OPERATORS MANUAL AND PARTS CATALOG

FOR

Onan®

ELECTRIC GENERATING PLANTS

FT

SERIES

ONAN 2515 UNIVERSITY AVE. S. E. · MINNEAPOLIS, MINNESOTA 55414
A DIVISION OF STUDEBAKER CORPORATION
IN CANADA: ONAN GENERATORS CANADA LTD., 233 CAMPBELL ROAD, GUELPH, ONTARIO
INTERNATIONAL DISTRICT OFFICE: EMPIRE STATE BLDG., 350-5TH AVE., RM. 2204, NEW YORK 10001

960-306 12A68 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 name-plate.

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

GENERAL INFORMATION

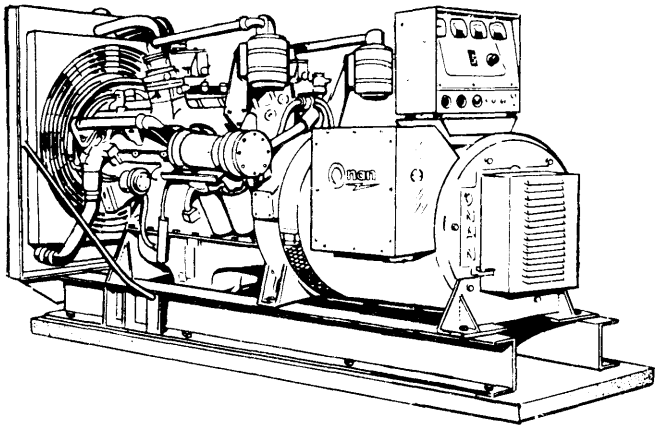
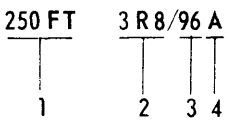


TABLE OF CONTENTS

INTRODUCTION

This manual includes instructions on the installation, operation, trouble-shooting and parts of the FT electric generating set. Identify your model by referring to the *MODEL AND SPECIFICATION NO.* as shown on the ONAN nameplate. Electrical characteristics are shown on the lower portion of the nameplate.

How to interpret MODEL and SPEC. NO.



1. Factory code for SERIES identification.
2. Combines with number 1 to identify model. Indicates model, output voltage, method of starting: E - ELECTRIC starting, R - REMOTE electric starting.
3. Factory code for designating optional equipment.
4. Specification letter. (Advances when factory makes production modifications.)

If it is necessary to contact a dealer or the factory regarding the plant, always mention the complete Model, Spec. No. and Serial No., as given on the ONAN nameplate. This nameplate information is necessary to properly identify your plant among the many types manufactured. Refer to the engine nameplate when requesting information from its' manufacturer.

Electric plants are given a complete running test under various load conditions and thoroughly checked before leaving the factory. Inspect your plant closely for loose or missing parts and any damage which may have occurred in shipment. Tighten loose parts, replace missing parts and repair any damage before putting plant in operation.

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.

IMPORTANT...RETURN WARRANTY CARD ATTACHED TO UNIT

SPECIFICATIONS

Dimension (nominal)	
Height (inches)	81 3/8
Width (inches)	55
Length (inches)	125
Weight (approximate in pounds)	10,500
Number of cylinders	12
Displacement (cu. in.)	1710
Bore (inches)	5 ½
Stroke (inches)	6
Max. BHP at 1800 rpm	408
Compression Ratio (Diesel)	12 : 1
Manufacturer (engine)	Cummins
Series	GV12-525-1P
Governor Regulation %	5
Nominal Battery Voltage	24
Battery Size	
SAE Group 8D (12 volts)	Two
Amp/Hr. SAE 20 hour Nominal	200
Solenoid Shift Starter	Yes
Engine Cooling Air (CFM at 1800 rpm)	
City Water Cooling	5000
Radiator Cooling	30,400
Combustion Air (CFM at 1800 rpm)	1560
Alternator Cooling Air (CFM at 1800 rpm)	800
Output Rated At Power Factor Load	0.8
Rating (Output in Watts)	
50 cycle AC intermittent service	210,000
50 cycle AC continuous service	170,000
60 cycle AC intermittent service	250,000
60 cycle AC continuous service	200,000
AC Voltage Regulation in ± %	2
AC Frequency Regulation in %	5
Revolving Field Alternator (4 pole)	Yes
Static Exciter	Yes
Cooling System Capacity	
Engine and Radiator (gallons)	37 ½
Engine and Heat Exchanger (gallons)	35
Engine Oil Capacity (gallons) (with filter)	18
Exhaust Connections (inches pipe thread)	4
Air Cleaner (Dry type)	Yes
Closed Crankcase Breather System	No
RPM (60 cycle)	1800
RPM (50 cycle)	1500
Battery Charging Alternator	Yes

DESCRIPTION

GENERAL

An Onan electric generating plant of the FT series is a complete unit consisting of a gas engine driving a self-excited AC generator, and such controls and accessories as specified by the purchaser.

ENGINE

The engine is a Cummins basic model GV12-525-1P as described in the Cummins manual. The specific engine used may have variations due to some of the optional equipment available as specified by the plant purchaser.

AC GENERATOR AND EXCITER

The complete generator consists of a 4 pole revolving field type alternator and a static exciter with a magnetic amplifier voltage regulator. The alternating current output is generated in the stator winding of the generator, attached to the rear portion of the engine. The alternator's rotating field, attached directly to the engine flywheel, turns at engine speed. The speed at which the rotor turns determines the current frequency, thus the 60 cycle plant must operate at approximately 1800 rpm and the 50 cycle plant at approximately 1500 rpm. The outer end of the rotor turns in a large ball bearing fitted into the end frame.

The exciter components are mounted inside a sheet metal enclosure attached to the alternator end frame. The exciter provides for almost constant AC output voltage over a wide range of load conditions. The static exciter is considerably smaller and lighter than a conventional DC generator and eliminates the necessity of an external voltage regulator, through the use of a magnetic amplifier. Some models are provided with a panel mounted rheostat control for voltage adjustment.

STANDARD ENGINE CONTROLS AND EQUIPMENT

Engine controls and equipment, which are mounted on the control box, contain components for starting, controlling and stopping the plant. Each of these controls is described below.

Run-Stop-Remote Switch: Starts and stops engine from either the plant or a remote location.

Cranking Limiter: Opens the starting circuit if engine does not start within approximately 45 seconds.

Oil Pressure Gauge: Indicates engine oil pressure. (Wired into a sending unit.)

Water Temperature Gauge: Indicates engine coolant temperature. (Wired into a sending unit.)

Emergency Latch Relay: Shuts engine off and protects from damage due to high water temperature, low oil pressure and engine overspeed. Utilizes a safety indicator light and an alarm terminal. When cause of trouble has been corrected a button must be manually reset before engine can be started again.

Automatic Overspeed Shutdown: If plant speed exceeds 2100 rpm this switch automatically actuates the latching relay and shuts down the plant.

High Water Temperature Cut-Out: If engine coolant temperature exceeds 215°F. the latching relay is energized, shutting down the plant.

Low Oil Pressure Cut-Out: Allows oil pressure buildup while starting and shuts down the plant through the latching relay if oil pressure drops below 14 psi.

Battery Charging DC Alternator: A 24 volt DC, 35 amp output charges the two 12 volt batteries necessary for starting. Also utilizes a mounted voltage regulator.

Battery Charge Rate Ammeter: Indicates the battery charging current.

AC GENERATOR CONTROLS AND EQUIPMENT

The electrical instrument panel and equipment will vary according to the model and purchaser options. The following is a brief description of each of the controls and components which are standard items.

AC Ammeter: Indicates load current connected to the generator circuit.

AC Voltmeter: Indicates the voltage of the AC output.

Voltage Adjusting Rheostat: Provides for approximately 5% plus or minus adjustment of the output voltage.

Voltmeter-Ammeter Selector Switch: Selects the phase of the generator output which is indicated by the AC ammeter and voltmeter.

Frequency Meter: Indicates the frequency of the output current in cycles per second. It can be used to check engine speed. (Each cycle per second equals 30 rpm engine speed.)

Running Time Meter: Registers the total number of hours to 1/10th. that the plant has run. Use it to keep a record of periodic servicing.

OPTIONAL EQUIPMENT

The FT electric generating plant is adaptable to automatic load transfer equipment, manual/automatic paralleling equipment and switchboards. Signal lights and alarms can be connected to warn the operator of improper operation. COOLING SYSTEM options include city water cooling (heat exchanger or standpipe), described earlier in this manual, remote mounting radiators, radiator air duct adapters and flexible coolant lines. FUEL SYSTEM options include "day" tanks, electric fuel pumps, flexible and rigid fuel lines, fuel level indicators and underground fuel tanks.

Heavy duty batteries, battery racks, mufflers, governors and engine water jacket (tank) heaters are also available. Contact factory for any other options which may be available for your unit.

INSTALLATION

GENERAL

Installations must be considered individually. Use these instructions as a general guide. Meet regulations of local building codes, fire ordinances, etc., which may affect installation details.

Installation points to consider include:

1. Adequate engine cooling air.
2. Adequate generator cooling air.
3. Adequate fresh induction air.
4. Discharge of circulated air.
5. Discharge of exhaust gases.
6. Electrical connections.
7. Fuel connections.
8. Water connections.
9. Accessibility for operation.
10. Accessibility for servicing.
11. Level mounting surface.

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a building for protection from extremes in weather conditions, and preferably heated in cold weather.

MOUNTING (FIGURES 1-5)

Plants are mounted on a rigid skid base which provides proper support and adequate vibration damping. For convenience in draining crankcase oil and general servicing, plants can be mounted on raised pedestals (at least 6" high). Extra vibration isolators are available and may be installed under the plant base. If mounting in a trailer, or for other mobile applications, bolt securely in place. Extra support for the vehicle flooring may be necessary. Bolting down is optional for stationary installations.

NOTE: *Alignment of the generator to the engine is very important. Refer to instructions. (Figures 1-4)*

VENTILATION

Plants create a considerable amount of heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but *mobile* and *indoor* installations need properly sized and positioned vents for the required air flow. See Specifications for the air required to operate with rated load under normal conditions at 1800 rpm.

Cooling air travels from the rear of the plant to the front end. Locate the room or compartment air inlet where most convenient, preferably to the rear of the plant. The inlet opening should be at least as large as the radiator area.

Engine heat is removed by a pusher fan which blows cooling air out through the front of the radiator. The cooling air outlet should be directly in front of the radiator and as close as practical. The opening size should be at least as large as the radiator area. A duct of canvas or sheet metal should be used between the radiator and the air outlet opening. The duct will prevent recirculation of heated air.

A means of restricting the air flow in cold weather should be provided to keep the room or compartment temperature at a normal point.

On city water cooled plants the conventional radiator is not used and a constantly changing water flow cools the engine. Ventilation is seldom a problem, but sufficient air movement and fresh air must be available to properly cool the generator and support combustion in the engine. For small compartments, a duct of equal or larger area is recommended to remove the heated air from the generator air outlet to the outside atmosphere. Limit bends and use radius type elbows where needed. A larger, well ventilated compartment or room does not require a hot air duct.

