OPERATOR'S MANUAL

AND PARTS CATALOG

FOR

Onan®

ELECTRIC GENERATING SETS

DWU

SERIES

ONAN

1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432

A DIVISION OF ONAN CORPORATION

N.Y. INTERNATIONAL OFFICE: Empire State Bldg.

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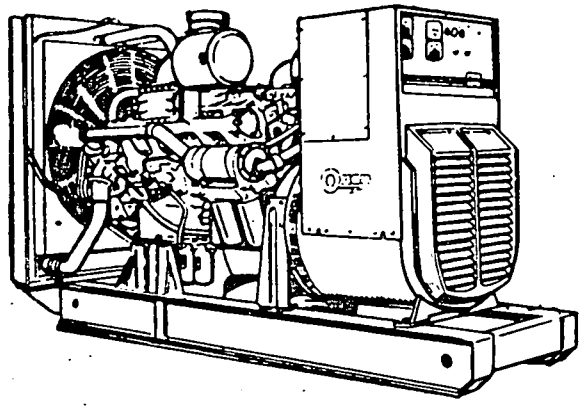
GENERAL INFORMATION



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INTRODUCTION

This manual includes instructions for the installation, operation, maintenance and parts of the DWU 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.

350.0DWU 4XR / 96 A
1 2 3 4

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 unit, mention the complete Model, Spec No. and Serial No., as given on the Onan nameplate. This nameplate information is necessary to properly identify the set among the many types manufactured. Refer to the engine nameplate when requesting information from its manufacturer.

Electric generating plants are given a complete running test under various load conditions and are 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 unit 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.

SPECIFICATIONS

ENGINE DETAILS

Engine Manufacturer	Waukesha
Engine Series	L-1616-D
Number of Cylinders	12
Displacement	1616 cu. inch.
BHP at 1800 rpm	
Compression Ratio	14 to 1
Bore	5-3/4 in.
Stroke	5-3/16 in.
Fuel Used	No. 2 Diesel
Battery Voltage	24 volts
SAE Battery Group	8D
Starting Method	Solenoid Shift
Ampere Rating of Battery Charging Alternator	35 amperes
Exhaust Connection (National Pipe Thread)	8 in.
Fuel Inlet Connection (National Pipe Thread)	1/4 in.
Fuel Return Connection (National Pipe Thread)	1/4 in.

GENERATOR DETAILS

60 Hertz Rating, Continuous Standby	350,000 watts (350 KW)
AC Voltage Regulation	±2%
60 Hertz RPM	1800
50 Hertz RPM	1500

VOLTAGE CODE (60 HERTZ)	VOLTAGE	PHASE	MAXIMUM CURRENT OUTPUT (AMPERES)
4R	120/208	3	1215
5DR	120/240	3	1054
7XR	240/416	3	607.5
6DR	240/480	3	527
4XR	277/480	3	527
9XR	347/600	3	421

CAPACITIES AND REQUIREMENTS

Oil Change with Filters and Lines	29 gallons (approx.)
Total Coolant Capacity, Radiator Cooled Models	51 gallons
Generator Cooling Air Required, CFM at 1800 RPM	3000
Engine Combustion Air Required, CFM at 1800 RPM	1300
Engine Cooling Air Required with Radiator, CFM at 1800 RPM	32,000
Total Air Requirements for Radiator Cooled Models**	36,300

** Radiator cooled models must have a compartment air inlet duct 1-1/2 times larger in total usable area than the radiator discharge area. See Typical Installation.

DESCRIPTION

GENERAL

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

ENGINE

The engine is a Waukesha basic model L-1616D as described in their 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 brushless, 4 pole revolving field type alternator and a rotating rectifier exciter with a solid state transistorized 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 rotating rectifier exciter provides for almost constant AC output voltage over a wide range of load conditions. It is used for providing excitation current (DC) to the rotating field of the generator. The improved design of this brushless unit simplifies servicing and maintenance. It does this by eliminating parts which are subject to normal wear, such as brushes, slip rings and commutator.

A solid-state transistorized voltage regulator system works in conjunction with the exciter.

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 again be started.

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 emergency latch 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 emergency latch 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 DWU 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 later 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 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 in Fig. 1.*

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 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 (FIGURES 3-4)

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. (Continued Page 10)

When installing ONAN electric plants, 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. (Either rigid foundation mounting or mounting plant on vibration isolators between skid base and 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 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. D).

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

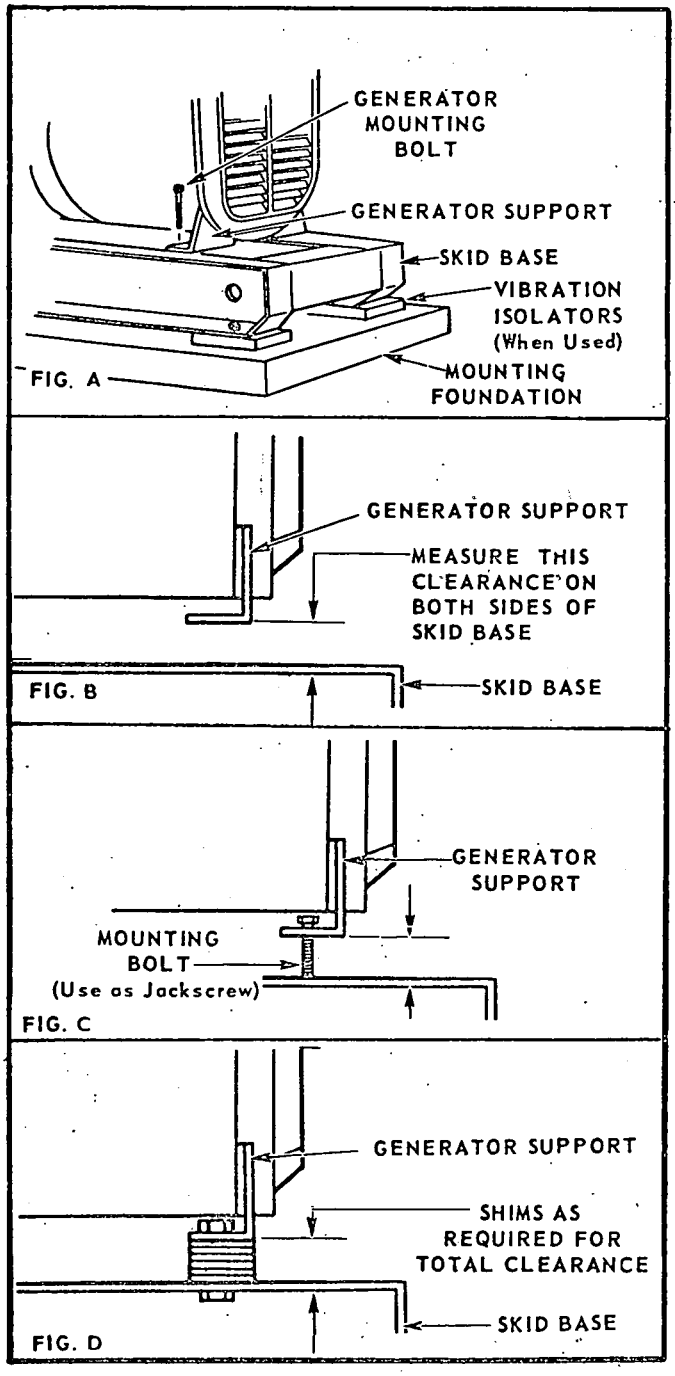


TABLE 1

PLANT MOUNTING	WEIGHT CORRECTION FIGURE - INCH
Rigid Mounting	.020
Vibration Isolator Mounts	.035

