OPERATORS MANUAL AND PARTS CATALOG

FOR

Onan®

ELECTRIC GENERATING PLANTS

DEG

SERIES

ONAN ENGINE/GENERATOR DIVISION Studebaker CORPORATION

2515 UNIVERSITY AVE. S.E. MINNEAPOLIS, MINN. 55414
IN CANADA: ONAN GENERATORS CANADA LTD., P.O. BOX 652, GUELPH, ONTARIO

977—301 Price $1.00 10A66 Printed in U.S.A.

This manual contains installation, operation and maintenance information. Read it, then file it in a safe place for future reference.

This equipment is the result of proven engineering design, quality materials, expert workmanship and high quality control standards. Thorough testing guarantees this equipment to perform as stated on the nameplate.

Should it ever become necessary to contact the dealer or manufacturer, always give the complete MODEL and SPEC. NO. and SERIAL NUMBER 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 cause.

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

DATED AUGUST 1, 1963

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT

Onan generating plants of the DEG series are a complete unit consisting of a diesel engine, static excited alternating current generator, and optional accessories as ordered by the purchaser.

Electrical characteristics vary according to model and are noted on the Onan nameplate. The rated power is based on .8 power factor load. For standby service, optional controls for automatic starting, load transfer, and stopping may be connected.

The generating plant has been load tested and 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 and a claim submitted to the carrier.

ENGINE

The engine is a Ford Model C5PL-6005-A (SO-30) which is described in the Ford manual. Basically it is a six-cylinder, water cooled, diesel (compression ignition) engine. The cylinder bore is 4.125 inches, piston stroke is 4.524 inches, and displacement is 363-cubic inches. The engine is rated 93 horsepower (standby) at 1800-rpm. Compression ratio is 16.5 to 1. The standard oil capacity is 12 U.S. quarts. 12-volt battery current is used for starting and control circuits. The specific engine used may have variations due to optional features of the generating plant (type cooling, etc.) specified by the purchaser. Refer to the engine nameplate when requesting information from its manufacturer.

GENERATOR

The generator consists of a 4-pole revolving field alternator and "static" exciter with magnetic amplifier regulation. The alternating current output is generated in the alternator stator winding attached to the rear of the engine. The rotating field of the alternator is attached to the engine flywheel, and turns at engine speed. The outer end of the rotor turns in a large sealed ball bearing fitted into the end bell. The speed at which the rotor turns determines the operating frequency - thus the 60-cycle plant must operate at approximately 1800-rpm, and the 50-cycle plant at approximately 1500-rpm.

The static exciter is mounted on a metal frame attached to the alternator end bell, and is protected by a sheet metal enclosure. The exciter provides voltage regulation of plus or minus 2%, from no load to load. Stable generator output is established within 5 seconds after a change in load. The exciter has no moving parts, and requires no external voltage regulator.

DESCRIPTION

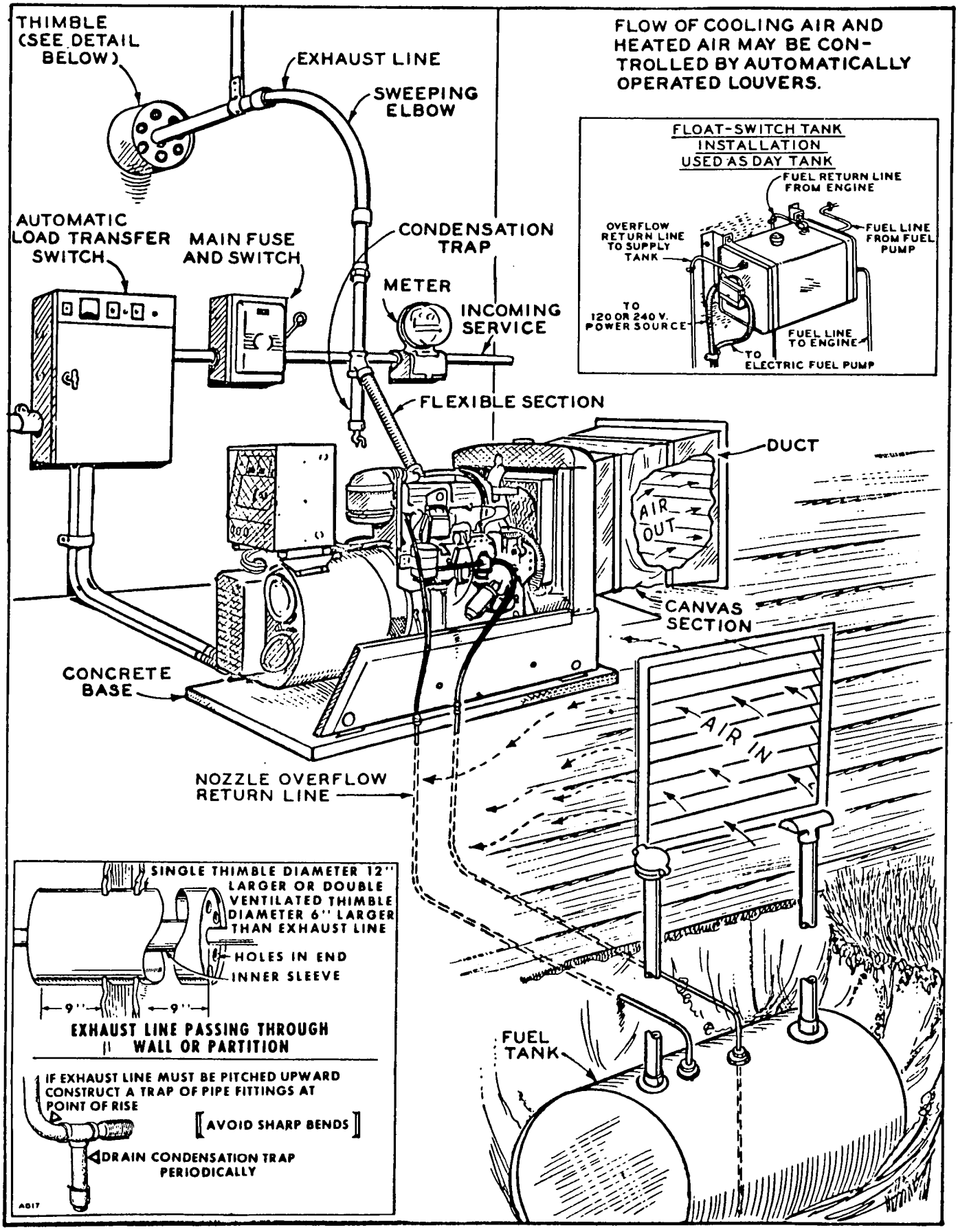
CONTROLS

Engine controls for standard plants include 12-volt starting and battery charging circuits with necessary relays, and a charge rate ammeter. Water temperature and oil pressure gages provide for checking engine performance. A water temperature safety shut-off switch protects against engine damage should coolant temperature rise dangerously high. Terminals may be provided for connection of optional warning devices, etc.

The generating plant can be adapted to use automatic load transfer control equipment (for emergency standby installations) if the ambient temperature will be above 50°F.

Electrical instrument panel equipment varies according to the model and purchaser options. Instruments may include voltmeter, ammeter, exciter circuit breaker, running time meter, etc. Output terminals are provided for load wire connections.

TYPICAL INSTALLATION



INSTALLATION

Generating plant installation involves its location, connection to a fuel source, exhaust system, starting battery, etc. Installations must be considered individually - use these instructions as a general guide. A typical installation is shown, and by following the principles outlined and referring to the installation outline drawing supplied, a proper installation can be made. Local regulations (building code, fire ordinance, etc.) may affect some details, and any such regulations should be fully observed.

LOCATION. - The location has usually been pre-selected. A warm indoor site is recommended. Local regulations sometimes require that for emergency standby service the ambient temperature must not fall below a specified minimum. The selected site should be dry, well ventilated, and reasonably dust free. Provide for sufficient clearance (at least 24 inches recommended) on all sides for convenience in servicing the plant.

MOUNTING. - The plant is mounted to a rigid base that provides proper support and adequate vibration damping. For convenience in draining crankcase oil, general servicing, etc., the plant can be mounted on raised pedestals or rails at least 6-inches high. Extra vibration dampers are available and may be installed under the plant base. If mounting in a trailer, or for other mobile application, bolt securely in place. Bolting down is optional for stationary installations.

VENTILATION. - The engine generates considerable heat which must be dissipated. Proper ventilation is of vital importance for radiator cooled units. Under average operating conditions, a cooling air volume of approximately 5070-cubic feet of air per minute will provide sufficient cooling. Installations made in a small room may require an auxiliary fan of sufficient size to assure proper volume of air. The fan can be connected to operate only when the plant is running.

Pusher fans used on radiator cooled units force the cooling air out through the front of the radiator. The usual method of exhausting the heated air from room or compartment installations is to construct a duct from the front of the radiator to an opening in an outside wall. The duct and wall opening area should be at least as large as the plant radiator outlet area. An air inlet opening of at least equal area must also be provided.

Air inlet and outlet openings should be provided with suitable shutters to prevent back flow of cold outside air during shut down periods. Proper consideration must be given to any other draft creating equipment installed in the same room. If unattended, automatic starting (as for emergency standby with automatic load transfer switch) is planned, the shutters should be automatically controlled.

EXHAUST. - Pipe the exhaust gases outside any enclosure. Use pipe at least as large as the 2-inch outlet of the engine. Increase the pipe diameter one pipe size for each additional 12-feet in length. Use a flexible connection at the engine exhaust manifold. Provide adequate support for the piping. Pipe fittings cause a resistance to the flow of exhaust gases and can result in a loss of engine power. Use sweeping type elbows in preference to standard pipe elbows, and keep the number of necessary turns to the minimum. If the exhaust line runs upward at any point, install a vapor trap at the low point, with provision for periodic draining. Shield or insulate the exhaust line if there is 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

Fuel system cleanliness is of utmost importance in any diesel engine installation. Make every effort to prevent entrance of any moisture or contaminating matter of any kind. Do not use lines or fittings of galvanized material.