NOTE: *City water cooled plants are those cooled by using either a heat exchanger or a tempering tank, but not the standard radiator cooled model.*

Installations made in a small room may require installation of an auxiliary fan (connected to operate only when the plant is running) of sufficient size to assure proper air circulation.

CITY WATER COOLING (FIGURES 6-9)

An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressurized water supply. This we refer to as CITY WATER COOLING. There are two varieties of city water cooling: the HEAT EXCHANGER SYSTEM and the STANDPIPE SYSTEM.

The HEAT EXCHANGER provides for a "closed" engine cooling system. Engine coolant flows through a tubed chamber, keeping the coolant separate from the cool "raw" water supply. The coolant chamber must be filled for operation, as for a radiator cooled plant.

The STANDPIPE SYSTEM uses a mixing or tempering tank. Cooling water that circulates through the engine mixes with a source of cool "raw" water. The "raw" water supply must be free of scale forming lime or other impurities. (Cont. Page 9)

INSTALLATION ALIGNMENT FOR LARGE GENERATING PLANTS TO 250 KW

When installing ONAN electric generating plants, to 250KW, the generator must be aligned to the engine to prevent premature generator bearing failure. Align the generator according to the following instructions:

1. Set the plant on its mounting foundation. Remove the two mounting bolts which secure the generator support to the skid base (FIG. 1). Remove shims between skid base and generator support. (Use mounting bolts as jackscrews to raise generator to remove shims. Remove tension from jackscrews and allow generator to hang free.)

2. Secure the skid base to the mounting foundations.

3. Measure the clearance from the top surfaces of the skid base to both mounting surfaces of the generator support (FIG. 2). Measure the length of the generator bands, (wide and narrow bands) to determine the weight correction figure (FIG. 1 and Table 1).

4. Add clearance of skid base-to-support (FIG. 2) and weight correction figure (Table 1) to determine the total amount of generator alignment shims required. The clearances may be different for both sides of the skid base. Select shims (Table 2) required according to alignment figures.

5. Using mounting bolts as jackscrews, increase clearance between base and support to allow placing the shims between base and support (FIG. 3). Lower generator and allow to rest on shims. Total generator clearance, base to support, must equal the base-to-support clearance plus the weight correction figure.

6. Remove jackscrew bolts and install as mounting bolts through generator support, shims, and skid base. Secure and lock the mounting bolts in place (FIG. 4).

Note: The laminated shim has .002" increment. Use these shims as thick as possible to eliminate having to separate the increments.

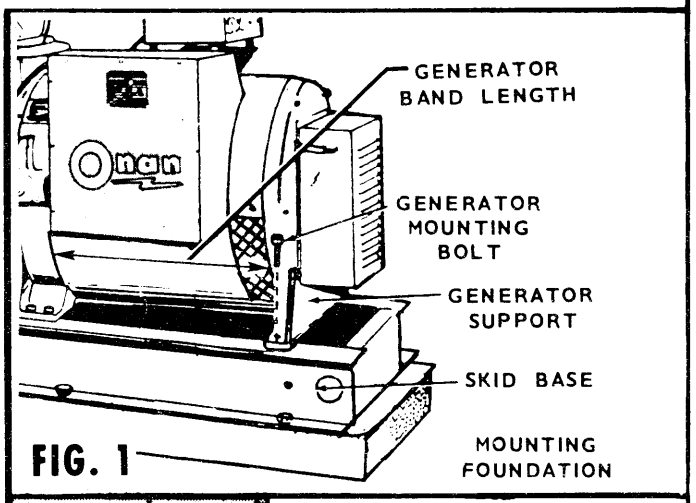


FIG. 1

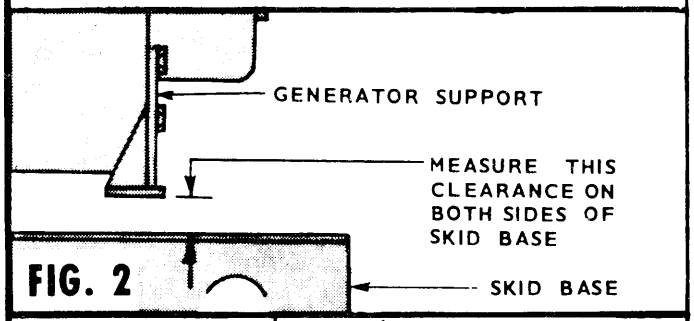


FIG. 2

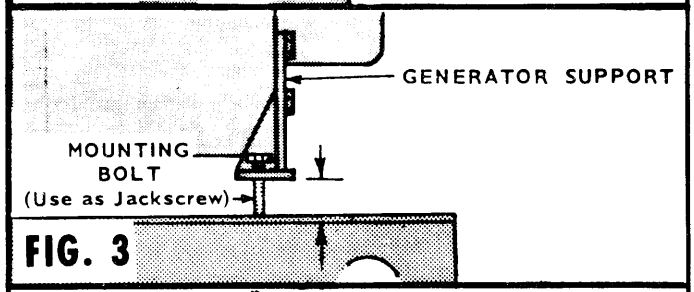


FIG. 3

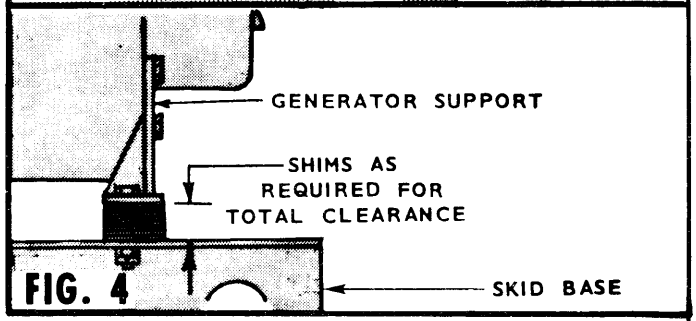


FIG. 4

TABLE 1

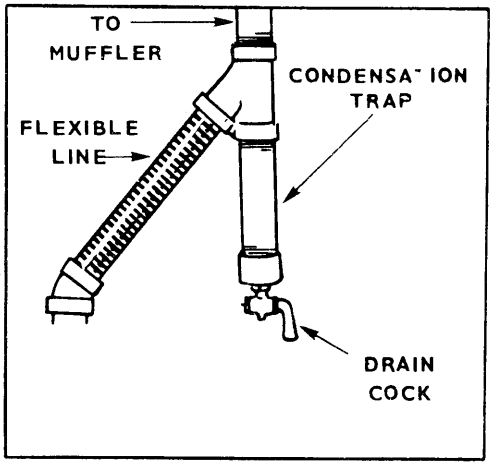
GENERATOR BAND LENGTH	WEIGHT CORRECTION FIGURE - INCH
19-1/4 to 21-1/4"	.012
23-5/8"	.014
25-5/8"	.018
28"	.026

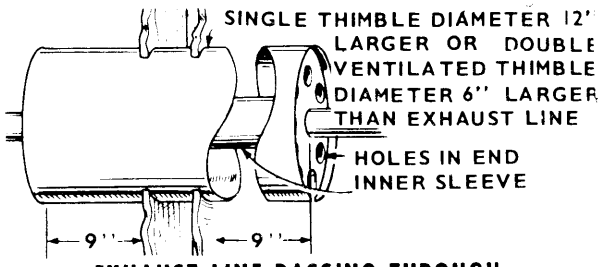
TABLE 2

SHIM PART NUMBER	THICKNESS INCH	METAL GAUGE	SIZE
232A1490	.0359	#20	3 x 3
232A1489	.0598	#16	3 x 3
232A1817	.002 to .062 (Laminated Shim) (.002 Increments)		2 x 2-1/2

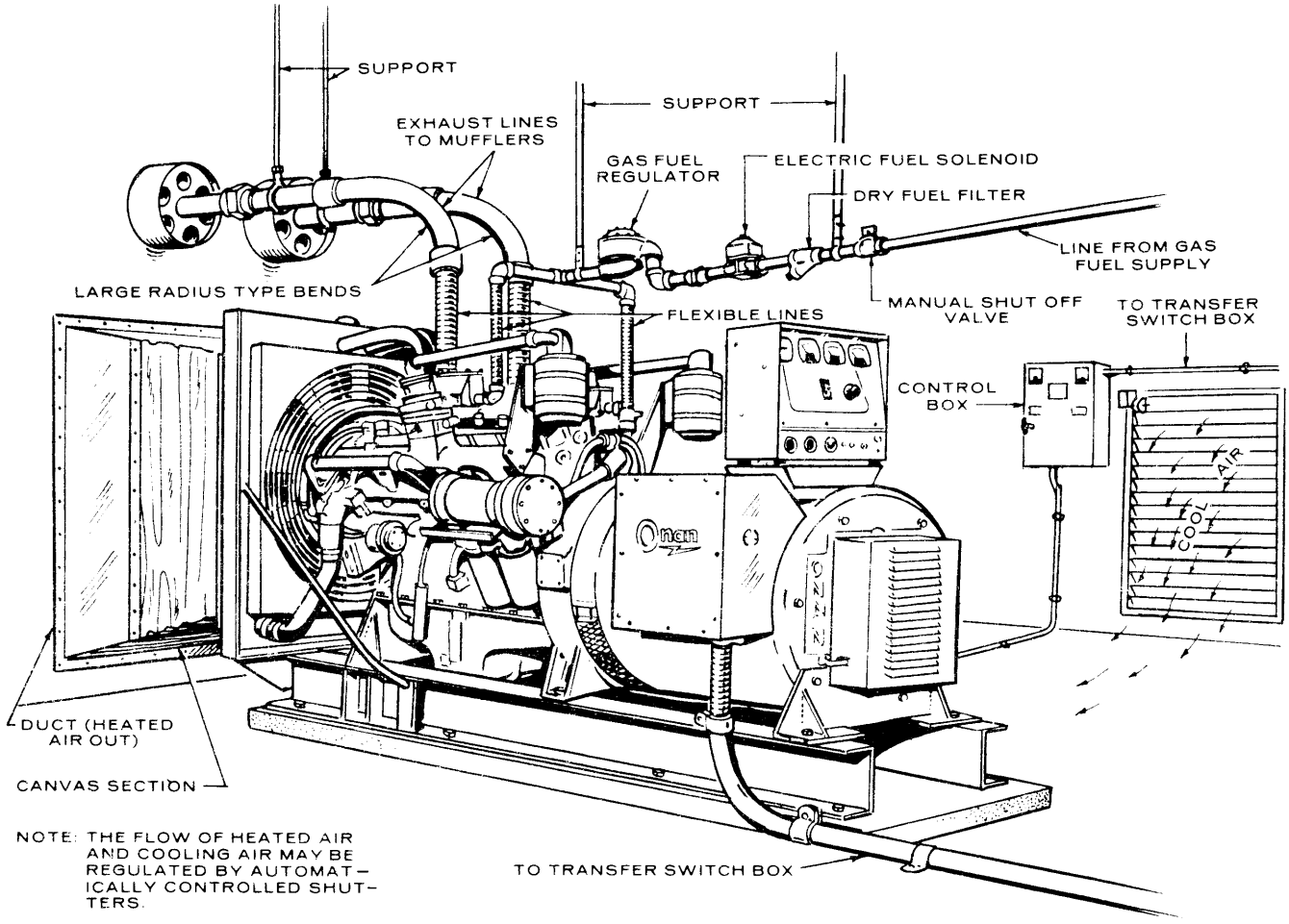
FIGURES 1-4. ALIGNING THE FT

IF EXHAUST LINE MUST BE PITCHED UPWARD CONSTRUCT A TRAP OF PIPE FITTINGS AT POINT OF RISE.