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

FIGURE 1. ALIGNING THE DWU

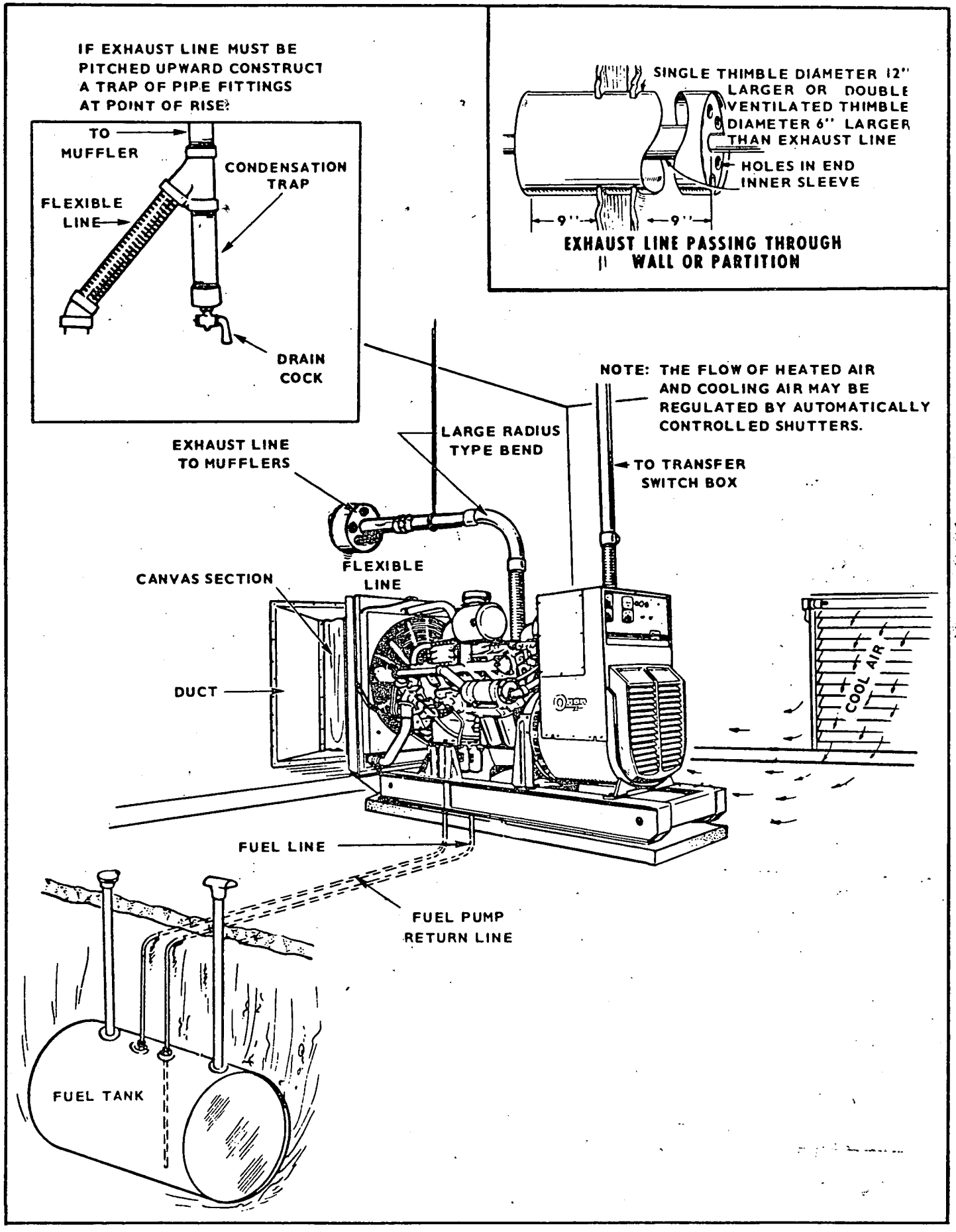


FIG. 2 A TYPICAL INSTALLATION

FIG. 3 TYPICAL HEAT EXCHANGER COOLING

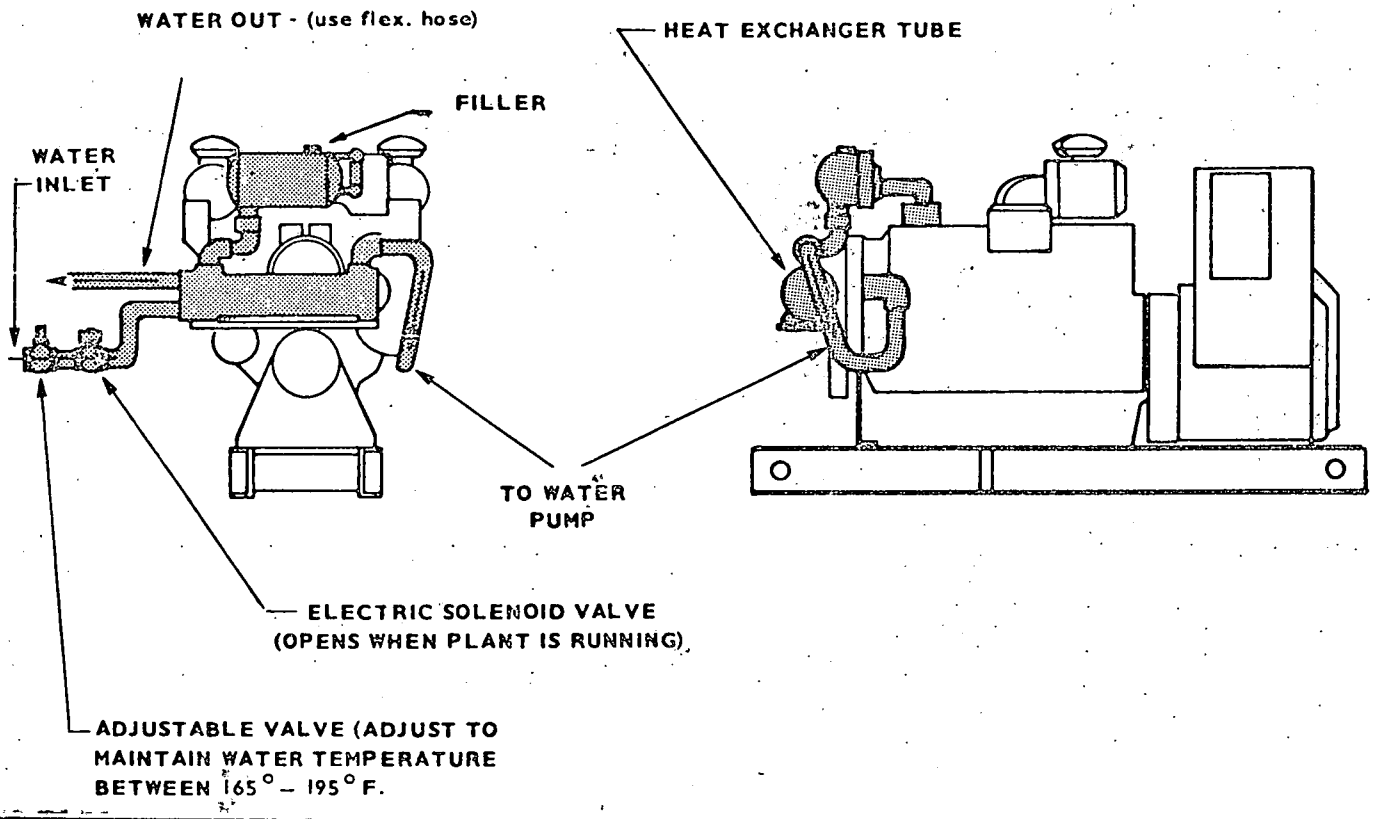
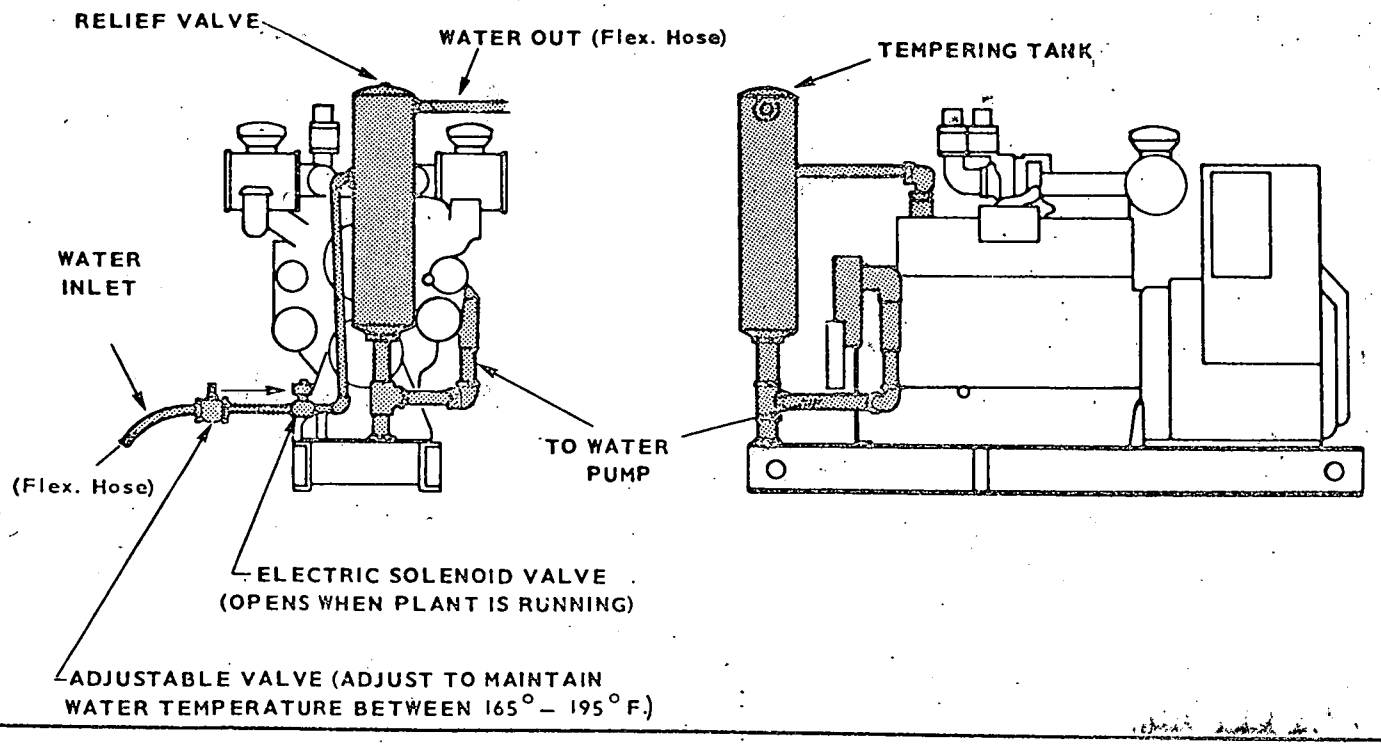


