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FILE

INSTRUCTION MANUAL AND PARTS CATALOG

FOR

Onan®

ELECTRIC GENERATING PLANTS

WC

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

948-302

6A68 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.

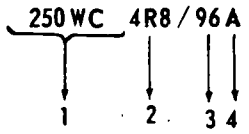
The name of ONAN is synonymous with satisfactory performance, certified performance.

TABLE OF CONTENTS

INTRODUCTION

When the instructions in this manual refer to a specific model of electric plant, identify the 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 ever becomes necessary to contact a dealer or the factory regarding the plant, be sure to mention the complete Model, Spec. No., and 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.

Electric plants are given a complete running test under various load conditions and thoroughly checked before leaving the factory. Inspect the 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)	85
Width (inches)	48
Length (inches)	128
Weight (approximate in pounds)	8800
Number of cylinders	6
Displacement (cu. in.)	1197
Bore (inches)	6-1/4
Stroke (inches)	6-1/2
BHP at 1,800-rpm (nominal)	475
Compression Ratio	8: 1
Fuel	Natural Gas
Manufacturer (engine)	Waukesha
Series	F119GRS1U
Governor Regulation %	3
Nominal Battery Voltage	24
Battery Size	
SAE Group 8D (12-volts)	Two
Amp/Hr. SAE 20-hr. Nominal	200
Solenoid Shift Starter	Yes
Engine Cooling Air (CFM at 1,800-rpm)	
City Water Cooling	7000
Radiator Cooling	28,500
Combustion Air (CFM at 1,800-rpm)	540
Alternator Cooling Air (CFM at 1,800-rpm)	800
Output Rated At Power Factor Load	0.8
Rating (Output in Watts)	
50-cycle AC standby service	200,000
50-cycle Ac continuous service	175,000
60-cycle AC standby service	250,000
AC Voltage Regulation in %	3
AC Frequency Regulation in %	5
Revolving Field Alternator (4-pole)	Yes
Exciter, Static	Yes
Cooling System Capacity	
Radiator (gallons)	36
Heat Exchanger (quarts)	107
Engine Oil Capacity (gallons)	8
Exhaust Connections (Flange)	5''
Air Cleaner (Dry type)	Yes
Closed Crankcase Breather System	No
RPM (60-cycle)	1800
RPM (50-cycle)	1500
Battery Charging Alternator	Yes
Turbocharger	Yes

DESCRIPTION

GENERAL

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

ENGINE

The engine is a Waukesha basic model F1197-GRS1U as described in the Waukesha Operator's Manual. The specific engine used may have variations due to some of the optional equipment available as specified by the plant purchaser. Complete specifications appear on the preceding page.

GENERATOR AND EXCITER

The generator assembly is a rotating field alternator. The rotor is supported at the end by a single ball bearing mounted in the stator frame. The opposite end of the rotor is provided with a blower and a coupling disc which is bolted directly to the engine flywheel. The 60 Hz generator is rated at 250 KW (standby service) when driven at a governed speed of 1800 rpm. When used at 50 Hz, the rating is 200 KW (standby service) and 175 KW (continuous service) when driven at a governed speed of approximately 1500 rpm.

The static exciter is mounted in a ventilated metal enclosure attached to the end-bell of the generator. The exciter is designed to supply DC current to the alternator field and will provide nearly constant AC output over a wide range of load conditions. Full voltage is maintained in large motor starting. The static exciter is much smaller and lighter than a conventional direct - connected generator type and eliminates the necessity of an external voltage regulator through the use of a magnetic amplifier.

STANDARD ENGINE CONTROLS & 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 205° F. the latching relay is energized, shutting down the plant.

Low Oil Pressure Cut-Out: Allows oil pressure build-up 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 & 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.

Phase 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 generating plant is adaptable to AUTOMATIC LOAD TRANSFER equipment, manual/automatic paralleling switchboards, and other devices. Terminals can be provided for connecting optional warning equipment, etc.

SIGNAL LIGHTS may be included to warn of improper operation. Terminals for connecting such lights, horn or other warning devices are available. Refer to the engine wiring diagram if such equipment is to be connected.

WATER JACKET (tank type) HEATERS are available to keep the engine coolant warm during periods of plant shutdown in low ambient temperatures.

WATER FLOW REGULATOR automatically regulates water supply for "City water cooling".

Other options include: Flexible water lines, Air Discharge Duct Adapter, Fuel lines and fittings, Mufflers, Vibration Isolators, and Cycle Cranking.

INSTALLATION

GENERAL

Installation points to consider include: adequate engine and generator cooling air, discharge of circulated air, adequate fresh induction air, discharge of exhaust gases, electrical connections, fuel connections, water connections, accessibility for operation and servicing and a sturdy, level floor.

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.

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 (Fig. 1 and 2)

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. (Fig. 1).*

VENTILATION

Plants create considerable amounts 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 is 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.

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

An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressurized water supply. For piping connections, etc., refer to the separate outline drawing furnished. Variations of "city" water cooling are optional: the water may circulate directly through the engine cooling system or may be cooled through a heat exchanger. The cooling water may also be used to cool the exhaust manifolds. (Water cooled exhaust manifolds are recommended.) An electric solenoid valve is installed in the water supply line, connected to open the water flow only when the plant is operating. A rate-of-flow valve (either automatic or hand adjusted) is recommended for installation in the supply line to control the water flow. Use flexible hose to connect water supply and outlet flow pipes to the engine connection points. Pipe the outlet flow to a convenient drain. (Continued page 10)

INSTALLATION ALIGNMENT

1. Set the plant on its mounting foundation. Remove the two mounting bolts which secure the generator support to the skid base (Fig. A). 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. B).
4. Add clearance of skid base-to-support (Fig. B) 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. C). Lower generator and allow to reset 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. D).

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

Heat Exchanger System (Fig. 3): The heat exchanger installation provides for a "closed" engine cooling system. Engine coolant circulates 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. An electric solenoid valve is installed in the water supply line, and is connected to open and allow water to flow only when the plant is operating. A rate of flow valve (either automatic or hand adjusted) is recommended for installation in the supply line to control the water flow. Use a flexible hose to connect water supply and outlet flow pipes to the engine connection points.

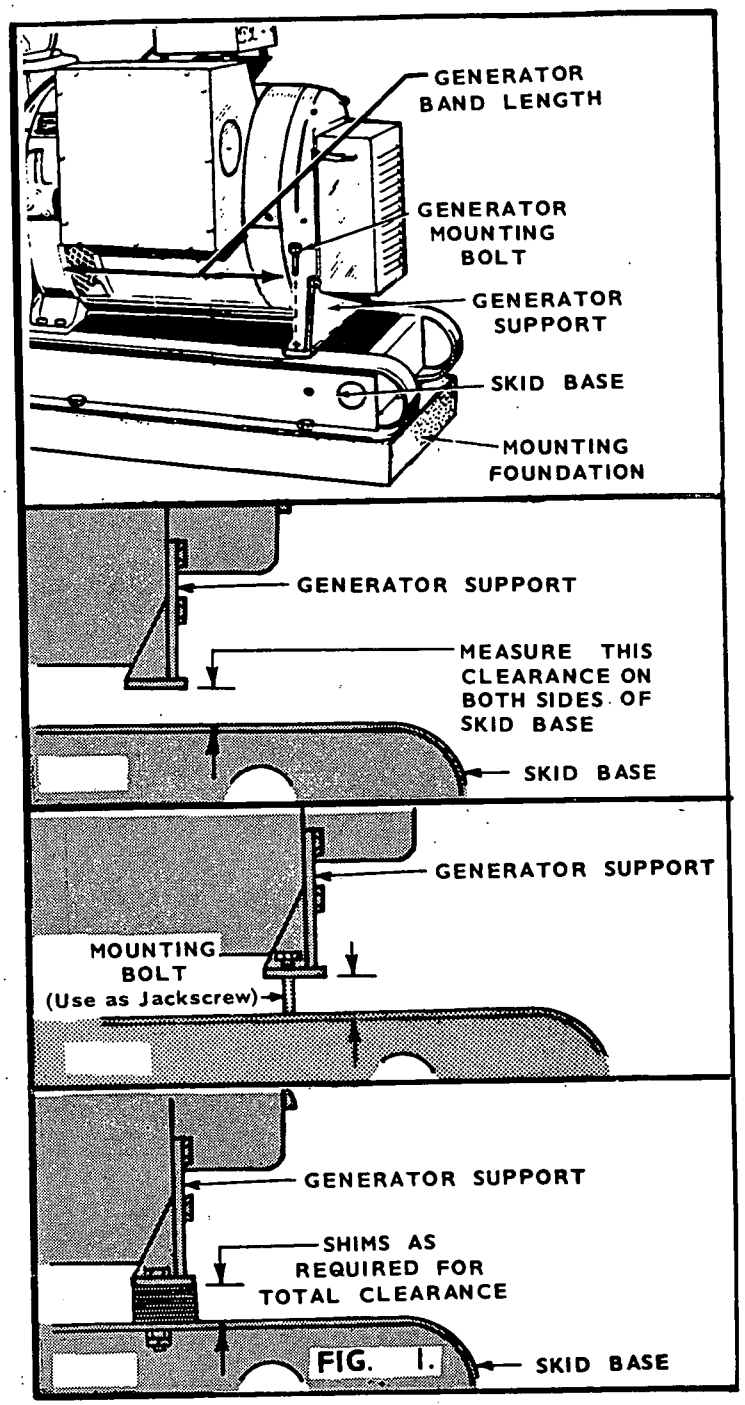


FIG. 1.