EXHAUST LINE PASSING THROUGH WALL OR PARTITION



NOTE: THE FLOW OF HEATED AIR AND COOLING AIR MAY BE REGULATED BY AUTOMATICALLY CONTROLLED SHUTTERS.

FIGURE 5. TYPICAL INSTALLATION

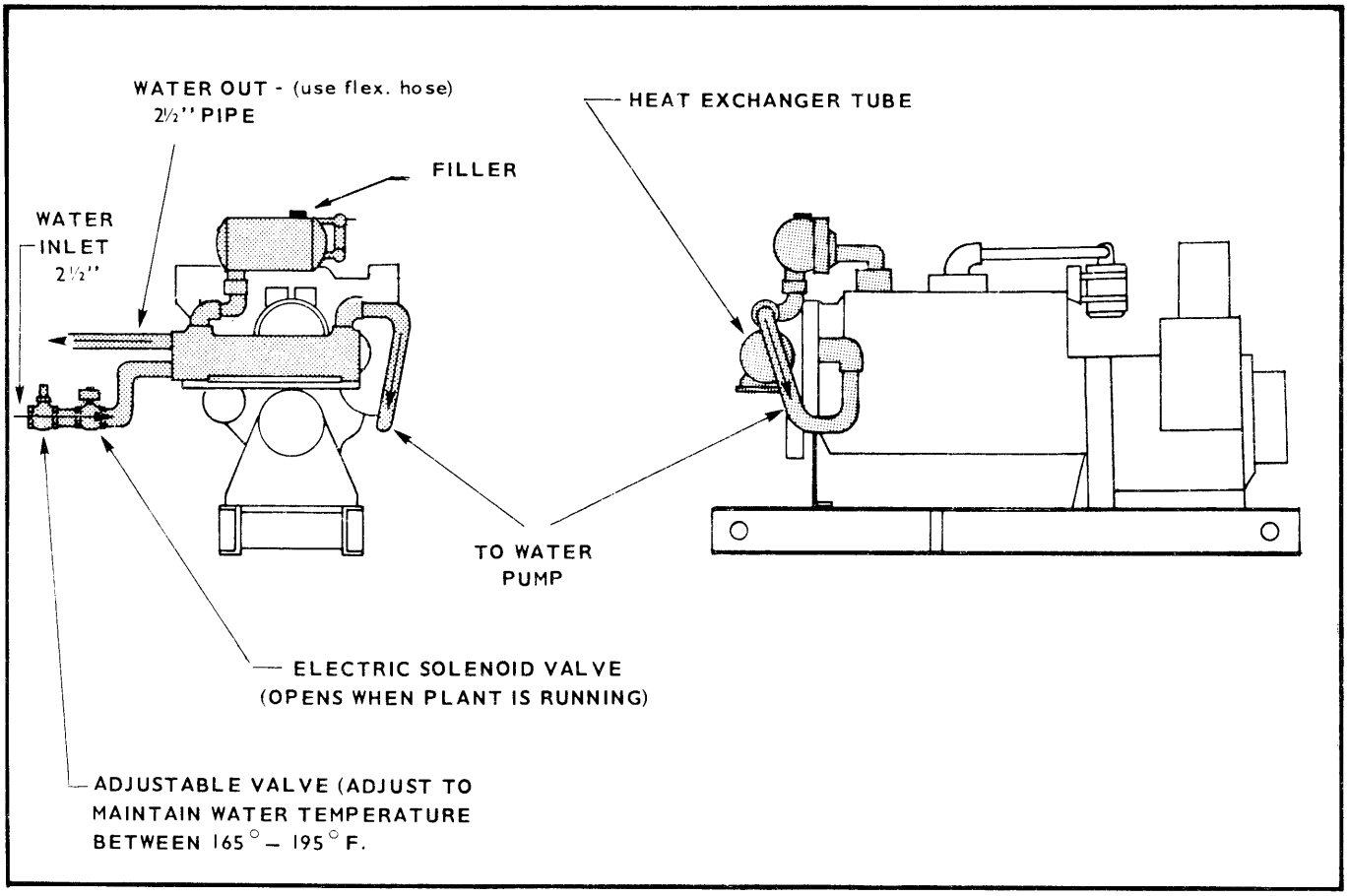


FIGURE 6. TYPICAL HEAT EXCHANGER INSTALLATION

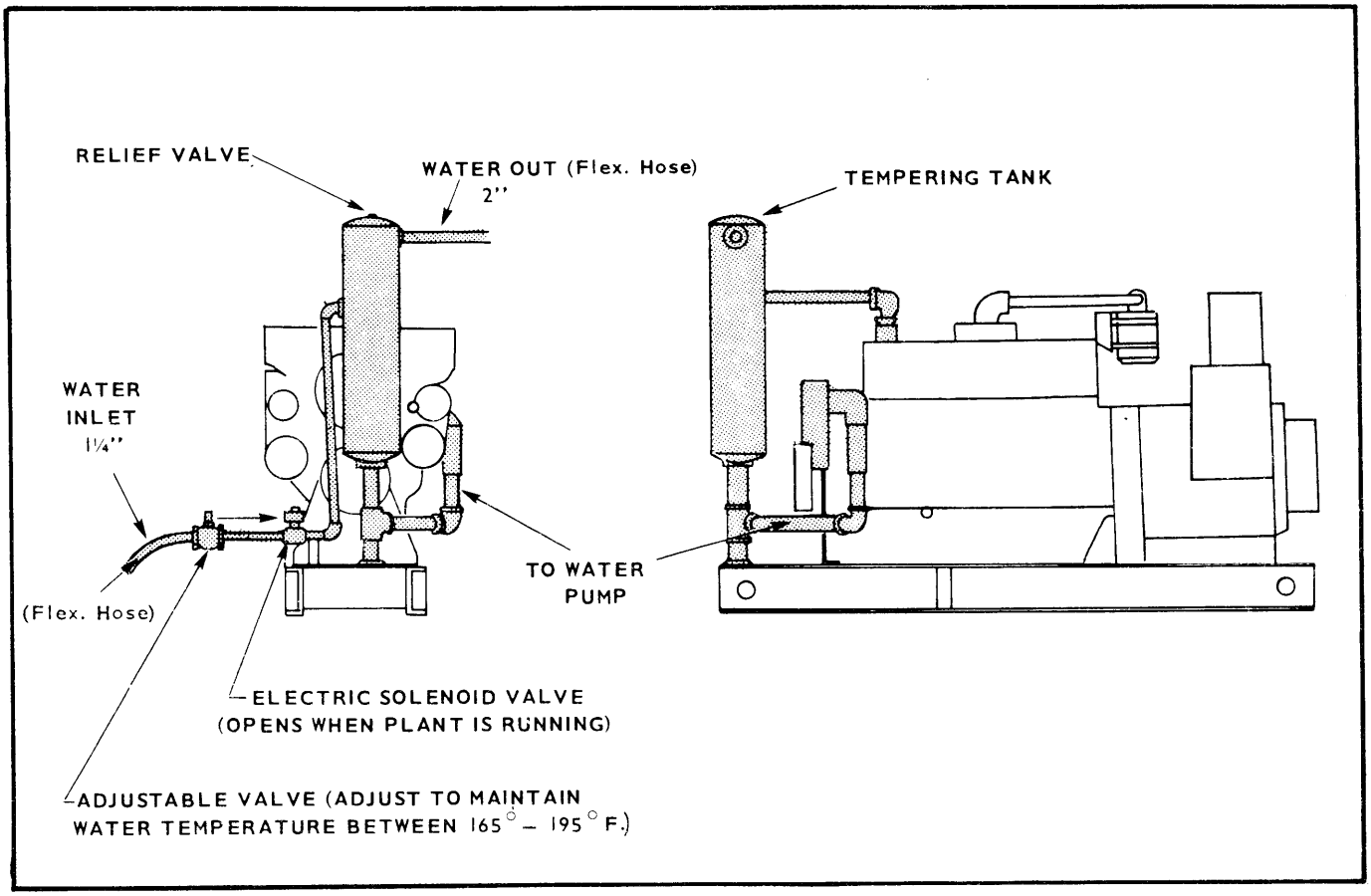


FIGURE 7. TYPICAL STANDPIPE INSTALLATION

On both systems use flexible pipe for connecting water supply and outlet flow pipes to engine. Pipe the outlet flow to a convenient drain. Install an electric solenoid valve and a rate of flow valve in the water supply line. The electric solenoid valve opens and allows water flow through the system only when the plant operates. The rate of flow valve, either automatic or manual, provides for the proper flow rate to the engine. The minimum flow rate is indicated in Figures 8 and 9. Adjust the flow to maintain water temperature between 165° and 195° while viewing the water temperature gauge.

ELECTRICAL LOAD	IF INLET WATER TEMP. IS:	THE MINIMUM FLOW (GAL/MIN) IS APPROX:
250 KW	40°	58
	60°	60
	80°	64

FIGURE 8. MINIMUM COOLANT FLOW, HEAT EXCHANGER

ELECTRICAL LOAD	IF INLET WATER TEMP. IS:	THE MINIMUM FLOW (GAL/MIN) IS APPROX:
250 KW	40°	17
	60°	20
	80°	24

FIGURE 9. MINIMUM COOLANT FLOW, STANDPIPE

IMPORTANT: *Before filling cooling system check all hardware for security. This includes hose clamps, capscrew, fittings and connections. Use flexible coolant lines when using with heat exchanger, standpipe or remote mounting radiator.*

EXHAUST

Pipe exhaust gases outside any enclosure (Figure 5). Use pipe at least as large as the 4 inch pipe size outlet of the engine. Increase the pipe diameter one pipe size for each additional 10 feet in length. Use a flexible connection at the engine exhaust manifold. Provide adequate support for the piping. Pipe fittings cause a resistance to the flow of exhaust gases and can result in a loss of engine power. Use sweeping elbows in preference to standard pipe elbows, and keep the number of necessary turns to a minimum. If the exhaust line runs upward at any point, install a vapor or condensation trap at the low point, with a provision for periodic draining. Shield or insulate the line if there is any danger of personnel contact. If the line passes close to a combustible wall or partition, allow at least 4 inch clearance. Install a suitable muffler.

FUEL CONNECTIONS (FIGURE 5)

Check local regulations governing fuel supply tank installation.

For incoming gas line, an overhead installation is recommended. Use 3 inch pipe for main fuel supply line. Install a shut-off valve and a dry fuel filter in main supply line. An electric fuel solenoid should be installed to open fuel supply when plant is energized. Install a line pressure regulator between solenoid and pressure reduction valves. Use flexible lines between "tee" and engine. DO NOT USE RUBBER HOSE. Provide proper support for entire installation. Refer to Cummins manual for additional information.

