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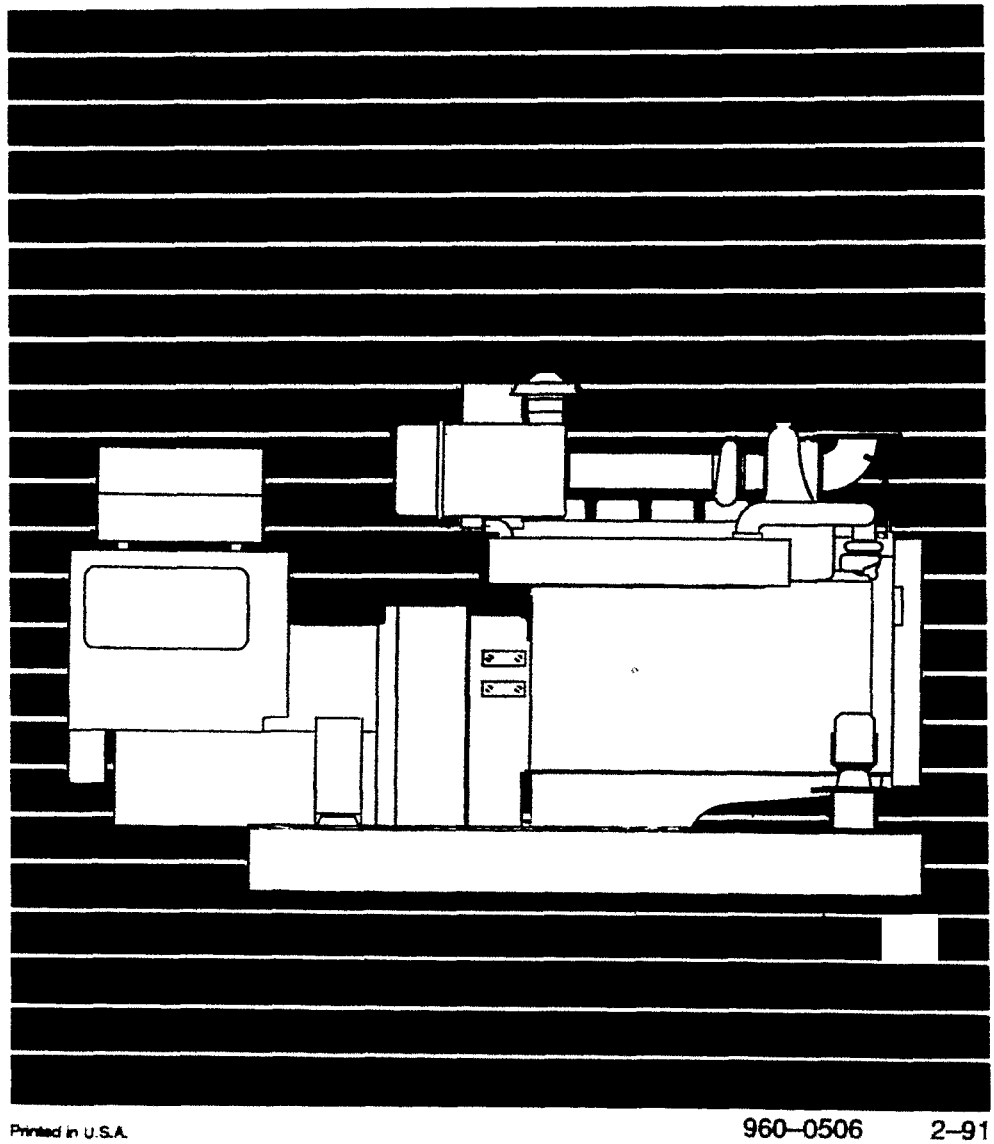
Cummins Onan

Service Manual

MDGBA MDGGA
MDGCA MDGDA
MDGCB MDGDB

MARINE GENERATOR SETS



Printed in U.S.A.

960–0506 2–91

Supplement 960-1033
Date: 2-93
Insert with-
Title: MDG Series Service Manual
Number: 960-0506

Beginning with Spec C, these Marine (Sea Aux) models use a new mechanical governor and an optional electronic governor. Add this information to Section 3 of your Service manual, 960-0506.