FIG. 4 TYPICAL STANDPIPE COOLING



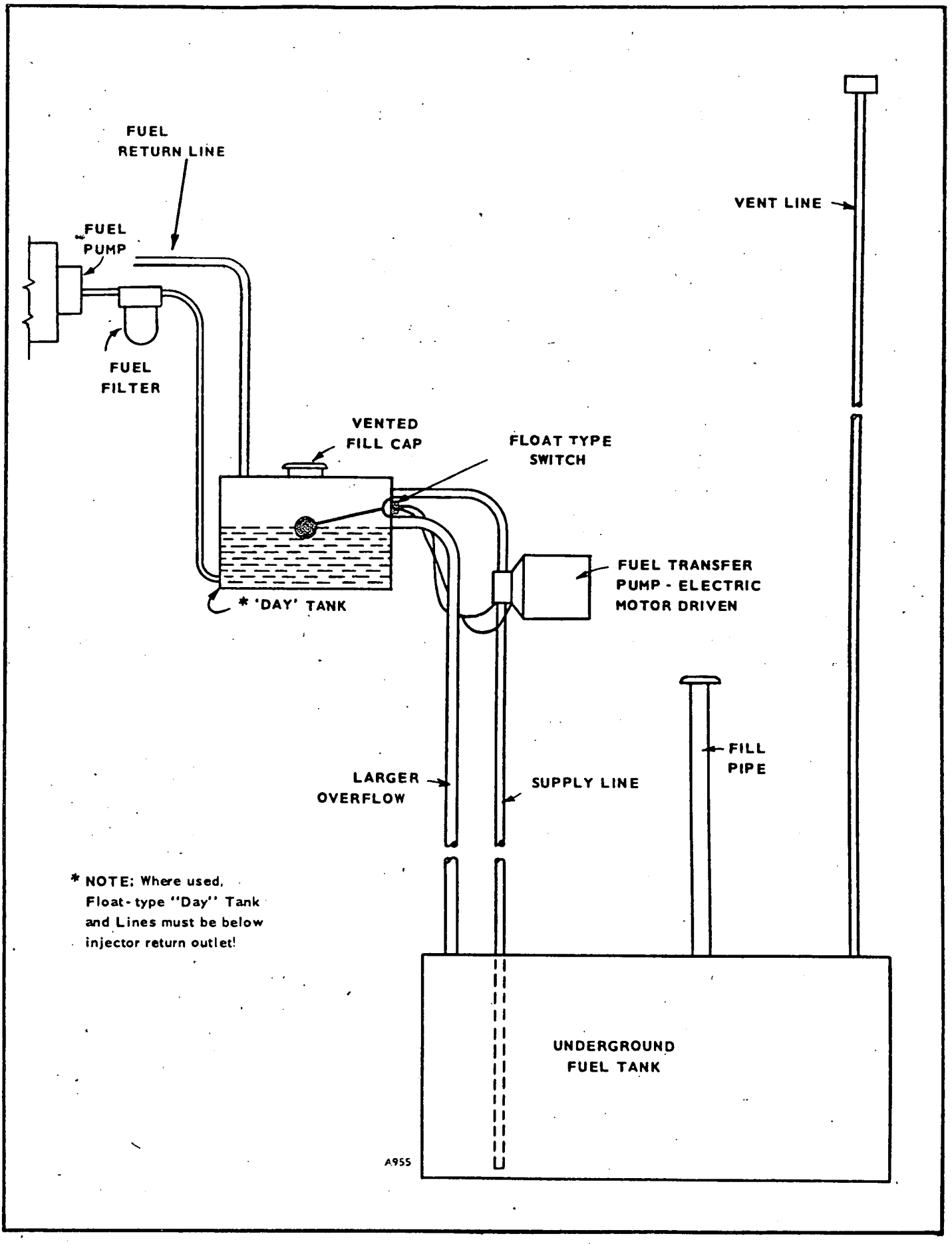


FIG. 5 OPTIONAL DAY TANK INSTALLATION

On both systems use flexible pipe for connecting water supply the 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. Adjust the flow to maintain water temperature between 165° and 195° while viewing the water temperature gauge.

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 (Fig. 2). Use pipe at least as large as the 8″ pipe size outlet of the engine. 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 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 CONNECTIONS

Check local regulations governing the installation of a fuel supply tank.

NOTE: *In any Diesel engine installation, fuel system cleanliness is of utmost importance. Make every effort to prevent moisture or foreign matter from entering the system.*

The maximum fuel lift without any horizontal run should not exceed eight feet. The horizontal run, if the supply tank is level with the fuel pump, should not exceed 12½ feet.

Day Tank (Figure 5)

Engines may be equipped with an optional day tank. A float operated switch controls the electric fuel pump (not included with day tank) to maintain the correct fuel level to assure a constant source of fuel. Do not mount the tank on the plant. Mount the tank on a vibration free support below the engine fuel return line. The tank overflow line to the supply tank is optional, consult local regulations. Refer to the installation instructions included with the tank.

BATTERY (FIGURE 6)

Twenty-four volt battery current is required for starting purposes. Use two 12 volt type 8D batteries for a normal

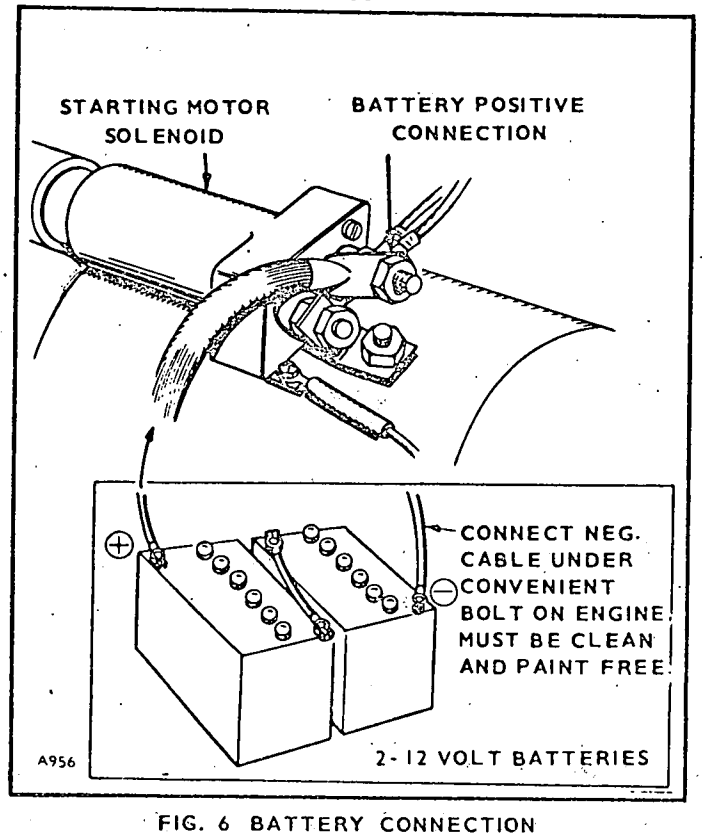


FIG. 6 BATTERY CONNECTION

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 an 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 No. 18 wire up to 900 feet (Fig. 7). The GND terminal is for a customer-supplied alarm at a remote location to warn of low oil pressure, high water temperature and overspeed.