Standpipe System (Fig. 4): 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 similar impurities.

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

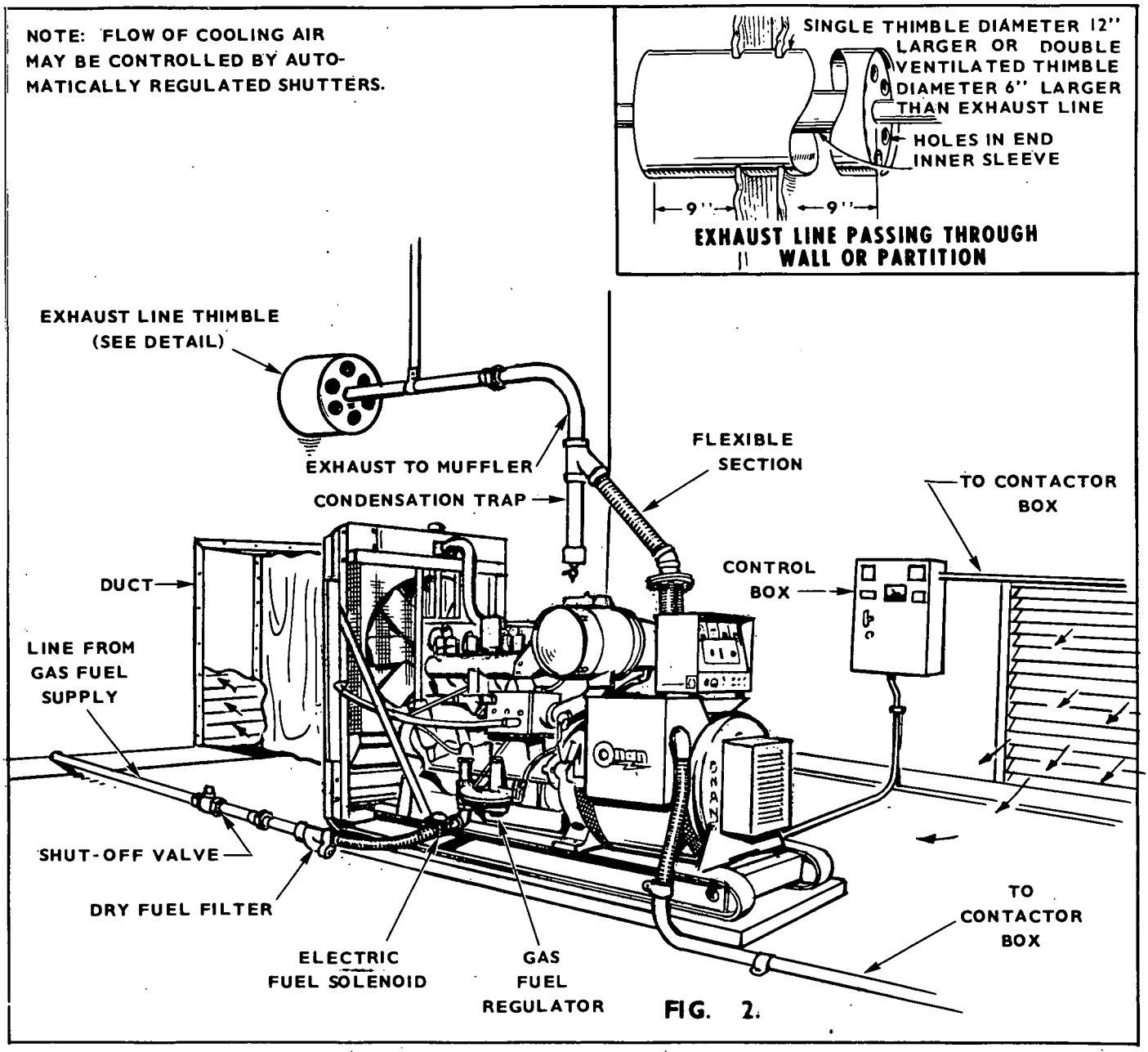


FIG. 2.

If the plant is equipped for "city" water cooling, see that the water supply to the engine is turned on. If the system is the "closed" (heat exchanger) type, see that the chamber portion is properly filled (107 quarts), similar to a radiator equipped unit. Make a preliminary adjustment of the water flow as indicated in Table 3 or 4. Make final adjustment after the plant warms up.

INTERCOOLER

The intake or combustion, air is super-charged by means of an exhaust driven "Turbocharger". During this process, the intake air becomes heated and must be cooled before it enters the carburetor, or mixer. To effect the cooling, the air is routed through an intercooler which is a water cooled chamber mounted on the side of the engine. In the standard radiator cooled engine, an auxiliary radiator is used to cool the intercooler water. In "city" water and heat exchanger cooled models, fresh, or raw, water is employed in the intercooler for air cooling purposes. Figures 3 and 4 are schematic plumbing drawings which illustrate the piping connections for the optional types of cooling which are used with the intercooler.

EXHAUST

Pipe exhaust gases outside any enclosure (Fig. 2). Use pipe at least as large as the 3½" pipe size outlet of the engine. See Installation drawing, Fig. 2. Increase the pipe diameter one pipe size for each additional 10' 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

HEAT EXCHANGER COOLING

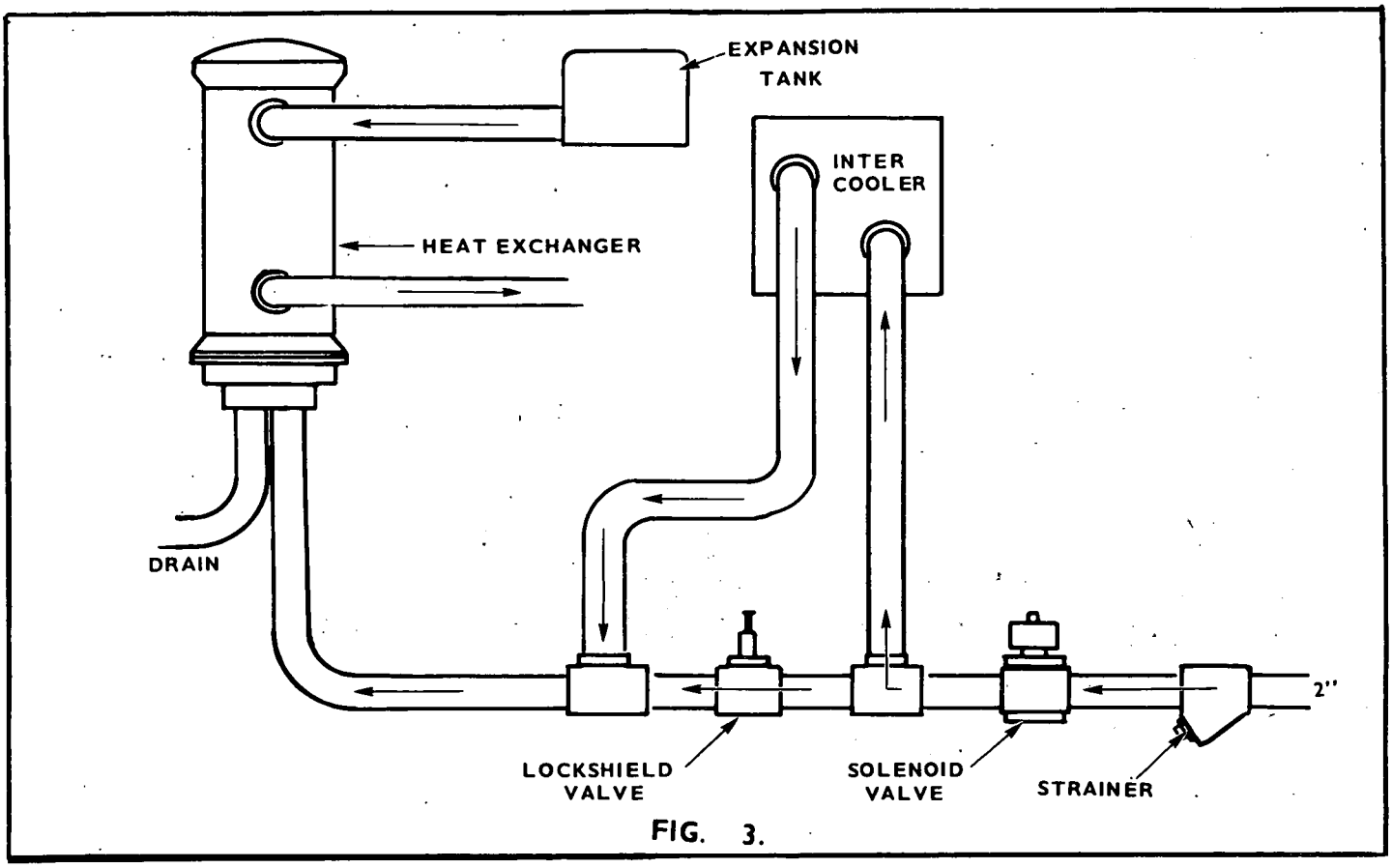


FIG. 3.