MECHANICAL GOVERNOR

Mechanical Governor Adjustments: B-Series Engines—Beginning Spec C

Output frequency (50 Hz or 60Hz) can be adjusted by turning the governor speed adjusting screw while the engine is running at its normal operating temperature under full load. Adjust droop to within five percent of nominal frequency (3 Hertz for 60 Hertz sets and 2.5 Hertz for 50 Hertz sets). Check operation under various loads and increase droop if the governor hunts. Readjust full-load frequency if droop is adjusted.

Do not adjust the idle adjusting screw; it is factory set and sealed.

⚠CAUTION ***Do not adjust the idle speed screw or break its wire seal. Doing so can void the generator set warranty.***

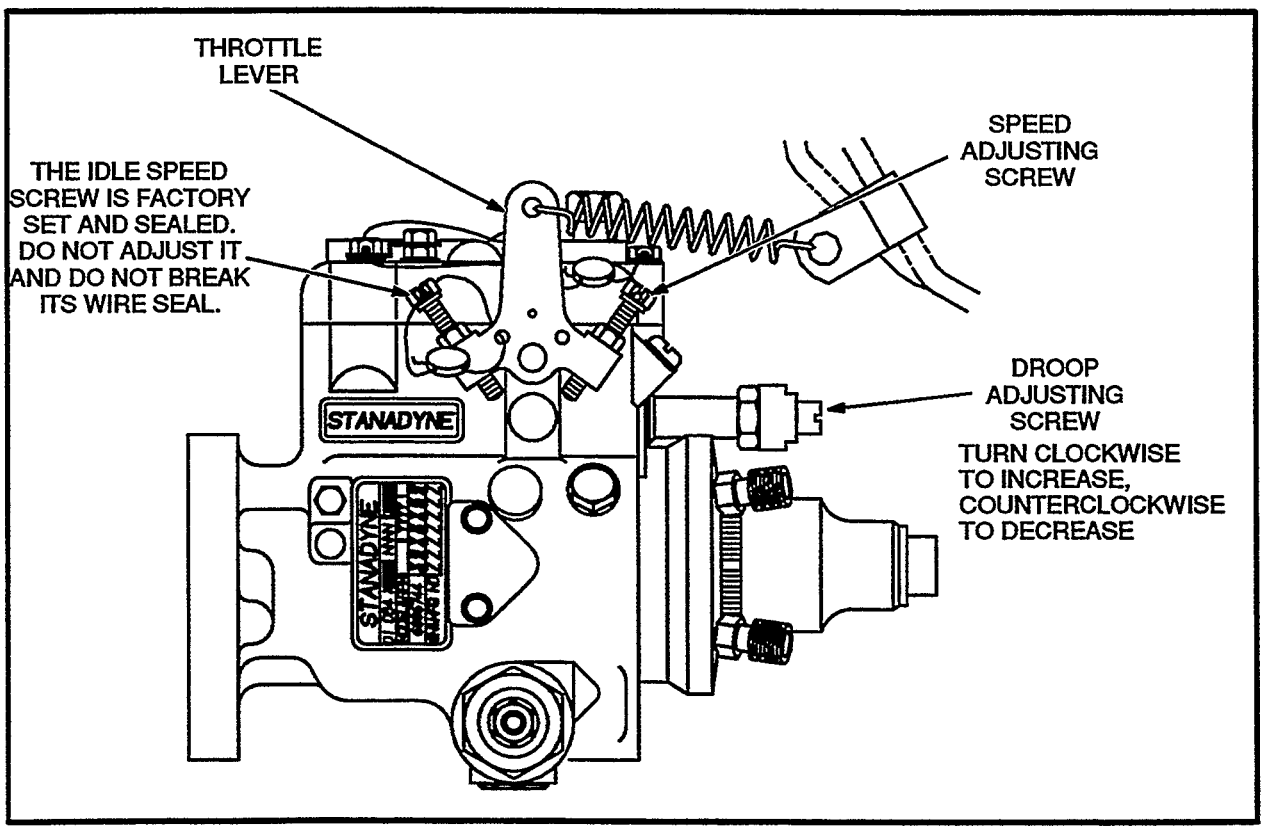


FIGURE 1. MDG SERIES MECHANICAL GOVERNOR–BEGIN SPEC C

Linkage Adjustments: B-Series Engines—Beginning Spec C

Figure 2 illustrates the arrangement of electric governor components on B-Series engines.

If the injection pump has been replaced, it will be necessary to adjust the position of the throttle lever before connecting the actuator linkage. The throttle lever is on the side of the pump away from the engine. See Figure 1.