The maximum fuel lift without any horizontal run should not exceed 6-feet. The horizontal run, if the fuel supply tank is level with the fuel pump, should not exceed 12-1/2 feet. Use a 1/2-inch tubing for the supply line from the fuel tank and 3/8-inch tubing for the nozzle overflow return line. Use a flexible section to connect the lines to the plant.

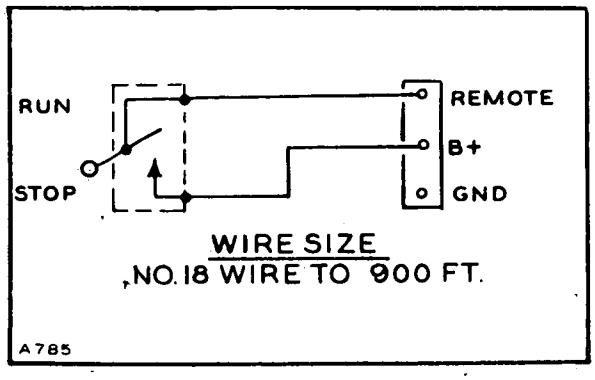
DAY TANK. - Engines may be equipped with an optional day tank. A float operated switch controls the electric fuel pump (not included with day tank) to maintain the correct fuel level to assure a constant source of fuel. Do not mount the tank on the plant. Mount the tank on a vibration free support below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

Use proper adapter fittings for line connections to the engine: the fuel inlet on the optional electric fuel pump, and the injector nozzle fuel return connection are threaded for a 1/8-inch pipe fittings. Be sure there is no possibility of an air leak in the supply line connections, which would prevent pumping of fuel.

BATTERY. - Two 6-volt batteries are recommended. Note that each battery cable terminal clamp is stamped "P" (positive) or "N" (negative) for connection to the proper battery terminal post. Connect positive to the large terminal of the start solenoid on the starter. Connect negative to a convenient ground point on the engine. Service the batteries as necessary.

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

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

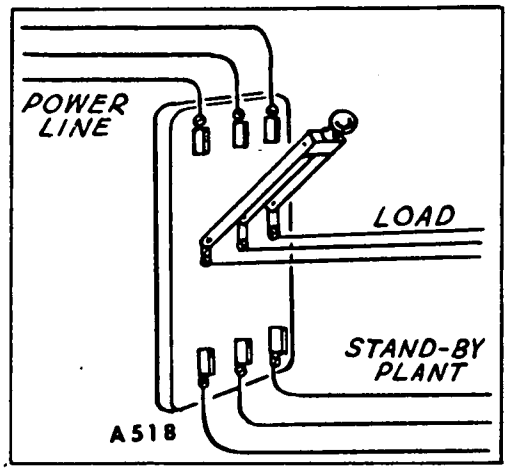


CONNECTING LOAD WIRES. - The plant AC output terminals are large studs located inside the control box, at the generator end of the plant. Knock out openings are provided for convenience in bringing load wires into the control box.

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.

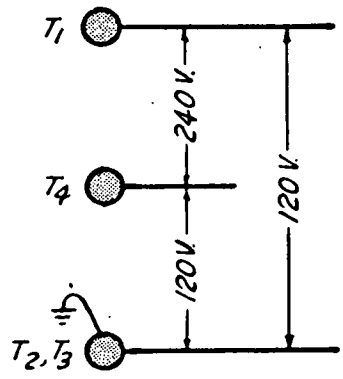
INSTALLATION

A double throw transfer switch must always be used where installations are for standby service. This switch (either manual or automatic) must be connected so that it is impossible for the generator current to be fed into the normal power source lines, or for the normal source and generator current to be connected 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.



120/240-VOLT, 1-PHASE, 3-WIRE PLANT

Terminal post T2, T3 is the grounded (neutral) terminal. For 120-volt current, connect the "hot" load wire to either the T1 or T4 terminal. Connect the neutral load wire to the T2, T3 terminal. Two 120-volt circuits are thus available, with not more than 1/2 the rated capacity of the plant available on each circuit. Balance the load as closely as possible.



For 240-volt current, connect one load wire to terminal T1 and the second load wire to terminal T4. Terminal T2, T3 is not used for 240-volt service.

If both 120 and 240-volt current is to be used at the same time, use care not to overload either circuit.

3-PHASE, 3-WIRE PLANT

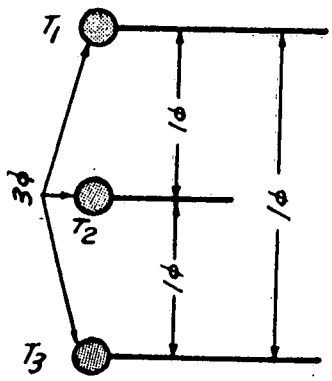
No terminal is grounded. For three phase current, connect separate load wires to each plant terminal T1, T2, and T3.

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. Three single phase circuits are thus available: T1-T2, T1-T3, and T2-T3. The load connected to any one single phase circuit must not be greater than 1/3 the rated capacity of the plant.

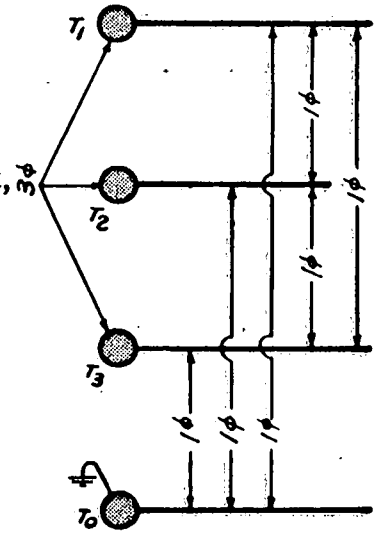
INSTALLATION

If both single and three phase current are to be used at the same time, use care not to over-load 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 over loading of the generator will result.



3-PHASE, 4-WIRE, WYE CONNECTED PLANT

The 3-phase 4-wire plant produces single phase current of one voltage and three phase current of a different voltage. The single phase voltage is the lower voltage as noted on the plant nameplate, and the three phase voltage is the higher nameplate voltage.



The terminal marked T0 is grounded. For single phase current, connect the neutral (white) load wire to the T0 terminal. Connect the "hot" (black) load wire to any one of the other three terminals - T1, T2, or T3. Three separate single phase circuits are available, with not more than 1/3 the rated capacity of the plant from any one circuit.

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

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

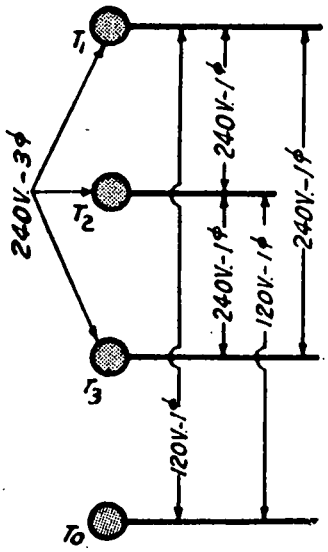
120/240-VOLT, 3-PHASE, 4-WIRE DELTA CONNECTED PLANT

The 3-phase Delta connected plant is designed to supply 120-volt single phase current and 240-volt 3-phase current. The T0 terminal is the generator center tap between T1 and T2, and is normally not grounded.

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

INSTALLATION

For 120/240-volt, 1-phase, 3-wire operation, terminals T1 and T2 are the "hot" terminals. The T0 terminal is the neutral, which can be grounded if required. For 120-volt service, connect the "hot" (black) load wire to either the T1 or T2 terminal. Connect the neutral (white) wire to the T0 terminal. Two 120-volt circuits are available. Any combination of single phase and three phase loading can be used at the same time as long as no terminal current exceeds the NAMEPLATE rating of the generator.



SIGNAL LIGHTS, ETC. - Optional equipment may include signal lights to warn of improper operation, or terminals for connecting such lights, horn, or other warning devices. Refer to the engine wiring diagram if such equipment is to be connected.

WATER JACKET HEATER. - The optional water jacket heater serves to keep the engine coolant warm during periods of plant shut-down in low ambient temperatures, thus promoting easier starting. Connect the heater to a normally energized electric power source. IMPORTANT: Make sure the line voltage is correct for the rated voltage of the heater.

CRANKCASE OIL. - Fill the crankcase with 12 quarts (U.S. measure) of a good quality oil designated for "type DS" service. Refer to the LUBRICATION section of the Ford engine manual for recommendations as to the SAE number of oil to use.

An oil level reading is most accurate if taken immediately upon stopping as approximately 1-pint of oil drains from the oil filter into the crankcase during shut down.

AIR CLEANER. - Service air cleaner with oil, filling to level marked on the cleaner. Use the same SAE number oil as used in the crankcase (it is not necessary to use expensive heavy duty oil in the air cleaner).

RADIATOR. - Fill the radiator with clean soft water using a good rust and scale inhibitor. If there is any danger of freezing temperatures, use standard antifreeze in the recommended proportion. The approximate capacity of the cooling system is 18 U.S. quarts. On the initial run, check the level several times and add liquid as necessary to compensate for any air pockets which may have formed when filling.

FUEL. - No. 2 diesel fuel is recommended. Refer to the Ford manual for fuel specifications. Check with fuel supplier to assure that the fuel meets specifications.

Fuel system must be properly primed and all air bled before the initial start. Refer to the Ford manual for instructions.

WARNING
THIS ENGINE CONTAINS BREAK-IN OIL

Before Operating: FILL cooling system. CHECK lubricating oil level. CHANGE break-in oil after 15-hours operation. CHANGE oil filter after 15-hours.

Rust Inhibiting Oil is applied to cylinders for shipping. After first start run plant 1/2-hour at 50% rated load.

STARTING. - Fuel system must be air free, as directed under PREPARATION. If fuel lines have been disconnected, or if fuel has been exhausted, bleed the entire fuel system. For normal starts, no further priming is necessary.

Engines 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.

For starting in temperatures below $-10^{o}F.$, be sure the fuel has a pour point well below the prevailing temperature. Fuel suppliers are responsible for providing a fuel suitable for temperature conditions. Engage the excess fuel device. If practical, keep the battery in a warm location during shut down and reconnect just before starting.

