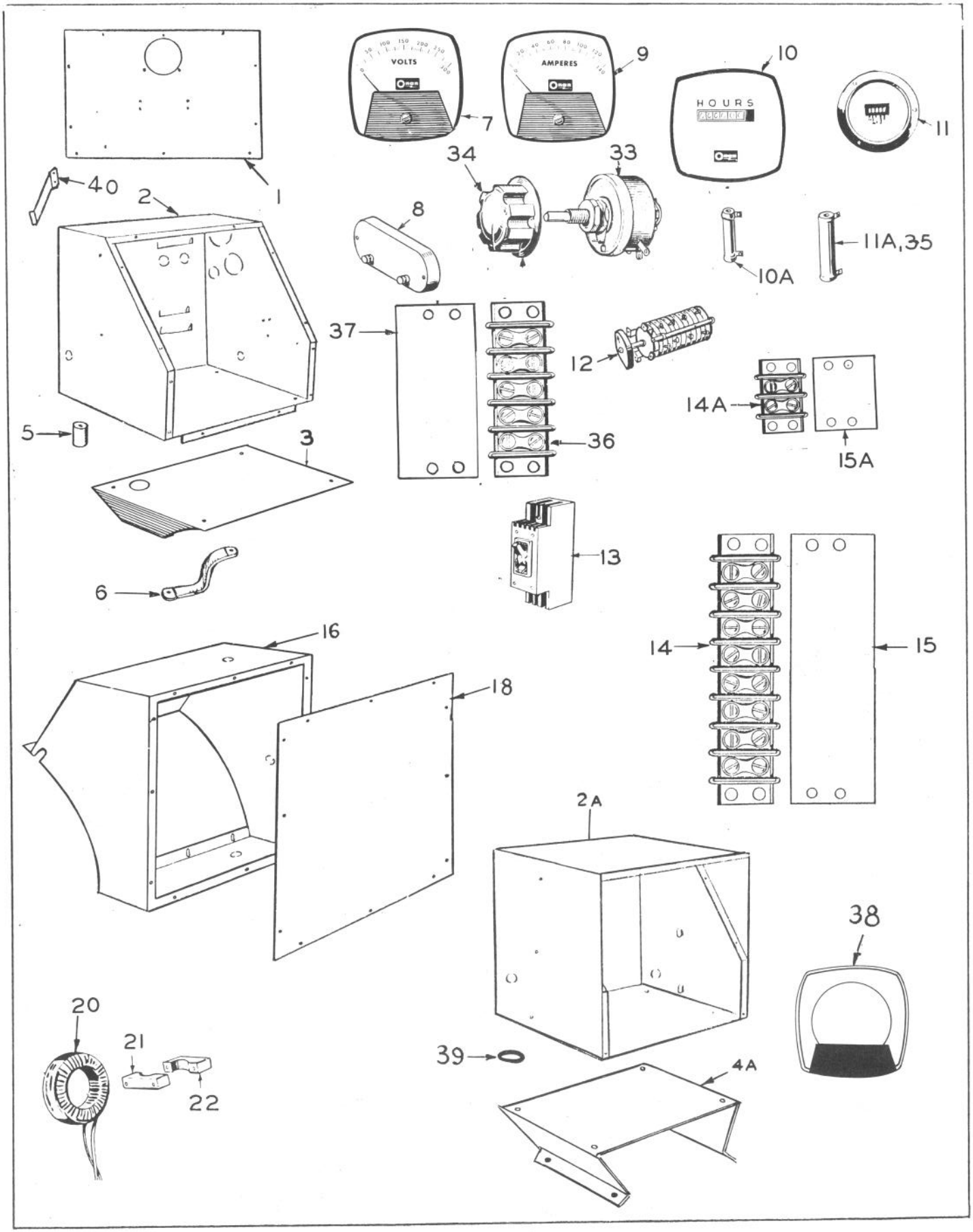


FIG. 6 - CONTROL GROUP - AC Output

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			REPLACEMENT ENGINE
			Engine, Replacement (Cummins Engine Company NHC-4)-
	100P257	1	Spec "A" Models only (With Engine to Generator Adapter) Flywheel Housing SAE #1.
	100P435	1	Begin Spec "B" Models only (Without Generator Adapter) Flywheel Housing SAE #2.
			General Description:
			Includes - Complete Cylinder Block; Fuel Pump; Air Cleaner; Fuel Filter; Oil Filter; Starter; Charge Generator & Voltage Regulator; Governor; Radiator; Water Pump; Fan Blades & Belt; Fan Guard; Exhaust Manifold; Flywheel Housing; and Engine Supports.
			Excludes - Generator Adapter; Throttle Control; Engine Wiring; Oil Pressure & Water Temperature Gauge Senders; and Mounting Base.
			FIG. 1 - MOUNTING BASE, BATTERY CABLES & SENDER GROUP
1			Base, Mounting -
	403C560	1	Prior to Spec "D".
	403C681	1	Begin Spec "D".
2	416A444	2	Cable, Battery - Positive.
3	416A445	2	Cable, Battery - Negative.
4	193A108	1	Sender, Oil Pressure Gauge - Engine Sending Unit Only.
5	193A109	1	Sender, Water Temperature Gauge - Engine Sending Unit Only.
7	312A58	2	Condenser - .1 Mfd. (1) Charge Generator, (1) Charge Regulator - Replaces 312A15.
8	502-218	1	Elbow, Male (5/8 x 1/2) Brass - Fuel Inlet to Injection Pump (Early models only).
9	309B1	1	Switch, High Water Temperature Cut-off - Order 309A146.
9A	309A146	1	Switch, High Water Temperature Cut-off - Non-adjustable Replaces 309B1.
10	309B64	1	Switch, Oil Pressure.
11	505-59	1	Tee, Pipe (1/8") Oil Pressure Gauge Sender and Switch Mounting.
12	505-98	1	Nipple, Close (1/8" x 3/4") Mounts Tee to Block.
13	505-19	1	Bushing, Pipe Reducer (1/2" to 3/8" High Water Temperature Switch - Used only with 309B1.
14	191A214	1	Connector, Starter Terminal (1" x 2" Copper Strip).
15	504-17	1	Valve, Radiator Drain.
16	504-3	1	Valve, Block Drain.

PARTS LIST

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION

FIG. 2 - GENERATOR GROUP (Alternator Portion)

NOTE: A - Output Terminal Box, Cover & Internal Parts are Listed with the AC Output Control Group (Mounts on Side of Generator).
B - Parts marked with the symbol (*) apply ONLY to Later models WITH the STATIC TYPE EXCITER. For like parts used on early models with Rotating Type Exciter, order by description, giving Model, Spec and Serial Number from ONAN Nameplate.

1	★	1	Rotor Assy., Incl. Brg., Blower & Dr. Assy.
			Blower -
2	205C61	1	Single Phase Models.
2A			3 Phase Models -
	205B55	1	Prior to Spec "D".
	205C49	1	Begin Spec "D".
3			Bearing.
	510P63	1	Prior to Spec "E".
	510P88	1	Begin Spec "E".
4	★	1	Stator Assembly, Wound.
5	212C248	1	*Rig Assembly, Brush - Includes Brushes, Springs & hardware (Does not include condenser).
6	212B1105	4	Spring, Brush.
7	214A56	4	*Brush.
8	312A17	1	*Condenser - 0.5 Mfd.
9	150A717	1	*Switch Assembly, Overspeed.
11	★	1	Lead, Overspeed Switch.
			Cover, End Bell Opening - Includes Latch & Bracket - 3 Phase Models Only -
12	232B1254	2	Plain.
13	232B1253	2	Screened.
14			Scroll, Air - 3 Phase Models Only -
	232C1271	1	Prior to Spec "D".
	234C84	1	Begin Spec "D".
15	234D69	1	Baffle, Air - Single Phase Models Only.
16	231D70	1	Adapter, Engine to Generator - 3 Phase Models Only.
			*Bell, End - Alternator to Exciter.
17	211D153	1	▲Single Phase Models.
18	211E131	1	3 Phase Models.
		1	*Band, Generator -
19	234D70	1	Single Phase Models (Front Portion - Narrow).
20	234D132	1	Single Phase Models (Rear Portion - Wide) Upper Half - Replaces 234D92.
21	234C133	1	Single Phase Models (Rear Portion - Wide) Lower Half - Replaces 234D91.
22	232C1221	1	3 Phase Models (Includes Channel Rubber) - Prior to Spec "D".

* - See Note "B" at beginning of this group.
★ - Order by description, giving Model, Spec and Serial Number (ONAN Nameplate).
▲ - To order end bell for single phase plants prior to Spec "E", also order 232A1807 Ring, 232A1808 Spring, 510P88 Bearing, 526A17 Spacer, and 812-192 Screw.