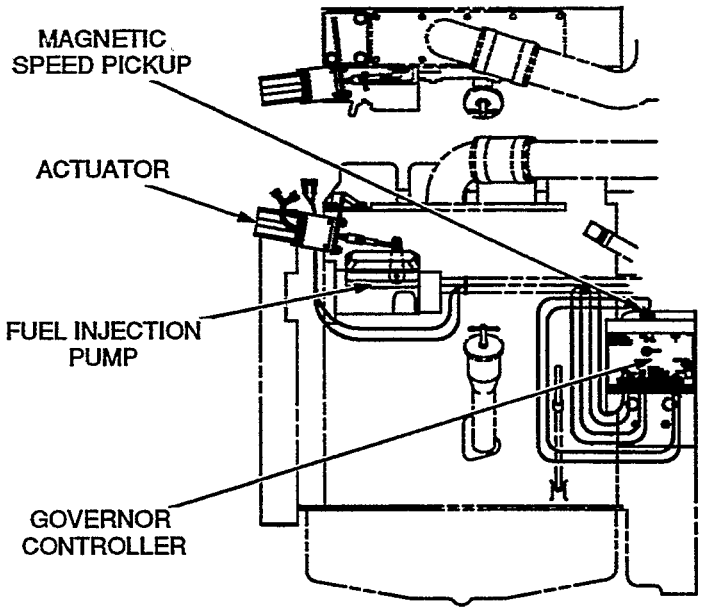
1. Operate the set and disconnect all loads after the engine has warmed up to normal operating temperature.
2. Loosen the locknut on the throttle lever speed adjusting screw and turn the screw counterclockwise to increase engine speed to 1980 RPM (66 Hertz) for 60 Hertz sets or to 1650 RPM (55 Hertz) for 50 Hertz sets.
3. Set the locknut. Leave the spring in place to maintain the position of the throttle lever.

   ⚠CAUTION ***Do not adjust the idle speed screw or break its wire seal. Doing so can void the generator set warranty.***

4. Move fuel pump stop lever (inboard lever) forward, slowly decreasing fuel until the engine stops. The stop lever must be in this position when linkage is connected.

Assemble the linkage as follows.

5. Thread the locknut onto the male swivel-end link. Then thread the female link five turns onto the male link and set the lock nut.
6. Secure the male end of the link to the injection pump lever on the engine side of the pump. Make sure to tighten two nuts on the screw before connecting the swivel end of the link to the injection pump lever.
7. Loosely thread the locknut and clevis onto the actuator shaft.
8. Rotate the injection pump lever to the established Stop position (Step 4). Turn the clevis on the actuator shaft until the hole in the link swivel registers with the holes in the clevis and connect the clevis and link with the screw, nut and lock washer as shown.
9. Tighten the clevis locknut on the actuator shaft.



