INSTALLATION & OPERATING INSTRUCTIONS

FOR

ONAN ELECTRIC GENERATING PLANTS

Service Dept File

DFK

SERIES

NOTE!!

The ONAN Manual and/or Parts Catalog only has been supplied. This model series has been out of production for a number of years. Due to reasons beyond our control we no longer stock or supply the engine manufacturers Manual or Parts Catalog. However we believe they are available direct from the engine manufacturer providing you furnish the SERIAL NUMBER and SPEC from the engine manufacturers nameplate on the engine. Refer to Parts Catalog and order from manufacturer as indicated under "Instructions for Ordering Repair Parts".

Onan®

DIVISION OF STUDEBAKER CORPORATION
MINNEAPOLIS 14, MINNESOTA

960-2

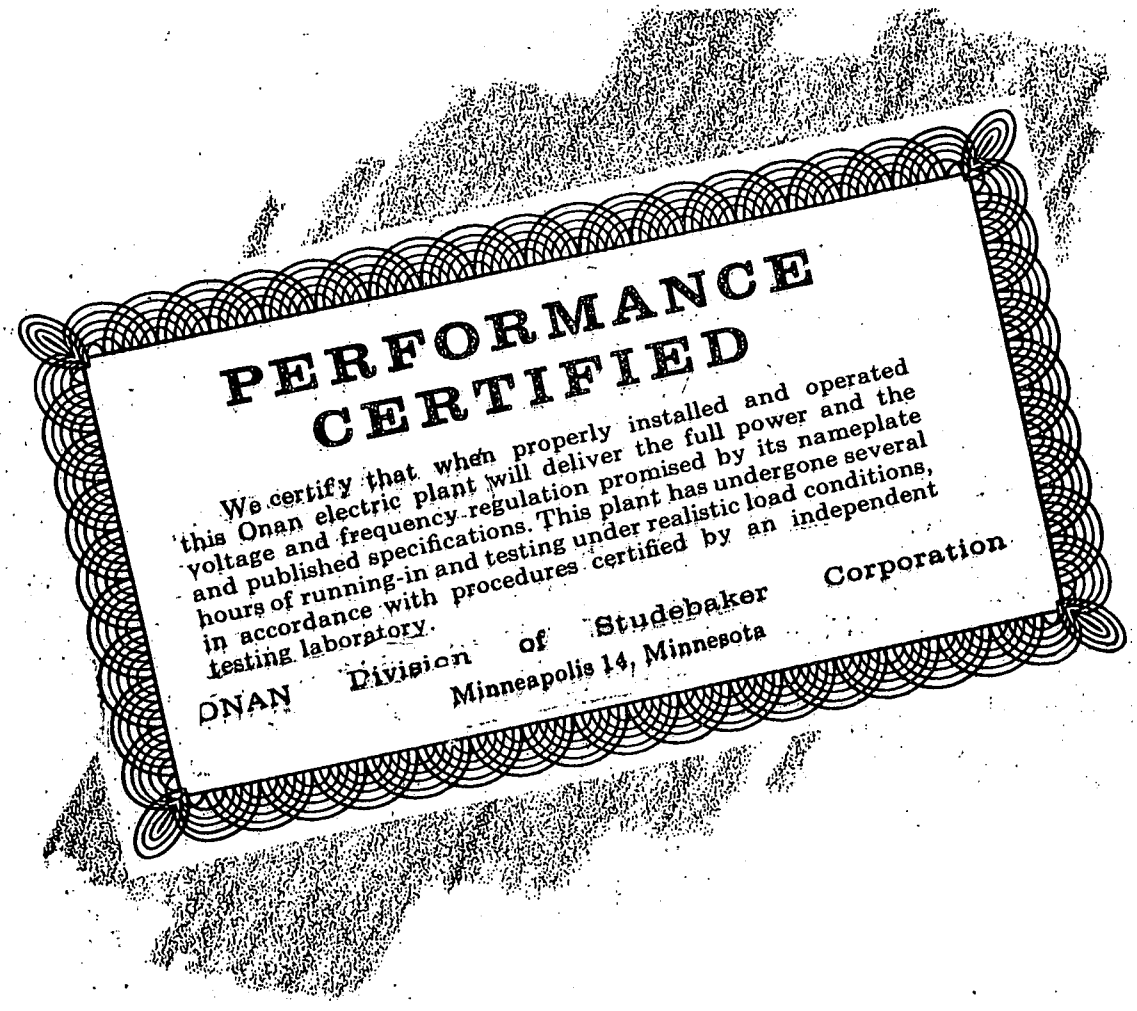
~~Price $1.00~~

Printed in U.S.A.

We mean it.....

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

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



GENERAL INFORMATION

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

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

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

MANUFACTURER'S WARRANTY

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

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

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

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

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

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT

TABLE OF CONTENTS

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

The electrical characteristics of the plant vary according to the particular model, and are noted on the Onan nameplate attached to the unit. When the plant is used for standby service, optional controls for starting, load transfer, and stopping may be connected during installation. If it ever becomes necessary to contact a dealer or the factory regarding the plant, be sure to mention the complete Model and Spec. No., and the Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify the plant among the many types manufactured. Refer to the engine nameplate when requesting information from Cummins.

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

ENGINE

The engine is a Cummins basic model NT-380-1P described in the Cummins manual. The specific engine used may have variations due to optional features of the generating plant, type of cooling, etc., specified by the plant purchaser. Basically, the engine is a 6 cylinder water cooled, supercharged diesel (compression ignition) type. The cylinder bore is 5-1/2 inches, piston stroke 6 inches, and displacement is 855 cubic inches. The engine is rated 325 horsepower at 1800 rpm. The standard oil capacity is 7 U. S. gallons. A 24 volt battery system is used for energizing the starting and control circuits. Accessories, safety devices, etc., vary according to the model and purchaser options.