STAND PIPE COOLING

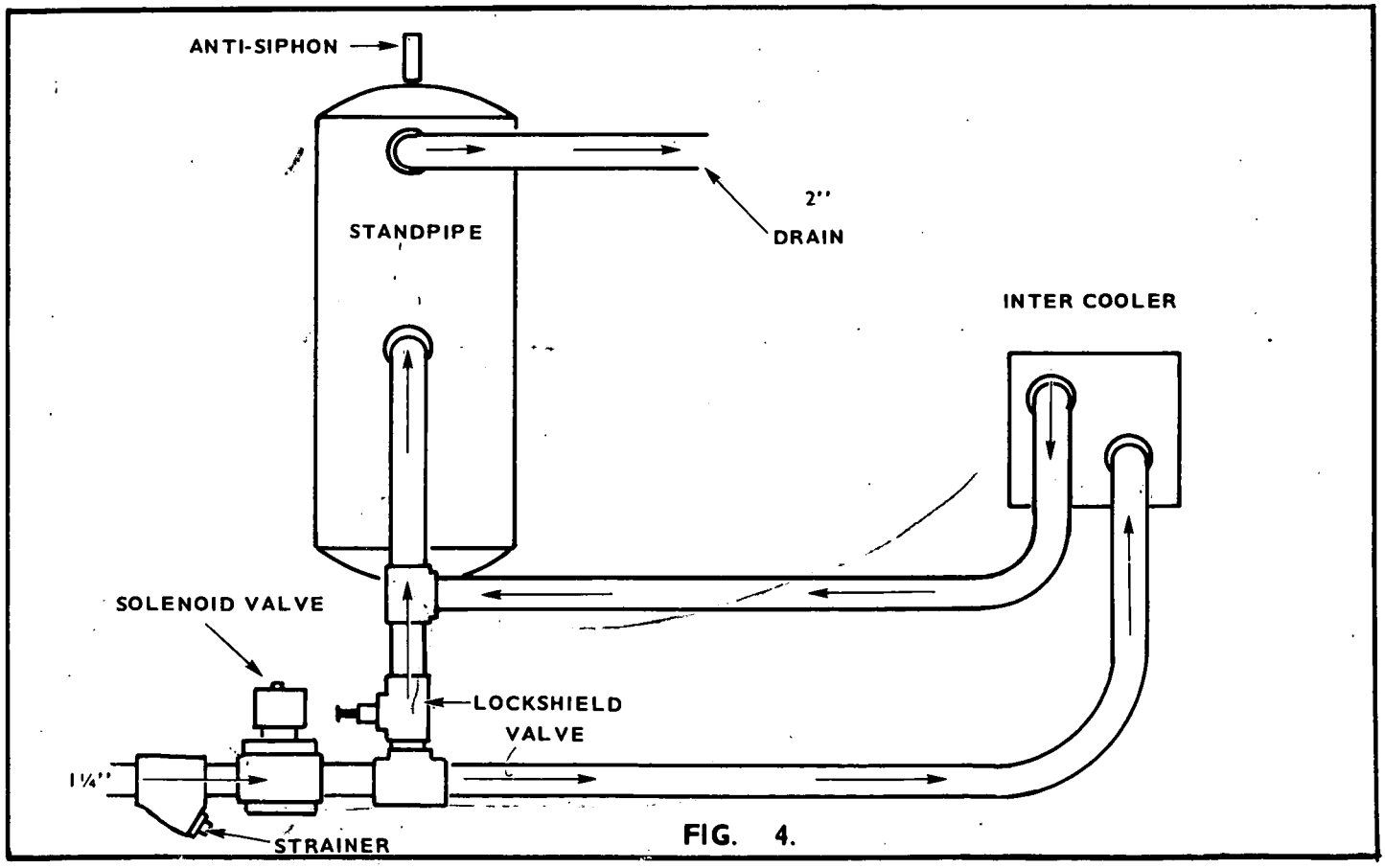


FIG. 4.

MINIMUM WATER FLOW, HEAT EXCHANGER COOLING

ELECTRICAL LOAD	WATER TEMP. °F	MIN. FLOW GAL./MIN.
175 KW	40	15
	60	20
	80	33
200 KW	40	16
	60	21
	80	36
250 KW	40	23
	60	36
	80	100

FIG. 5

MINIMUM WATER FLOW, TEMPERING TANK COOLING

ELECTRICAL LOAD	WATER TEMP. °F	MIN. FLOW GAL./MIN.
175 KW	40	17.4
	60	20.2
	80	25.0
200 KW	40	19.8
	60	25.2
	80	27.8
250 KW	40	25
	60	29
	80	35

FIG. 6

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" clearance. Install a suitable muffler.

FUEL CONNECTION

The plant is equipped to operate on natural gas only. The gas flow regulator mounted on the plant is designed for a line pressure of 7 to 10 inch water column (max. 6 oz. per sq. in.). If the line pressure is excessive, install a suitable pressure reducing regulator. Be sure all local regulations are complied with: electric solenoid shut-off valve (usually installed at the factory), hand shut-off valve at the fuel source, supply line filter, etc. Use a short length of approved flexible connection between the supply pipe and the plant regulator inlet.

BATTERIES (FIG. 5)

24-volt battery current 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). Note a small wire connected to one of the two larger terminals on the starter magnetic switch. Connect the battery positive cable to this switch terminal. 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.

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. See Fig. 6.

NOTE: *The Run-Stop-Remote switch must be in the Remote position for remote starting.*

The size wire to use is determined by the plant-to-control distance. Use #18 wire up to 900-ft (Fig. 6).

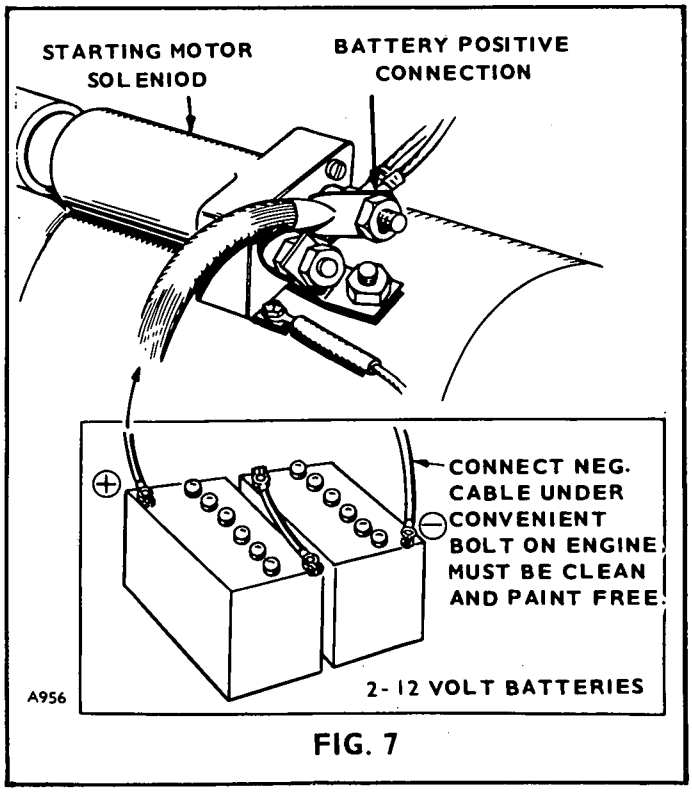
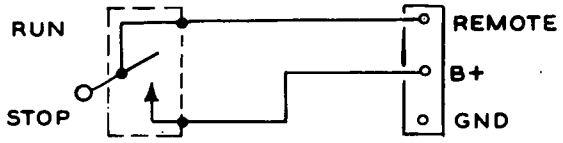


FIG. 7

FIG. 8

BEGIN SPEC.



WIRE SIZE
NO. 18 WIRE TO 1900 FT.

The GND terminal is for a customer-supplied alarm at a remote location to warn of low oil pressure, high water temperature and overspeed.

NOTE

DO NOT USE POSITIVE GROUND AS SHOWN IN THE ENGINE INSTRUCTION MANUAL. REFER TO THE PLANT WIRING DIAGRAM FURNISHED.

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 (Fig. 7) 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 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 have extra leads. These are pre-connected according to the nameplate ratings.

CAUTION

Reconnection, for different output voltage than shown on the plant nameplate, will involve very extensive changes including a complete new control panel. For specific information, contact the factory. Give the COMPLETE information shown on the ONAN nameplate, and indicate the NEW voltage desired.

1. Use commercially available cable connectors to make connections.
2. Connect the load wires to the appropriate generator wire group (or terminal post) according to the proper connection diagram.