—DETAIL OF ACTUATOR, MOUNTING BRACKET AND LINKAGE—

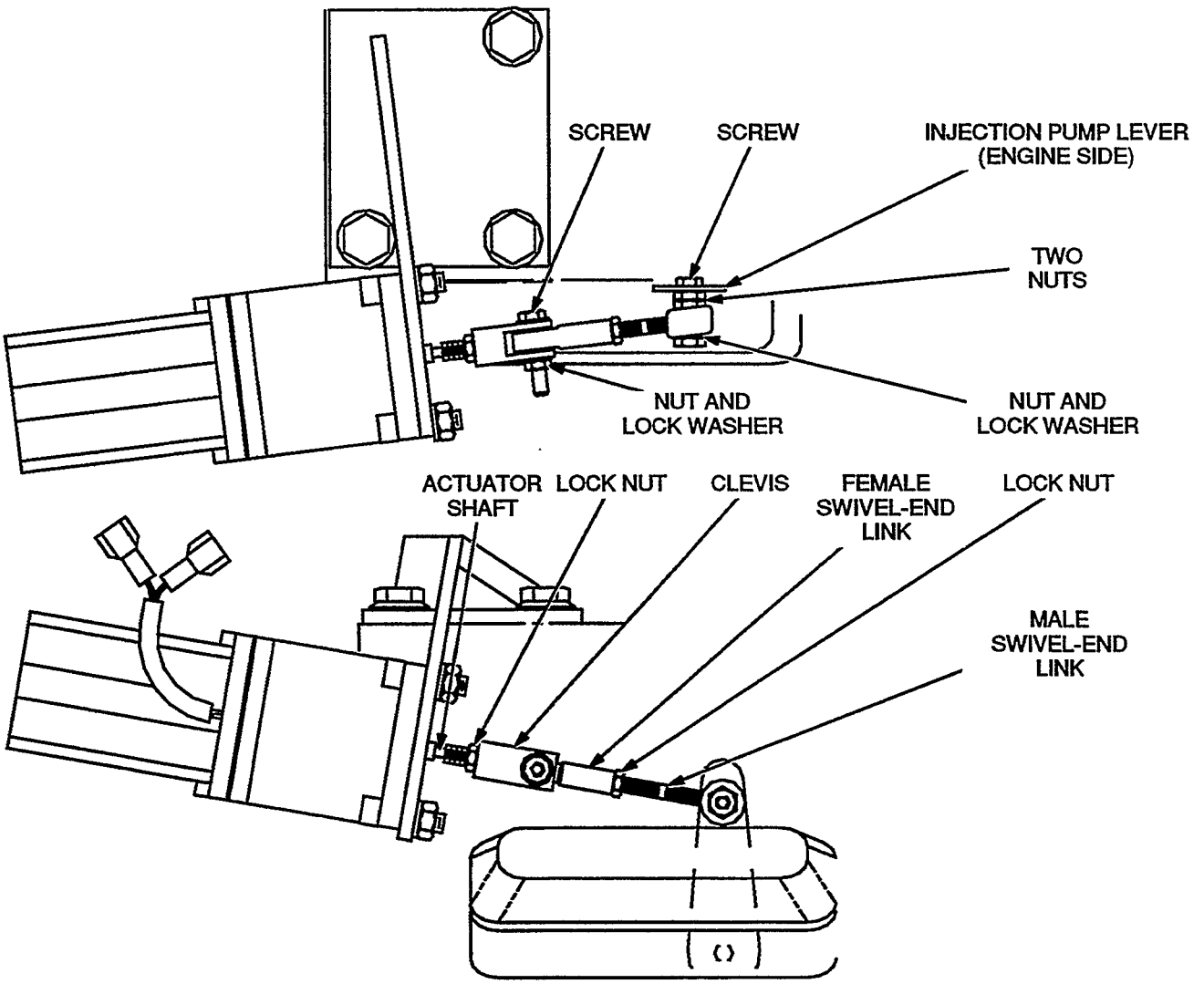


FIGURE 2. ELECTRONIC GOVERNOR LINKAGE – BEGIN SPEC C

ELECTRIC GOVERNOR

Electric Governor Adjustments: B-Series Engines—Beginning Spec C

If necessary, adjust the linkage according to Figure 2, wire the controller according to Figure 4 and install the magnetic speed pickup unit according to Figure 5. Then adjust the governor controller as follows:

1. Push both selector switches (**S1, S2**) on the controller to their **OFF** positions.
2. Note that the pots (potentiometers) on the controller are adjustable from zero to 100 percent and are marked off in divisions of ten percent. The speed pot has a 20-turn adjustment range. Set the pots initially as follows:

   Gain 20%

   I 20%

   D 30%

   Droop 0%
3. If a remote speed pot is used, set it at its midpoint.
4. Start the set and adjust the **Speed** pot to obtain the required output frequency: 60 Hertz (1800 RPM) or 50 Hertz (1500 RPM). Warm up the set under load until it is up to normal operating temperature.
5. Disconnect the load and turn the **GAIN** pot to 100 percent or until operation becomes unstable. Then turn the pot counterclockwise until operation again becomes stable.
6. Adjust **D** as in Step 5.
7. Adjust **I** as in Step 5.
8. Readjust **Speed** if necessary.
9. Manually push the throttle to the minimum speed position and hold it there until the engine reaches minimum speed. Release the throttle and observe speed overshoot. Two to Five Hertz overshoot may be acceptable. If overshoot is unacceptable:

   Turn the "I" potentiometer clockwise to lessen overshoot. If there is a small hunt at steady state, turn the "I" potentiometer slightly counterclockwise until stable.