The standard engine cooling system uses a radiator and pusher type fan. Optional cooling systems use "city" water, or similar separate pressure source of water supply. When the water supply is very alkaline or otherwise unsuitable for circulating through the engine, a "heat exchanger" system is recommended. If the water supply can safely be used directly, a "mixing" standpipe or tempering tank can be used.

GENERATOR

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

The exciter components are mounted inside a sheet metal enclosure attached to the alternator end frame. The design of the exciter provides for almost constant ac output voltage over a wide range of load conditions. This is particularly advantageous when the generator is called upon to start large electric motors. The static exciter is considerably smaller and lighter than a conventional dc generator type. A magnetic amplifier system working in conjunction with the static exciter replaces the external voltage regulator. A voltage control rheostat is a standard feature.

CONTROLS

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

The engine is started through a run-stop switch, a fuel solenoid relay, 2 cycle cranking relays, a pilot relay, a series-parallel solenoid and a starter motor. Cranking alternates in 10 second cranking cycle and 5 second rest cycle until the engine starts or the cranking limiter opens. A start disconnect relay stops the cranking when the engine starts.

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

WARNING

AN OVERSPEED PROTECTIVE SWITCH IS BUILT INTO THE OUTER END OF THE GENERATOR SHAFT. THIS OVERSPEED DEVICE AUTOMATICALLY SHUTS OFF THE ENGINE IF THE SPEED REACHES 2100 RPM. UNDER NO CIRCUMSTANCES SHOULD THE OVERSPEED SWITCH BE BY-PASSED OR DISCONNECTED. EXTENSIVE GENERATOR DAMAGE WILL RESULT FROM OVERSPEED.

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

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

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

LOCATION. - In the average installation, the location has been pre-selected. However, there are certain basic requirements for a satisfactory location. The ambient temperature should be warm enough to assure easy starting. A plant used for emergency standby service should be installed where the ambient temperature will not fall below 50° F. unless special heating accessories are used. Many specifications and local regulations require a minimum of 65° F. Special starting aids are required for temperatures below 32° F.

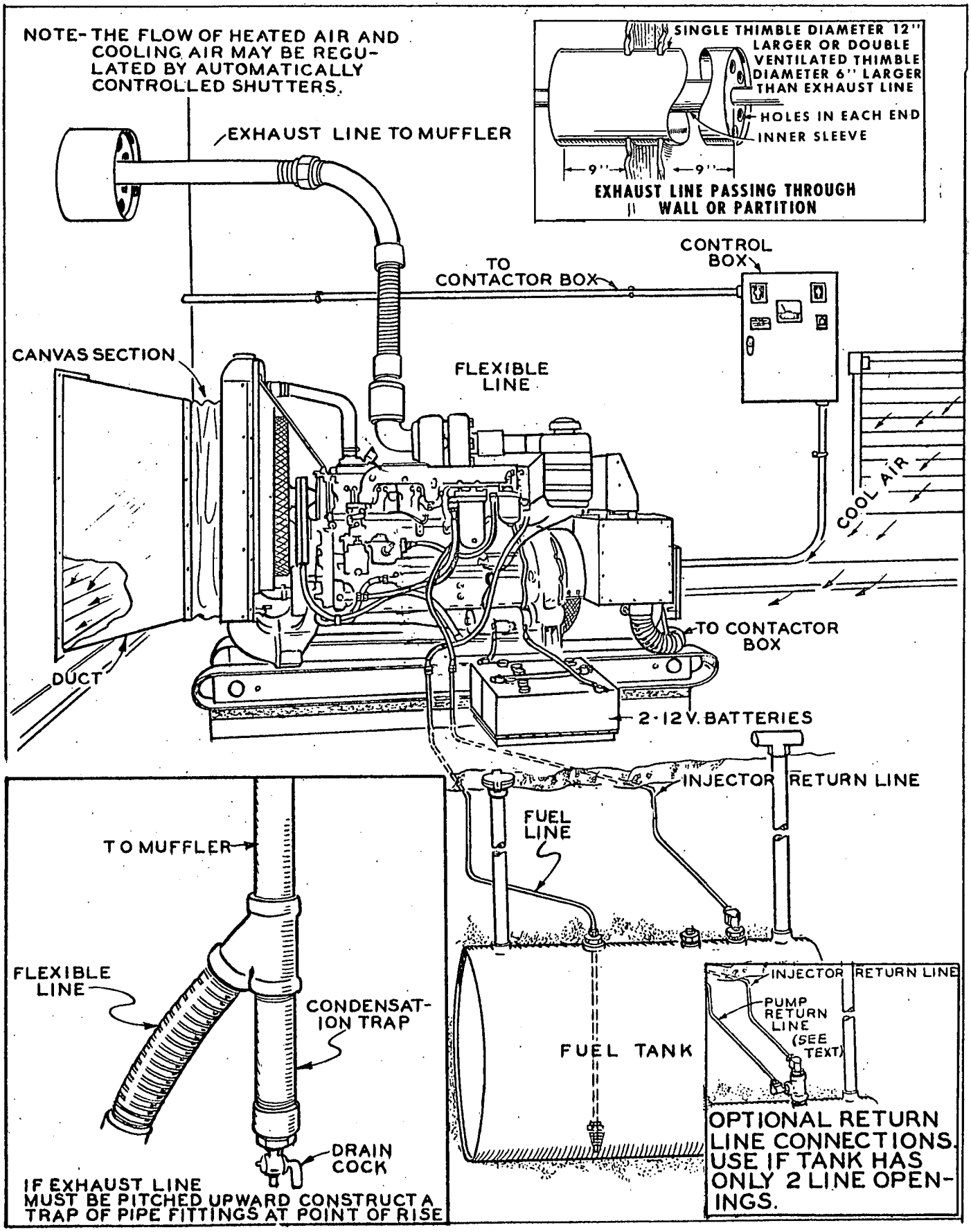
Extremely high ambient temperatures can create cooling problems. A radiator cooled plant is usually limited to an ambient temperature below 120° F. See COOLING AND VENTILATION.