BATTERY (FIGURE 10)

Battery current of 24 volts is required for starting purposes. Use two 12 volt, type 8D batteries for a normal installation. Connect the batteries in series (negative post of first battery to positive post of second).

Connect the battery positive cable to the starter solenoid. Connect the battery negative cable to a good (paint free) ground on the engine frame. Service the batteries as necessary.

Infrequent plant use (as in emergency standby service) may allow the batteries to self-discharge to the point where they cannot start the plant. If installing a load transfer switch that has no built-in charge circuit, a separate trickle charger should be connected. Onan load transfer controls include such a battery charging circuit.

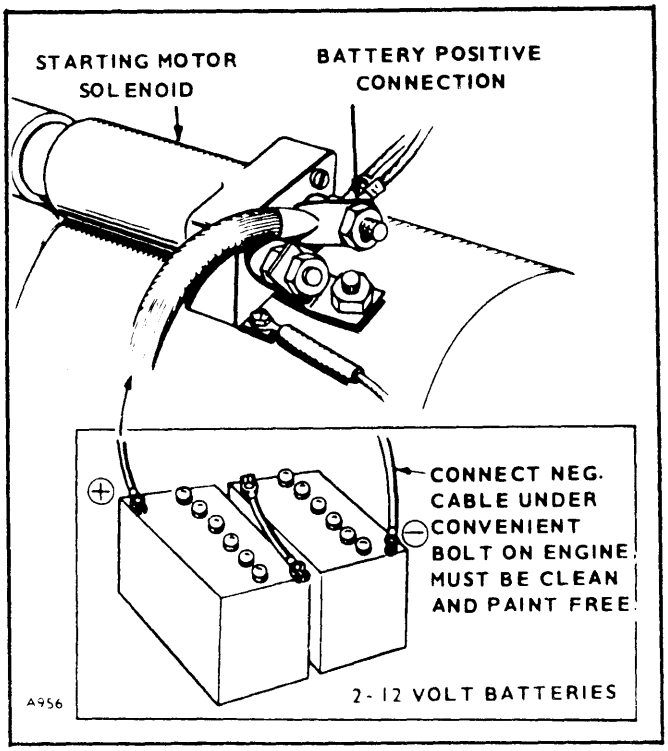


FIGURE 10. BATTERY CONNECTION

REMOTE CONTROL CONNECTIONS

Starting and stopping is through a 2 wire electrical system. To extend this control to one or several remote locations, a 3 place terminal block is provided in the plant control box. The terminal block is marked REMOTE, B+ and GND. If a load transfer or an automatic control is used, follow the instructions supplied with the control. If a SPST manual switch is used, connect the wires and mount the switch so the engine will run when the switch handle is up; the same as an ordinary light switch. The size wire to use is determined by the plant-to-control distance. Use # 18 wire up to 900 feet (Figure 11). The GND terminal is for a customer-supplied alarm at a remote location to warn of low oil pressure, high water temperature and overspeed.

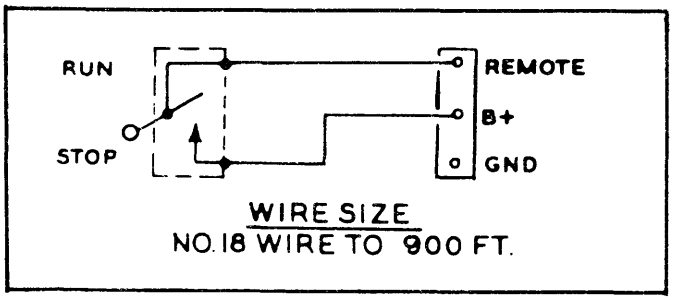


FIGURE 11. REMOTE STARTING

CONNECTING LOAD WIRES

Most local regulations require that wiring connections be made by a licensed electrician and that the installation be inspected and approved before operation. All connections, wire size, etc., must conform to requirements of electrical codes in effect at the installation site.

If the installation is for standby service, a double throw transfer switch (Figure 12) must always be used. This switch (either manual or automatic) must be connected so that it is impossible for the normal source and generator current to be connected to the load at the same time. Instructions for connecting an automatic load transfer control are included with such equipment. IT IS ASSUMED THAT PERSONNEL CONNECTING THE GENERATOR AND ANY SUCH AUXILIARY EQUIPMENT, ARE FULLY QUALIFIED AND UNDERSTAND THE PROBLEMS OF BALANCING THE CIRCUITS, GROUNDING THE PLANT, ETC. Refer to the output control wiring diagram furnished. Each generator lead is marked according to the wiring diagram.

Make load wire connections to the generator according to the type of facilities provided. If large terminal posts are provided, make load wire connection directly to the posts. Some plants are "reconnectible" for different voltages and extra leads. These are preconnected according to the nameplate ratings.

IMPORTANT: *Before attempting to reconnect a generator – contact the Onan factory for required instrument changes, new wiring diagrams, new plant nameplate with proper specification number and voltage.*

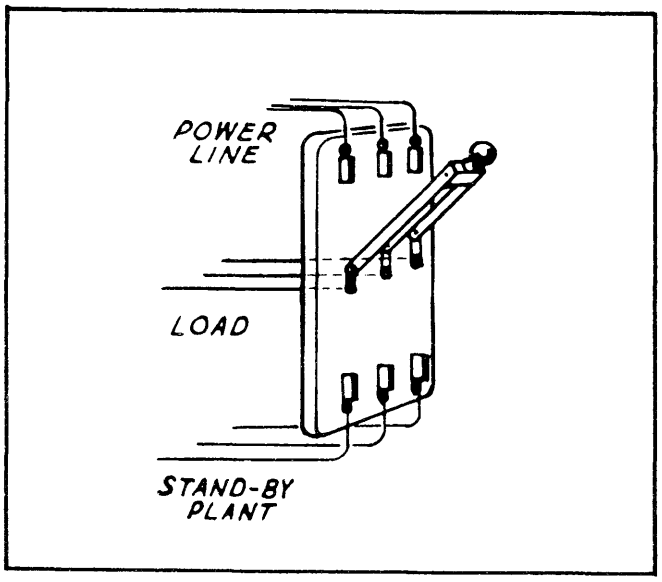


FIGURE 12. DOUBLE THROW TRANSFER SWITCH

3 Phase, 3 Wire Plant (Figure 13): No terminal is grounded. For three phase current, connect separate load wires to each plant terminal T1, T2 and T3.

If phase sequence is important, as with 3 phase motors, final connections may be postponed until a trial run is made. When the plant is installed for standby service, phase sequence of the normal line service and the generator output must be the same, for proper load operation.

Single phase current is obtained from any two plant terminals. These single phase circuits are thus available: T1-T2, T1-T3 and T2-T3. The load connected to any single phase circuit must not be greater than 1/3 the rated capacity of the plant.

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 connected to any one single phase circuit. For example, a 10,000 watt, 3 phase load is connected to a 25,000 watt plant. This leaves 15,000 watts available for single phase use – 5,000 watts on each circuit. Do not attempt to take all 15,000 watts in this example off one circuit, as overloading of the generator will result.

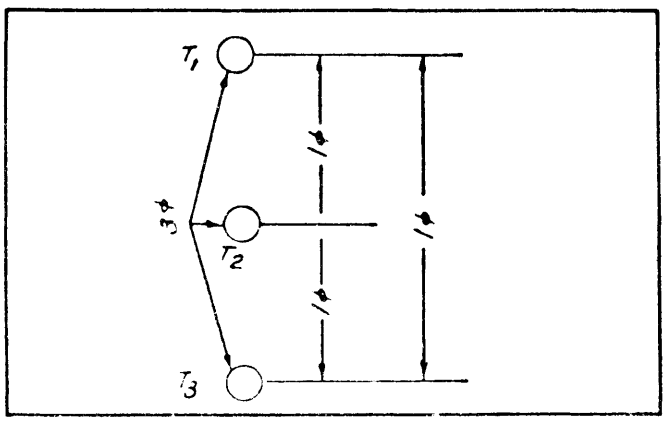


FIGURE 13. 3 PHASE, 3 WIRE

3 Phase, 4 Wire, Wye Connected Plant (Figure 14): The 3 phase, 4 wire plant produces single phase current of one voltage and three phase current of a different voltage. The single phase voltage is the lower voltage as noted on the plant nameplate and the three phase voltage is the higher nameplate voltage.

The terminal marked T0 is grounded. For 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 or T3. Three separate single phase circuits are available, with not more than 1/3 the rated capacity of the plant from any one circuit.

For 3 phase current, connect separate load wires to each of the plant terminals T1, T2 and T3. If phase sequence is important, refer to the principles of connection as given for the 3 phase, 3 wire plant. Single phase current is obtained between any two 3 phase terminals.

If single phase and 3 phase current is to be used at the same time, use care to properly balance the single phase load.

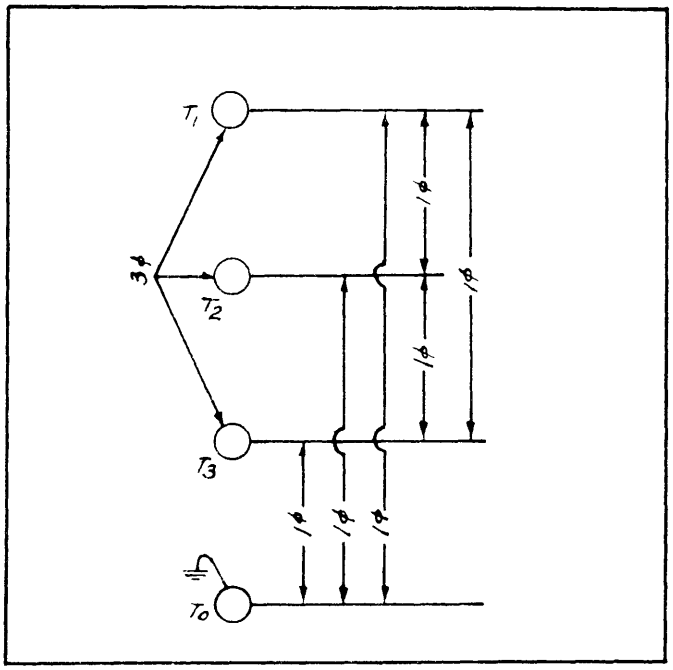


FIGURE 14. 3 PHASE, 4 WIRE WYE CONNECTION

120/240 Volt, 3 Phase, 4 Wire Delta Connected Plant (Figure 15): The 3 phase Delta connected plant is designed to supply 120 volt, single phase current and 240 volt, 3 phase current. For single phase operation, connect the three load wires to the three plant terminals T1, T2 T3 – one wire to each terminal. For 3 phase operation the T0 terminal is not used.

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 required. For 120 volt service, connect the "hot" (black) load wire to either the T1 or T2 terminal. Connect the neutral (white) wire to the T0 terminal. Two 120 volt circuits are available. Any combination of single phase and three phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase KVA.