CHECKING OPERATION. - Always check the oil pressure as soon as the engine starts. Normal oil pressure is 30 to 45 lbs. at operating temperature, but will be considerably higher until the engine warms up.

Coolant temperature during operation is indicated on a water temperature gage. Normal operating temperature is approximately $190^{o}F.$

A small DC ammeter indicates the battery charging current. An automatic regulator controls the charging rate, which varies according to the charge condition of the batteries. Normal charge rate is 5 to 10-amperes when the plant first starts. Charge rate should fall to almost zero as the batteries become fully charged.

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

LOW OIL PRESSURE SWITCH. - This switch acts through the emergency stop relay to stop the plant in case of low engine oil pressure. After correcting the cause of the low oil pressure, press the reset button before attempting to start the engine.

HIGH WATER TEMPERATURE. - If the engine coolant rises to a dangerously high temperature, a thermostatic switch actuates the stop circuit and stops the plant. Correct the condition which caused the high temperature (coolant temperature must drop approximately $10^{o}F.$ before the plant can be started again). The high water temperature switch acts through the EMERGENCY STOP RELAY, and the PUSH TO RESET button must be pressed to restore normal operation.

VOLTAGE REGULATOR RHEOSTAT. - On plants so equipped, the rheostat provides for approximately 5% plus or minus adjustment of the output voltage. Turn clockwise to increase the voltage, counter-clockwise to decrease the voltage.

BATTERY, HOT LOCATION. - Batteries will self discharge very quickly when 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 a full charge to a 1.225 reading. The cranking power of the battery will be reduced slightly when the electrolyte is so reduced, but if the temperature is above 90°F. this should not be noticed, and the lengthened battery life will be a distinct advantage.

CRANKING LIMITER. - The cranking limiter is a safety device which prevents excessive engine cranking. An electrically operated thermal relay will automatically open the engine cranking circuit after approximately one-minute cranking time. The limiter must be manually reset after opening. Allow at least one minute before attempting to reset the limiter. Investigate any failure in starting.

EXERCISE PERIOD. - Plants used infrequently, such as in standby service, should be started and operated for at least 30 to 45 minutes once a week. This exercise period keeps oil distributed on engine parts, fuel system full, etc., and promotes easier starting.

NO LOAD OPERATION. - Periods of no load operation should be held to a minimum. After about 4 hours of continuous no load operation, the injection nozzles may become fouled enough to 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.

OPERATION

SPECIAL EQUIPMENT

Some plants are equipped with electrical indicating meters (running time meter, circuit breakers, etc). Such equipment varies according to purchaser options or plant model.

AC AMMETER. - Indicates the amount of load connected to the generator circuit. On three phase models, the current shown will be for one phase only, according to the position of the selector switch.

AC VOLTMETER. - Indicates the voltage of the ac output. On three phase models, the voltage shown will be for the same phase as the amperage shown, according to the position of the selector switch. On a single phase (no selector switch) or four wire, three phase model, the voltage shown will be the higher nameplate voltage.

METER SELECTOR SWITCH. - Provided on three phase models. The position of its handle indicates the phase of the generator output which is indicated on the ac ammeter and voltmeter.

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.

CIRCUIT BREAKER. - Protects generator against damage from an overload. If an overload should occur, the circuit breaker will automatically trip, disconnecting the generator output from the load terminals. After correcting the overload condition, it is necessary to manually reset the breaker to the ON position.

WATER JACKET HEATER. - Intended for use in cold weather applications. The electrically operated heater keeps the engine coolant at a moderate temperature to prevent condensation, oil thickening, hard starting.

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).

TACHOMETER. - Indicates the engine operating speed in revolutions per minute. It can be used to check current frequency.

EMERGENCY STOP RELAY. - Stops the plant if a plant safety device operates. Emergency stop relay PUSH TO RESET button must be pressed in before the plant can be started again. Always be sure to correct the condition that caused the emergency stop.

PERIODIC SERVICE

GENERAL. - Follow a definite schedule of inspection and servicing, based on operating hours. Keep an accurate record of operating time. Use the running time meter (optional equipment) to keep a record of operation and servicing. Service periods outlined below are for normal service and operating conditions. For continuous duty, extreme temperatures, etc., service more frequently. For infrequent use, light duty, etc., service periods can be lengthened accordingly. Refer to the Ford engine manual for details of engine service operations.

DAILY SERVICE, NORMAL 8 HOURS OF OPERATION.

1. FUEL OIL. - Check, replenish as necessary.
2. CRANKCASE OIL. - Check level, add as necessary.

NOTE

Check the oil level immediately after stopping, before oil in the filter drains back into the crankcase.

3. RADIATOR. - Check level, add as necessary.
4. CLEAN AND INSPECT. - Wipe clean of dust, spilled oil, etc. Inspect for loose parts, leaks, etc.

WEEKLY SERVICE, NORMAL 50-HOURS OF OPERATION.

1. AIR CLEANER. - Check, clean, replenish oil as frequently as necessary.

SEMI-MONTHLY SERVICE, NORMAL 100-HOURS OF OPERATION.

1. CRANKCASE BREATHER. - Clean and inspect.
2. FAN BELT. - Inspect and adjust to 1/2 inch depression between pulleys.
3. FUEL FILTER. - Drain sediment. Reprime.
4. COOLING SYSTEM. - Check for rust or scale formation.

MONTHLY SERVICE, NORMAL 200-250 HOURS OF OPERATION.

1. CHARGE ALTERNATOR. - Clean and inspect for loose connections, etc.
2. STARTER. - Oil front bearing sparingly, check brushes.
3. INJECTION NOZZLE. - Check for proper spray pattern, etc. Refer to the Ford manual.
4. AC GENERATOR. - Check brushes, replace if worn to 1/2 inch or if damaged. DO NOT LUBRICATE.
5. FUEL FILTER - Replace elements, clean, and reprime.
6. CRANKCASE OIL. - Drain and refill unless experience indicates otherwise. Refer to LUBRICATION in the Ford manual.
7. OIL FILTER. - Replace the element at time of oil change.

MAINTENANCE

ENGINE

GENERAL. - Basic engine maintenance procedures are covered in the Ford engine manual. Proper attention to correct operating and periodic service procedures will lessen the necessity for future maintenance repairs.

ENGINE SPEED. - The frequency of generator output current is in direct ratio to engine speed. Engine speed is controlled by the built-in governor of the fuel injection pump. Original factory settings of the governor should not be disturbed. However, in case of pump repair, the governor is easily reset.

1. See that the injection pump is properly timed to the engine. Refer to the Ford manual.

2. Adjust the governor to give an engine speed of approximately 1800-rpm for a 60-cycle plant (1500-rpm for a 50-cycle plant). Use an accurate tachometer to determine engine speed, or a frequency meter connected to the AC generator output. Multiply frequency by 30 to obtain engine speed.

EXAMPLE: 30 x 61 (cycles) equals 1830-rpm.

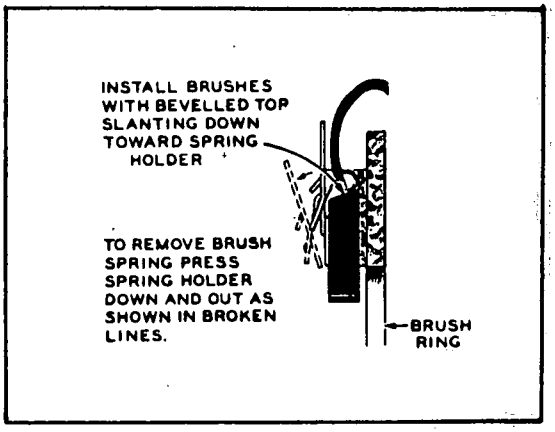
Check the generator voltage. It may be necessary to make a slight adjustment of the speed setting to obtain the preferred voltage at average load. A range of 1830 to 1890-rpm (61 to 63 cycles) might give the desired voltage.

GENERATOR

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

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

Brushes should be replaced when worn to approximately 1/2-inch in length, or the lead end of the brush is below a point midway between the outer and inner end of its guide. Do not attempt to remove the brush without first removing its spring and bracket as shown. Never bend a spring back over its bracket - doing so will put a kink in it and require its replacement. Do not use a substitute brush that may look identical but may have entirely different electrical characteristics. Be sure the brush is installed so that the short side of its taper is toward the spring and its bracket.



GENERATOR BEARING. - It is prelubricated for its life, and requires no servicing.

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

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

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

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

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

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

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

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

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Generator will not build up voltage.	Circuit breaker in "off" or "tripped" position	Reset and close breaker	None
	Open in circuit breaker	Stop plant and check breaker continuity	None
	No AC power to Magneciter	Check AC voltage at E1-E2 with the plant operating. Voltage should be five per cent of the rated voltage. If not, check continuity from E1-E2 back to the generator	None
	Partial loss of residual in Rotor	With plant operating jumper from E2 to heat sink of field rectifier Z until voltage begins to build-up. Then remove.	None
	Pair of Field Rectifiers (either W & Z or X & Y) open	Test rectifiers and replace if defective	2
	Both Field Rectifiers X and Y shorted	Test rectifiers and replace if defective	2

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Output voltage slow to build up. Circuit breaker opens in about five seconds	Either Field Rectifier X or Y shorted	Test rectifiers and replace if defective	2
Output voltage slow to build up and five per cent below rated voltage after build up. Voltage regulation poor.	Either Field Rectifier W or Z shorted	Test Rectifier and replace if defective	2
Output voltage slow to build up and higher than rated voltage after build up	Open circuit in one or more Control Rectifier	Test rectifier and replace if defective. Check soldered connections to rectifiers	2
Output voltage slow to build up and ten to twenty percent above rated voltage after build up	Open in one Field Rectifier	Test rectifiers and replace if defective	2
	Open circuit in Gate winding G1-G2 of Reactor A or B	If Field Rectifiers Z and Y check okay, check continuities of Gate windings G1-G2	3
Output voltage builds up normally but less than rated voltage after build up	Shorted winding in Control Reactor	Test Control Reactor and replace if defective	4
Output voltage builds up normally with slightly less than rated voltage at no load and low voltage at full load	Compound winding S1-S2 installed backward or has open circuit.	Check wiring diagram for polarity of Compound windings through Reactors A and B and test for continuity	None
Output voltage builds up normally but 20 percent above rated voltage after build up. Voltage regulation poor.	Compound winding S1-S2 installed backward through one Reactor (A or B)	Check wiring diagram for polarity of Compound winding through Reactor A or B	None
Output voltage builds up normally but is twenty five percent above rated voltage after build up	Open circuit in Control Rectifier bridge	Check continuity from the junction of Control Rectifiers W and X to the junction of Control Rectifiers Y and Z	None