The plant location should be dry and reasonably dust free. Provide for at least 24 inches space on all sides for convenience in servicing the plant.

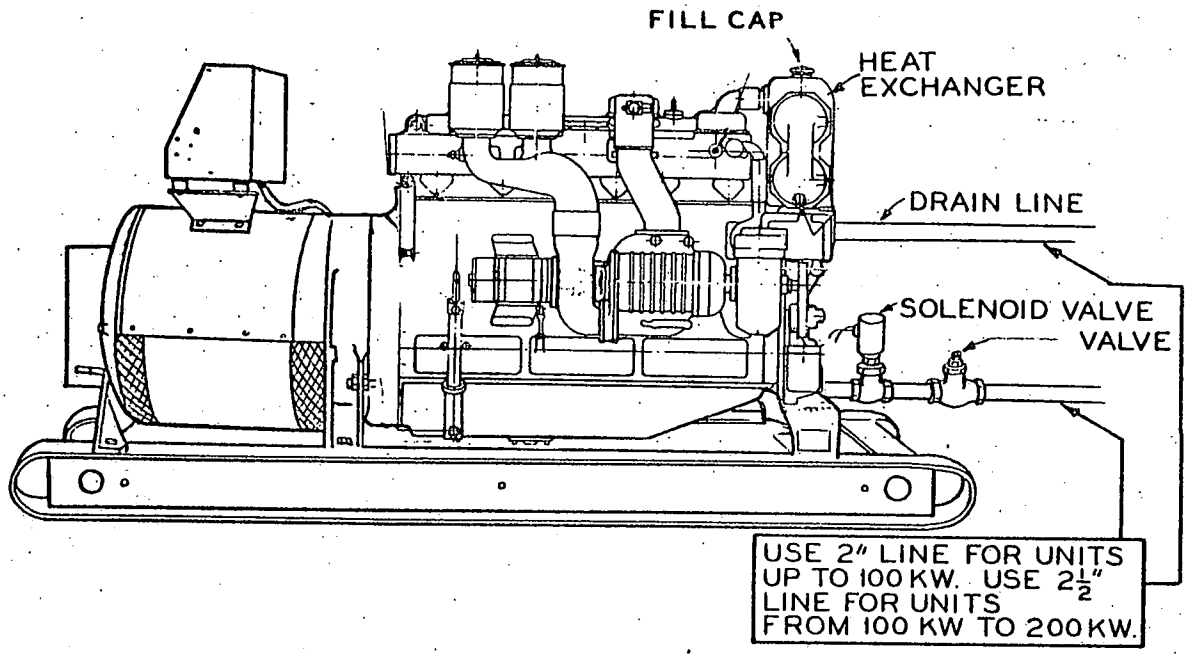
MOUNTING. - The plant is mounted on a rigid skid base that provides proper support. If additional vibration dampers, raised pedestals, etc., are used, it may be necessary to provide special footings or other support as necessary to carry the load. Refer to the separate outline drawing for mounting dimensions, etc.

COOLING AND VENTILATION. - Proper ventilation is of vital importance, particularly for a radiator cooled unit. Under normal operating conditions, approximately 18,750 cubic feet of air per minute will provide for proper cooling. For a "city water" cooled unit, approximately 4,688 cu. ft. per minute will provide sufficient air for cooling the generator and supporting combustion in the engine. In a small room installation this may require the installation of an auxiliary air intake fan connected to operate only during plant operation.