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			FIG. 2 - GENERATOR GROUP (Alternator Portion) (Cont.)
22A	234C83	1	3 Phase Models, Begin Spec "D" - Front Portion - Narrow.
22B	234D81	1	3 Phase Models, Begin Spec "D" - Rear Portion - Wide.
23		1	Holder, Bearing - Anti-Rotation.
	232A1186	1	Prior to Spec "E".
	232A1808	1	Begin Spec "E".
24		1	Spring, Bearing Holder - Anti-Rotation.
	232A1187	1	Prior to Spec "E".
	232A1807	1	Begin Spec "E".
25	232D1396	1	Bracket, Generator Support - Single Phase Models.
26	232A1493	2	3 Phase Models - Prior to Spec "D".
26A	232C1556	2	Pad, Generator Support - 3 Phase Models Begin Spec "D".
27	150A713	1	*Bracket, Overspeed Switch (Includes Contact Point) Single Phase Models (Note: For 3 Phase Models, See Fig. 3 - Exciter Portion).
28	805-35	4	Bolt, Place - Generator Support Bracket Mounting - Single Phase Models.

* - See Note "B" at beginning of this group.

FIG. 3 - GENERATOR GROUP (Exciter Portion) Single Phase Models

NOTE: This group covers only the "Static" type exciter. Some early models were built with a "Rotating" type exciter. For models with the "Rotating" type exciter, contact the factory direct. Order parts by description and be sure to include the complete Model & Spec and Serial Number as stated on the Onan Nameplate.

1			Cover, Exciter.
	234D73	1	Prior to Spec "C".
	234D116	1	Begin Spec "C".
2	232A1376	3	Bracket, Fastening - Exciter Cover to Alternator End Bell.
3	234D74	1	Panel Only, Exciter.
4			Rectifier Assembly, Power (Complete) Includes four Rectifiers plus Wire and Hardware.
	305B206	1	Prior to Spec "C".
	305B228	1	Begin Spec "C".
			Rectifier Only, Power (Field) Included in Rectifier Assembly.
5	305P234	4	Prior to Spec "C" - Replaces 305-205.
5	305P234	2	Begin Spec "C" (Positive) - Replaces 305P225.
6	305P233	2	Begin Spec "C" (Negative) - Replaces 305P236.

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			FIG. 3 - GENERATOR GROUP (Exciter Portion) Single Phase Models (Cont.)
			Reactor, Voltage Control.
7	315B53	1	Prior to Spec "C" (Includes #304-443 Resistor and four Rectifiers #305-203).
8	315A78	1	Begin Spec "C".
9			Resistor, Voltage Control Reactor.
	304-443	1	Prior to Spec "C" (Included in #315B53 Reactor).
	304P476	1	Begin Spec "C" (Included in #305B227 Assembly).
			Strip, Marker - Voltage Control Reactor Connections.
10	332A644	1	Prior to Spec "C" (Marked +, C, -).
11	332A645	1	Prior to Spec "C" (Marked 1, 2, 3, 4).
			Bracket, Mounting - Voltage Control Reactor.
12	232B1404	1	Prior to Spec "C".
13	234B115	1	Begin Spec "C".
14	234B75	2	Bracket, Gate Reactor Mounting.
15	520A190	1	Stud, Resistor Mounting.
16	304A15	2	Washer, Resistor Centering.
17	304-442	1	Resistor, Fixed - Mounts to Gate Reactor Bracket.
18	315A51	2	Reactor, Gate.
19	232B1389	2	Retainer, Gate Reactor.
20	232A1403	2	Stud, Gate Reactor Mounting.
21	232B1388	4	Insulation, Gate Reactor to Bracket.
			Insulation, Reactor Mounting.
22	232B1387	4	Gate Reactor to Retainer.
23	895-70	2	Voltage Control Reactor Mounting - Begin Spec "C" - SPECIFY size required.
			Block Terminal
24	332A503	1	Prior to Spec "C" (8 Place).
25	332A532	1	Begin Spec "C" (5 Place).
			Strip, Terminal Block Marker.
26	332A643	1	Prior to Spec "C".
27	332A693	1	Begin Spec "C".
			Rectifier, Voltage Control Reactor.
28	305-203	4	Prior to Spec "C" (Included in #315B53 Reactor).
29	305P218	4	Begin Spec "C" (Included in #305B227 Assembly).
30	305B227	1	Resistor Assembly, Rectifier and (Includes #304P476 Resistor and 4 Rectifiers #305P218).