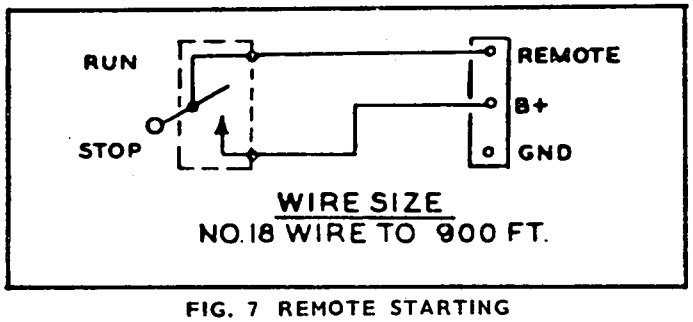


FIG. 7 REMOTE STARTING

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 (Fig. 8) 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.

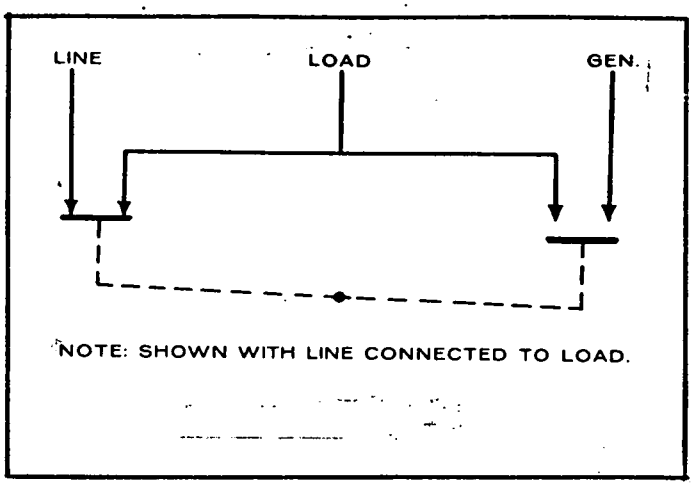


FIG. 8 DOUBLE THROW TRANSFER SWITCH

Connect load wires directly to the large terminal bars provided (Fig. 9). Some plants are "reconnectible" for different voltages and have extra leads. These are pre-connected according to the nameplate ratings.

CAUTION: *Reconnection, for a different output voltage then that shown on the plant nameplate, may involve control panel changes, sometimes of an extensive nature. For specific information, contact the factory. Give the complete information shown on the ONAN nameplate, and indicate the desired new voltage.*

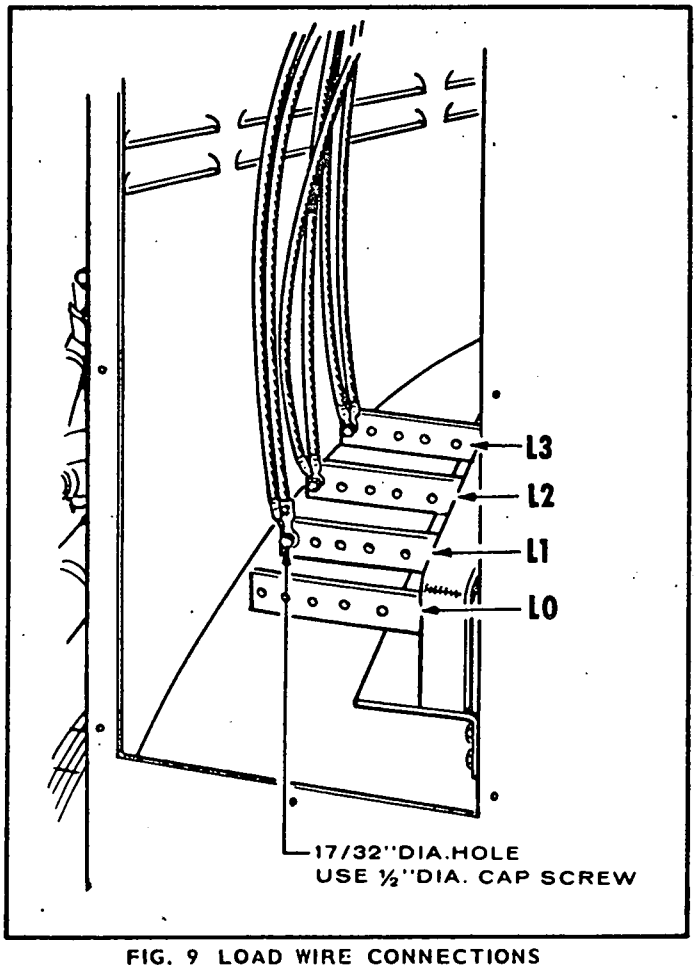


FIG. 9 LOAD WIRE CONNECTIONS

3 Phase, 3 Wire Plant (Fig. 10): No terminal is grounded. For three-phase current, connect separate load wires to each plant terminal L_1, L_2, and L_3.

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: L_1-L_2, L_1-L_3, and L_2-L_3. The load connected to any one single phase circuit must not be greater than 1/3 the rated capacity of the plant.

If both single phase and three phase current are 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.

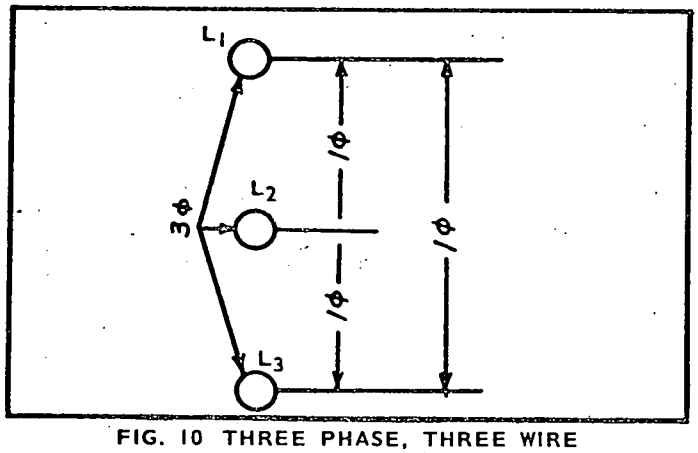


FIG. 10 THREE PHASE, THREE WIRE

3 Phase, 4 Wire, Wye Connected Plant (Fig. 11): 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 L_0 is grounded. For single phase current, connect the neutral (white) load wire to the L_0 terminal. Connect the "hot" (black) load wire to any one of the other three terminals – L_1, L_2, or L_3. 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 L_1, L_2, and L_3. 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 using single phase and three phase current at the same time, use care to properly balance the single phase load.

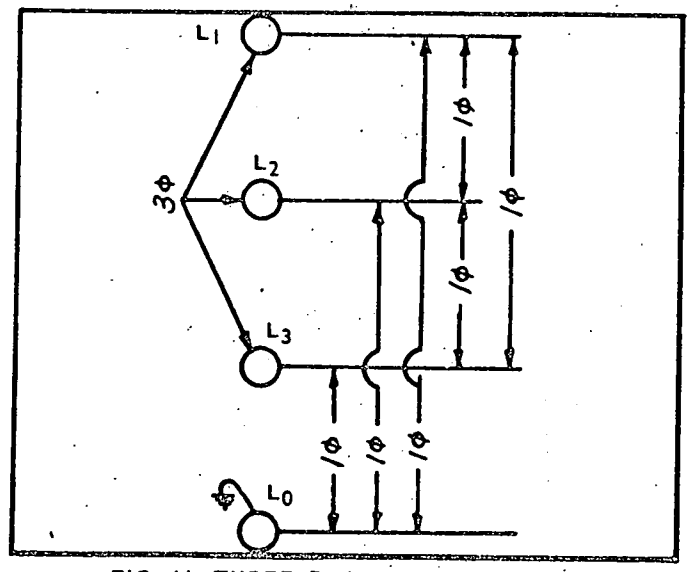


FIG. 11 THREE PHASE, FOUR WIRE

120/240 Volt, 3 Phase, 4 Wire Delta Connected Plant (Fig. 12): 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 L_1, L_2, and L_3 – one wire to each terminal. For 3 phase operation the L_0 terminal is not used.

For 120/240 volt, 1 phase, 3 wire operation, terminals L_1 and L_2 are the "hot" terminals. The L_0 terminal is the neutral, which can be grounded if required. For 120 volt service, connect the "hot" (black) load wire to either the L_1 or L_2 terminal. Connect the neutral (white) wire to the L_0 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.