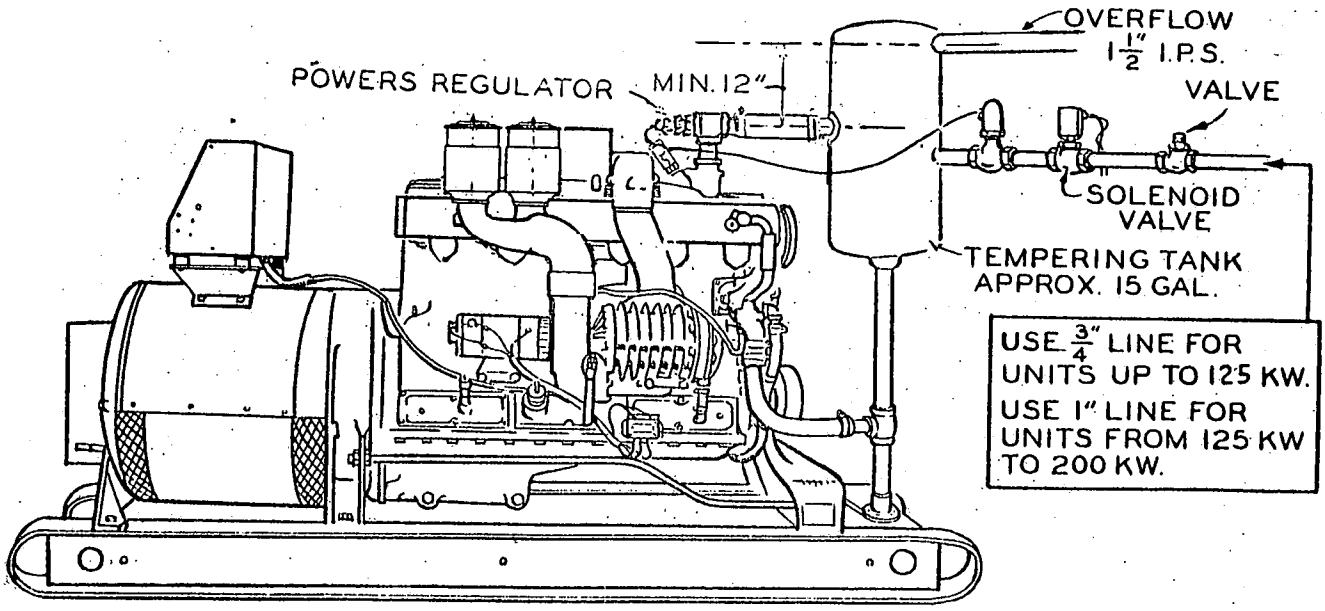
The pusher type fan used on a radiator cooled plant forces the heated air out through the front of the radiator. The usual method of exhausting the heated air from a room or compartment is to construct a sheet metal duct from the front of the radiator to an outside wall. Use a short canvas section next to the plant to reduce transmission of noise and vibration. The air inlet opening should be located to prevent recirculation of heated air or exhaust fumes, and at least as large in area as the air outlet. If the engine is cooled by the "city water" method, ventilation is seldom a problem, but sufficient air movement and fresh air must be available to properly cool the generator and to support combustion in the engine.



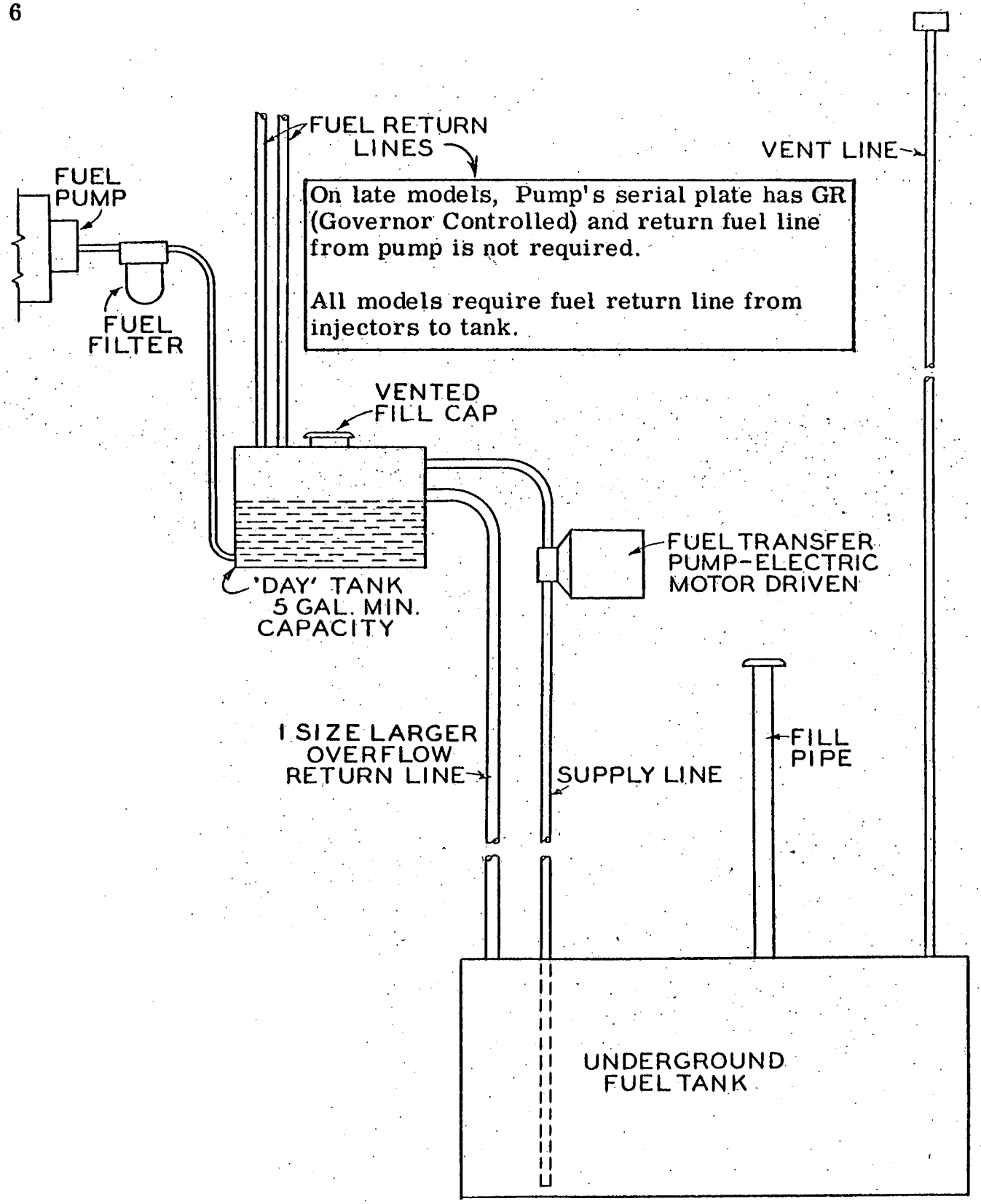
TYPICAL STANDBY INSTALLATION



CITY WATER HEAT EXCHANGER COOLING



CITY WATER STANDPIPE WITH POWERS REGULATOR



'DAY' TANK INSTALLATION

There are two types of city water cooling systems available as optional equipment for this unit. In both cases, the conventional radiator is not used.