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	STEP
Output voltage builds up normally but 125 to 150 percent above rated voltage after build up	Shorted turn in gate winding G1-G2 of Reactor A or B	Test Reactors A and B for shorted turns and replace if defective	3
Output voltage builds up normally but 150 to 200 percent above rated voltage after build up. No regulation possible	Control winding C1-C2 of Reactor A or B polarized incorrectly	Check circuit connections of both Reactors A and B	None
	Shorted turn in Control winding C1-C2 of Reactor A or B	Test Reactors A and B for shorted turn and replace if defective	3
	Open in Control Circuit	Check continuity from E1 to E2 through Control Circuit	None
Generator Voltage fluctuating while engine running at constant speed	Incorrect setting on the Stabilizing Resistor	Check resistance and reset.	5

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

CAUTION

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

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

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

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

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

CAUTION:

The extend to which the resistance values obtained when trouble shooting with an ohmmeter are reliable and useful is governed by the accuracy of that ohmmeter. Resistance readings of the range of values found between G and G_2 cannot be read with accuracy on the multimeter.

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

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

c. Isolate one Control winding by disconnecting either lead C1 or C2 from the terminal block especially provided for this check without the lead joining the two Control windings. Measure the resistance in the Control winding across C1-C2. Should be 8.5.

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

Results:

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

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

4. Checking Control Reactor.

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

Results:

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

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

5. Checking Resistors:

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

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

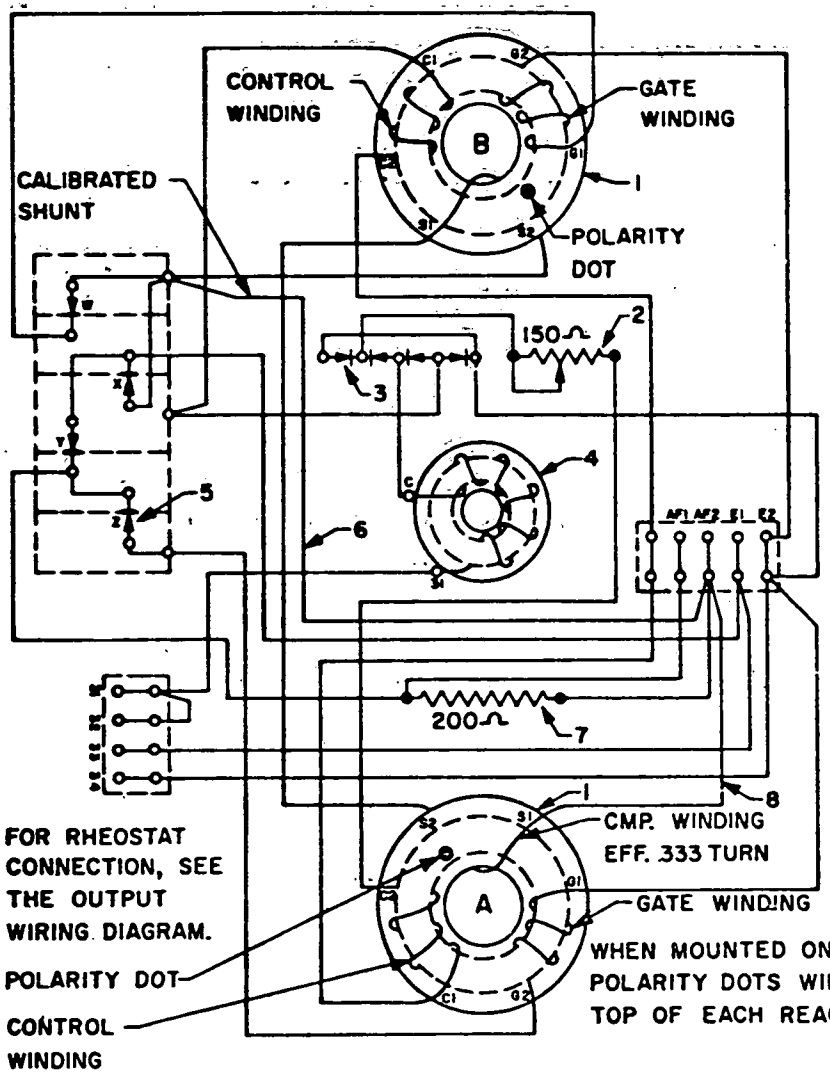
Results:

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

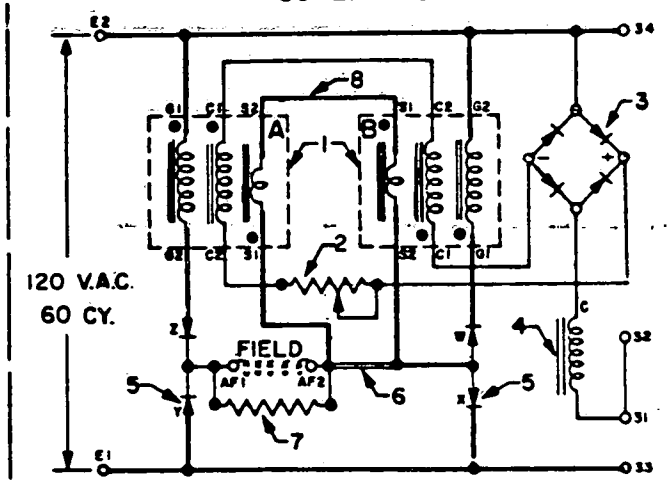
2. RESISTOR IS DEFECTIVE if there is no indication of continuity through the resistor. If the measured resistance exceeds the percent limits either way, the Stabilizing Resistor can be adjusted to bring the resistance within the required limits.

625A257

PICTORIAL



SCHEMATIC



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

PARTS LIST

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

MODEL: 102SXINIB

DWG. NO.: 625A257

PARTS CATALOG

This parts catalog applies to the 50DEG-4R8/5469A electric generating plants. They are powered by a Ford Model C5PL-6005A(SO-30) Engine, which is more completely described in the FORD manual. Basically, the engine is a 6 cylinder, water cooled, diesel (compression ignition) type. The cylinder bore is 4.125 inches, parts must be selected from the appropriate Ford parts list and parts must be secured from the Ford Motor Company.

"Right" and "Left" sides of the Generator, Control and Housing are determined by FACING the Radiator (Front) end.

ONAN parts are illustrated in groups and have reference numbers which correspond to the like numbers in the list for that group. Parts illustrations are typical and do not necessarily portray a particular part number.

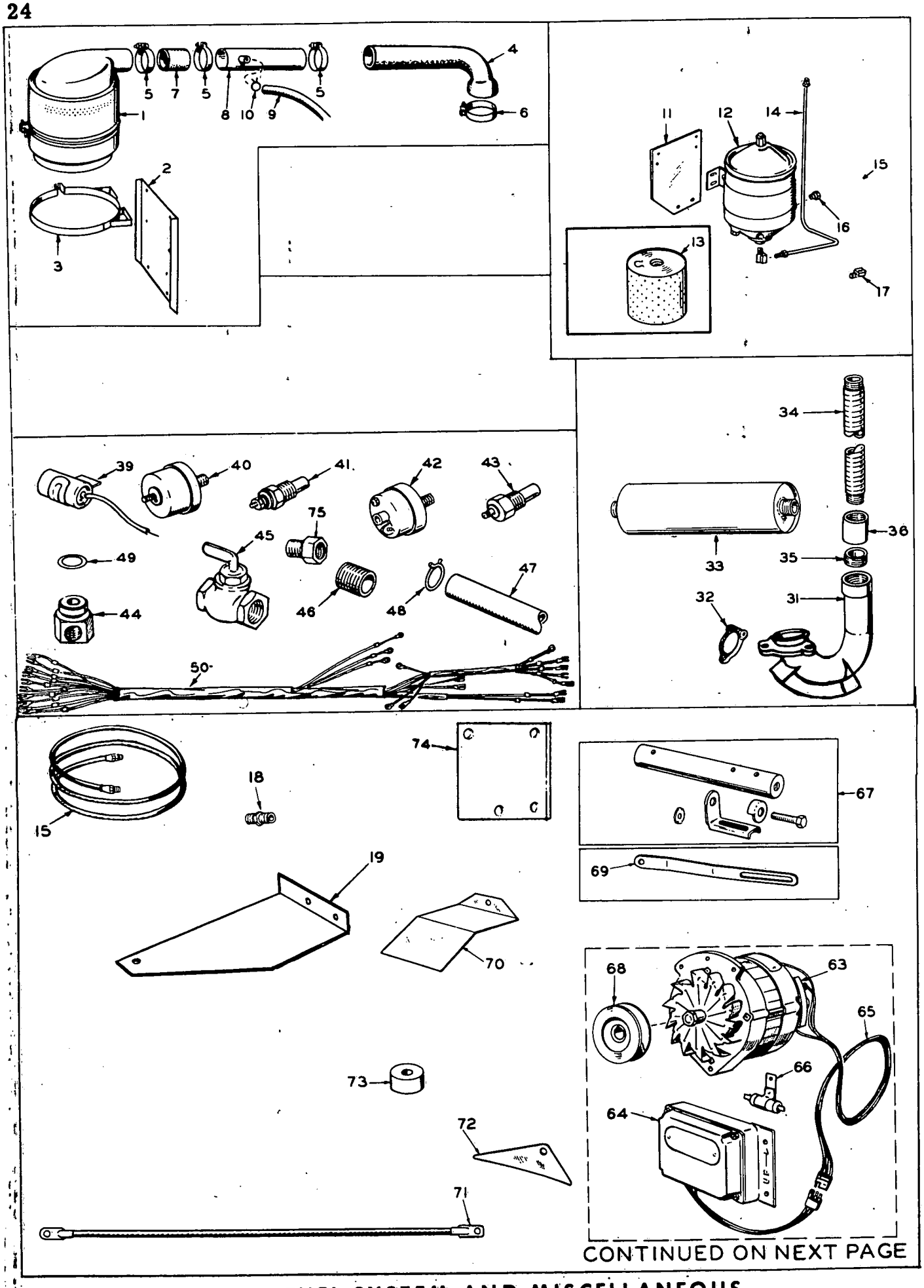


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FIG.1-FUEL SYSTEM AND MISCELLANEOUS