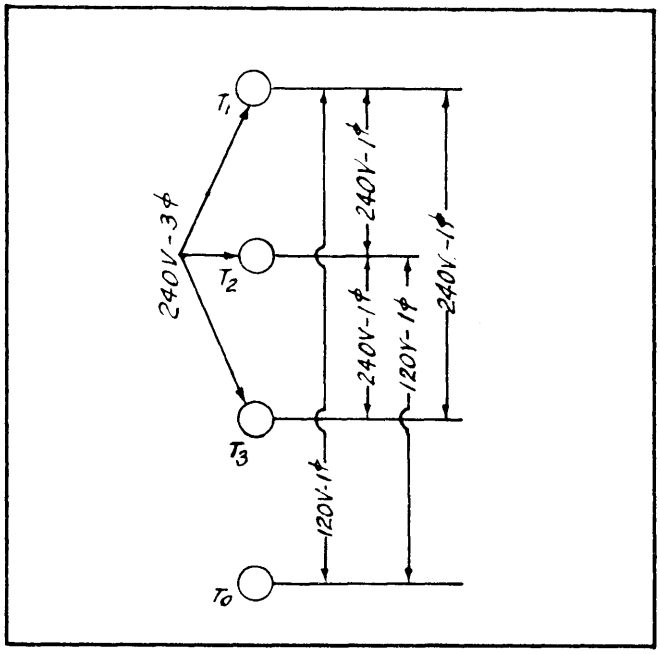


FIGURE 15. 3 PHASE, 4 WIRE DELTA CONNECTION

PARTS!

LOOK FOR THEM . . . . ASK FOR THEM . . . . BE SURE YOU GET GENUINE ONAN REPLACEMENT PARTS. NEVER ACCEPT SUBSTITUTES! IF YOU WANT TO MAKE YOUR ONAN ELECTRIC PLANT OR ENGINE AS GOOD AS NEW, WATCH FOR THE GREEN AND WHITE LABEL WITH THE IDENTIFYING WORDS: GENUINE ONAN PARTS.

SERVICE!

REMEMBER TOO, THAT ONAN AUTHORIZED SERVICE STATIONS, WITH THEIR FACTORY TRAINED PERSONNEL, HAVE THE BEST OF FACILITIES FOR COMPLETE OVER-HAULING AND REBUILDING YOUR ONAN ELECTRIC PLANT OR ENGINE. SEE YOUR PARTS AND SERVICE CENTER FOLDER FORM F-115.

OPERATION

CRANKCASE OIL

Refer to Section 5 of the Cummins manual. Note that for average operating conditions, MIL-L-2104A military specification oil is recommended. Many oils designated for MS or DG service meet these requirements. Check with the oil supplier.

The capacity of the oil pan is approximately 18 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 uses. Do not mix brands nor grades of lubricating oils.

WARNING
ENGINE OIL and COOLANT DRAINED

Rust inhibiting oil is applied to cylinders for shipping.

Before operating: Fill crankcase with oil. Fill cooling system.

GOVERNOR OIL

Fill the sump of governor to level indicated on dipstick with engine lubricating oil of the viscosity recommended for engine lubrication at operating temperature.

CRANKCASE BREATHER AIR CLEANER

Service the crankcase breather air cleaner as outlined in Cummins manual, Section 3.

COOLANT

For units which use either a radiator or heat exchanger (city water cooled), fill the cooling system with clean soft water. Use a good rust and scale inhibitor. If there is any possibility of a radiator cooled plant being exposed to freezing temperatures, use antifreeze with an ethylene glycol base. On the initial run, check the coolant level several times and add liquid if necessary to compensate for any air pockets which may have formed during filling. Refer to Cummins manual for additional information.

NOTE: *The electric solenoid valve, used with city water cooled plants, should be energized before initial starting of plant to allow coolant chambers to fill with coolant. This is accomplished by using a jumper from the 24 volt battery supply to the solenoid.*

If the plant is equipped for "city" water cooling, see that the water supply is turned on.

FUEL

Check with the fuel supplier for assurance that the fuel supplied meets the specifications. Make every effort to to keep the fuel supply clean.

BEFORE INITIAL START

Refer to Pre-Start instructions (Section 2) in the Cummins manual.

STARTING

To start, press the RUN-STOP switch to its RUN position, holding in contact to crank the engine. The engine should start with a few seconds of cranking. Investigate any failure to start – do not crank for more than 30 seconds at one time. If engine fails to crank, check that the cranking limiter switch is closed.

OPERATORS NOTE: *Always use all instruments provided with the unit to obtain the most satisfactory service from it.*

CHECKING OPERATION

As soon as the engine starts, always check the oil pressure. Normal oil pressure is approximately 90 psi at operating temperature.

The water temperature gauge indicates the coolant temperature during operation. Normal operating temperature is approximately 190°F.

The DC ammeter on the engine control panel indicates the battery charging current. An automatic regulator controls the charging rate, which will vary according to charge condition of the battery. Normal charge rate is 5 to 10 amperes when the plant first starts. The rate should fall to almost zero as the battery becomes fully charged.

BREAK-IN NOTE: *Run plant at 50% rated load for the first 1/2 hour after reaching operating temperature.*

WATER FLOW (FIGURES 8 and 9)

If the plant is city water (pressure) cooled, but without the optional flow (Powers) regulator, check the rate of water flow. At installation, an adjustable valve was connected in the water supply line. With the key provided, adjust the valve to provide a flow of water sufficient to keep the water temperature gauge reading within the range of 165°F to 195°F. Excessive water flow is wasteful and expensive – too little flow will cause a rise in coolant temperature and automatic shut down by the high temperature safety switch. To avoid unauthorized tampering after proper adjustment, remove and store the adjusting key.

STOPPING

If conditions permit, disconnect electrical load and allow the plant to run a few minutes at no load. This will allow the plant to cool off slightly, and may prevent an excessive temperature rise when the plant stops and ventilation ceases. Press the RUN-STOP switch to its STOP position to stop the plant.

BATTERY, HOT LOCATION

Batteries will self discharge very quickly when installed where the ambient temperature 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 worth the effort.

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 distilled water, to normal 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.

NO LOAD OPERATION

Periods of no-load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electrical output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

EXERCISE PERIOD

If the plant is used infrequently, such as in standby service, start and operate for at least 30 minutes once a week. This exercise period keeps engine parts lubricated and insures easy emergency starts.

OUT-OF-SERVICE PROTECTION

Protect a plant that is to be out-of-service for more than 30 days as follows:

1. Run plant until thoroughly warm.
2. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
3. Service air cleaner as outlined in Cummins manual.
4. Clean governor linkage and protect by wrapping with a clean cloth.
5. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
6. Wipe entire unit. Coat parts susceptible to rust with a light film of grease or oil.
7. If battery is used, disconnect and follow standard battery storage procedure.
8. Provide a suitable cover for the entire unit.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to and from the plant.
2. Keep cooling system clean.
3. Use correct SAE No. oil for temperature conditions.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Keep fuel system clean and batteries in a well charged condition.
3. Partially restrict cool air flow but use care to avoid overheating.
4. Refer to Cummins manual for additional information.

DUST AND DIRT

1. Keep plant clean. Keep cooling system free of dirt, etc.
2. Service air cleaners as frequently as necessary.
3. Change crankcase oil every 100 operating hours.
4. Keep oil in dust-tight containers.

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet, standard cooling, normal ambients and with natural gas fuel. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

GENERAL MAINTENANCE

GENERAL

Follow a definite schedule of inspection and servicing, based on operating hours. Use the running time meter to keep a record of operation and servicing. Service periods outlined below are for normal service and operating conditions. For continuous duty, extreme temperature, etc., service more frequently. For infrequent use, light duty, etc., service periods can be lengthened accordingly.

ENGINE

Refer to the Cummins engine manual (Section 3) for details and periodic maintenance.

AC GENERATOR

In addition to the engine service operations scheduled in the Cummins manual, check the condition of the AC generator. Service and maintenance are outlined in the next chapter.

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 at the proper level above the plates by adding distilled water.

CONNECTIONS (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the plant while running at rated load. Some of the things to check for are as follows:

1. Check all fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically or daily drain moisture from condensation traps.
4. Inspect water lines and connections for leaks and security.
5. Inspect electrical wires for security.

ENGINE SPEED

Generator frequency is a direct ratio to the engine speed. Engine speed is controlled by the governor. The original factory governor setting should not be disturbed. If necessary to readjust, refer to instructions in the Cummins manual. Adjust the engine speed to 1800 rpm for 60 cycle operation and 1500 rpm for 50 cycle operation. Use an accurate tachometer for setting engine speed, or a frequency meter connected to the AC generator output terminals. Multiply frequency by 30 to obtain engine speed.

EXAMPLE: 30 times 60 (cycles) equals 1800 rpm

Check generator voltage. It may be necessary to make a slight re-adjustment of the speed setting to obtain the preferred voltage at average load. A range of 1830 to 1890 rpm (61 to 63 cycles) should give the desired voltage.

BATTERY CHARGING DC ALTERNATOR

The information in this section is presented for field use only. If a major repair should become necessary, contact your local authorized dealer.

Brush Assembly Removal:

1. Remove the three No. 10-24 screws which fasten voltage regulator to DC alternator. Remove regulator to gain access to phenolic cover, disconnecting leads as required.
2. Remove the two No. 8-32 screws on phenolic cover and lift out cover and gasket.
3. Pull brush assembly straight up and lift out.
4. For reassembly reverse procedure.
5. For troubleshooting see following page.

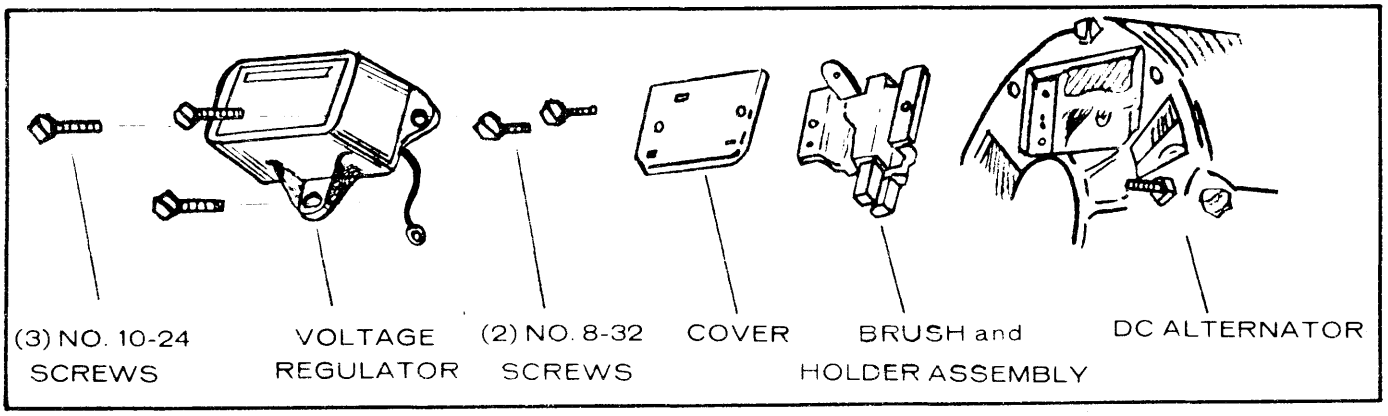


FIGURE 16. DC ALTERNATOR DISASSEMBLY

TROUBLE SHOOTING
DC ALTERNATOR

POSSIBLE CAUSE	REMEDY
ALTERNATOR FAILS TO CHARGE OR PUTS OUT LOW OR UNSTEADY CHARGE RATE	
Alternator belt loose.	Tighten belt
Loose or dirty battery connections.	Clean and tighten.
Worn or defective brushes.	Replace brushes.
Faulty regulator.	Replace regulator.
EXCESSIVE CHARGING RATE (Battery requires filling frequently)	
Loose connections on alternator and regulator.	Tighten connections.
Faulty regulator.	Replace regulator.
NOISY ALTERNATOR	
Defective or badly worn belt.	Replace belt.
Misaligned belt or pulley.	Align properly.
Loose pulley.	Tighten pulley.
Worn bearings.	Replace bearings.