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION

FIG. 4 - GENERATOR GROUP (Exciter Portion) 3 Phase Models

NOTE: This group covers only the "Static" type exciter. Some early models were built with a "Rotating" type exciter. For models with the Rotating" type exciter, contact the factory direct. Order parts by description and be sure to include the complete Model & Spec and Serial Number as stated on the ONAN Nameplate.

1			Cover, Exciter.
	234D59	1	Prior to Spec "C".
	234D106	1	Begin Spec "C".
2	520A575	3	Stud, Exciter Cover Mounting.
3			Panel Only, Exciter.
	234D100	1	Prior to Spec "C".
	234D105	1	Begin Spec "C".
4	305B212	1	Rectifier Assembly, Power (Complete) Includes four Rectifiers plus Wire and Hardware.
5	305-211	4	Rectifier Only, Power (Field) Included with Rectifier Assembly.
7	150A733	1	Bracket Only, Over speed Switch.
8	232A1365	1	Stud & Contact Point Assembly, Voltage Reactor Mounting.
9			Washer, Fibre Insulating - Voltage Control Reactor Stud Mounting.
	508-18	2	1/4" x 3/4" x 1/16".
	508-29	1	1/4" x 3/8" x 1/32".
10			Reactor, Voltage Control.
	315A49	1	Prior to Spec "C".
	315A74	1	Begin Spec "C".
11			Block, Terminal - Voltage Control Reactor.
	332A622	1	Prior to Spec "C".
	332A687	1	Begin Spec "C".
12	305B202	1	Rectifier Assembly, Resistor and (Includes parts marked † plus Wire and Hardware).
13	234B60	2	† Bracket, Gate Reactor Mounting (NOTE: 1 only included in #305B202 Assembly).
14	304A5	1	† Resistor, Control - Adjustable (150 Ohm, 25 Watt - 9/16" x 2").
15	320A579	2	† Stud, Resistor & Rectifier Mounting (NOTE: 1 only included in #305B202 Assembly).
16	232A1473	2	† Spacer, Adjustable Resistor & Rectifier to Stud (3/8" O.D. x 3/16" I.D. x 7/32" Long).
17			Washer, Resistor Centering.
	304A14	2	Adjustable Resistor Mounting.
	304A15	2	Fixed Resistor Mounting.

† - Included in #305B202 Rectifier Assembly.

PARTS LIST

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			FIG. 4 - GENERATOR GROUP (Exciter Portion) 3 Phase Models (Cont.)
18	305-208	4	† Rectifier, Regulator (Control).
19	315A57	2	Reactor, Gate.
20	234B62	2	Retainer, Reactor Gate.
21	232A1361	2	Stud, Gate Reactor Mounting.
22	304A21	1	Resistor, Fixed - Mounts to Gate Reactor Bracket (200 Ohm, 50 Watt - 3/4" x 4").
24	332A604	1	Block, Terminal - 5 Place.
25	332A678	1	Strip, Terminal Block Marker - 5 Place.
			Condenser - 0.5 Mfd.
26	312A17	1	Left Hand - Prior to Spec "C".
27	312A27	1	Right Hand - Prior to Spec "C".
28	232A1051	4	Insulation, Gate Reactor to Bracket.
29	895-70	8	Insulation, Reactor Mounting (6 Gate Reactor to Retainer and 2 Voltage Control Reactor Mounting - SPECIFY size required).
30	232A1474	2	Spacer, Fixed Resistor to Stud (3/8" O.D. x 3/16" I.D. x 11/32" Long).
31	332A537	1	Block, Terminal - 4 Place - Begin Spec "C".
32	332A686	1	Strip, Block Mounting - 4 Place - Begin Spec "C".

† - Included in #305B202 Rectifier Assembly.

			FIG. 5 CONTROL GROUP (Engine Instruments Portion)
1			Panel Only, Lower Control -
	301C1608	1	Prior to Spec "D".
	301C2124	1	Begin Spec "D".
2	308-90	1	Switch, Start Stop - Used on some early models - Use 308A166.
2A	308A166	1	Switch and Adapter Assembly, Start-Stop - Replaces 308-90.
2B	308P154	1	Switch, Start-Stop - Prior to Spec "D".
3	301A974	1	Bracket, Start-Stop Switch Mounting - Used only with 308-90 Switch.
4	302-63	1	Ammeter, Charge (60-0-60).
5	193B106	1	Gauge, Water Temperature (Panel unit only).
6	193B107	1	Gauge, Oil Pressure (Panel unit only).
7			Relay, Time Delay.
	307A388	1	Prior to Spec "F".
	307A899	1	Begin Spec "F".
8	301A1685	1	Bracket, Time Delay Relay Mounting.
9	307B299	1	Relay, Emergency Stop - Prior to Spec "D".
9A	307A655	1	Relay, Latching - Emergency Stop - Begin Spec "D".
10	308-91	1	Button, Emergency Stop Re-Set - Prior to Spec "D".
11	307B4	1	Relay, Stop - Prior to Spec "D".