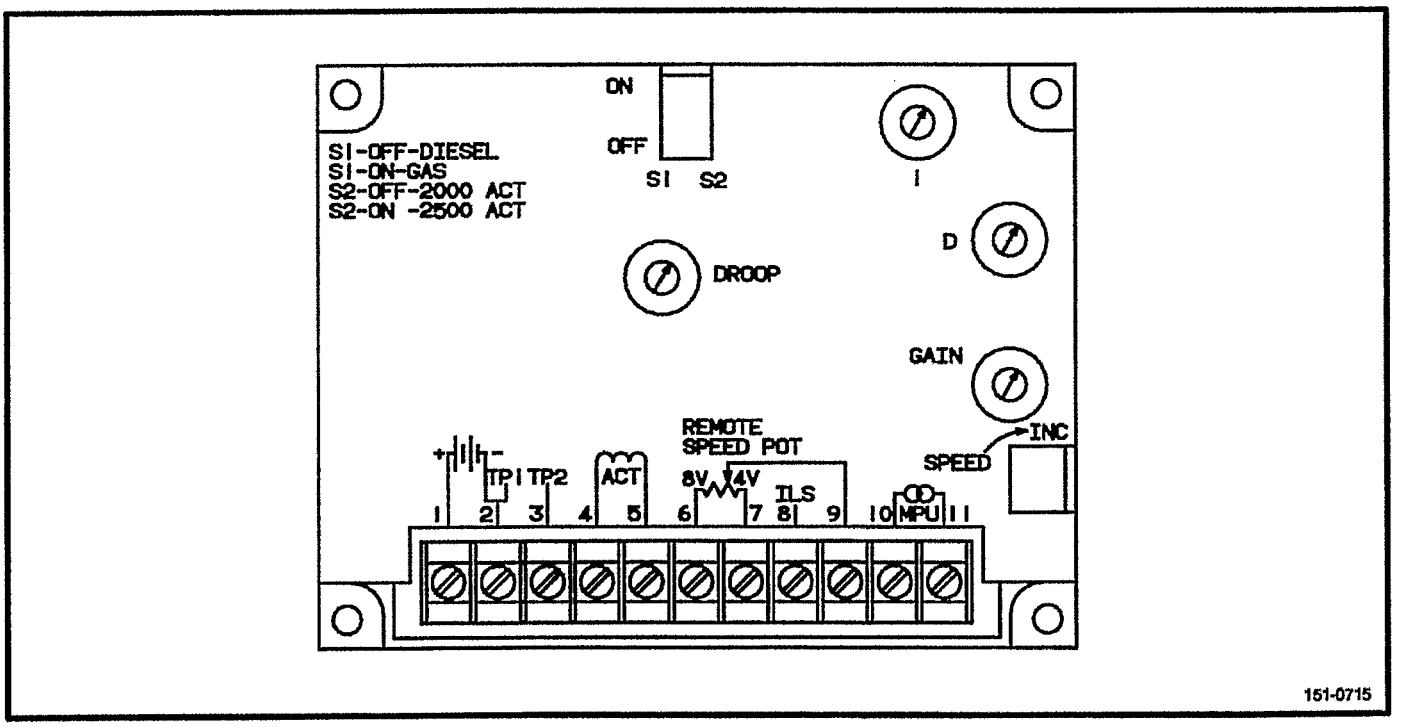


FIGURE 3. GOVERNOR CONTROLLER TERMINALS, SWITCHES AND ADJUSTING POTENTIOMETERS

Electric Governor Wiring

Wire the governor according to Figure 4.

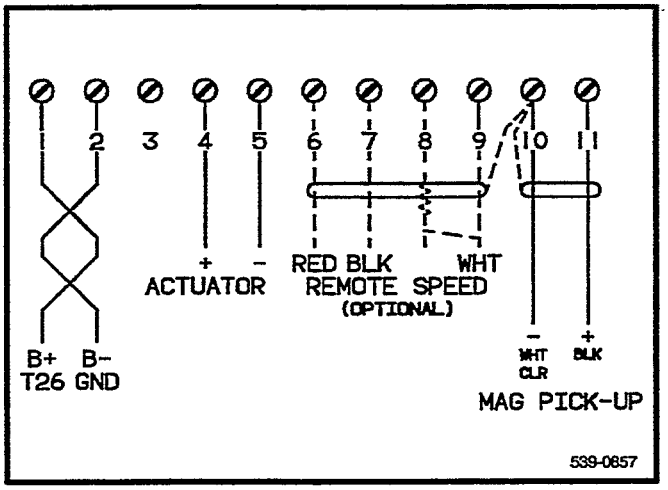


FIGURE 4. WIRING THE GOVERNOR

Magnetic Speed Pickup Unit Installation

To install the magnetic speed sensor, bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the sensor in gently by hand until it just touches the gear tooth. Back it out one quarter turn and set the locknut.