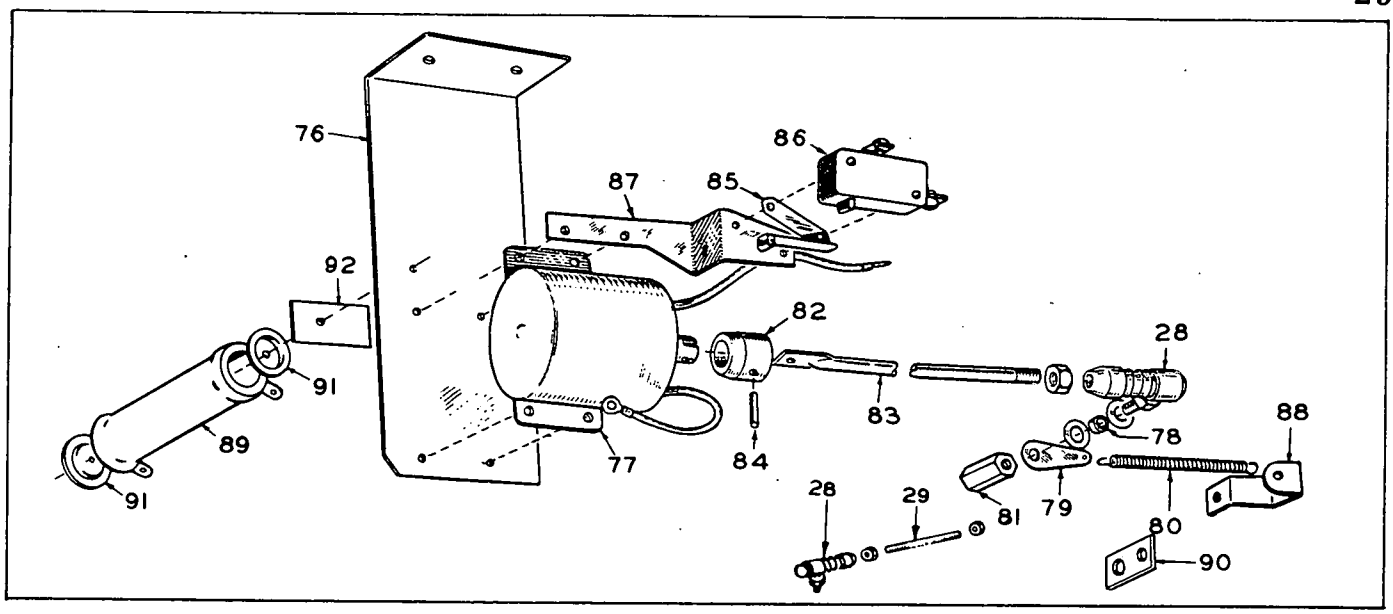


FIG.1-FUEL SYSTEM AND MISCELLANEOUS (CONT.)

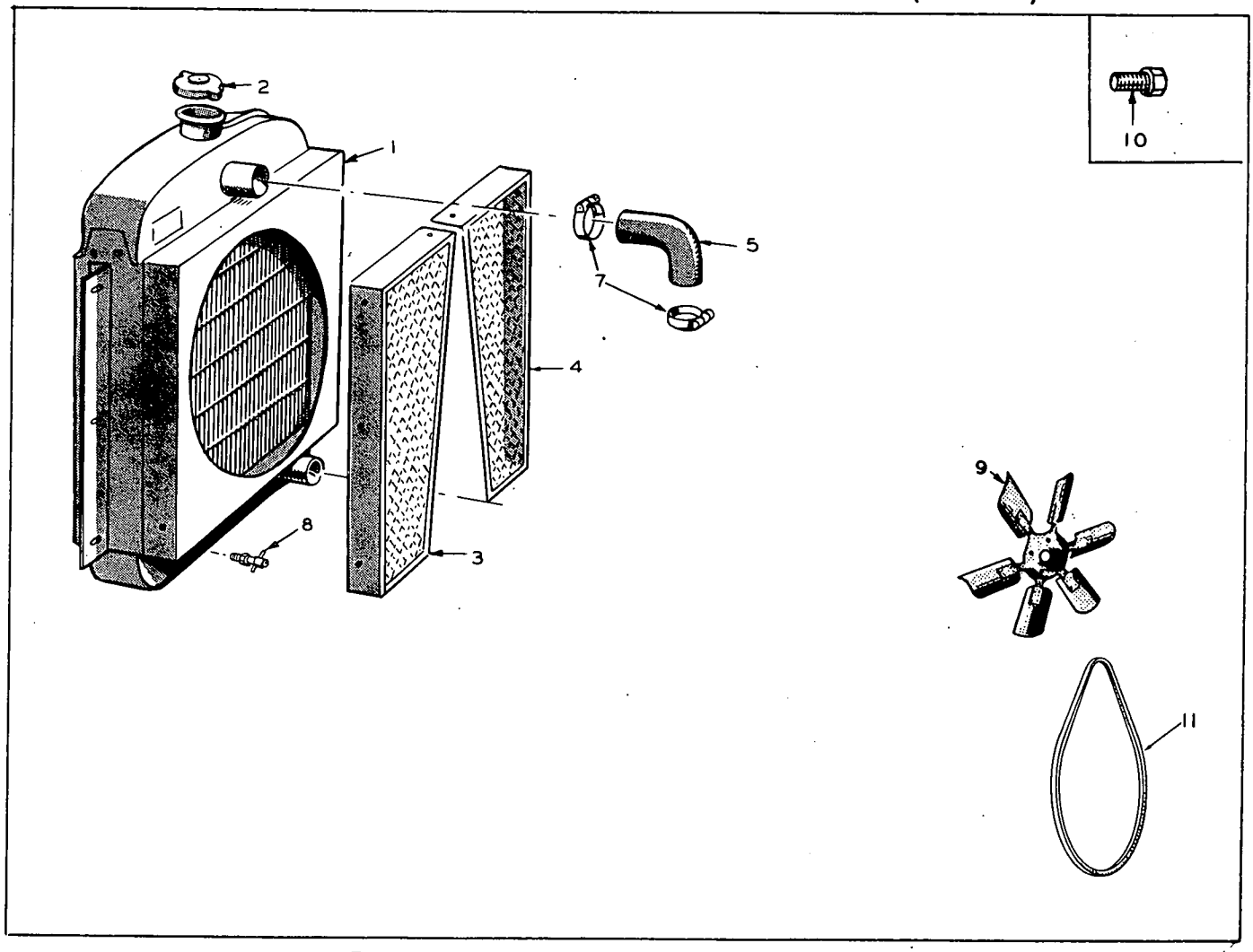


FIG.2-COOLING SYSTEM GROUP

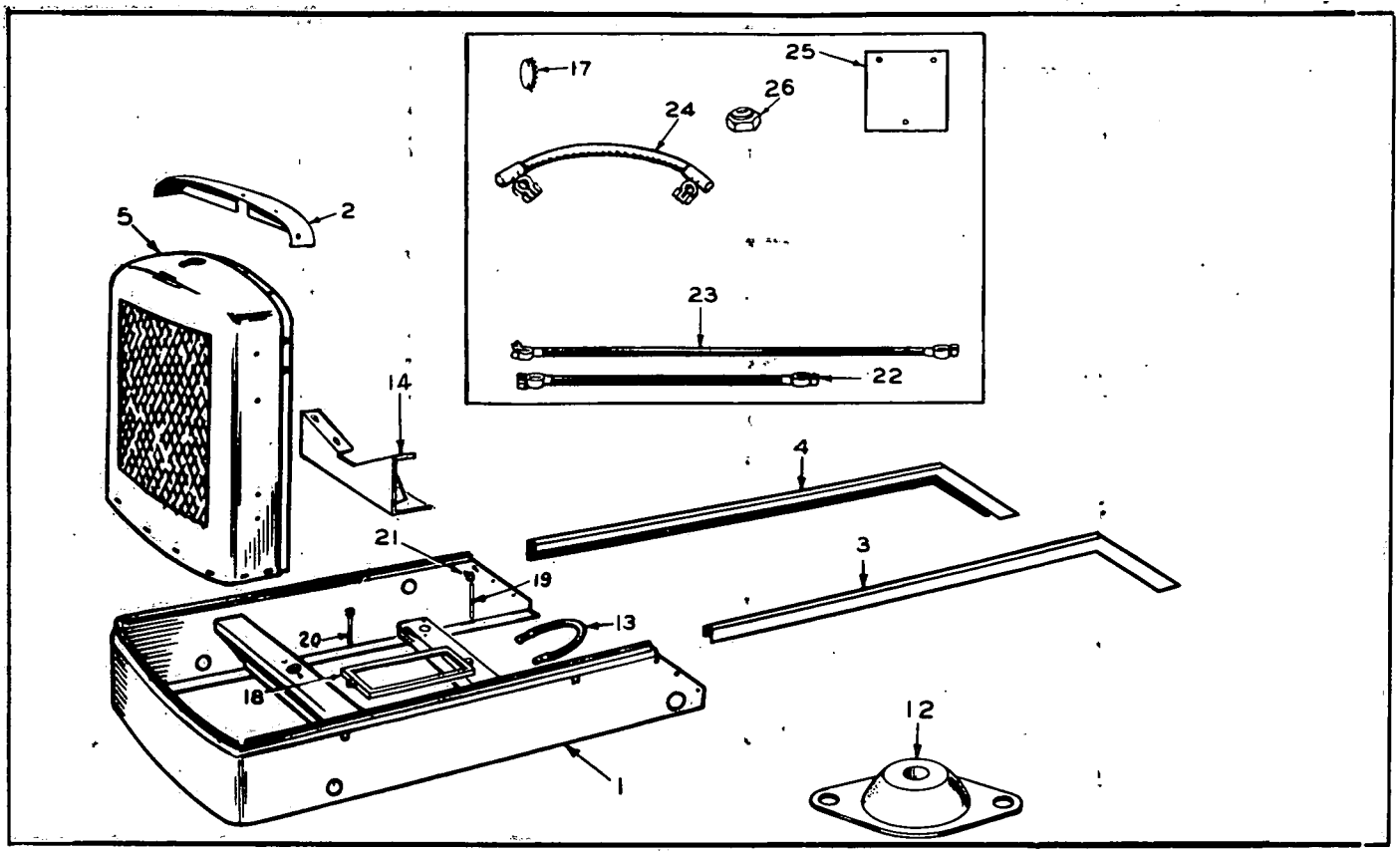


FIG.4-MOUNTING GROUP (UNHOUSED PLANTS ONLY)