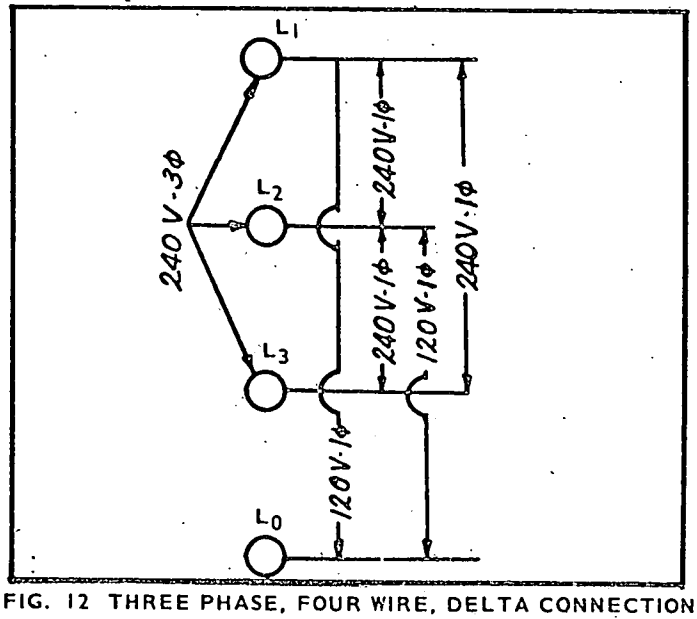


FIG. 12 THREE PHASE, FOUR WIRE, DELTA CONNECTION

OPERATION

CRANKCASE OIL

Refer to the Waukesha 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.

CAUTION *Engine oil and coolant are drained prior to shipping. Rust inhibiting oil is applied to cylinders. Before operating: Fill crankcase with oil. Fill cooling system with coolant.*

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 Waukesha manual for additional information.

CAUTION: *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. Use a jumper from the 24 volt battery supply to the electric solenoid.*

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

FUEL

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

BEFORE INITIAL START

Refer to Pre-Start instructions in the Waukesha 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 40-50 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 (See typical installations on page 8)

If the plant is city water (pressure) cooled, but without the optional flow (automatic) 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 shutdown 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 one 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. After about four hours of continuous no-load operation, the injection nozzles may become fouled and require servicing. 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 injector. Pour one ounce (two tablespoons) of rust inhibitor (or SAE #50 oil) into each cylinder. Install injector.
4. Service air cleaner as outlined in the 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. If battery is used, disconnect and follow standard battery storage procedure.
9. 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. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean, and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.
5. 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 frequently.
3. Change crankcase oil every 100 operating hours.
4. Keep oil and fuel in dust-tight containers.
5. Keep injector pump linkage clean.

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet, standard cooling, normal ambients and with No. 2 Diesel 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 Waukesha engine manual for details and periodic maintenance.

AC GENERATOR

In addition to the engine service operations scheduled in the Waukesha manual, check the condition of the AC generator.

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 a direct ratio to the engine speed. Engine speed is controlled by the built-in governor of the fuel injection pump. The original factory governor setting should not be disturbed. However, in case of pump repair, the governor can easily be reset.

1. See that the injection pump is properly timed to the engine. Refer to the engine manual.
2. Refer to instructions in engine manual for governor adjustment. Adjust engine speed to 1800 rpm for 60 cycle operation 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.

BATTERY CHARGING DC ALTERNATOR

This information is presented for field use only. If a major repair is needed, 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.

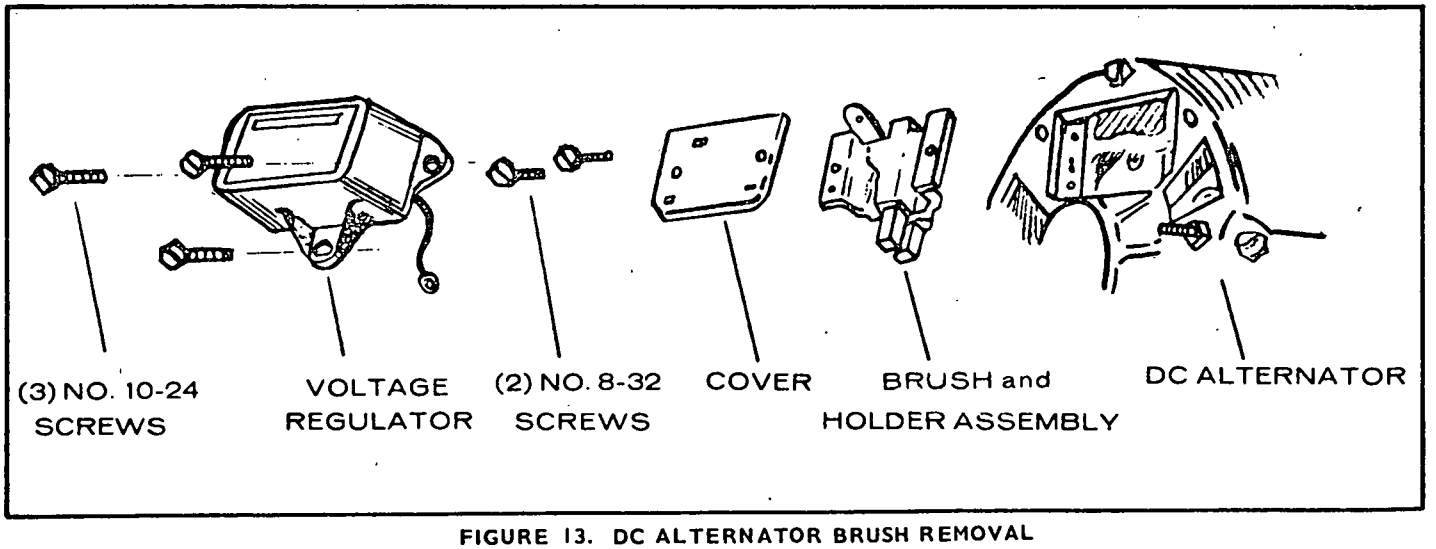


FIGURE 13. DC ALTERNATOR BRUSH REMOVAL

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.

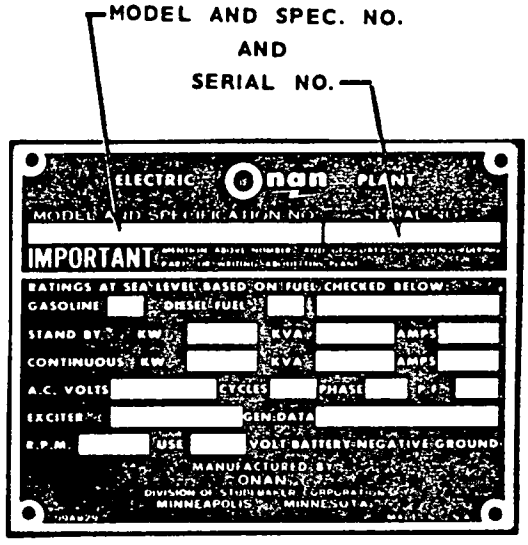
INSPECTION AND CLEANING

When inspecting the rotating rectifier assembly or voltage regulator, make sure diodes are kept free of dust, dirt and grease. Excessive foreign matter on these diodes and heat sinks will cause the diodes to overheat and will result in their failure. Blow the assembly out, periodically, with filtered, low pressure air. Also check to see that diodes and leadwires are properly torqued. The diodes should be torqued to 30 in. lb. or finger tight plus a quarter turn.

PARTS CATALOG

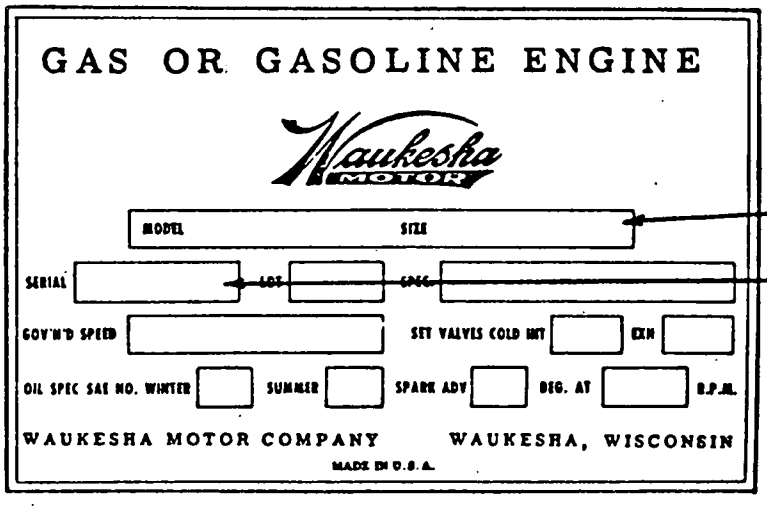
ONAN PARTS

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.