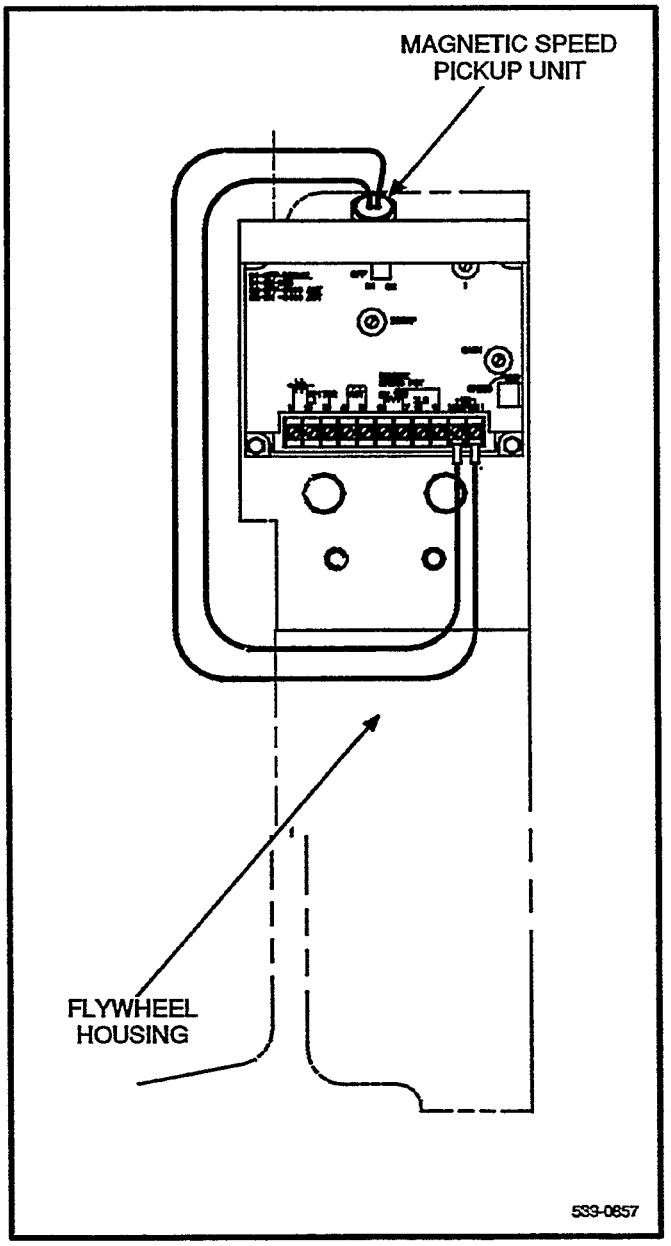


FIGURE 5. MAGNETIC SPEED PICKUP UNIT

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and your unit. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

Throughout this manual you will notice symbols which alert you to potentially dangerous conditions to the operator, service personnel, or the equipment itself.

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠ WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC. Fire, explosion, and personal injury can result from improper practices.

- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Do not fill fuel tanks with the engine running. Do not smoke around the generator set area. Wipe up any oil or gas spills. Do not leave oily rags in engine compartment or on the generator set. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip the engine fuel supply with a positive fuel shutoff.
- Always disconnect the battery ground (–) lead first and reconnect it last. Make sure you connect the battery correctly. A direct short across the battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is very explosive.
- Keep a fire extinguisher available in or near the engine compartment and in other areas throughout the vessel. Use the correct extinguisher for the area. For most types of fires, an extinguisher rated ABC by the NFPA is available and suitable for use on all types of fires except alcohol.

EXHAUST GASES ARE DEADLY

- Provide adequate ventilation. Equip the bilge with a power exhauster.
- Be sure propulsion and generator set engine exhaust systems are free of leaks. Perform thorough, periodic inspections of the exhaust system and repair leaks immediately. Exhaust gases are deadly.
- Never sleep in the vessel with the generator set running unless the vessel is equipped with an operating carbon monoxide detector.