1. Heat Exchanger. - The heat exchanger cooling system provides a "closed" engine water system. The engine coolant circulates through a tubed chamber. A constant flow of fresh cool water surrounds the cooling tubes and is piped out to a convenient drain. A solenoid valve opens the water flow when the plant starts, and shuts off the water flow as the plant stops. The solenoid valve is connected as shown on the engine control wiring diagram. Rate of water flow is controlled by either a hand valve or an optional automatic regulator. If rate of flow is hand adjusted, refer to the water flow table showing the approximate minimum water required at the loads listed. Use the pipe size indicated on the installation outline drawing supplied. Do not use pipe smaller than indicated.

MINIMUM WATER FLOW, HEAT EXCHANGER

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL./MIN.
175KW	40°F.	33
	60°F.	40
	80°F.	60
200KW	40°F.	45
	60°F.	60
	80°F.	85

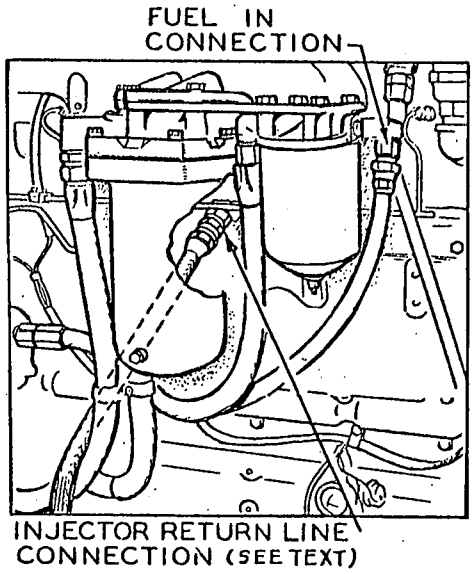
2. Standpipe. - In this system, a tempering tank is used to mix engine water and fresh "city" water. The hottest water rises and drains out an overflow near the top of the tank. The overflow water is piped to a suitable drain. A solenoid valve controls water flow by opening when the engine starts and closing when the engine stops. The solenoid valve is connected as shown on the engine control wiring diagram. Rate of flow is controlled by either a hand valve or an optional automatic regulator. If the hand valve is used, refer to the water flow table for a list of approximate minimum water requirements at various loads.

MINIMUM WATER FLOW, TEMPERING TANK

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL./MIN.
175KW	40°F.	10.8
	60°F.	12.9
	80°F.	15.7
200KW	40°F.	12.2
	60°F.	14.5
	80°F.	17.7

FUEL CONNECTIONS. - Use 5/8" tubing for the fuel supply line; the inlet fitting on the fuel filter is threaded for a 5/8" SAE flared fitting. Use 1/2" tubing for the fuel return line from the injector manifold; the fit-

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



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

An underground tank usually has connections at the top, requiring a drop or suction tube extending to within an inch or two of the tank bottom. All supply line connections must be air tight to assure that the fuel pump will lift fuel from the tank. The tank must have an approved vent cap.

NOTE

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

EXHAUST. - Pipe the exhaust gases outside. Use wrough iron, cast iron, or steel pipe at least as large as the exhaust outlet. Increase the pipe diameter one size for each 10 foot span. Install the pipe nipple and coupling on the exhaust outlet. Use a flexible pipe between the pipe nipple and rigid exhaust pipe. Avoid using sharp elbow turns; use sweeping type elbows to keep back-pressure to a minimum. If the exhaust line runs upward at any point, install a condensation trap at the low point, with provision for periodic draining. Shield or insulate the line if there is danger of personnel contact. If the line passes through a combustible wall or partition, the opening must be protected by a thimble having the dimension shown in the typical installation illustration. Install a suitable muffler to the exhaust line.

BATTERY CONNECTION. - 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). Connect to the magnetic (solenoid) switch located on the opposite side of the engine from the starter. Note a small wire connected to one of the two large ter-

minals on the 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. Service the batteries as required.

Infrequent use of the plant (as in standby service) may allow the battery to self discharge to the point where the battery may not be able to start the plant in an emergency. If the line transfer switch does not provide a trickle charging circuit, a separate charger should be used.

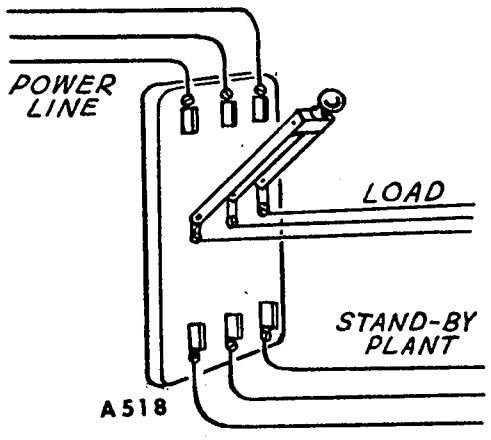
CONTROL CONNECTIONS. - Line transfer and automatic demand controls operate through the plant control to start, control, and stop the plant as demanded by the application. Wiring instructions are in the manuals supplied with these automatic controls. Connections at the remote control terminal block are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

OPTIONAL SIGNALS. - Refer to the engine control wiring diagram furnished. Terminals are provided for connection of a signal light or audible alarm to indicate an emergency stop, or for failure to start automatically. Any such signals, etc., must be rated for 24 volt dc service.