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
	FIG. 5 CONTROL GROUP (Engine Instruments Portion) (Cont.)		
12	307B81	2	Relay - (1) Pilot, (1) Starting Pilot - Prior to Spec "D".
12A	307B514	1	Relay - Pilot - Spec "D" through "E".
13	307B52	1	Relay, Start Disconnect.
14			Relay, Cycle Cranking - Plug in Type -
	307-502	1	Prior to Spec "D".
	307A696	1	Spec "D" through "E" - 10 Second Delay.
	307A734	1	Spec "D" through "E" - 5 Second Delay.
15	323-52		Socket, Relay -
		1	Prior to Spec "D".
		2	Begin Spec "D".
16			Resistor, Fixed -
	304-32	1	Prior to Spec "D" - Between Start-Disconnect Relay and Stop Relay - 15 Ohm 10 Watt.
	304A192	1	Begin Spec "D" - Between Start-Disconnect Relay and Cranking Limiter - 3 Ohm 10 Watt.
17			Block, Terminal
	332A607	1	12-Place - Prior to Spec "F".
	332A795	1	16-Place - Begin Spec "F".
18			Strip, Block Marker
	332A608	1	Marded 4 through 15 - Prior to Spec "F".
	332A862	1	Marked 4 through 19 - Begin Spec "F".
			Block, Terminal -
19	332A537	1	Prior to Spec "D" - 4 Place.
19A	332A611	1	Begin Spec "D" - 3 Place.
			Strip, Block Marker -
20	332A566	1	Prior to Spec "D" - 4 Place - (B+, 1, 2, 3).
20A	332A762	1	Begin Spec "D" - 3 Place - (Remote, B+, Grd.).
21	322-4	3	Bulb, (2) Panel Lights (1) Pilot Light - Begin Spec "D".
22	322P72	2	Receptacle, Panel Lights - Begin Spec "D".
23	322P69	1	Receptacle Assembly, Pilot Light - Begin Spec "D".
24	320A104	1	Breaker, Circuit - Cranking Limiter - Begin Spec "D".
25	308-2	1	Switch, Panel Lights - Begin Spec "D".
26	308P138	1	Switch, Run-Stop-Remote - Begin Spec "D".
27	307B597	1	Relay, Fuel Solenoid - Spec "D" thru "E".
28	307P820	1	Relay, Fuel Solenoid - Begin Spec "F".
29	320P240	1	Breaker, Circuit-Starter Motor - Begin Spec "F".
	FIG. 6 - CONTROL GROUP (AC Output Portion)		

NOTE: This group is to be used only on standard units with the "Static" type Generator Exciter. For models with the "Rotating" type Generator Exciter, contact the factory direct. Order control parts by description and be sure to include the complete Model & Spec and Serial Number as stamped on the ONAN Nameplate.

1	★	1	Panel Only, Upper Control.

★ - Describe part when ordering and give Model and Serial Number.

PARTS LIST

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION

FIG. 6 - CONTROL GROUP (AC Output Portion) (Cont.)