AC GENERATOR MAINTENANCE

GENERAL

AC generators normally require very little servicing. Periodic inspection, to coincide with engine oil changes, will assure good performance.

BRUSHES

To examine the brushes, brush springs and slip rings, remove the inspection and ventilating covers from the end bell openings. Keep the end bell, brush rig, etc., free of dust and dirt.

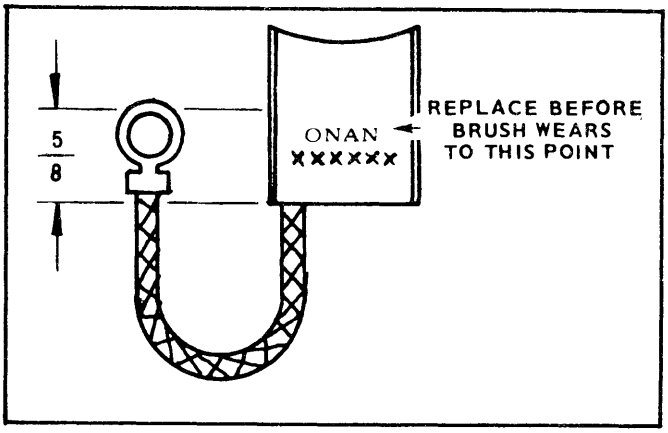


FIGURE 17. BRUSH REPLACEMENT

Brushes should be replaced when worn to approximately 5/8″ long, or when the brush is wearing into the stamped Onan name. Do not attempt to remove the brush without first removing its spring and brackets as shown. Never bend a spring back over its bracket – doing so will put a kink in it and require its replacement. Do not use a substitute brush that may look identical but may have entirely different electrical characteristics. Be sure the brush is installed so that the short side of its taper is toward the spring and its bracket. (Figure 17)

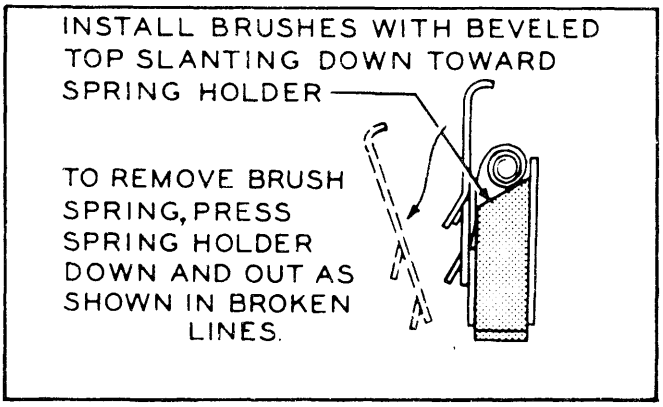


FIGURE 18. BRUSH REMOVAL

GENERATOR BEARING

The generator bearing is double-sealed and lubricated for life.

EXCITER

The exciter contains no moving parts. Occasionally blow out dust, etc. with clean, filtered air. Check thoroughly to assure that all components are mechanically secure and that all electrical connections are tight.

GENERATOR TESTS

If the generator does not function properly, a few simple tests with the plant not running may isolate the case.

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 an 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.

CHECKING STATIC EXCITER

Troubles are listed in advancing order, from no output voltage to 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.*

TROUBLE SHOOTING CHART

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 percent of the rated voltage. If not, check continuity from E1 - E2 back to 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 open (either W & Z or X & Y).	Test rectifiers and replace if defective.	(1)
	Both field rectifiers X and Y shorted.	Test rectifiers and replace if defective.	(1)
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.	(1)
Output voltage slow to build up and five percent below rated voltage after build up. Voltage regulation poor.	Either field rectifier W or Z shorted.	Test rectifiers and replace if defective.	(1)
Output voltage slow to build up and higher than rated voltage after build up.	Open circuit in one or more control rectifier.	Test rectifiers and replace if defective. Check soldered connections to rectifiers.	(1)
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.	(1)
	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.	(3)
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.	(3)
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 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.	(2)

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
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 or reactor A or B.	Test reactors A and B for shorted turn and replace if defective.	(2)
	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 stabilizing resistor.	Check resistance and reset.	(4)

STEP 1 – 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.

STEP 2 – CHECKING REACTORS "A" and "B"

CAUTION: *Use an accurate ohmmeter when checking resistance values. Resistance readings between "G" and "G2" cannot be read with accuracy on the multimeter.*

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 0.75.
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 9.0.
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 SERVICABLE 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.

STEP 3 – 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 number 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.

STEP 4 – CHECKING RESISTORS

The resistors must be checked with a multimeter adjusted to 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 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.

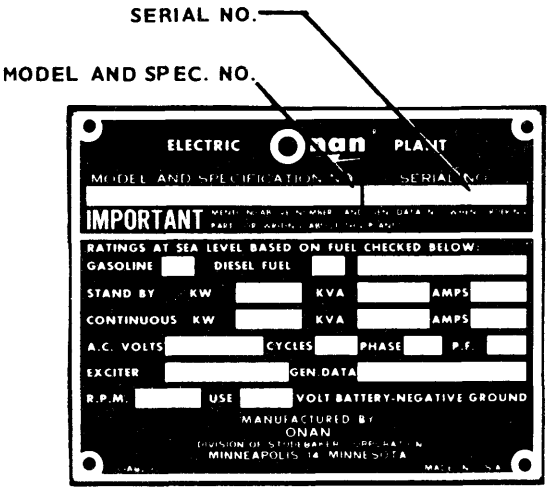
PARALLEL OPERATION

Parallel operation involves making many changes in the control system. Some of these changes are; special control panel with synchronizing lights, governor speed control, cross current compensating circuit, etc. Consult the factory for specific information.

INSTRUCTIONS FOR ORDERING
REPAIR PARTS

ONAN PARTS

All parts in this list are *Onan* parts. For *Onan* parts or service, contact the dealer from who you purchased this equipment or your nearest authorized service station. To avoid errors or delay in filling your order, please refer to the *Onan nameplate* located on the upper right side of the flywheel housing and give the complete:

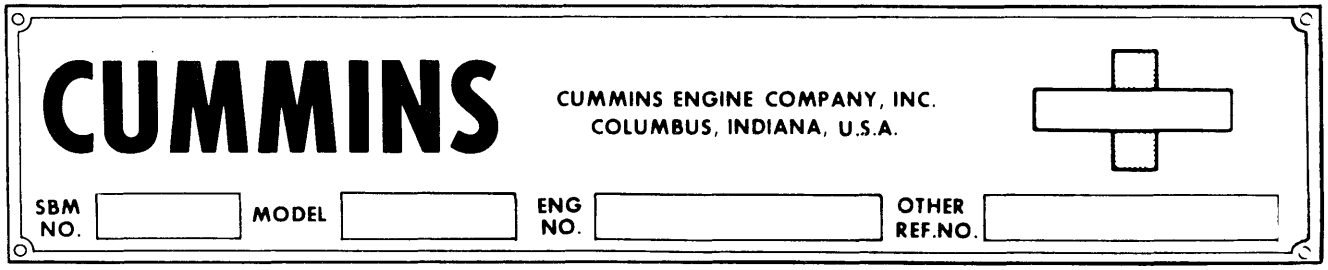


CUMMINS PARTS

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

This catalog applies to the standard FT plants as listed below. Powered by a Cummins GV12-525-IP engine (see Cummins Manual). Engine parts modified or added by *Onan* will be in this list and have *Onan* part numbers. These supersede similar parts listed in the Cummins manual, *Onan* parts are arranged in groups of related items and are identified by a reference. All parts illustrations are typical. Unless otherwise mentioned, parts are interchangeable. Right and left plant sides are determined by facing the front end of the engine.

PLANT DATA TABLE

MODEL AND SPEC NO. *	ELECTRICAL DATA				
	WATTS **	VOLTS	CYCLES	PHASE	WIRE
250FT-4R8/	250,000	120/208	60	3	4
250FT-4XR8/	250,000	277/480	60	3	4
250FT-5DR8/ ***	250,000	120/240	60	3	4
250FT-7R8/	250,000	220/380	60	3	4
250FT-9XR8/	250,000	347/600	60	3	4

* - The Specification Letter advances (A to B, B to C, etc.) with manufacturing changes.