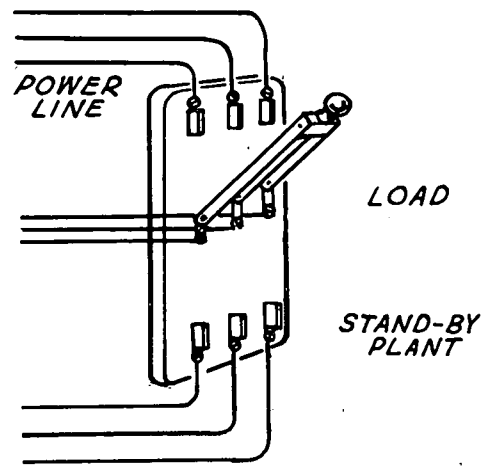
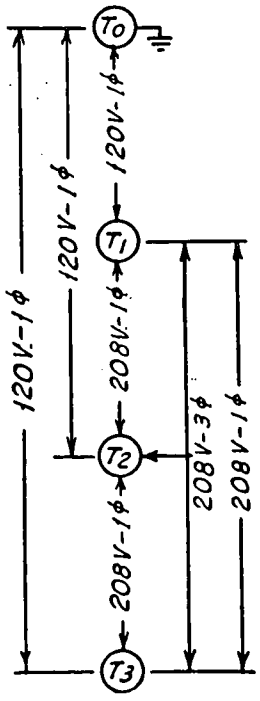


FIG. 9

3. Tape or otherwise insulate each connection where loose leads are used. Such insulation must be at least equal to the original wire insulation.
4. Follow connections diagrams with care.

3-PHASE, 4-WIRE, WYE-CONNECTED PLANT
(120/208-volt example shown)

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", "T3". Three separate 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 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 single phase current of the 3-phase voltage, connect separate load wires to each of any two terminals, T1, T2, or T3. Do not use the T0 terminal. Three separate 1 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 circuits.

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

3-PHASE, 4-WIRE, DELTA-CONNECTED PLANT (120/240 - volt example shown)

This type of generating plant is specially designed so that two types of loading can be applied to the generator; regular 3-phase, 3-wire operation; or, combination, 3-phase, 3-wire and 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.

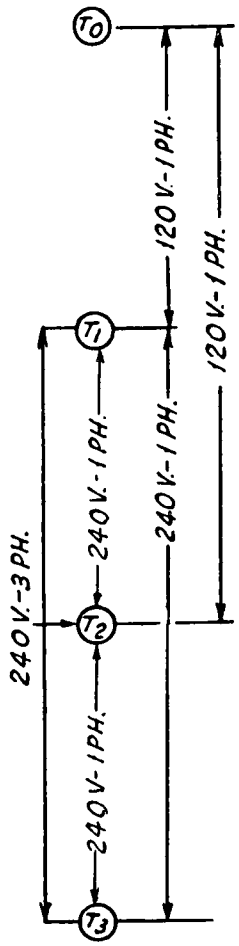
For 3-phase, 3-wire operation connect the three load wires to the three terminals T1, T2, T3 one wire to each terminal. For 3-phase, 3-wire operation the T0 terminal is not used and is normally not grounded.

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

For 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).

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.

Combination single phase and three phase loads applied to a three phase generator are unbalanced loads which cause the phase voltages to be unequal. These unbalanced loads will not create voltage unbalance of the phase voltages of greater then 5-per cent so long as no terminal current exceeds the rated current of the generator.



PRE-OPERATING CHECKS

Crankcase Oil: Refer to the SERVICE section of the Waukesha engine manual. Fill the engine crankcase with oil as recommended, according to the temperature conditions. The capacity of the standard oil pan is 32 quarts, U.S. measure. 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.

For average operating conditions, oil designated as meeting requirements for military specification MIL-L-2104A, type A, is recommended. Many oils designated for MS or DG service meet these requirements. Check with the oil supplier.

Cylinder Top Oiler: An auxiliary top cylinder oiler is supplied as optional equipment on some models. This unit should be serviced according to the instructions attached to the unit.

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

Air Cleaners: Service as instructed on the air cleaners. Be sure to properly install and tighten the air cleaner cup after servicing.

COOLANT

For units which use either a radiator or heat exchanger (city water cooled), fill the cooling system with clean soft water (36 gallons for radiator cooling and 107 quarts for heat exchanger model). 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 Waukesha manual for additional information.

NOTE: *The electric solenoid valve, used with city water cooled plant, 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.

DRYING OUT GENERATOR WINDINGS

If the generator set has been subjected to extreme dampness, a preliminary period of operation may be required to thoroughly dry all windings. Use a megger to determine if drying out is necessary. The insulation resistance of the generator stator at 75° C should measure at least one megohm. The insulation resistance of the rotor at the same temperature should be in the range of one to 50 megohms.

NOTE: *Before measuring the resistance of the generator stator and rotor, disconnect all controls. Do not use a megger to check the rectifiers and other components installed in the voltage regulator and excitation unit.*

To dry out the generator windings, first disconnect the static exciter leads from the generator brushes and connect an external source of field excitation direct current to the brushes. Short circuit the stator terminals and insert a current transformer and ammeter capable of reading full-load generator current, in one of the shorting leads. Operate the generator at rated speed (1800 rpm) and apply sufficient field excitation to develop rated full-load stator current. Operate under these conditions for sufficient time to insure thorough drying of the windings as determined by periodic measurements of rotor and stator insulation resistance.

OPERATION

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.

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

WATER FLOW **(See typical installation on page).** 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 160° F to 185° 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.

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 remains at a stable level. Should the voltage tend to wander from the stable point, a governor sensitivity adjustment may be required. Operating instructions for a line transfer or an automatic demand control are in separate manuals.

AC Ammeter: The AC ammeter indicates the amount of load connected to the generator circuit. On three models, the current for one phase only will be shown, according to the selector switch position.

AC Voltmeter: The voltmeter indicates the AC voltage. On three phase models, the voltage of one phase only will be shown according to the selector switch position. On the four wire, three phase model the voltage shown will always be the three phase (higher) voltage.

On the single phase model, only the higher voltage will be shown.

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.

Safety Stopping Devices: In addition to the AC circuit breaker (which does not stop the plant) the plant is equipped with three safety devices which stop the the engine under circumstances which could cause severe damage to the plant.

1. **High Water Temperature Cut-Off:** A non-adjustable engine mounted thermostatic switch shuts off the plant if coolant temperature rises above 205 degrees F ± 5 degrees.
2. **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
3. **Over Speed Cut-Off:** A centrifugal weight type switch is attached to the outer end of the generator shaft and is not adjustable. The switch operates to stop the plant if the engine speed should accidentally rise to 2100 rpm. Under no circumstances should the plant be operated if the switch is disconnected or otherwise made inoperative. Excessive speed could cause extensive generator damage.

   If the switch stops the plant, check the governor system to make sure it is adjusted correctly and operating freely. If the governor is correctly adjusted and engine is otherwise functioning properly, the plant still shuts down, the switch may not be operating properly. Do not attempt to adjust the switch, replace with a new one.

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.*

NORMAL CONTROL FUNCTIONS

Oil Pressure: The oil pressure gauge indicates the engine oil pressure while the engine is running. Normal oil pressure at operating temperature is approximately 40-psi. Pressure will be higher until the engine warms up.

Water Temperature: The water temperature gauge indicates the coolant temperature during operation. Normal operating temperature is approximately 160 to 185 degrees F.

Amperes: The small ammeter indicates the battery charging current. An automatic regulator controls the charging rate, and it will vary according to the 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.

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 the reset 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.

Meter Selector Switch: The selector switch is provided on the three phase models. The position of its handle indicates which phase of the generator output is indicated on the AC ammeter and voltmeter.

Circuit Breaker: The circuit breaker protects the plant against damage from an extreme overload. If the breaker trips, it must be reset manually.

Frequency Meter: The frequency meter indicates the frequency of the output current in cycles per second. A vibrating reed indicator shows the exact frequency.

Running Time Meter: The 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 service.

Optional Signals or Alarms: Provision is made for connecting a signal light or alarm to indicate an emergency stop, and to indicate a failure to start. Investigate immediately and correct the cause of any improper operation.

VOLTAGE REGULATOR RHEOSTAT

The voltage regulator rheostat provides for adjusting the AC output voltage for normal operating conditions. It provides an adjustment range of approximately 5 per cent plus or minus if the engine governor is properly adjusted for correct frequency. Turn clockwise to increase the voltage, counterclockwise to lower the voltage. In normal operation the regulator should keep the output voltage within 3 per cent plus or minus, between no load and full load conditions. It should not be necessary to change the rheostat setting once set, under normal operating conditions.

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 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. Remove each spark plug. Pour 1 oz. (two tablespoons) of rust inhibitor (or SAE #50 oil) into each cylinder. Reinstall spark plugs.
4. Service air cleaner as outlined in Waukesha manual.
5. Clean governor linkage and protect by wrapping with a clean cloth.
6. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
7. Wipe entire unit. Coat parts susceptible to rust with a light film of grease or oil.
8. Provide a suitable cover for the entire unit.
9. If battery is used, disconnect and follow standard battery storage procedure.

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 Waukesha 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 and fuel in dust-tight containers.

GENERAL MAINTENANCE

GENERAL

Follow a definite schedule of inspection and servicing, based on operating hours. See chart on page . Use the running time meter to keep a record of operating 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 Waukesha engine manual for details and periodic maintenance.

AC GENERATOR

In addition to the engine service operations scheduled, 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 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 in direct ratio to the engine speed. Engine speed is controlled by the governor. The original factory governor setting should not be disturbed. However, should the governor become out of adjustment it must be reset to maintain proper rpm for watt ge, cps and voltage needed.