			Box Only, Control -
2	301D1537	1	Prior to Spec "D".
2A	301D2115	1	Begin Spec "D".
3	301C2539	1	Bracket, Control Box Mounting - Replaces 2 Piece Brackets - All 3 Phase Models.
4A	301C1830	1	Bracket, Control Box Mounting - Single Phase Models - Begin Spec "D".
5	402-78	4	Rubber, Mounting - Control Box to Mounting Bracket.
6	337A44	1	Strap, Ground.
7			Voltmeter, AC (Check VOLTMETER Scale - Select according to rating).
	302P421	1	Voltmeter Scale Reads 0-300 - Replaces 302-41.
	302P422	1	Voltmeter Scale Reads 0-600 - Replaces 302-42.
	302P423	1	Voltmeter Scale Reads 0-750.
8	302-157	1	Multiplier, Meter (Resistor) Use only with 0-500 Scale Voltmeter.
9			Ammeter, AC (Check AMMETER Scale - Select according to rating).
	302P410	1	Ammeter Scale Reads 0-150 - Replaces 302-12.
	302P411	1	Ammeter Scale Reads 0-200 - Replaces 302-13.
	302P413	1	Ammeter Scale Reads 0-300 - Replaces 302-14.
	302P414	1	Ammeter Scale Reads 0-500 - Replaces 302-371.
10			Running Time Meter -
	302-212	1	Prior to Spec "D" - (NOTE: When used to replace #302-387 on plants requiring a resistor, also order #304A99 for 120/240 Volt Models).
			Begin Spec "D" -
	302P465	1	120/240 Volt - Single Phase Models.
	302P465	1	120/208 Volt, 120/240 Volt, and 600 Volt - 3 Phase Models.
	302P466	1	220/380 Volt - 3 Phase Models.
	302P467	1	277/480 Volt - 3 Phase Models.
10A			Resistor, Running Time Meter - Used only on Models Specified -
	304A444	1	120/240 Volt - 3 Phase Models - Prior to Spec "C" (Used with #302-387 Meter).
	304A125	1	480 Volt Models (Used with 302-212 Meter) - Prior to Spec "D".
	304A99	1	220/380 Volt Models (Used with #302-212 Meter) - Prior to Spec "D".
	304A402	1	600 Volt Models - Begin Spec "D" - (Use with 302P465 Meter).
11	302-213	1	Meter, Frequency - 60 Cycle.

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			FIG. 6 - CONTROL GROUP (AC Output Portion) (Cont.)
11A			Resistor, Frequency Meter - Used only on Models Specified.
	304A125	1	120/240 Volt - 3 Phase - Prior to Spec "C".
	304A125	1	220/380 Volt Models.
	304A305	1	480 Volt, and 277/480 Volt Models.
	304A402	1	600 Volt Models.
12	308-22	1	Switch, Voltage and Current Selector - 3 Phase Only.
13			Breaker, Circuit -
	320B170	1	Single Phase Models - 18 Amp.
	320B18	1	3 Phase Models - 20 Amp
			Block, Terminal -
14	332A503	1	8 Place.
14A	332A333	1	2 Place (Used only on 220/380 Volt Models).
			Strip, Terminal Block Marker -
15	332A601	1	8 Place.
15A	332A600	1	2 Place (Used only on 220/380 Volt Models).
16			Box Only, Output Terminal - Mounts on Side of Generator -
	301E1675	1	Single Phase Models.
	301D1209	1	3 Phase Models.
18			Cover, Output Terminal Box -
	301B1676	1	Single Phase Models.
	301B1190	1	3 Phase Models.
20			Transformer, Current (Mounts in Output Terminal Box) Check TRANSFORMER Nameplate - Select according to rating -
	302B79	3	Transformer Nameplate Reads "Ratio 150/5" (Use with 0-150 AC Ammeter).
	302B106	3	Transformer Nameplate Reads "Ratio 200/5" (Use with 0-200 AC Ammeter).
	302B107	3	Transformer Nameplate Reads "Ratio 300/5" (Use with 0-300 AC Ammeter).
	302B372	2	Transformer Nameplate Reads "Ratio 500/5" (Use with 0-500 AC Ammeter).
			Clamp, Current Transformer - 3 Phase Models Only -
21	302A235	3	Inside Half.
22	302A236	3	Outside Half.
33			Rheostat, Voltage Regulator -
	303-111	1	Single Phase Models - Begin Spec "C".
	303-97	1	3 Phase Models (75 Ohm, Model "H") Begin Spec "C" - Replaces 302-97 listed in error.
34	303-32	1	Knob, Rheostat - Begin Spec "C".

PARTS LIST

REF. NO.	PART NO.	QUANT. USED	DESCRIPTION
			FIG. 6 - CONTROL GROUP (AC Output Portion) (Cont.)
35			Resistor, Voltage Regulator -
	304A484	1	Single Phase Models - Begin Spec "C" - (825 Ohm, 75 Watt).
	304A479	1	3 Phase Models (425 Ohm, 50 Watt - 3/4" x 4") Begin Spec "C".
36	332A604	1	Block, Terminal - 5 Place - Begin Spec "C".
37			Strip, Terminal Block Marking - 5 Place -
	332A689	1	120/240, and 120/208 Volt - 3 Phase Models.
	332A690	1	All Models EXCEPT 120/240, and 120/208 Volt - 3 Phase Models.
38	302B448	1	Plate, Meter Face (To give round meter square appearance.
39	508P63	1	Grommet, Control Box.
40	301A1914	1	Bracket, Panel Stop.

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