This catalog applies to the standard DWU plants as listed below. These plants are powered by a Waukesha 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. 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					PARTS
	WATTS**	VOLTS	HERTZ	WIRE	PHASE	KEY NO.
350.0DWU-4R8/	350,000	120/208	60	4	3	
350.0DWU-4XR8/	350,000	277/480	60	4	3	
350.0DWU-7XR8/	350,000	240/416	60	4	3	1
350.0DWU-5DR8/	350,000	120/240	60	4	3	
350.0DWU-6DR8/	350,000	240/480	60	4	3	
350.0DWU-9XR8/	350,000	347/600	60	4	3	
290.0DWU-57R8/	290,000	220/380	50	4	3	1

* The Specification Letter advances (A to B, B to C, etc.) with manufacturing changes.
** Maximum rating is shown. Continuous rating also appears on nameplate.

NOTE: Hertz is a unit of frequency equal to one cycle per second.

REPLACEMENT ENGINES

100P977 1

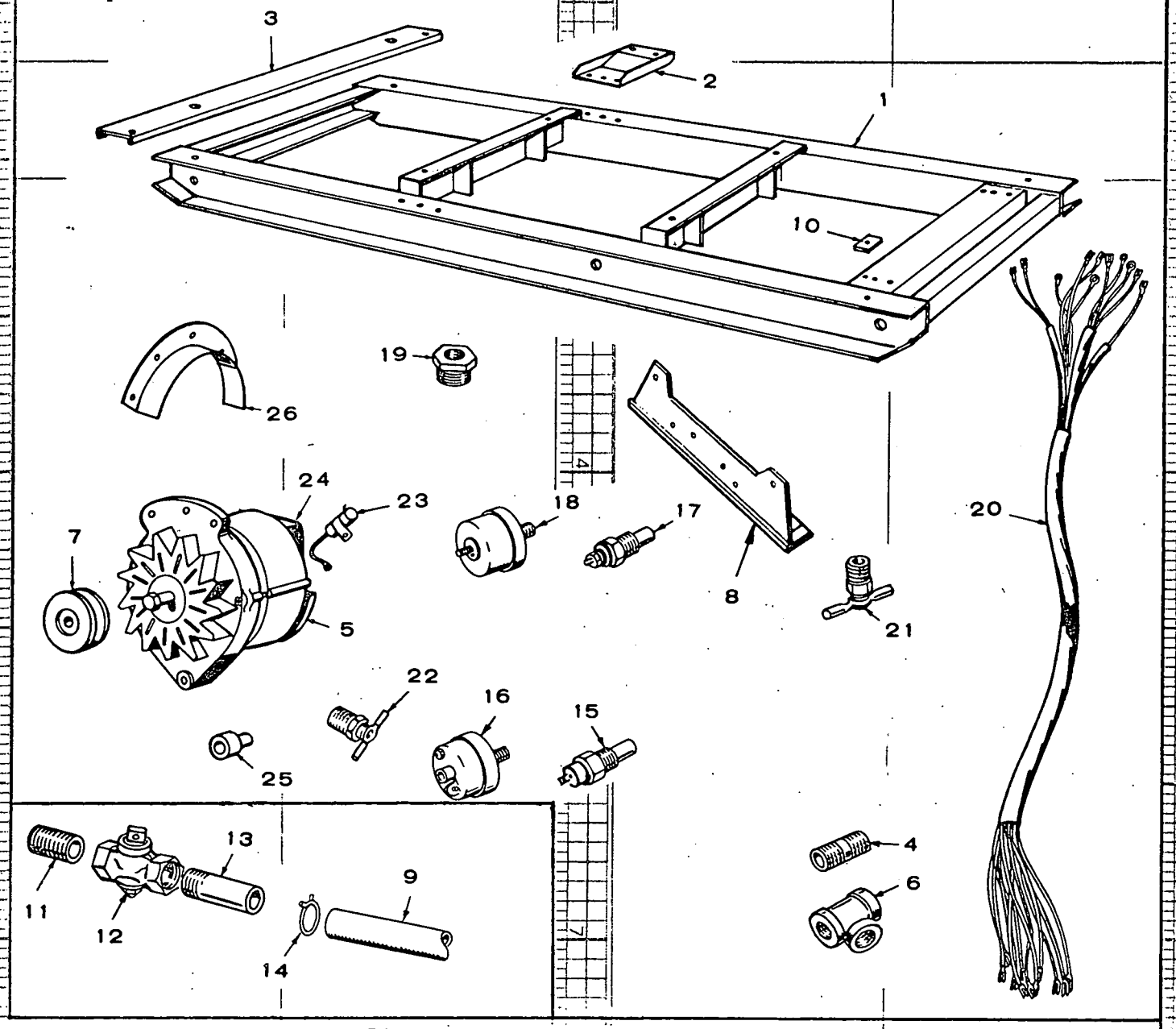
Waukesha Engine Company Model L1616-DSUI.

General Description:

Includes – Complete Cylinder Block, Fuel Pump, Air Cleaner, Fuel Filter, Oil Filter, Starter Motor, Governor, Fan Blades, Fan Belt, Fan Guard, Flywheel, Flywheel Housing, Water Pump, Engine Supports, Oil Pan, Oil Cooler, Exhaust Manifold, Radiator, Fuel Injection System, Viscous Damper, Barring Device, Front Engine Support, Turbo Charger and Intercooling, Pump and Surge Tank, Closed Breather System, Flexible Exhaust System, Intercooling Plumbing, and Start Stop Control Device.

Excludes – Alternator, Alternator Mounting Brackets, Alternator Belt, Temperature Sender, and Oil Pressure Sender.