Refer to instructions in Waukesha manual for governor adjustment. Adjust engine speed to 1800-rpm for 60-cycle operating and 1500-rpm for 50-cycle operation. Use an accurate tachometer for determining engine speed settings, or a frequency meter connected to AC generator output terminals. Multiply frequency by 30 to obtain engine speed.

EXAMPLE: 30 x 61 (cycles) equals 1830-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. Frequency at full load should not drop below 59 cycles.

PERIODIC SERVICE SCHEDULE CHART

DAILY SERVICE, NORMAL 8 HOURS OPERATION

1. **Crankcase Oil:** Check, add as necessary.
2. **Air Cleaners:** Check, clean as frequently as necessary.
3. **Radiator:** Check level, add as necessary.
4. **Water Pump:** Turn grease cup.
5. **Cylinder Top Oiler:** Service as necessary.
6. **Cleaning:** Wipe clean of dust, spilled oil, etc.
7. **Inspection:** Inspect for loose parts, leaks, etc.

WEEKLY SERVICE NORMAL 50 HOURS OPERATION

1. **Crankcase Oil:** Drain and refill unless experience indicates oil can be used for longer period. Maximum 100 hours operation.
2. **Governor Linkage:** Lubricate sparingly. Keep dust free.
3. **Oil Filter:** Replace element at oil change.
4. **Battery:** Check the electrolyte level.

MONTHLY SERVICE, 200-250 HOURS OPERATION

1. **Spark Plugs:** Clean, re-set, test.
2. **Ignition Points:** Check, re-set.
3. **Ignition Timing:** Check.
4. **Valves:** Check tappet clearances.
5. **Breathers:** Clean.
6. **Battery Charge Alternator:** Wipe clean of dust, spilled oil, etc.
7. **Alternator Brushes:** Check, replace if worn to 1/2-inch or if damaged. DO NOT LUBRICATE.

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

NOTE: *For remote mounted voltage regulators use only steps 2 and 3.*

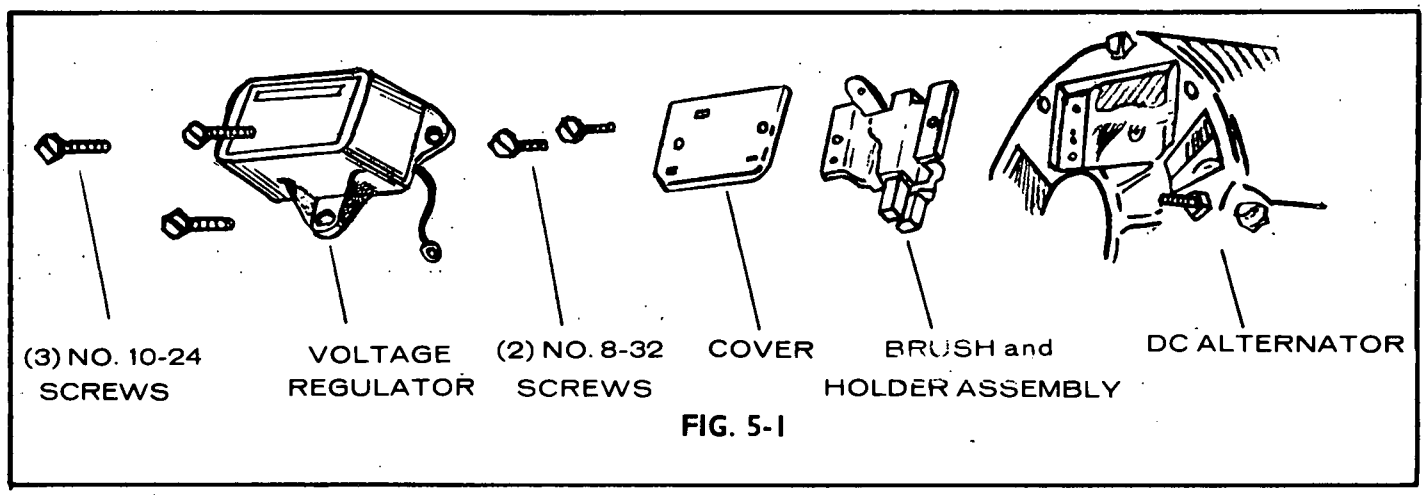


FIG. 5-1

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 too frequent filling).	
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.

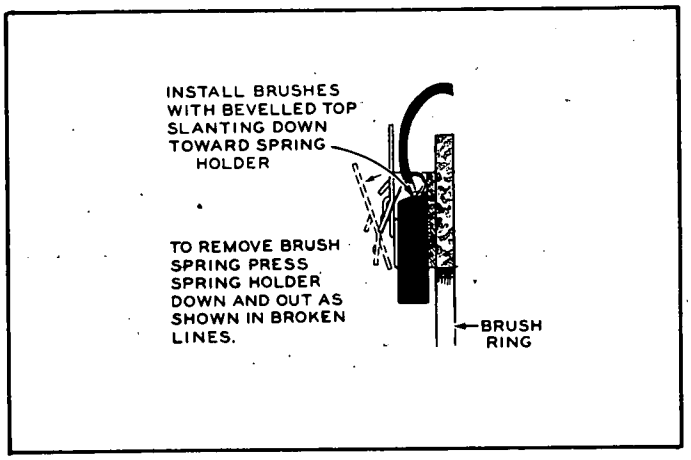
MAINTENANCE

GENERATOR

The AC generator normally requires very little servicing. Periodic inspection, to coincide with engine oil changes, will assure continued 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.

Brushes should be replaced when worn to approximately 1/2-inch long, or so that the lead end of the brush is below a point midway between the outer and inner end of its guide. Do not attempt to remove the brush without first removing its spring and bracket 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.



Generator Bearing: The generator bearing is prelubricated for its life and sealed. It requires no servicing.

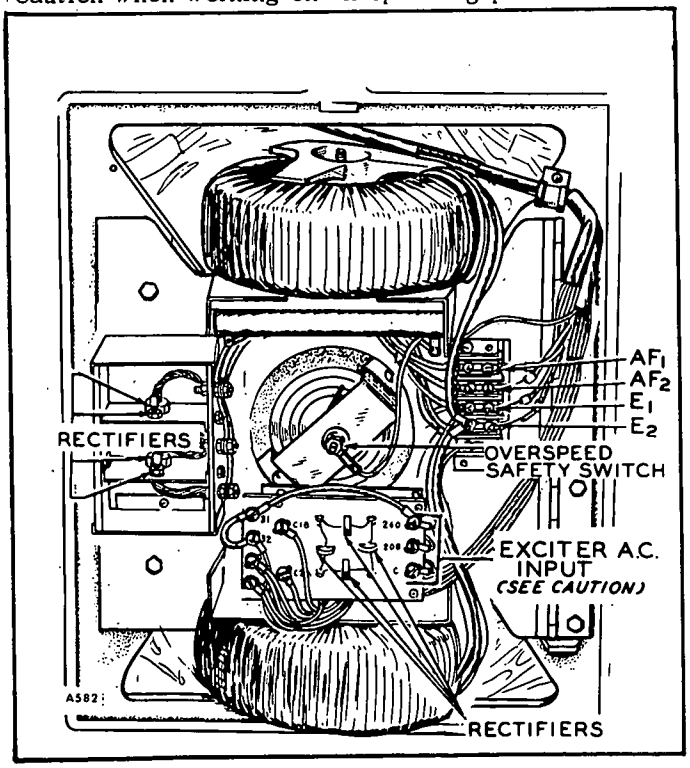
Exciter: The exciter contains no moving parts. Occasionally blow out any dust, etc. Check thoroughly to assure that all components are mechanically secure, and that all electrical connections are tight.

CAUTION: *On some models, the exciter is operable on either 208 or 240-volt AC input, and is factory connected for the correct voltage. This exciter input voltage has no direct relationship to the generator AC OUTPUT voltage. DO NOT change the original factory exciter jumper connection unless the special instructions for reconnecting for different AC output are being followed. These special instructions are supplied on request.*

(1) 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.*



TROUBLE SHOOTING

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 (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	
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	2
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 Rectifier and replace if defective	2
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	2
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	2
	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	4
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 W and X to the junction of Control Rectifiers Y and Z	None

(3) Checking Reactors "A" and "B".

CAUTION: *The extent to which the resistance values obtained when trouble shooting with an ohmmeter are reliable and useful is governed by the accuracy of that ohmmeter. Resistance readings of the range of values found between G1 and G2 cannot be read with accuracy on the multimeter.*

a. *Turn the resistance range selector on the meter to the desired range as given in steps b and c directly below.*
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 0.37.*
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 17.5.*
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 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.

(4) 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 150.0

Results:

1. CONTROL REACTOR IS SERVICABLE 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.

(5) 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.

(2) Checking Rectifiers.