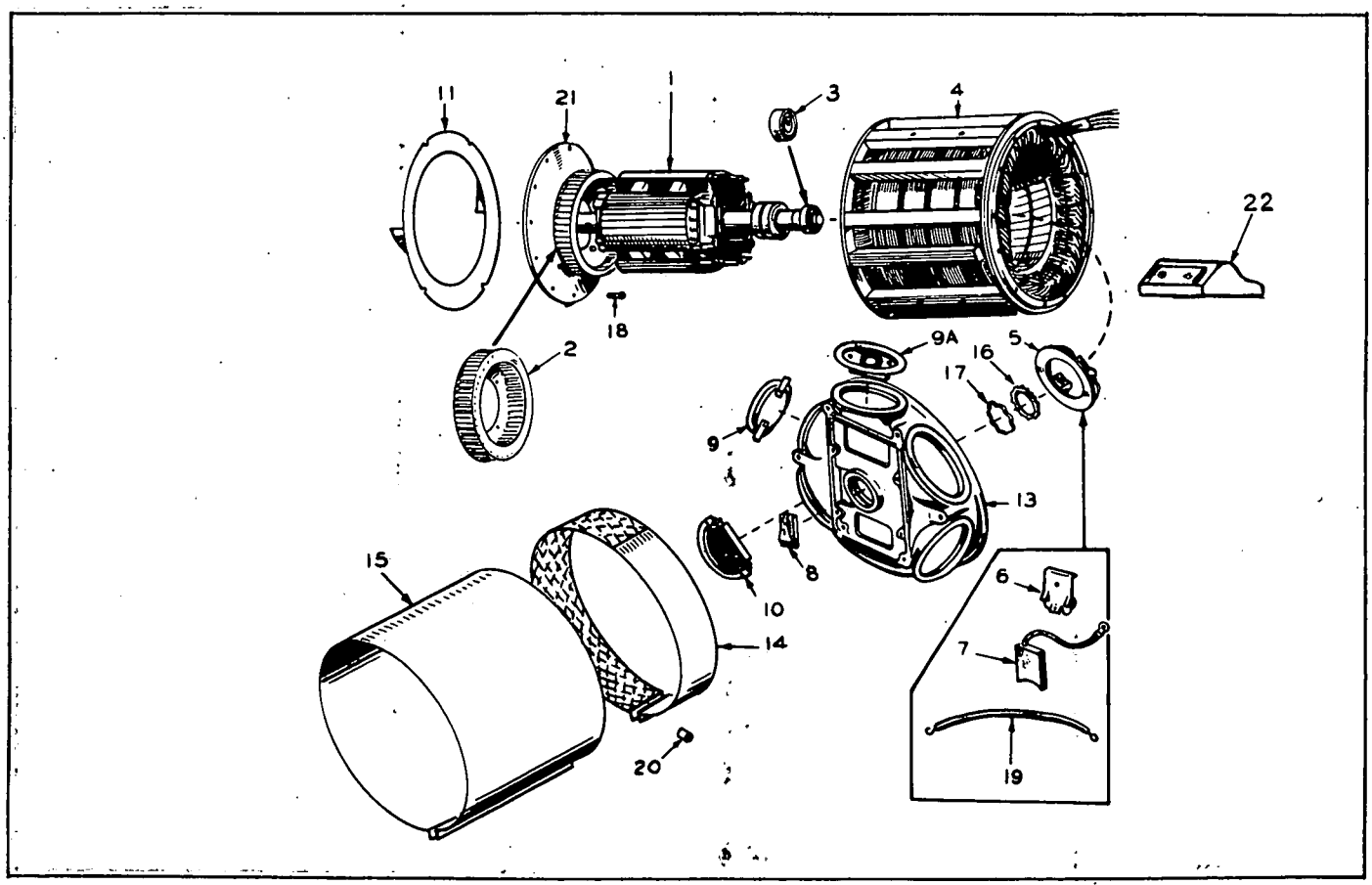


FIG.5-GENERATOR GROUP (AC ALTERNATOR PORTION)

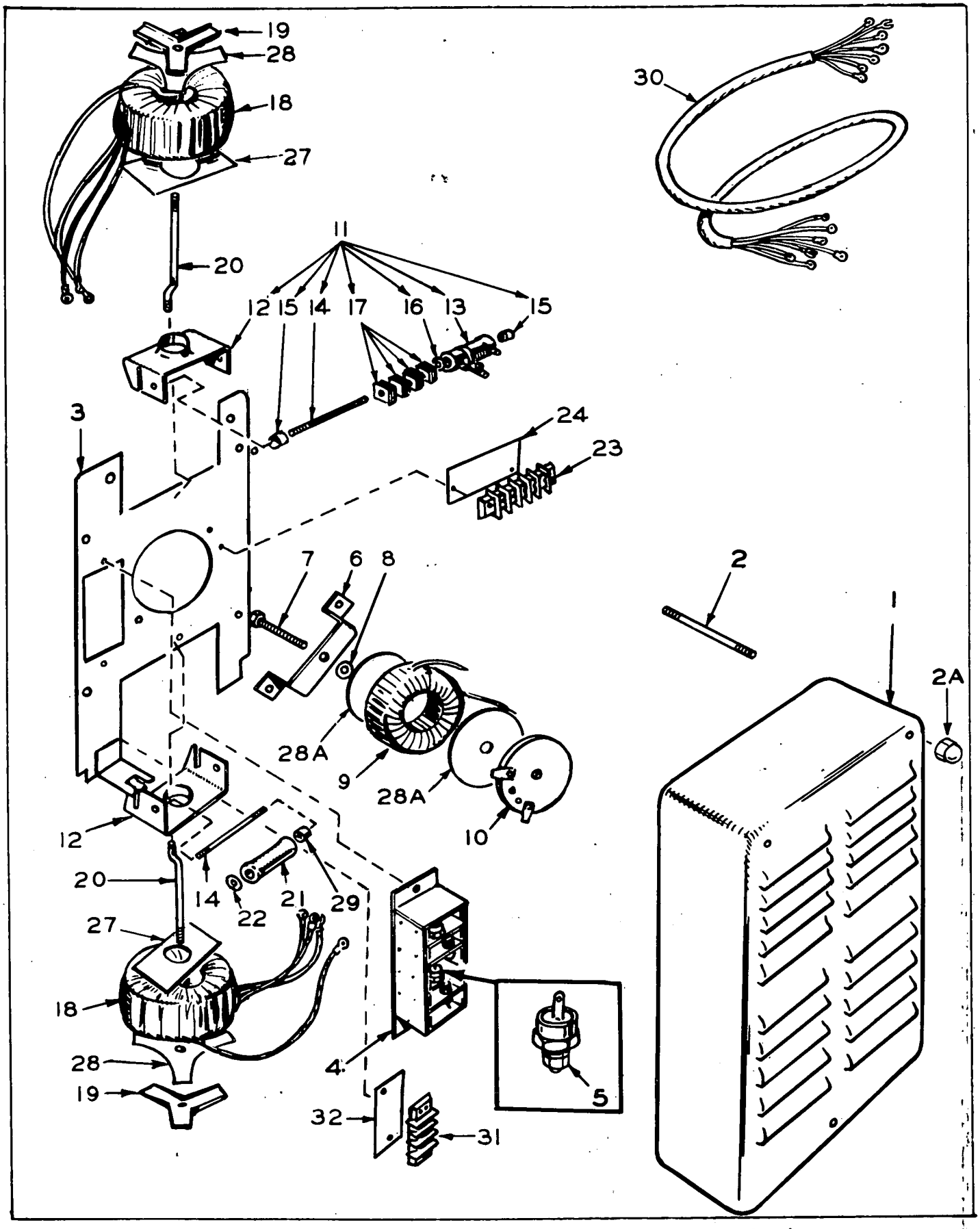
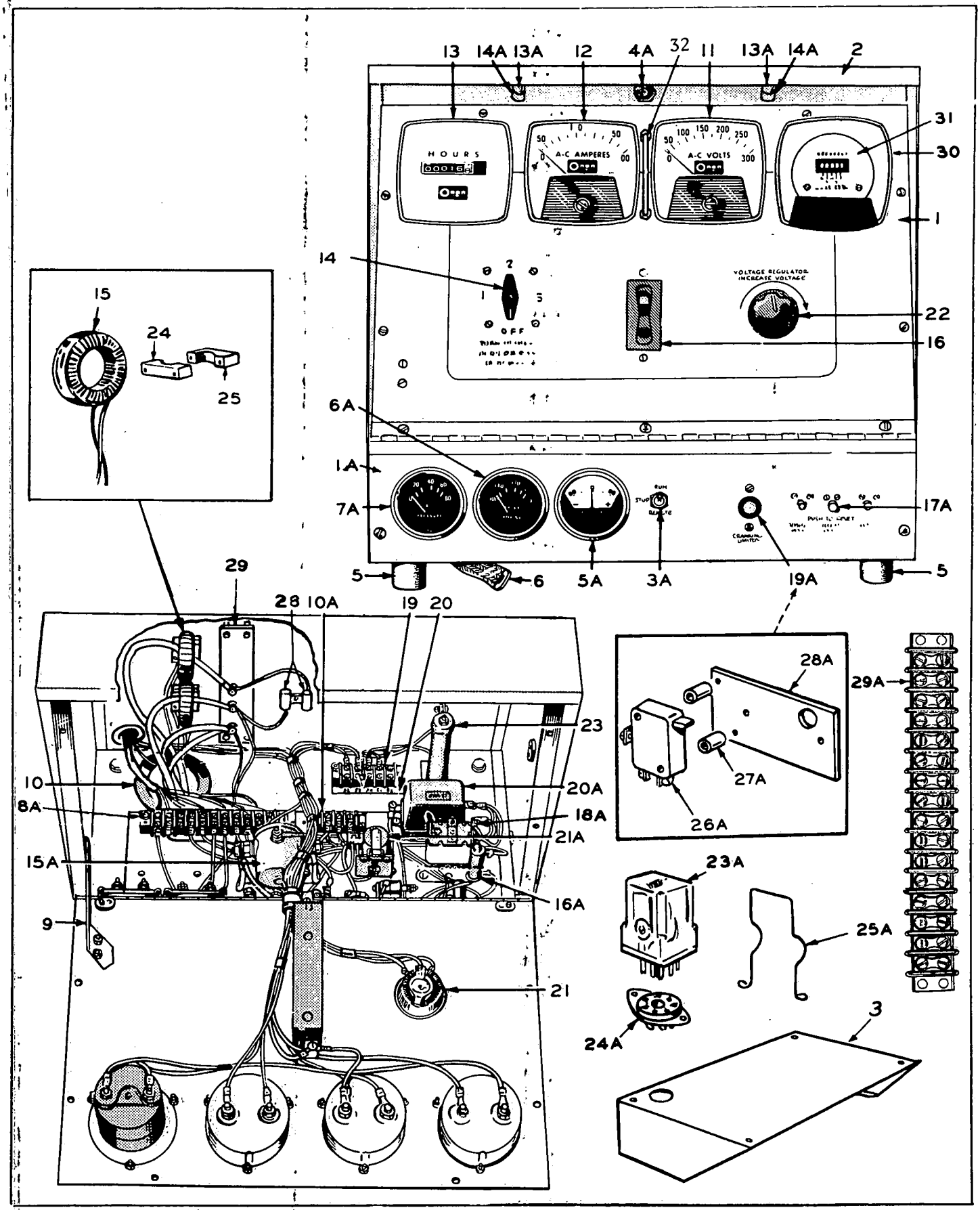