** - Maximum rating is shown. Continuous rating also appears on nameplate.

*** - 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.

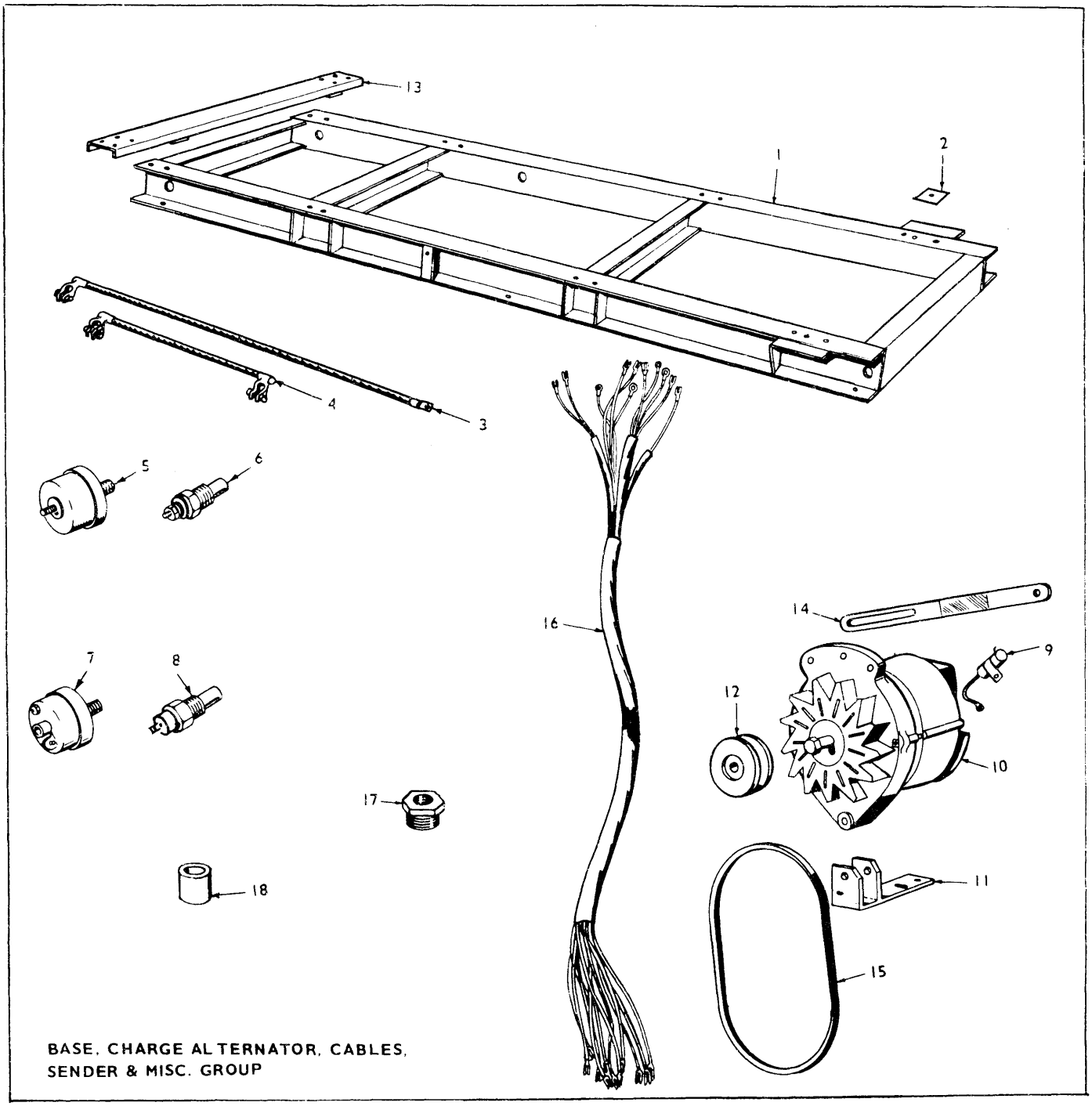
REPLACEMENT ENGINE:

100P779	1	Engine, Replacement (Cummins Engine Company Model GV12-525-IP)

General Description:

Includes - Complete Cylinder Block, Carburetor, Air Cleaner, Oil Filter, Starter Motor, Magneto Spark Plugs, Governor, Fan Blades and Belt, Flywheel and Flywheel Housing, Water Pump, Radiator, Fan Guard, Radiator Brace, Oil Pan, Oil Cooler, Vibration Damper, Exhaust Manifold, Alternator Adjusting Bracket, and Gas Regulator.

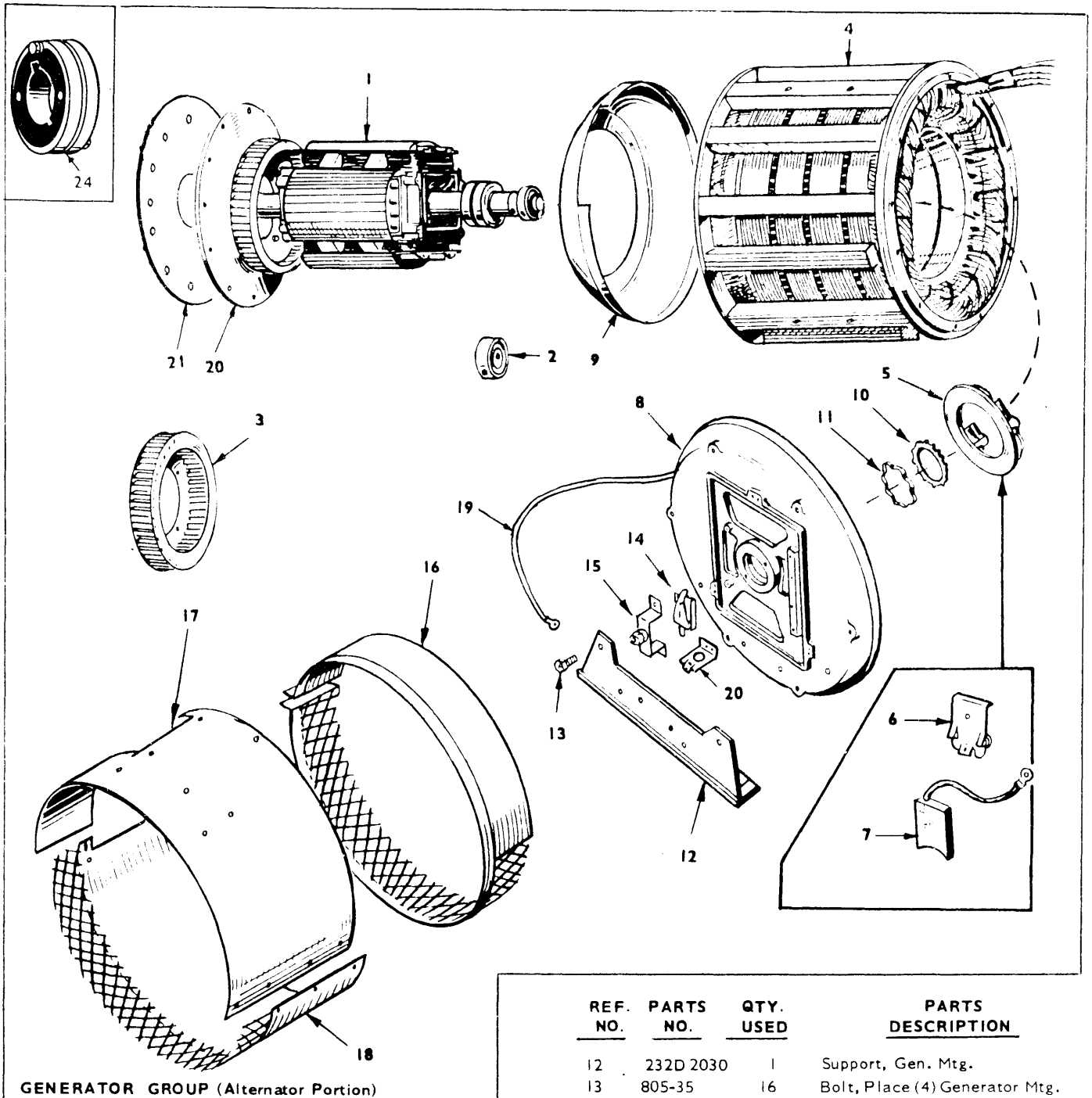
Excludes - Alternator, Regulator, Oil Pressure and Water Temperature Gauge and Ammeter.



BASE, CHARGE ALTERNATOR, CABLES, SENDER & MISC. GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403D867	1	Base, Mounting.
2	SHIM, GEN. TO MTG. BASE.		
	232A1489	As Req.	No. 16 Gauge (.0598")
	232A1490	As Req.	No.20 Gauge (.0359")
	232A1817	As Req.	Laminated Shims (.062")
3	CABLE, BATTERY.		
	416A444	1	Positive
	416A445	1	Negative
4	416A446	1	Cable, Battery Jumper.
5	193A98	1	Sender, Oil Press. Gage
6	193A100	1	Sender, Water Temp. Gage
7	309P64	1	Switch, Oil Press.
8	309A178	1	Switch, High Water Temp. Cut-Off.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
9	312A58	1	Condenser
10	191B688	1	Alternator, Batt. Charging (Incl. Regulator & Fan)
11	191B697	1	Bracket, Alternator Mtg.
12	191C624	1	Pulley, Alternator
13	130D758	1	Support, Radiator
14	191A101	1	Bracket, Alternator Adj.
15	511-37	1	Belt, Alternator Drive
16	338C459	1	Harness, Engine
17	BUSHING, PIPE REDUCER		
	505-21	1	3/4 to 1/2"
	505-131	1	3/4 to 3/8"
18	403A851	6	Spacer, Head



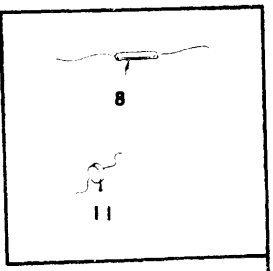
GENERATOR GROUP (Alternator Portion)

NOTE: Output Terminal Box, Cover & Internal Parts listed in the AC Output Control Group (Mounts on Side of Gen.).

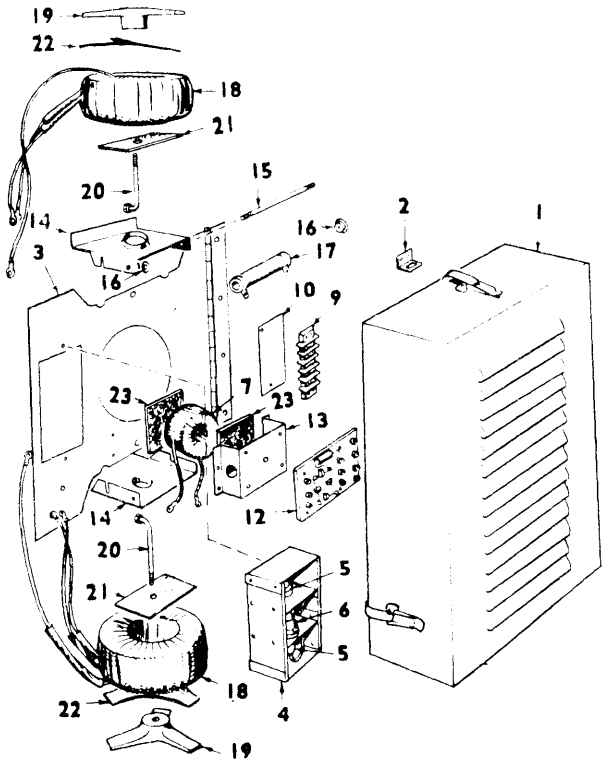
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	*	1	Rotor Assy., Wound, Incl. Brg., Blower & Drive Assy.
2	510P88	1	Bearing
3	205C61	1	Blower
4	*	1	Stator Assy., Wound
5	212C248	1	Rig Assy., Brush, Incl. Brushes & Springs
6	212B1105	4	Spring, Brush
7	214A56	4	Brush
8	211D153	1	Bell, End, Alt. to Exciter
9	234D69	1	Baffle, Air
10	232A1807	1	Holder, Brg.
11	232A1808	1	Spring, Brg. Holder
12	232D 2030	1	Support, Gen. Mtg.
13	805-35	16	Bolt, Place (4) Generator Mtg. Support to End Bell (12) Drive Disc. to Hub
14	150A717	1	Switch Assembly, Overspeed
15	150A713	1	Bracket, Overspeed Switch - Includes Contact Point
16	234D70	1	Band, Generator - Front Portion (Narrow) Band, Generator - Rear Portion (Wide)
17	234C140	1	Upper Half
18	234C141		Lower Half
19	234A107	1	Bracket, Conduit Connector
20	232C1394	1	Disc, Drive
21	232B1378	As req.	Shim, Drive Disc to Hub
24	204A83	1	Collector Ring