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

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	3
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 and B	Test Reactors A and B for shorted turn and replace if defective	3
	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	3

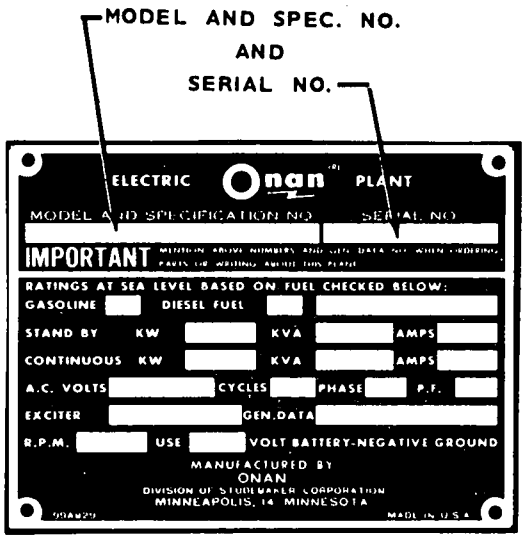
CAUTION: *Note carefully the DIRECTION OF MOUNTING of any rectifier removed. It must be remounted in its original direction.*

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.*

INSTRUCTIONS FOR ORDERING REPAIR PARTS

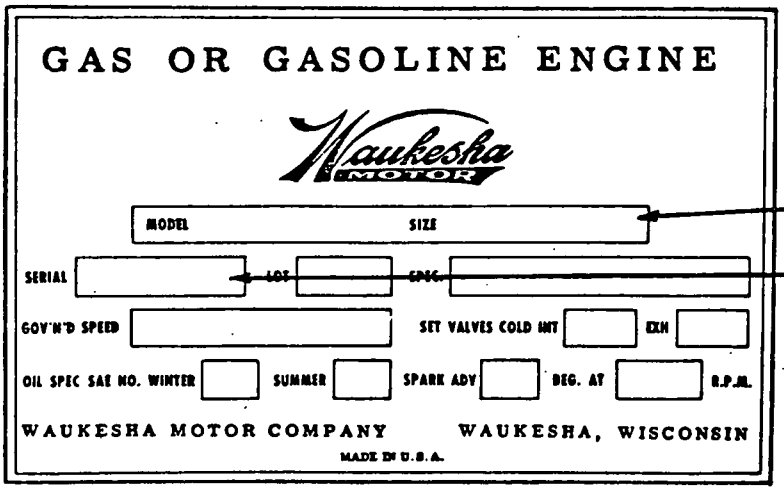
ONAN PARTS

All parts in this list are *Onan* parts. For *Onan* parts or service, contact the dealer from whom you purchased this equipment or 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:



WAUKESHA PARTS

All Waukesha parts must be ordered from the Waukesha Motor Company of Waukesha, Wisconsin, or their nearest authorized distributor. Refer to the Waukesha Engine flywheel housing. When ordering parts, always supply Waukesha with the following nameplate information:



MODEL, SIZE
AND
SERIAL NUMBER
shown on the engine nameplate.

PARTS CATALOG

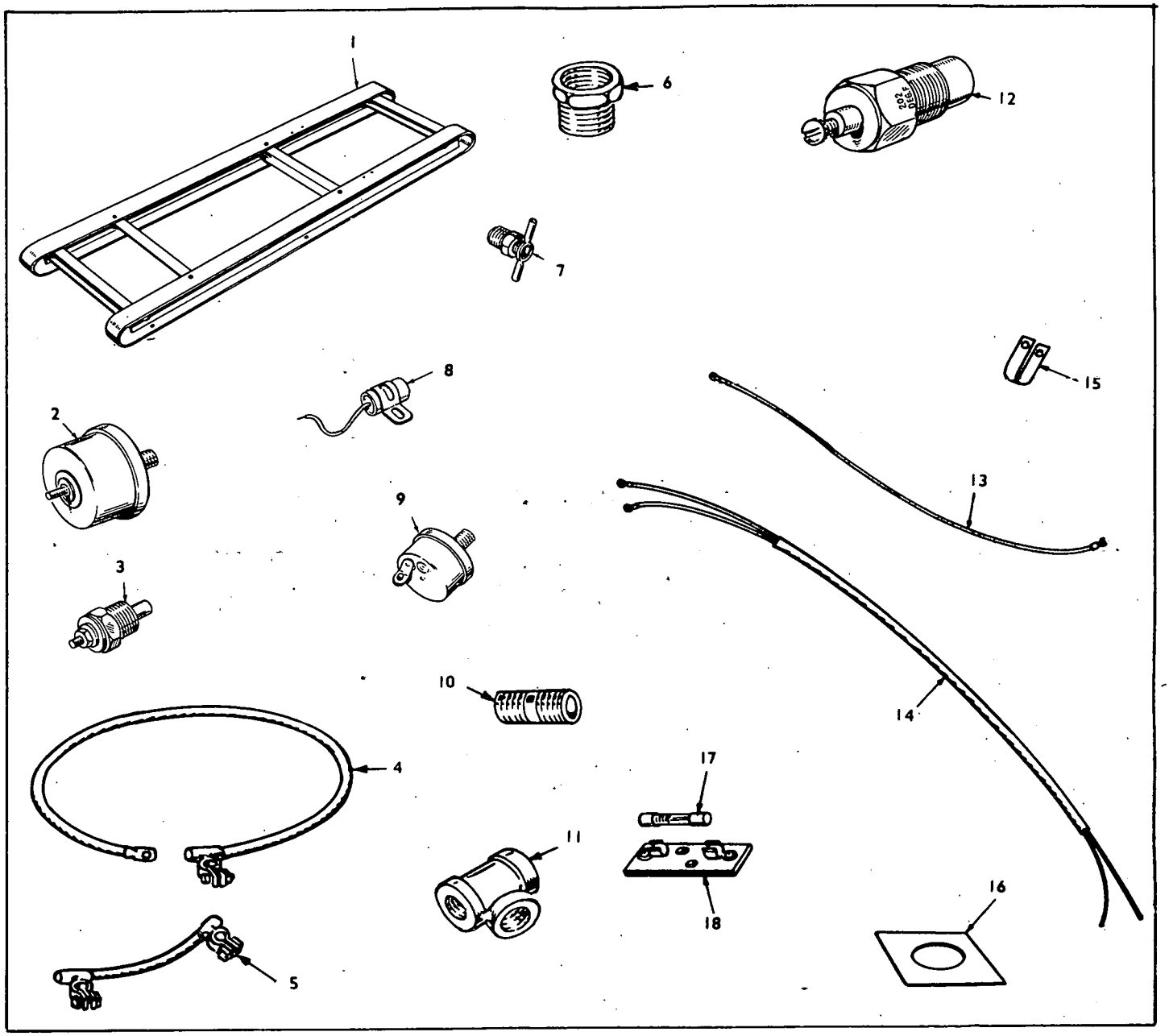
This catalog applies to the standard WC plants as listed below. Powered by a Waukesha F1197GRSIU engine (see Waukesha Manual). Engine parts modified or added by *Onan* will be in this list and have *Onan* part numbers. These supersede similar parts listed in the Waukesha manual. *Onan* parts are arranged in groups of related items and are identified by a reference. All parts illustrations are typical. Using the Model and Spec. No. from the *Onan* plant nameplate, select parts from this catalog that apply to your plant. 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. NUMBER *	ELECTRICAL DATA				
	WATTS**	VOLTS	CYCLES	PHASE	WIRE
200WC-54R8/	200,000	120/208	50	3	4
200WC-54XR8/	200,000	277/480	50	3	4
200WC-55DR8/	200,000	120/240	50	3	4
200WC-57R8/	200,000	220/380	50	3	4
200WC-59XR8/	200,000	347/600	50	3	3
250WC-4R8/	250,000	120/208	60	3	4
250WC-4XR8/	250,000	277/480	60	3	4
250WC-5DR8/	250,000	120/240	60	3	4
250WC-9XR8/	250,000	347/600	60	3	3

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

** - Maximum Standby rating, continuous rating is also shown on Onan nameplate.



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403C575	1	Base, Mounting
2	193A98	1	Sender, Oil Press. (Eng. Unit Only)
3	193A100	1	Sender, Water Temp. (Eng. Unit Only)
4	CABLE, BATTERY		
	416A445	1	Negative
	416A444	1	Positive
5	416A446	1	Cable, Batt. Jpr.
6	BUSHING, PIPE REDUCER		
	505-117	1	High Water Temp. Switch (1/2 x 3/8")
	505-19	1	Water Temp. Gage (1/2 x 3/8")
	505-131	1	Radiator Outlet (3/4 x 3/8")
7	504-28	1	Valve, Rad. Drain
8	312A58	2	Condenser, 0.1-Mfd.(1) Charge Reg. (1) Ign. Coil
9	309B64	1	Switch, Oil Press. Cut-Off

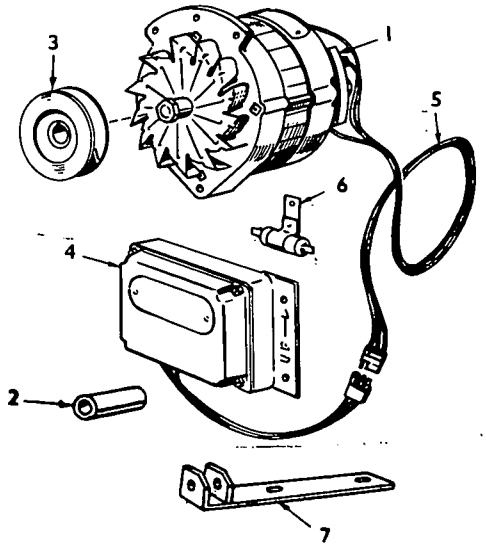
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
10	505-98	2	Nipple, Close (1/8 x 3/4") Oil Press. Tee to Crnks.
11	505-59	1	Tee, Pipe (1/8) Oil Press. Switch & Sender
12	309A178	1	Switch, High Water Temp. Cut-Off
13	336A1211	1	Lead, Starter (14" Long)
14	HARNESS ASSEMBLY		
	338B213	1	Voltage Regulator
	338C399	1	Engine Control
	338B242	1	Static Exciter
15	416A96	1	Clip, Eng. Cont. Harness
16	SHIM, GEN. TO MTG. BASE		
	332A1817	As	.062"
	232A1489	Req.	.0598"
	232A1490		.0354"
17	321-139	1	Fuse, 6-1/4-Amp. 32-Volt
18	321-140	1	Holder, Fuse

ENGINE REPLACEMENT: Furnish complete Model, Spec., and Serial Numper from ONAN nameplate.