FIG.6-GENERATOR GROUP (EXCITER PORTION)



NOTE: Control groups are shown separately in the Parts List.

FIG.7-CONTROL GROUP- AC OUTPUT

FIG.7A-CONTROL GROUP- ENGINE INSTRUMENTS

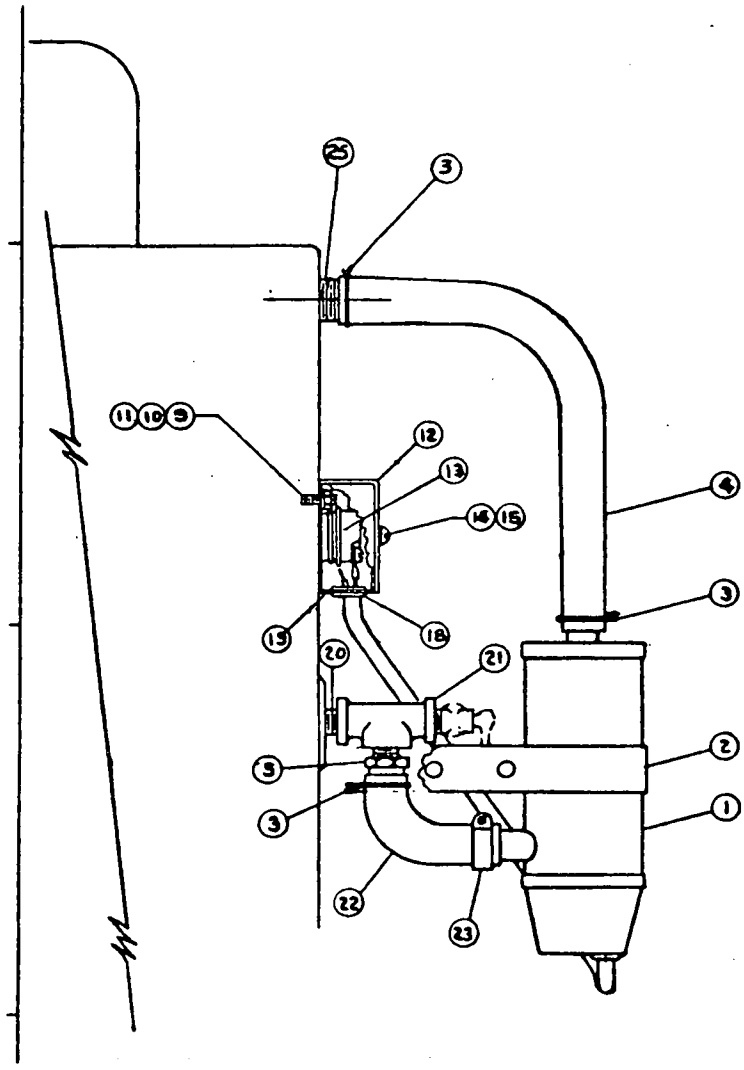


FIG. 9 - WATER HEATER GROUP (Optional Equipment)

	100P643	1	Engine Replacement (Ford Motor Company, Model C5PL-6005A (SO-30) General Description Includes - Complete Cylinder Block; Oil Pan; Governor; Injection Pump; Oil Pump; Oil Filter; Water Pump; Secondary Fuel Filter; Flywheel; 12-Volt Starter Motor; Generator Brackets; Valve Rotators; Fuel Transfer Pump; and Oil Fill Tube. Excludes - Air Cleaner; Radiator and Hoses; Charge Generator Voltage Regulator and Front Mounting Brackets

FIG. 1 - FUEL SYSTEM AND MISCELLANEOUS ENGINE PARTS GROUP

1	140B62	1	Cleaner, Air
2	140B764	1	Bracket, Air Cleaner Mounting
3	140A80	2	Band, Air Cleaner Mounting
4	503B456	1	Hose, Air Cleaner Connector Manifold
5	503-465	3	Clamp, Air Cleaner Hose
6	503-354	1	Clamp, Air Cleaner Hose
7	503-482	1	Hose, Air Cleaner to Connector
8	140A769	1	Connector, Air Cleaner to Manifold
9	503-217	1	Hose, Breather
10	503-197	2	Clamp, Breather Hose
11	149A985	1	Plate, Primary Fuel Filter Mounting
12	149C823	1	Filter, Fuel - Primary
13	149P846	1	Cartridge, Fuel Filter
14	149C988	1	Line, Fuel - Primary to Secondary Filter
15	501A78	1	Line, Fuel - Pump to Primary Filter
16	502-33	1	Connector, Primary, Fuel Filter
17			Elbow, 90°
	502-55	1	Fuel Pump Outlet 1/8"
	502-56	1	Fuel Pump Inlet 1/4"
18	502-166	1	Connector, Fuel Pump Inlet
19	149B1089	1	Bracket, Fuel Filter Support
28	150A638	2	Joint (1) Rod to Injection Pump, (1) Governor Adjusting Stud
29	151B284	1	Stud, Governor Adjusting
31	155C864	1	Elbow, Exhaust Outlet
33	155B917	1	Muffler, Exhaust
34	155A633	1	Tube, Exhaust - Flexible
36	505-203	1	Coupling, Exhaust Tube Connection
39	312A58	2	Condenser, (1) Voltage Regulator (1) Charge Gen.
40	193A108	1	Sender, Oil Pressure
41	193A104	1	Sender, Water Temperature
42	309B10	1	Switch, Low Oil Pressure
43	308A179	1	Switch, Hi-Temperature Cut-Off
44	102A553	1	Adapter, Oil Drain

45	504-30	1	Valve, Oil Drain
46	505A135	2	Nipple, Close - Oil Drain
47	503-484	1	Hose, Oil Drain
48	503-131	1	Clamp, Oil Drain Hose
49	102P532	1	Gasket, Oil Drain
50	338C316	1	Harness, Engine Control
63	191-543	1	Alternator, Charge
64	191-542	1	Regulator, Charge Alternator
65	191-544	1	Cable, Alternator to Regulator
66	191-545	1	Resistor, Charge Alternator
67	191-546	1	Bracket, Alternator Mounting
68	191-624	1	Pulley, Charge Alternator
69	191A101	1	Bracket Alternator - Adjusting
70	191B619	1	Shield, Heat - Alternator
71	416A532	1	Cable, Starter Motor Ground
72	191A516	1	Cover, Starter Motor Mounting Hole
73	403A315	2	Spacer, Air Cleaner Mounting Bracket
74	305A315	1	Plate, Voltage Regulator Mtg.
75	505-7	2	Bushing, Reducer (1) Oil Sender (1) Oil Switch
76	150B1056	1	Bracket, Solenoid Mounting
77	307B259	1	Solenoid, Stopping
78	150A302	1	Bushing
79	145A118	1	Link, Throttle Spring
80	145A158	1	Spring, Throttle
81	150A1054	1	Spacer, Gov. Linkage
82	309A132	1	Cam, Switch
83	150A1055	1	Rod, Stop Sol. to Inj. Pump Joint
84	516-86	2	Pin, Roll
85	309P133	1	Actuator
86	309A155	1	Switch, Micro
87	309A131	1	Bracket, Switch Mounting
88	150A1057	1	Bracket, Gov. Sprg. Mounting
89	304A45	1	Resistor
90	150A1060	1	Bracket, Gov. Linkage
91	304A15	2	Washer, Resistor Centering
92	304A292	1	Insulator, Resistor Mtg.