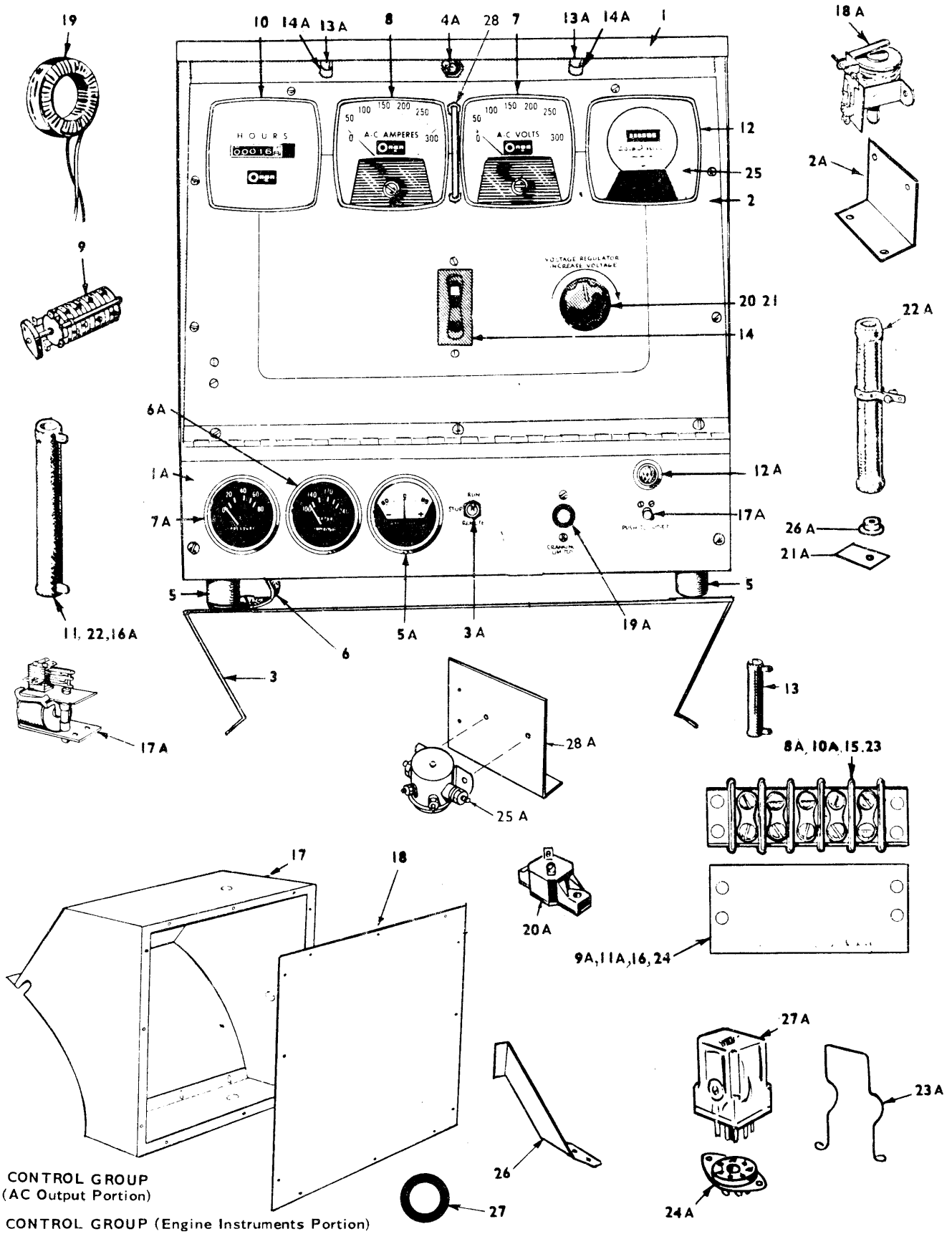
* - Order by description, giving complete Model, Spec. & Serial Number (ONAN Nameplate).

GENERATOR GROUP (Exciter Portion)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	EXCITER COMPLETE		
	209-25	1	Exciter complete. Less cover
1	234D116	1	Cover, Exciter
2	232A1376	3	Bracket, Fastening - Exc. Cover to Alt. End Bell
3	234D74	1	Panel,Only, Exciter
4	305B228	1	Rectifier Assy. Power - Complete - Incl. two #305P233 and two #305P234 Rect. plus wire and hardware
	RECTIFIER ONLY, POWER (FIELD)		
5	305P233	2	Lower Two - Neg. (Incl. in Rect. Assy. #305B228).
6	305P234	2	Upper two - Pos. (Incl. in Rect. Assy. 305B228).
7	315A78	1	Reactor, Voltage Control
8	304P476	1	Resistor, Volt. Cont. Reactor (Incl. in Rect. & Resistor Assy. 305B227).
9	332A532	1	Block, Terminal
10	332A693	1	Strip, Term. Blk, Marker (5-Place)
11	305P240	4	Rectifier, Volt. Cont. Reactor (Incl. in Rect. & Resistor Assy. 305B227).
12	305B227	1	Rectifier & Resistor Assy. (Incl. #304P476 & (4) 305P240).
13	234B115	1	Bracket, Mounting - Voltage Control Reactor.
14	234B75	2	Bracket, Gate Reactor Mtg.
15	520A190	1	Stud, Fixed Resistor Mtg.
16	304A15	2	Washer, Fixed Resistor Centering.
17	304-442	1	Resistor, Fixed - Mts. to Gate Reactor Brkt.
18	315A51	2	Reactor, Gate
19	232A1389	2	Retainer, Gate Reactor.
20	232A1403	2	Stud, Gate Reactor Mtg.
21	232B1388	2	Gasket, Gate Reactor Mtg.
22	232B1387	2	Gasket, Gate Reactor to Ret.
23	232A1548	2	Gasket, Control Reactor Coil Mtg.
24	508-8	1	Grommet





CONTROL GROUP
(AC Output Portion)

CONTROL GROUP (Engine Instruments Portion)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1	301D2115	1	Box Only, Cont.
2	*	1	Panel Only, Upper Cont.
3	301C1830	1	Bracket, Cont. Box Mtg.
5	402-78	4	Rubber, Mtg. - Cont. Box to Mtg. Brkt.
6	337A44	1	Strap, Ground.
7	VOLTMETER, AC (Check VOLTMETER Scale - Select according to rating).		
	302P421	1	Scale Reads 0-300.
	302P422	1	Scale Reads 0-600.
	302P423	1	Scale Reads 0-750.
8	AMMETER, AC (Check AMMETER Scale - Select according to rating).		
	302P413	1	Scale Reads 0-300.
	302P414	1	Scale Reads 0-500.
	302P415	1	Scale Reads 0-750.
	302P416	1	Scale Reads 0-1000.
9	308-22	1	Switch, Volt. & Current Sel.
10	METER, RUNNING TIME		
	302P465	1	120/208, 120/240, & 347/600-V., 3-PH., 60-Cycle Plts.
	302P466	1	220/380-V, 3-Ph, 60-Cycle Plts.
	302P467	1	277/480-V, 3-Ph, 60-Cycle Plts.
11	304A536	1	Resistor, Fixed (900-Ohm, 50-Watt) Off Running Time Meter, 600-V 3-Ph., Hsd. Plts.
12	METER, FREQUENCY		
	302-213	1	60-Cycle plants
	302-234	1	50-Cycle plants
13	RESISTOR, FREQ. METER		
	304A305	1	277/480-V, 3-Ph, 60-Cycle
	304A402	1	600-V, 3-Ph, 60-Cycle Plts.
	304A125	1	220/380-V, 3-Ph, 60-Cycle
14	320B170	1	Circuit – 18-Amp.
15	332A503	1	Block, Term. (8-Place).
16	332A1174	1	Strip, Block Marker (55 through 62)
17	301E1682	1	Box Only, Output Term. - Mts. on Side of Gen.
18	301C1683	1	Cover, Output Term. Box
19	TRANSFORMER, CURRENT (Mts. in Output Term. Box) Check TRANSFORMER Nameplate - Select according to rating.		
	302B107	3	Nameplate Reads "Ratio 300/5" (Use with 0-300 Scale AC Ammeter).
	302B372	3	Nameplate Reads "Ratio 500/5" (Use with 0-500 Scale AC Ammeter).
	302B385	3	Nameplate Reads "Ratio 750/5" (Use with 0-750 Scale AC Ammeter).
	302B394	3	Nameplate Reads "Ratio 1000/5" (Use with 0-1000 Scale AC Ammeter).
20	303-111	1	Rheostat, Volt. Reg. - 175-Ohm (Model H)
21	303-32	1	Knob, Rheostat
22	304A484	1	Resistor, Fixed - Rheostat (825-Ohm, 75-Watt).
23	332A604	1	Block, Term. - Exciter Connections - (5-Place).
24	332A690	1	Strip, Block Marker (5-Pl).
25	302B448	1	Plate, Meter Face
26	301A1914	1	Bracket, Panel Stop
27	508P63	1	Grommet, Rubber (For 2-7/8" Hole)
28	301A2727	1	Handle, Panel

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
1A	301C2124	1	Panel Only, Lower Cont.
2A	301A1685	1	Bracket, Time Delay Relay Mounting
3A	308P138	1	Switch (Run-Stop-Remote)
4A	308-2	1	Switch, Panel Light
5A	302A61	1	Ammeter, Charge (30-0-30)
6A	193B112	1	Gage, Water Temp.
7A	193B111	1	Gage, Oil Pressure
8A	332A795	1	Block, Term. (16-Place)
9A	332A862	1	Strip, Marker (4 through 19)
10A	332A611	1	Block, Term. (3-Place)
11A	332A762	1	Strip, Marker (Remote, B+, Ground)
12A	322P69	1	Receptacle Assy., Pilot Light
13A	322P72	2	Receptacle, Panel Light
14A	322P17	3	Bulb, (2) Panel (1) Pilot
16A	304A446	2	Resistor, Fixed (150-Ohm, 10-W)
17A	307A655	1	Relay, Emergency Latch
18A	307A899	1	Relay, Time Delay.
19A	320A104	1	Limiter, Cranking
20A	320P240	1	Breaker, Circuit
21A	304-292	2	Insulator, Resistor Mtg
22A	304A66	1	Resistor, Adjustable
23A	307P778	1	Spring, Relay Hold-down
24A	323P52	2	Socket, Relay
25A	307-61	1	Relay, Pilot
26A	304-15	2	Washer, Centering-Resist.
27A	307P820	2	Relay, Start-Disconnect.
28A	306A220	1	Bracket, Pilot Relay

* - Order by description, giving complete Model, Spec and Serial Number.

ONAN

★ **Electric Plants**

★ **Two-Bearing Generators**

★ **Air Cooled Engines**

THESE OUTSTANDING PRODUCTS, designed and built by Onan, are known the world over for their ruggedness and dependability!

WHENEVER YOU NEED an independent source of electric power for any purpose, be sure to see the complete line of Onan Gasoline or Diesel Engine-Driven Electric Plants and Onan Generators. You'll find a type and size to fit every job...portable or mobile...heavy duty primary or emergency standby. AC - 500 to 400,000 Watts. DC to 15,000 Watts. Battery Chargers to 5,000 Watts.

IF YOU DESIGN AND BUILD commercial or military equipment requiring stamina-tested air cooled engines, consult the Onan factory for complete information about Onan deluxe engines.

Onan®