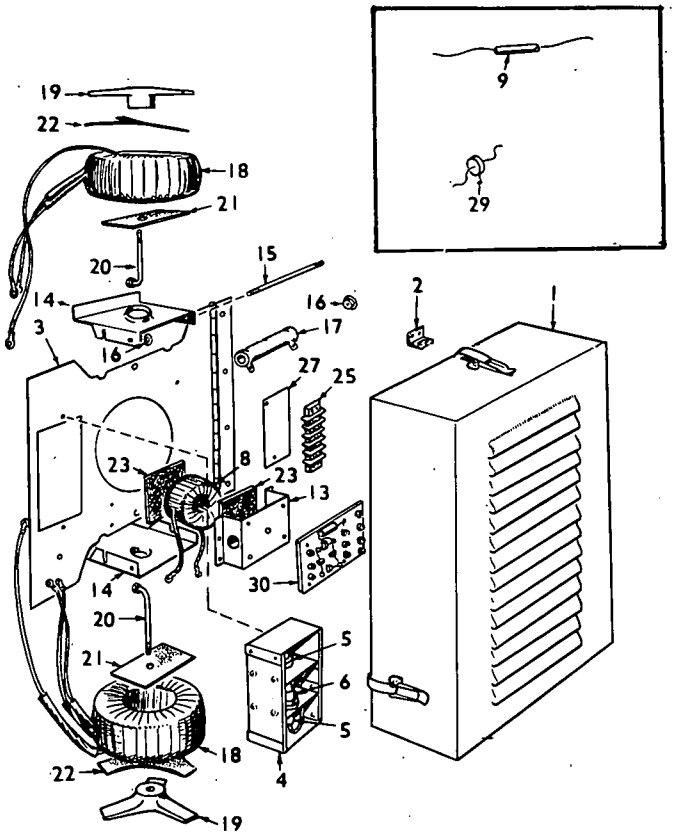
ALTERNATOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191P549	1	*Alternator, Charge
2	232A1813	1	Spacer, Alternator Mtg.
3	191B649	1	Pulley, Alternator
4	191C548	1	*Regulator, Charge
5	191B544	1	Cable Alternator
6	191C550	1	Resistor, Alternator
7	191B690	1	Bracket, Alternator

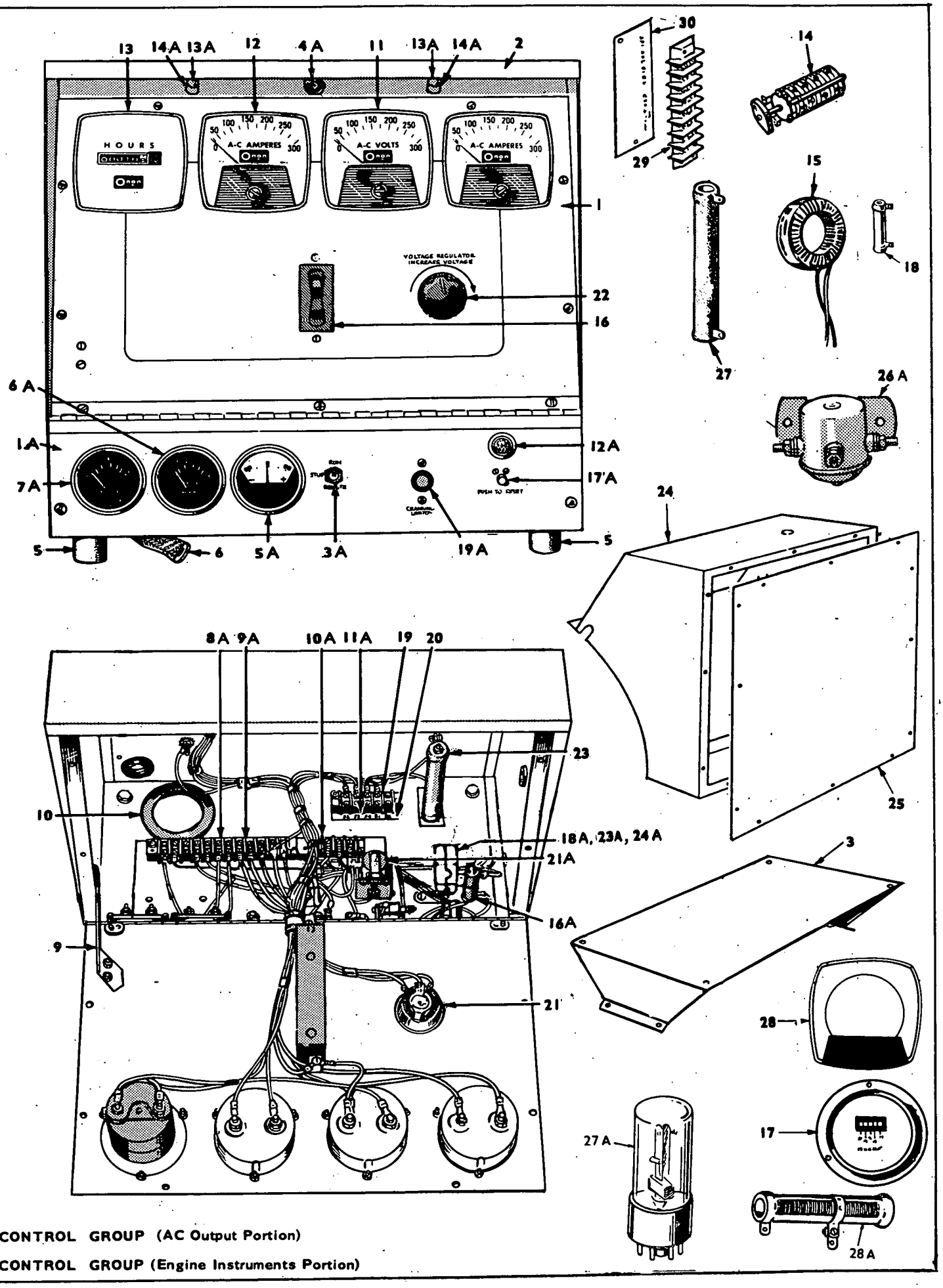
* - Check nameplate and order components from your nearest dealer.



GENERATOR GROUP (Exciter Portion)



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTIONS
	209-25	1	Magneciter Assy., Complete
1	234D116	1	Cover, Exciter
2	232A1376	3	Bracket, Fastening, Cover to Alt. End Bell
3	234D74	1	Panel Only, Exciter
4	305B228	1	Rectifier Assy., Power Complete (Incl. two #305P233 & two #305P234 Rect. plus wire and hardware)
5	RECTIFIER ONLY, POWER (Field)		
	305P233	2	Lower Two, Neg. (Incl. in Rect. Assy. #305B228)
6	305P234	2	Upper Two, Pos. (Incl. in Rect. Assy. #305B228)
8	315A78	1	Reactor, Voltage Control
9	304P476	1	Resistor, Voltage Control Reactor (Incl. in Rect. & Resistor Assy. #305B227)
13	234B115	1	Bracket, Mtg., Volt. Cont. Reactor
14	234B75	2	Bracket, Gate Reactor Mtg.
15	520A190	1	Stud, Resistor Mtg.
16	304A15	2	Washer, Resistor Ctrg.
17	304-442	1	Resistor, Fixed, Mts. to Gate Reactor Bracket
18	315A51	2	Reactor, Gate
19	232A1389	2	Retainer, Gate Reactor
20	232A1403	2	Stud, Gate Reactor Mtg.
21	232B1388	4	Gasket, Gate Reactor Mtg.
22	232B1387	4	Gasket, Gate Reactor to Ret.
23	232A1548	2	Gasket, Cont. React. Coil Mtg.
25	332A532	1	Block, Terminal (5-Place)
27	332A693	1	Strip, Term. Blk. Marker (5-Place)
29	305P240	4	Rectifier, Volt. Control Reactor (Incl. in Rect. & Resistor Assy. #305B227)
30	305B227	1	Resistor Assy., Rect. (Incl. 304P476 Resistor & (4) Rect. 305P240)