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any belt guards or covers with the generator set running.
- Keep hands and loose clothing away from moving parts. Do not wear jewelry while servicing any part of the generator set.
- Never step on the generator set (as when entering or leaving the engine compartment). It can stress and break unit components, possible resulting in dangerous operating conditions... from leaking fuel, leaking exhaust fumes, etc.
- Before performing any maintenance on the generator set, disconnect its batteries to prevent accidental starting. do not disconnect or connect battery cables if fuel vapors are present. Ventilate the generator set compartment or bilge thoroughly with the power exhauster.

ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not make adjustments in the control panel or on engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel standing on dry surfaces to reduce shock hazard.
- DO NOT CONNECT THE GENERATOR SET TO THE PUBLIC UTILITY OR TO ANY OTHER ELECTRICAL POWER SYSTEM. Electrocution or damage to property can occur at a site remote from the boat where line or equipment repairs are being made if the set is connected to the power system. An approved transfer switch must be used if more than one power source is to be made available to service the boat.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

Copy and post these suggestions in potential hazard areas of the vessel.

Table of Contents

Section 1. Introduction

ABOUT THIS MANUAL

This service manual is for marine generator sets with the B-Series diesel engines. It includes engine and generator troubleshooting guides. Engine service instructions are in the applicable engine service manual. Operating and maintenance instructions are in the applicable Operator's Manual.

This manual does not have instructions for servicing printed circuit board assemblies. Always replace a faulty printed circuit board assembly. Attempts to repair a printed circuit board can lead to costly damage to the equipment.

Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.

TEST EQUIPMENT

Most of the tests in this manual can be done with an AC-DC multimeter, frequency meter, Wheatstone bridge (0.001 ohm precision is necessary for measuring stator winding resistance) and load test panel.

HOW TO OBTAIN SERVICE

Your Distributor has factory-trained representatives who can help you with parts and service. They will need to know the model number and serial number of the generator set in order to help you. These are found on the nameplate on the side of the generator output box.

⚠WARNING IMPROPER SERVICE CAN LEAD TO EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH. SERVICE MUST BE PERFORMED BY QUALIFIED PERSONS WHO KNOW ABOUT FUEL, ELECTRICAL AND MECHANICAL HAZARDS. READ THE SAFETY PRECAUTIONS INSIDE THE FRONT COVER AND CAREFULLY OBSERVE ALL INSTRUCTIONS AND PRECAUTIONS IN THIS MANUAL.