MISCELLANEOUS ENGINE PARTS GROUP

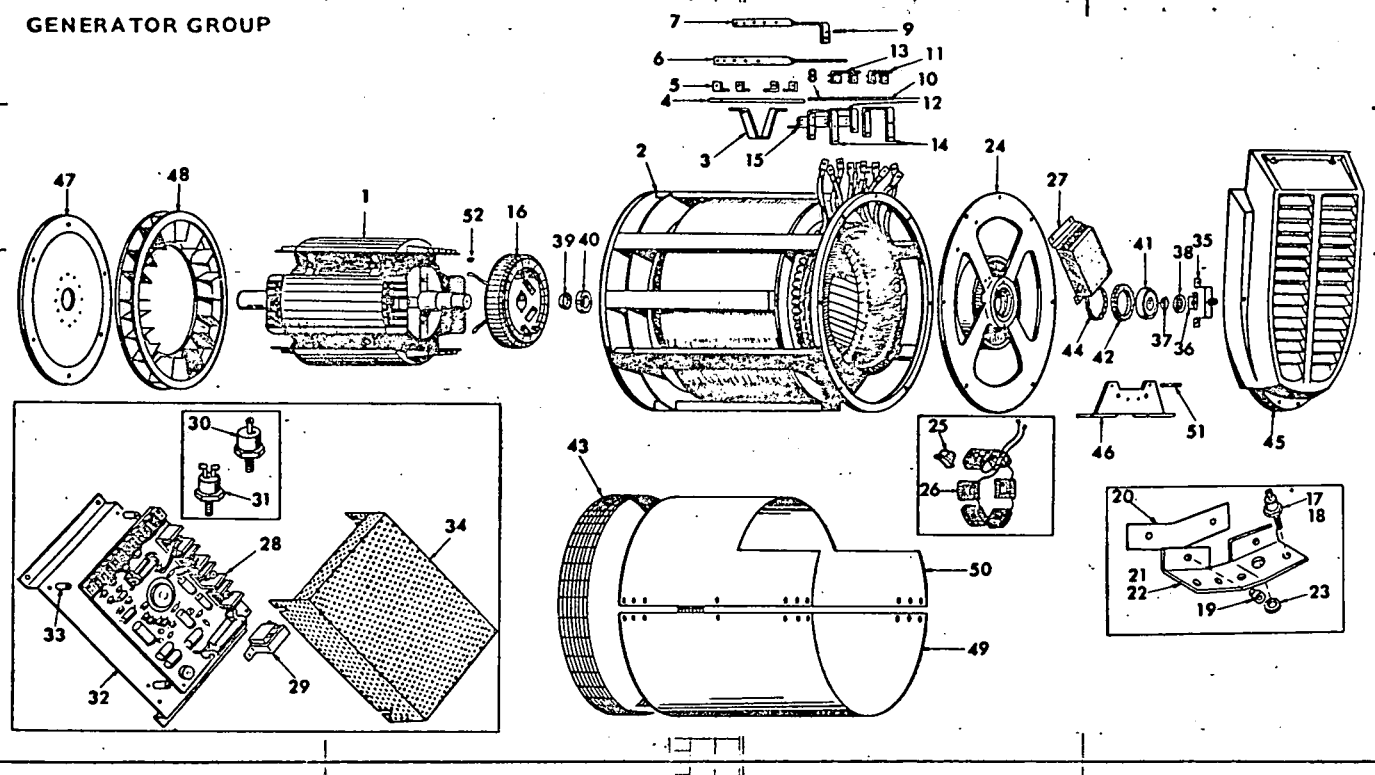


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403D884	1	Base, Mounting
2	130C853	1	Brace, Radiator Mounting
3	130D852	1	Support, Radiator
4	505-98	1	Nipple, Oil Pressure (1/8 x 3/4″)
5	191B688	1	*Alternator, Charge
6	232D1957	1	Tee, Oil Pressure (1/8″)
7	191C624	1	Pulley, Alternator
8	232D1957	1	Support, Generator
9	503-249	1	Hose, Oil Drain
10	SHIM, GENERATOR TO MOUNTING BASE		
	232A1817	As Req.	.062″
	232A1489		.0598″
	232A1490		.0359″
11	505-102	1	Nipple, Oil Drain (3/4 x 1-3/8″)
12	504-69	1	Valve, Oil Drain
13	505-324	1	Nipple, Half - Oil Drain (3/4 x 2″)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
14	503-189	1	Clamp, Oil Drain Hose
15	309B178	1	Switch, High - Temperature
16	309B64	1	Switch, Low - Oil Pressure
17	193B100	1	Sender, Water Temperature
18	193A195	1	Sender, Oil Pressure
19	505-19	1	Bushing, Reducer - 1/2 to 3/8″
20	338C493	1	Harness, Engine
21	504-28	1	Valve, Radiator Drain
22	504-3	1	Valve, Block Drain
23	312-58	1	Condenser, Alternator
24	191-733	1	Regulator, Alternator
25	232A1813	1	Spacer, Alternator Mounting
26	191B725	1	Guard, Alternator Belt

* For components not listed, check nameplate and contact your nearest Motorola dealer.

GENERATOR GROUP



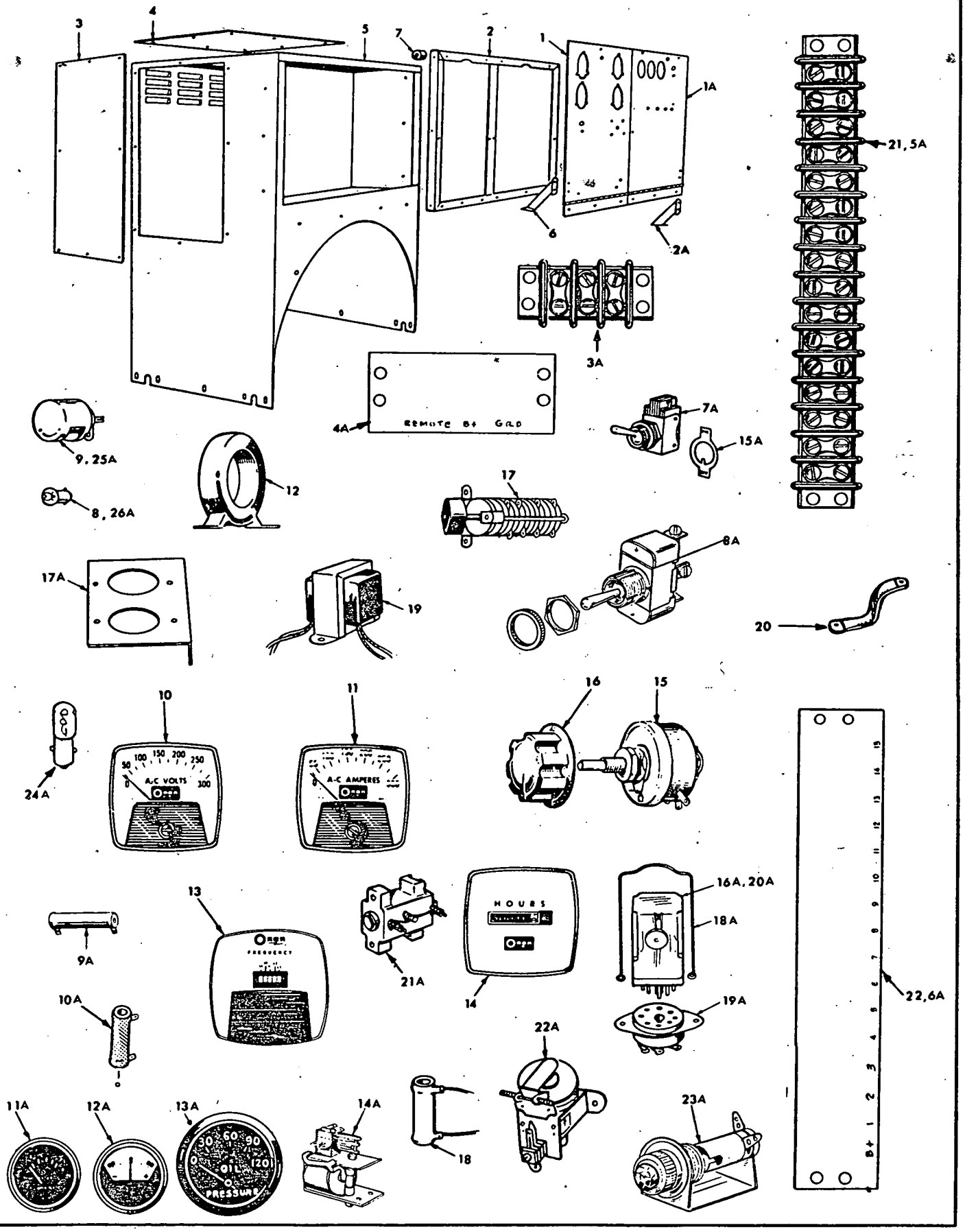
REF NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	*	1	Rotor Assembly, Wound
2	*	1	Stator Assembly, Wound
3	232B1994	1	Bracket, Bus Bar Support
4	232B1997	1	Board, Insulating - Bus Bar Support
5	232A1992	4	Bracket, Bus Bar
6	232B1996	1	Bar, Bus
7	232B2001	3	Bar, Bus
8	232B1995	1	Board, Insulating - Terminal
9	520A693	16	Stud, Terminal Board
10	232B1998	1	Board, Insulating - Terminal
11	232A1990	3	Bar, Bus
12	232B2000	1	Bracket, Terminal Board Mounting
13	232A1991	1	Bar, Bus
14	232B1999	2	Bracket, Terminal Board Mounting
15	315B302	1	Shelf, Current Transformer
16	201D1501	1	Rotor Assembly, Exciter (Wound)
17	358C11	3	Rectifier, Positive Stud
18	358C12	3	Rectifier, Negative Stud
19	508A124	4	Bushing, Shoulder - Heat Sink Mounting
20	232A1985	2	Insulator, Heat Sink Mounting
21	363B25	1	Sink, Heat - Rectifier (Positive)
22	363B33	1	Sink, Heat - Rectifier (Negative)
23	508P93	2	Grommet, Heat Sink
24	*	1	Bell, End
25	221B153	6	Shoe, Pole - Exciter
26	222B1693	1	Coil Assembly, Field (Set of 6 Coils)
27	305C455	1	Regulator, Voltage
28	332D1160	1	Board Assembly, Printed Circuit
29	315D301	1	Inductor
30	RECTIFIER, VOLTAGE REGULATOR		
	358C15	1	300 Volt, 12 Ampere - Negative Base
	358C16	1	300 Volt, 12 Ampere - Positive Base
31	364-6	2	Rectifier, Gate Controlled 300 Volt, 5.5 Ampere - Negative Base

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
32	305C454	1	Chassis, Voltage Regulator
33	305A458	4	Spacer, Printed Circuit Board Mounting
34	305C456	1	Cover, Voltage Regulator
35	*	1	Bracket, Overspeed Switch
36	150B717	1	Switch Assembly, Overspeed
37	510P93	1	Lockwasher, Bearing
38	510P91	1	Locknut, Bearing
39	510P94	1	Lockwasher, Bearing
40	510P92	1	Locknut, Exciter
41	510P90	1	Bearing
42	232B1923	1	Ring, Bearing Holder
43	234B272	1	Cover, Fan
44	232B1924	1	Spring, Bearing Holder
45	232E1973	1	Grille, End Bell
46	232D1957	1	Support, Generator End
47	232C1880	1	Disc, Rotor Drive
48	205D76	1	Fan, Generator
49	234C277	1	Band, Stator - Bottom
50	234C287	1	Band, Stator - Top
51	520A692	2	Stud, Generator Support
52	515A162	1	Key, Exciter Rotor

* Order by description, giving plant Model, Spec and Serial Number from Onan nameplate.