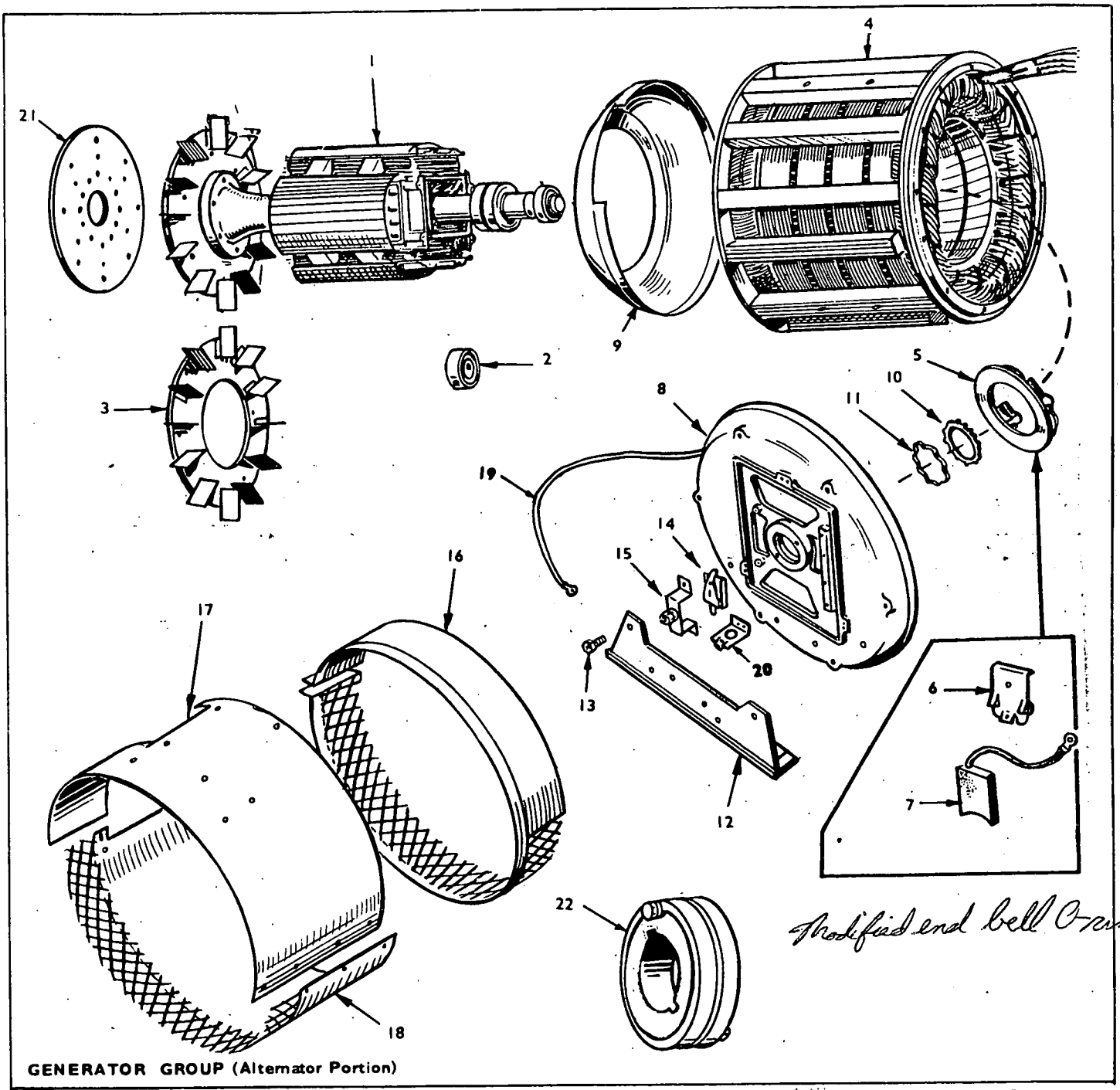
CONTROL GROUP (AC Output Portion)

CONTROL GROUP (Engine Instruments Portion)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	*	1	Panel Only, Upper Cont.
2	301D2115	1	Box Only, Control
3	301C1830	1	Bracket, Cont. Box Mtg.
5	402-78	4	Mount, Rubber, Cont. Box Mtg.
6	337A44	1	Strap, Grd.
9	301A1914	1	Bracket, Panel Stop
10	508-63	1	Grommet (2-3/4" Hole)
11	VOLTMETER, AC (Check Scale & Select According to Rating)		
	302P421	1	Voltmeter Scale 0-300
	302P422	1	Voltmeter Scale 0-600
	302P423	1	Voltmeter Scale 0-750
12	AMMETER, AC (Check Scale and Select According to Rating) NOTE: 1-Phase use 2.		
	302P414	1	Ammeter Scale 0-500
	302P415	1	Ammeter Scale 0-750
	302P416	1	Ammeter Scale 0-1000
13	£METER, RUNNING TIME		
			60-Cycle Plants
	302P465	1	120/240-V, 1-Ph., 120/208-V, 3-Ph., 120/240-V, 3-Ph. & 600-V, 3-Ph.
	302P467	1	277/480-V, 3-Ph.
			50-Cycle Plants
	302P468	1	120/240-V, 1-Ph., 120/208-V 3-Ph., 120/240-V, 3-Ph. & 600-V, 3-Ph.
	302P469	1	220/380-V, 3-Ph.
	302P470	1	277/480-V, 3-Ph.
14	308-22	1	Switch, Volt. & Current Sel.
15	£TRANSFORMER, CURRENT (Check Transformer Nameplate, Select According to Rating)		
	302B372	3	Nameplate Ratio 500/5 (Use with 0-500 AC Ammeter)
	302B385	3	Nameplate Ration 750/5 (Use with 0-750 AC Ammeter)
	302B394	3	Nameplate Ratio 1000/5 (Use with 0-1000 AC Ammeter
16	320B170	1	Breaker, Circuit
17	METER, FREQUENCY		
	302-213	1	60-Cycle Plants
	302-234	1	50-Cycle Plants
18	RESISTOR FREQUENCY METER		
	304A305	1	For 277/480-V, 3-Ph. Plants (45,000-Ohm, 10-W)
	304A125	1	For 220/380-V, 3-Ph. Plants (15,000-Ohm, 25-W)
	304A402	1	For 600-V, 3-Ph. Plants (60,000-Ohm, 10-W)

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

REF. NO.	PARTS NO.	QTY. USED	PARTS DESCRIPTION
19	332A604	1	Block, Term. (5-Place)
20	332A690	1	Strip, Block Marker (5-Place)
21	303-111	1	Rheostat, Volt. Reg.
22	303-32	1	Knob, Rheostat
23	304A484	1	Resistor, Volt. Reg.
24	301C1682	1	Box, Output Term (Side of Gen.)
25	301C1683	1	Cover, Output Term. Box
27	304A536	1	£Resistor, Fixed (9000-Ohm, 50-Watt) Off Running Time Meter, 600-V 3-Ph.,
28	302B448	1	Plate, Meter Face
29	332A503	1	Block, Term. (8-Place)
30	332A601	1	Strip, Blk. Marker (15 through 22)
31	301A2727	1	Handle, Control Box
32	508P63	1	Grommet
1A	301C2124	1	Panel Only, Lower Cont.
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	332A607	1	Block, Term. (12-Place)
9A	332A608	1	Strip, Marker (4 through 15)
10A	332A611	1	Block, Term. (3-Place)
11A	332A762	1	Strip, Marker (Remote, B+, Ground)
12A	322P69	1	Receptacle Assy., Pilot Light
13A	332P72	2	Receptacle, Panel Light
14A	322-17	3	Bulb, (2) Panel (1) Pilot
16A	RESISTOR, FIXED		
	304A446	2	Water Temp. Gage & Oil press. Gage (150-Ohm 10-Watts)
	304A248	1	Time Delay Relay (100-Ohm 10-W)
17A	307A655	1	Relay, Emergency Latch
18A	307B820	2	Relay, Start-Disconnect
19A	320A104	1	Limiter, Cranking
21A	307A388	1	Relay, Time Delay, Low Oil Pressure Switch
23A	307P778	2	Spring, Relay Hold-down
24A	323P52	4	Socket, Relay
26A	307-61	1	Relay, Pilot
27A	RELAY, CYCLE CRANKING		
	307A697	1	10 Second Delay
	307A753	1	5 Second Delay
28A	304A66	1	Resistor, Adjustable



GENERATOR GROUP (Alternator Portion)

Modified end bell O-ring P/N

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	214A46	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

REF. NO.	PARTS NO.	QTY. USED	PARTS DESCRIPTION
12	232D1396	1	Support, Gen. Mtg.
13	805-35	4	Bolt, Place, Gen. Mtg.
14	150A717	1	Switch Assy., Overspeed
15	150A713	1	Bracket, Overspeed Switch, Incl. Contact Point
16	234D70	1	Band, Gen., Frt. Port. (Narrow)
17	234D140	1	Band, Gen., Rr. Port., Upper Half (Wide)
18	234D141	1	Band, Gen., Rr. Port., Lower Half (Wide)
19	336A1213	1	Lead Assy., Overspeed Switch
20	234A107	1	Bracket, Conduit Connector
21	232C1394	1	Disc. Drive
22	204A83	1	Ring, Collector

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

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