AUXILIARY HEATER. - If the plant is equipped with an optional auxiliary water or oil heater, connect the device to a normally energized power source. Be sure the voltage is correct for the heater rated voltage.

LOAD CONNECTIONS. - Be sure wiring meets requirements of electrical codes in effect at the installation site. Many local regulations require that the installation be inspected and approved before operation.

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



Instructions for connecting an automatic switch (line transfer control) are supplied with such equipment. It is assumed that personnel connecting the generator and any auxiliary equipment are fully qualified.

Knock out sections are provided for entrance of load wires to the connection box at the side of the generator. Make connections according to the type of facilities provided. If large terminal posts are provided, make load wire connections directly to the posts. Some plants are "reconnectible" for different voltages (see CAUTION) and have extra leads that are pre-connected for the nameplate rated voltage.

CAUTION

Reconnection, for different output voltages than shown on the plant nameplate, involves also control panel changes—sometimes of a very extensive nature. For specific information, contact the factory. Give the COMPLETE information shown on the Onan nameplate, and indicate the desired NEW voltage.

1. Preliminary Connections. - Each individual lead is labeled, T1 through T12. Leads are combined into groups of 2 or more as indicated on the output control wiring diagram provided. Some lead groups are further identified for load wire connections. Thus on a 4 wire, 3 phase plant, there may be a group of 12 leads identified as T0 for the load neutral wire connection. Other groups will be identified in a similar manner.

a. Use commercially available cable connectors to connect the leads of each group.

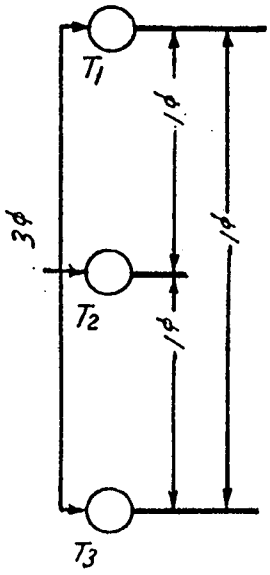
b. See that the small leads (transformer, etc.) are connected to the ground post inside the connection box.

c. Select each generator lead group that is to be connected to a load wire. Connect the load wires to the proper generator wire group, as shown on the output wiring diagram. Typical connection diagrams are shown below.

d. If a "T0" (neutral) wire group is used, note that one wire of the group connects to the ground post in the connection box.

e. Tape or otherwise insulate each connection. Such insulation must be at least equal to the original wire insulation.

3 PHASE, 3 WIRE PLANT

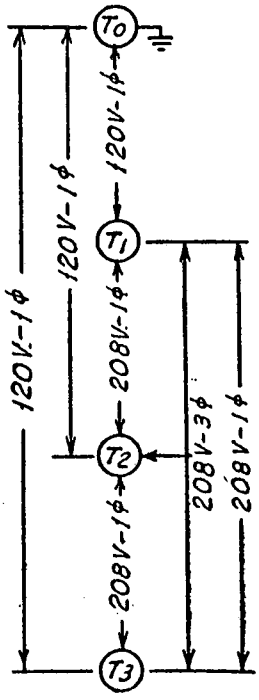


No terminal is grounded. For three phase current, connect separate load wires to each plant terminal "T1", "T2" and "T3", one wire to each terminal. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. If phase sequence is important, be sure to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

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

If both single phase and three phase current 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 taken from any one circuit for single phase current use.

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.

If both single and three phase current are used at the same 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.

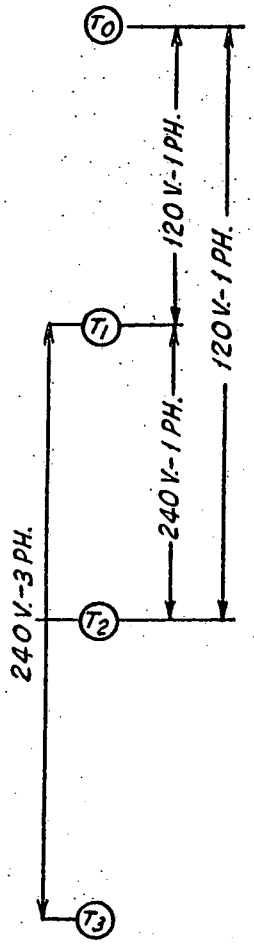
The load terminals are marked T1, T2, T3 and T0. The T0 terminal is the generator center tap between T1 and T2. The T0 terminal of the generator is not grounded.

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

When it is desired to use combination single phase and three 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.



CRANKCASE OIL. - Refer to section 3 of the Cummins manual. Note that for average operating conditions, MIL-L-2104A military specification oil is recommended. Many oils designated for MS or DG service meet these requirements. Check with the oil supplier.

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

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

GOVERNOR OIL. - The standard engine is equipped with a hydraulic governor. The governor does not have an independent oil sump, but uses engine oil as a control medium.

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

CRANKCASE BREATHER AIR CLEANER. - Service the crankcase breather air cleaner in the same manner as the main combustion intake air cleaner.

COOLANT. - For units which use either a radiator or heat exchanger (city water cooled), fill the cooling system with clean soft water. The standard radiator and block capacity is 18 U.S. gallons. Use a good rust and scale inhibitor. If there is any possibility of a radiator cooled plant being exposed to freezing temperatures, use antifreeze with ethylene glycol base as instructed in the Cummins manual. 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.

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

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

STARTING. - During the initial run have the field circuit breaker OFF so the unit can run at no load. To start the unit, move the run-stop switch to the RUN position and leave it there. The unit will run as long as the switch is at that position. The cranking motor will be disconnected by the start disconnect relay when the engine comes up to speed. If the unit fails to start within about 10 seconds, the cycle cranking relay will interrupt cranking for about 5 seconds, and then the unit will automatically crank again.