CONTROL GROUP (ENGINE INSTRUMENTS PORTION)

CONTROL GROUP (AC QUTPUT PORTION)

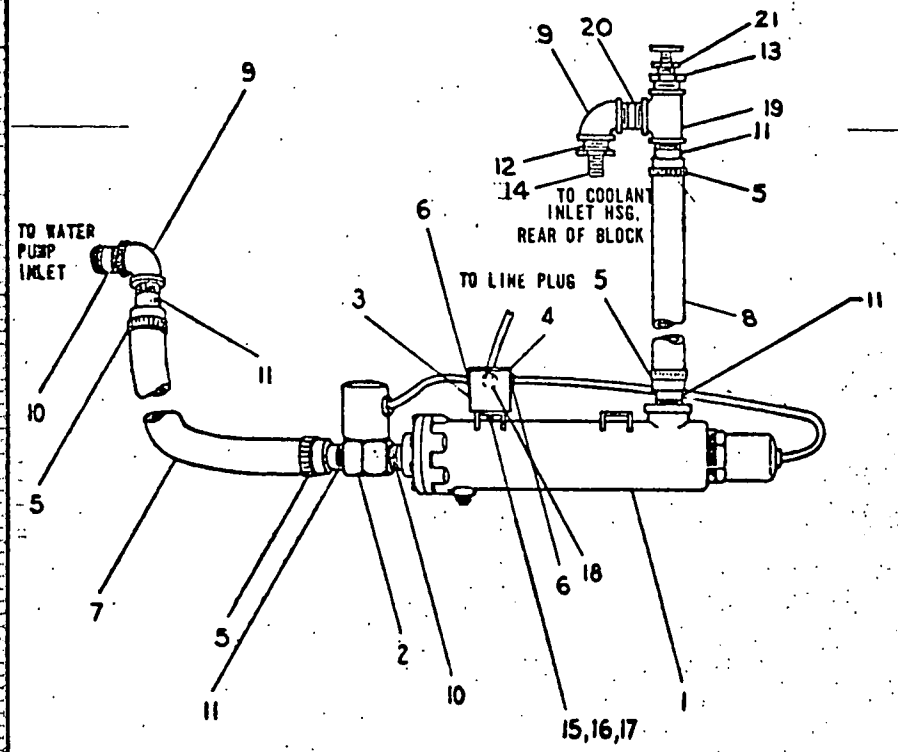


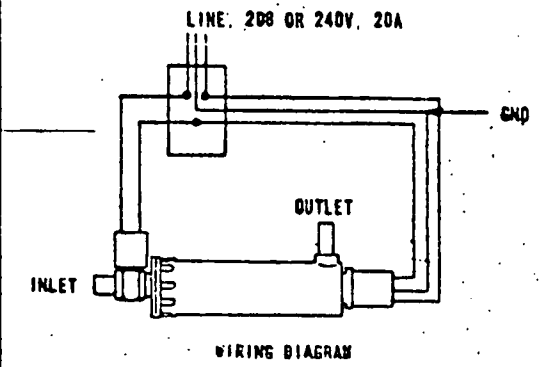
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	301C2908	1	Panel, Control
2	301C2906	1	Frame, Control Panel Mounting
3	301A2905	2	Plate, Control Box-Side
4	301B2904	1	Plate, Control Box-Top
5	301D2903	1	Box, Control
6	301A1914	1	Bracket, Panel Stop
7	402A70	5	Mount, Rubber-Control Box Frame
8	322-81	1	Lamp, Panel
9	322-73	1	Receptacle, Panel Lamp
10	VOLTMETER, AC (Check Voltmeter Scale-Select According to Rating)		
	302P421	1	Scale Reads 0-300
	302P422	1	Scale Reads 0-600
11	AMMETER, AC (Check Ammeter Scale - Select According to Rating)		
	302P640	1	Scale Reads 0-1200
	302P641	1	Scale Reads 0-1500
	302P642	1	Scale Reads 0-2000
12	TRANSFORMER, CURRENT (Check Transformer Nameplate - Select According to Rating)		
	302P643	3	Transformer Nameplate Reads 1200/5 (Use with 0-1200 Ammeter)
	302P644	3	Transformer Nameplate Reads 1500/5 (Use with 0-1500 Ammeter)
	302B645	1	Transformer Nameplate Reads 2000/5 (Use with 0-2000 Ammeter)
13	METER, FREQUENCY		
	302B213	1	60 Hertz
	302B234	1	50 Hertz
14	METER, RUNNING TIME		
	302P465	1	120/208 Volt, 60 Hertz Plants
	302P466	1	240/416 Volt, 60 Hertz Plants
	302P467	1	277/480 Volt, 60 Hertz Plants
	302P468	1	120/208 Volt, 50 Hertz Plants
	302P469	1	240/416 Volt, 50 Hertz Plants
	302P470	1	277/480 Volt, 50 Hertz Plants

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
15	303-111	1	Rheostat, Voltage Adjustment
16	303P32	1	Knob, Rheostat
17	308B22	1	Switch, Voltage & Current Sel
18	304A305	1	Resistor, Adjustable-45,000 Ohm, 10 Watt (277/480 Volt)
19	TRANSFORMER, POTENTIAL		
	315B292	1	120/208 Volt Plants
	*	1	All, Except 120/208 Volt
20	337-44	1	Strap, Ground
21	332A795	1	Block, Terminal
22	332A1134	1	Strip, Terminal Block Marker
1A	301C2915	1	Panel, Control
2A	301A2951	1	Bracket, Panel Stop
3A	332A611	1	Block, Terminal
4A	332A1009	1	Strip, Terminal Block Marker
5A	332A1005	1	Block, Terminal
6A	332A1006	1	Strip, Terminal Block Marker
7A	308-2	1	Switch, Panel Light
8A	308P138	1	Switch, Run-Stop-Remote
9A	304A262	1	Resistor, 50 Ohm, 10 Watt
10A	304A66	1	Resistor, 10 Ohm, 50 Watt
10A	304A446	1	Resistor, 150-Ohm, 10 Watt
11A	193B112	1	Gauge, Water Temperature
12A	302A61	1	Ammeter, Charge
13A	193B194	1	Gauge, Oil Pressure
14A	307A655	3	Relay, Shutdown
15A	308-3	1	Plate, On-Off Switch
16A	307P820	1	Relay, Fuel Solenoid
17A	301A2393	1	Bracket, Relay Mounting
18A	307P778	2	Spring, Relay Holddown
19A	323-52	2	Socket, Relay
20A	307P820	1	Relay, Start Disconnect
21A	320B259	1	Relay, Cranking
22A	307A899	1	Relay, Oil Pressure
23A	322P69	1	Receptacle, Emergency Lamp
24A	322-17	3	Lamp, Emergency
25A	322P73	3	Receptacle, Panel Lamp
26A	322-81	1	Lamp, Panel

* Order by description, giving complete Model, Spec and Serial number from ONAN nameplate

179B330





WIRING DIAGRAM

ITEM	PART NO.	QTY.	*BULK DESCRIPTION OR MATERIAL
21	504-28	1	COCK - DRAIN
20	505-4	1	NIPPLE - PIPE 1 x 1-1/2
18	505-304	1	TEE - PIPE 1"
18	508P1	1	GROMMET 3/4 ID x 19/32 OD
17	870-53	2	NUT - HAS 10-32UNF
16	850-30	2	WASHER - LK #10
15	813-103	2	SCREW - RHM 10-32UNF x 3/4 LG
14	505-102	1	NIPPLE - CLOSE 3/4 x 1-3/8
13	505-455	1	BUSHING - REDUCER 1 x 3/8
12	505-129	1	BUSHING - REDUCER 1 x 3/4
11	505A350	4	NIPPLE - HALF 1 x 4-3/4 LG
10	505-107	2	NIPPLE 1 x 2
9	505-41	2	ELBOW 1 x 90°
8	*503-587	95"	HOSE - 1-1/4 ID
7	*503-587	27"	HOSE - 1-1/4 ID
6	508P8	2	GROMMET 1/2 ID x 1-1/16 OD
5	503-429	4	CLAMP - HOSE
4	330-4	1	COVER - BOX
3	330A5	1	BOX - OUTLET
2	309P253	1	THERMOSTAT
1	333P138	1	HEATER - ENG (4000 WATTS 240 VOLTS)

Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota

INSTL-WATER JACKET HTR

PART NO. | DWG NO. 179B330

OPTIONAL TANK HEATER GROUP