FIG. 2 - COOLING SYSTEM GROUP

1	130D688	1	Radiator
2	130P372	1	Cap, Radiator
3	130C352	1	Guard, Fan - Right Hand Side
4	130C351	1	Guard, Fan - Left Hand Side
5	503A441	2	Hose, Radiator
7	503P365	4	Clamp, Radiator Hose
8	504-28	1	Valve, Radiator Drain
9	130C605	1	Blade, Fan
10	801-24	4	Screw, Hex - 5/16-24 x 1/2" - Fan Blade Mounting
11	511P79	1	Belt Fan

FIG. 4 - MOUNTING GROUP

1	403D786	1	Chassis, Mounting
2	405C1409	1	Extension, Radiator Hood
3	403C702	1	Trim, Chassis - Right Side
4	403C703	1	Trim, Chassis - Left Side
5	405D1588	1	Panel, Front End
12			Mount, Vibration
	402P209	2	Generator End
	402P190	1	Engine End
13	336A476	1	Cable, Ground - Generator to Chassis
14	403C785	1	Support, Engine Mounting
17	517-19	2	Plug, Dot Button, Radiator Trim
18	416C480	1	Frame, Battery Hold-Down
19	520A231	1	Stud, Battery Hold-Down
20	800-31	1	Screw, Cap - Battery Hold-Down
21	865-7	1	Nut, Wing - Battery Hold-Down
22	416A530	1	Cable, Battery - 16" Long
23	416A531	1	Cable, Battery - 24" Long
24	416A446	1	Cable, Battery - 9" Long
25	305A317	1	Plate, Voltage Regulator Mounting
26	870-68	2	*Nut, Huglock - Engine Mounting

FIG. 5 - GENERATOR GROUP (Alternator Portion)

1	201-1135	1	Rotor Assembly, Wound - Includes Bearing, Blower and Drive Assembly
2	205B68	1	Blower
3	510P63	1	Bearing
4	220-759	1	Stator Assembly, Wound
5	212C248	1	Rig Assembly; Brush - Includes Brushes & Springs
6	212B1105	4	Spring, Brush
7	214A56	4	Brush
8	150A717	1	Switch Assembly, Overspeed
9	232B1254	2	Cover, End Bell Opening (Includes Latch and Bracket) - Plain
9A	234B20	1	Cover, End Bell Opening (Includes Latch and Bracket) - With Grommet
10	232B1253	2	Cover, End Bell Opening (Includes Latch and Bracket) - Screened
11	234C175	1	Scroll, Air
13	211E131	1	Bell, End - Alternator to Exciter
14	234C174	1	Band, Generator - Front - Narrow
15	234C178	1	Band, Generator - Rear - Wide
16	232A1186	1	Holder, Bearing - Anti-Rotation
17	232A1187	1	Spring, Bearing Holder - Anti-Rotation
18	232A1653	6	Bolt, Shoulder - 5/16-18" - Drive Disc to Engine Flywheel
19	336A943	1	Jumper, Brush Rig
20	232A1615	1	Spacer, Air Outlet Band
21	232B1820	1	Disc Drive
22	232C1556	1	Pad, Generator Mounting

FIG. 6 - GENERATOR GROUP (Exciter Portion) Model 102SX1N1B

	209-21	1	Magneciter Assembly - Complete
1	234D106	1	Cover, Exciter
2	520A575	3	Stud, Exciter Cover Mounting
2A	866-1	3	Nut, Acorn - Exciter Cover Mounting
3	234D105	1	Panel Only - Exciter
4	305B212	1	Rectifier Assembly, Power (Complete) - Includes Four #305P244 Plus Wire and Hardware
5	305P244	4	Rectifier Only, Power (Field - Included in #305P212 Assembly
6	150B733	1	Bracket Only, Overspeed Switch
7	150A772	1	Stud and Contact Point Assembly, Voltage Control
8			Washer, Fibre Insulating - Voltage Control Reactor Mounting
	508-18	2	1/4" x 3/4" x 1/16"
	508-29	1	1/4" x 3/8" x 1/32"
9	315A74	1	Reactor, Voltage Control (does not include terminal block)
10	332A687	1	Block, Terminal - Voltage Control Reactor
11	305B202	1	Rectifier Assembly, Resistor and (Includes Parts Marked * Plus Wire and Hardware)
12	234B60	2	*Bracket, Gate Reactor Mounting (NOTE: 1 Only Included in #305B202 Assembly)
13	304A5	1	*Resistor, Control - Adjustable (150-Ohm, 25-Watt - 9/16 x 2")
14	520A579	2	*Stud, Resistor and Rectifier Mounting (NOTE: 1 Only Included in #305B202 Assembly)
15	232A1473	2	*Spacer, Adjustable Resistor and Rectifier to Stud (3/8" O.D. x 3/16"I.D. x 7/32")
16	304A14	2	*Washer, Centering - Adjustable Resistor Mounting
17	305P208	4	*Rectifier, Regulator Control
18	315A57	2	Reactor, Gate
19	234B62	2	Retainer, Gate Reactor
20	232A1361	2	Stud, Gate Reactor Mounting
21	304A21	1	Resistor, Fixed - Alternator Field (200-Ohm, 50-Watt - 3/4 x 4")
22	304A15	2	Washer, Centering - Fixed Resistor Mounting
23	332A604	1	Block, Terminal - 5-Place
24	332A678	1	Strip, Block Marker -5-Place (Marked AF1, AF2, E1, E2)
27	232A1547	2	Insulation - Gate Reactor to Mounting Bracket
28	232A1546	2	Insulation - Gate Reactor to Retainer
28A	232A1548	2	Insulation - Voltage Center Reactor Mounting
29	232A1474	2	Spacer, Fixed Resistor to Stud (3/8"O.D. x 3/16" I.D. x 11/32"
30	338B237	1	Harness, Wiring - Exciter to Control
31	332A537	1	Block, Terminal - 4-Place
32	332A686	1	Strip, Block Marker (Marked 31, 32, 33, 34)

FIG. 7 - CONTROL GROUP (AC Output Portion)

1	301C1815	1	Panel Only - Upper Control
2	301D2115	1	Box Only, Control
3	301C2539	1	Bracket (One Piece) Control Box Mounting
5	402-78	4	Mount, Rubber - Control Box Mounting
6	337A44	1	Strap, Ground
9	301A1914	1	Bracket, Panel Stop
10	508P63	As Req.	Grommet, Rubber - For 2-3/4" Hole
11	302P421	1	Voltmeter, AC
12	302P411	1	Ammeter
13	302P465	1	Meter, Running Time
14	308-22	1	Switch, Voltage and Current Selector
15	302B106	3	Transformer, Current
16	320B2	1	Breaker, Circuit
19	332A604	1	Block, Terminal - 5-Place
20	332A689	1	Strip, Terminal Block Marker - Marked 32, 33, 34, E1, E2
21	303-97	1	Rheostat, Voltage Regulator
22	303-32	1	Knob, Rheostat
23	304A479	1	Resistor, Voltage Regulator
24	302A235	3	Clamp, Current Transformer Mounting - Inside Half
25	302A236	3	Clamp, Current Transformer Mounting - Outside Half
28	312A58	3	Condenser, Output Terminal Suppression
29	332A513	1	Block, Terminal - Output
30	302B448	1	Plate, Meter Face
31	302B213	1	Meter, Frequency
32	301A2727	1	Handle

FIG. 7A - CONTROL GROUP (Engine Instruments Portion)

1A	301C2751	1	Panel Only, Lower Control
3A	308P138	1	Switch, Run-Stop-Remote
4A	308-2	1	Switch, Panel Light
5A	302A61	1	Ammeter, Charge (30-0-30)
6A	193B106	1	Gage, Water Temperature (Panel Unit Only)
7A	193B107	1	Gage, Oil Pressure (Panel Unit Only)
8A	332A751	1	Block, Terminal
10A	332A611	1	Block, Terminal - 3-Place
13A	322P72	2	Receptacle, Panel Light
14A	322-4	2	Bulb, Panel Lights
15A	307B514	1	Relay, Starter Pilot
16A	304A192	1	Resistor, Fixed - 3-Ohm, 10-Watt
17A	307A908	3	Relay, Emergency Stop and Alarm
18A	307B52	1	Relay, Start-Disconnect - Spec A only
19A	320B220	1	Limiter, Cranking
20A	307B597	1	Relay, Fuel Solenoid
21A	307A388	1	Relay, Time Delay - Low Oil Pressure Switch Circuit
23A	307P819	1	Relay, Start Disconnect
24A	323-52	1	Socket, Start Disconnect Relay
25A	307P778	1	Spring, Start Disconnect Relay Holdown
26A	309A42	1	Switch, Micro
27A	320A222	2	Spacer, Cranking Limiter
28A	233A256	1	Insulator, Switch Mounting
29A	332A795	1	Block, Terminal - Engine

FIG. 9 - WATER HEATER GROUP (Optional Equipment)

1	333P52	1	Heater, Tank Type (1500 W.) - Includes Bracket, Hose Adapter and Cord
2		1	Clamp, Heater Mounting - NOT SOLD SEPARATELY (Included with tank assembly)
3	503-197	3	Clamp, Hose
4		As Req.	Hose 5/8" I.D. x 61/64" O.D. x 20" (Bulk #503P386)
5		1	Adapter, Hose - NOT SOLD SEPARATELY (Included with tank assembly)
9	520A446	2	Stud, Thermostat Box Mounting
10	850-30	2	Lockwasher (#10), Thermostat Box Mounting
11	870-53	2	Nut, Hex (#10-32) - Thermostat Box Mounting
12	333A13	1	Cover, Thermostat Mounting Box
13	309P29	1	Thermostat, Heater Control
14	850-25	2	Lockwasher (#8), Thermostat Box Cover
15	812-76	2	Screw, RHS (#8-32) Thermostat Box Cover
18	508-8	1	Grommet, Thermostat Box
19	333A12	1	Box, Thermostat Mounting
20	505-71	1	Nipple, Pipe 1/4 x 2"
21	505-184	1	Tee, Pipe 1/4"
22		As Req.	Hose 5/8" I.D. x 61/64" O.D. x 16" (Bulk #503P386)
23	503-183	1	Clamp, Hose (Lower Tank Fitting)
25	505-135	1	Nipple, Half - Pipe 3/8 x 1-1/2"