The standard engine is designed for normal starting in temperatures of 50°F. or higher. Optional equipment is available if operation in lower temperatures is required.

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.

WATER FLOW. - If the plant is city water (pressure) cooled, but without the optional flow 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 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.

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

NORMAL OPERATING FUNCTIONS

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

NOTE

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

1. Low Oil Pressure Cut-Off. - A pressure operated switch mounted on the engine stops the plant if the engine oil pressure drops below about 9 lbs. The switch is not adjustable.

2. 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 a dangerous point. 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.

3. High Water Temperature Cut-Off. - A thermostatic switch is mounted on the engine. If the water temperature rises to about 205°F., the switch acts to stop the plant. The coolant temperature must drop about 10° before the engine can be restarted.

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

WATER TEMPERATURE. - The panel water temperature gauge indicates the coolant temperature during operation. Normal operating temperature is 165°F. to 185°F.

CHARGE AMMETER. - The small dc ammeter indicates the battery charge rate. An automatic regulator controls the charge rate, which varies according to the charge condition of the battery. The charge rate will be comparatively high when the plant first starts, but 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 a button protrudes from the control panel to indicate a latched relay.

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

METER SELECTOR SWITCH. - The selector switch handle position indicates which phase of the generator output is indicated on the ac voltmeter and ammeter. Turn the handle to the desired position.

VOLTAGE REGULATOR RHEOSTAT. - Some models are not equipped with a voltage regulator rheostat. If voltage adjustment is necessary (be sure engine speed is correct) refer to the ADJUSTMENTS section.

The voltage regulator rheostat provides for output voltage adjustment of approximately plus or minus 5 per cent. In normal operation the regulator should keep the output voltage within 3 per cent - plus or minus - between no load and full load conditions. Once set, the rheostat setting should not have to be changed under normal operating conditions.

CIRCUIT BREAKER. - The circuit breaker protects the generator from damage from an extreme over load. The circuit breaker can be used as a connect-disconnect output switch. If tripped automatically from an over load condition, the breaker must be reset manually after correcting the over load condition.

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, etc.

AC AMMETER. - The ac ammeter indicates the amount of load connected to the phase indicated by the selector switch position.

AC VOLTMETER. - The ac voltmeter indicates the voltage of the same phase as the amperage shown. On a three phase, four wire model, the voltage shown will always be the three phase (higher) nameplate voltage.

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

EXERCISER PERIOD. - If the plant is used infrequently, as in standby service, start and operate at least once a week. Operate long enough (15 to 30 minutes) to thoroughly warm up the engine. This will help to keep oil distributed on engine parts, fuel system full etc., and promote easier starting and longer engine life.

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 approved water, to recommended level.
4. Continue charging for 1 hour at a 4 to 6 ampere rate.
5. Test each cell. If the specific gravity is still above 1.225, repeat steps 2, 3 and 4 until the reading is reduced to 1.225. Usually, repeating steps twice is sufficient.

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

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

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

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

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

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

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

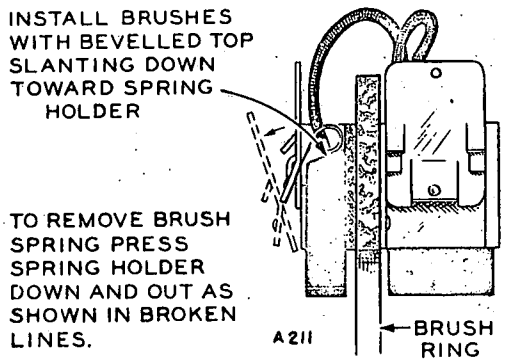
GOVERNOR. - Basic principles of governor adjustment are given in the Cummins manual. The purpose of the governor is to control the engine speed, under various load conditions, to keep the generator output current stable.

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

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

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

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



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

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

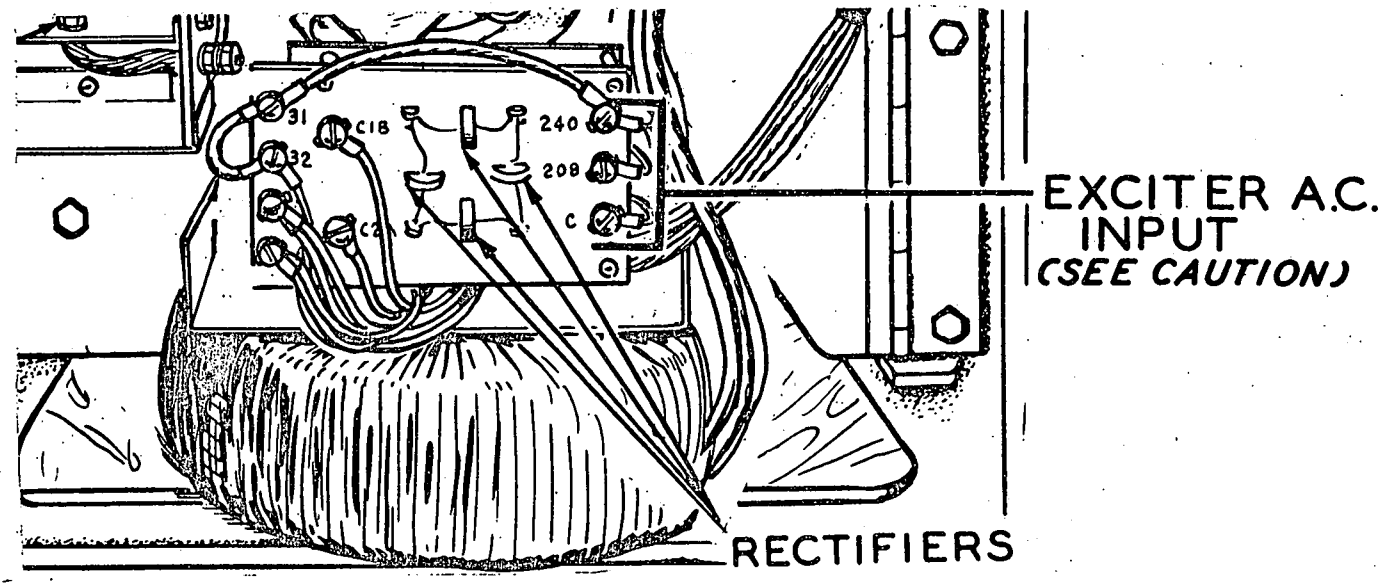
GENERATOR TESTS. - If the generator does not function properly, a few simple tests may isolate the cause.

1. Temporarily disconnect leads E1, E2, AF1, and AF2 from the terminal block. Connect a substitute ac power source, such as the normal line voltage. Be sure the substitute power source is the correct voltage, as indicated on the exciter wiring diagram. For example, do not connect 480 volt current directly to the E1 and E2 exciter terminals. CAUTION - Limit test voltage application to one minute or less.

   If there is no dc voltage at terminals AF1 and AF2 with an independent power source connected to exciter terminals E1 and E2, the exciter is not functioning.

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.



2. No component or terminal of the exciter should show a grounded circuit.
3. If dc voltage is present at terminals AF1 and AF2 in step 1 above, check the alternator for grounds, opens, etc.
4. Connect exciter leads. If ac voltage drops under load conditions, check the exciter rectifiers. Use a low voltage battery powered "Multimeter" type ohmmeter. Disconnect one lead from, or remove, each rectifier for the test.

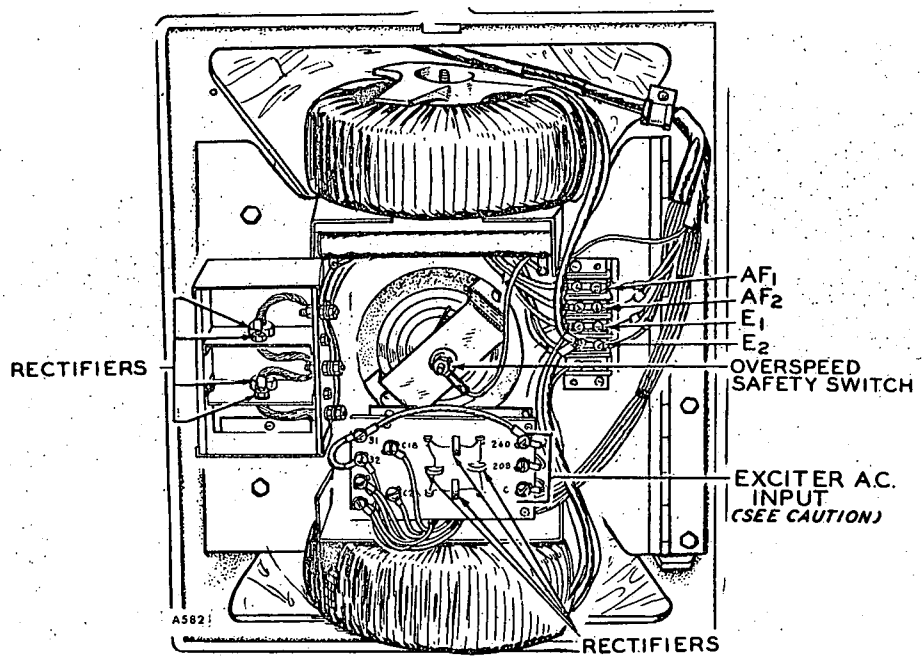
NOTE

Note carefully the DIRECTION OF MOUNTING of any rectifier removed. It must be remounted in its original direction. Use extreme care not to overheat a rectifier if working on a soldered connection.

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

b. Reverse the ohmmeter-rectifier 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. If both readings are low, or if both indicate an "open" circuit, replace the rectifier with a new part.



RECONNECTIBLE POSSIBILITIES. - The "reconnectible generator" is designed to provide for conversion to a different type of output than the original nameplate rated output voltage.

The reconnectible generator will be one of three basic types — 2X, 5X, or 6X. These codes make up a portion of the generator data number stamped on the plant nameplate, as for example, 150UK2XN1A, 150UK5XN1A, and 150UK6XN1A. Each basic type can be reconnected to deliver the alternate voltages shown in the following table.

CAUTION

Reconnection, for different output voltage than shown on the plant nameplate, involves also control panel changes, sometimes of an extensive nature. For a basic "2X" type generator, a change in the exciter circuit may also be necessary. For specific information, contact the factory. Give the COMPLETE information shown on the Onan nameplate, and indicate the desired NEW voltage.

GENERATORS RECONNECTIBLE ONLY AS SHOWN

TYPE "2X"	TYPE "5X"	TYPE "6X"
120/208 - 3 ph, 4 wire	240/416 - 3 ph, 4 wire	277/480 - 3 ph, 4 wire
240/416 - 3 ph, 4 wire	240 - 3 ph, 3 wire*	138/240 - 3 ph, 4 wire
120/240 - 3 ph, 4 wire*	240/480 - 3 ph, 4 wire*	240/416 - 3 ph, 4 wire
240/480 - 1 ph, 3 wire		
220/380 - 3 ph, 4 wire		

* - Delta connection