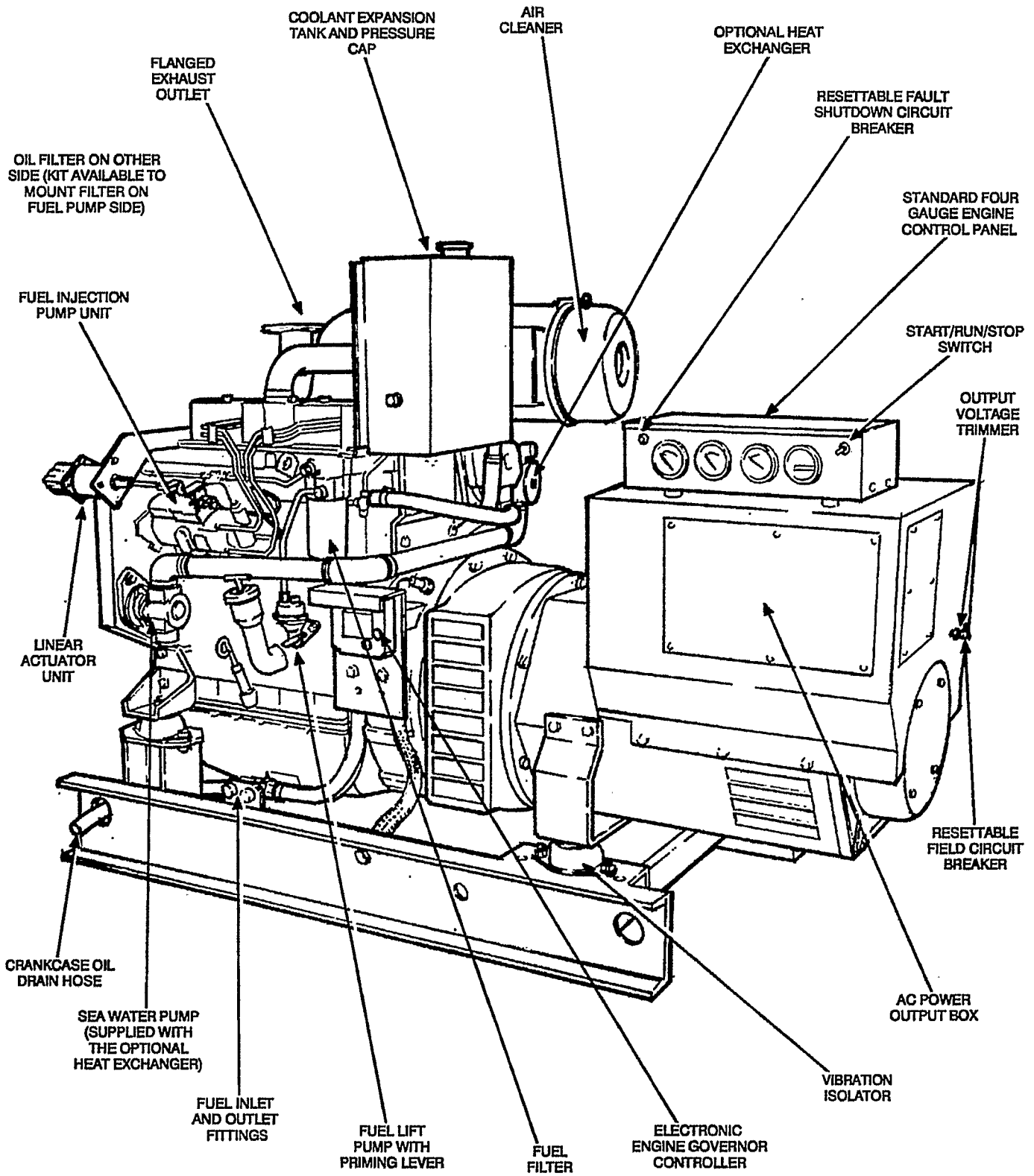


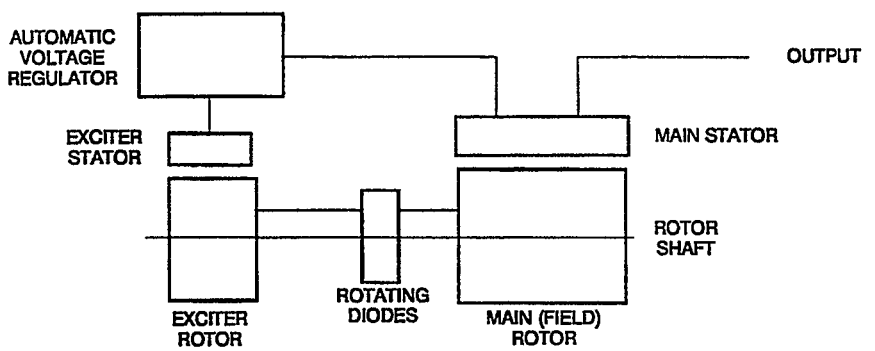
FIGURE 1-1. TYPICAL GENERATOR SET

Section 2. AC Control

PRINCIPLE OF GENERATOR OPERATION

1. The generator field (four-pole magnetic rotor) is rotated by the engine to induce output current (AC) in the main stator windings (Figure 2-1).
2. Generator output current is proportional to field strength, which is varied to match the load. Output voltage and frequency are held constant by the voltage regulator and engine governor, respectively.
3. Generator field strength is proportional to field current, which is supplied by the exciter.
4. The exciter field (14-pole magnetic stator) induces current in the exciter rotor windings. A full wave rectifier bridge mounted on the exciter rotor(rotating diodes) converts exciter output (3-phase AC) to DC. The exciter rotor is mounted on the main rotor shaft.
5. Exciter output current is proportional to exciter field current.
6. The automatic voltage regulator regulates exciter field current by comparing generator output voltage and frequency with preset reference values.
7. **Self-Excited (Non-PMG) Generators.** Exciter field current is supplied by the generator stator through the voltage regulator. Residual field magnetism initiates "self-excitation" during startup.
8. **PMG-Excited Generators.** Exciter field current is supplied by a PMG (permanent magnet) exciter through the voltage regulator. The PMG consists of a stator and a permanent magnet rotor mounted on the end of the main rotor shaft.

SELF-EXCITED GENERATORS



PMG-EXCITED GENERATORS

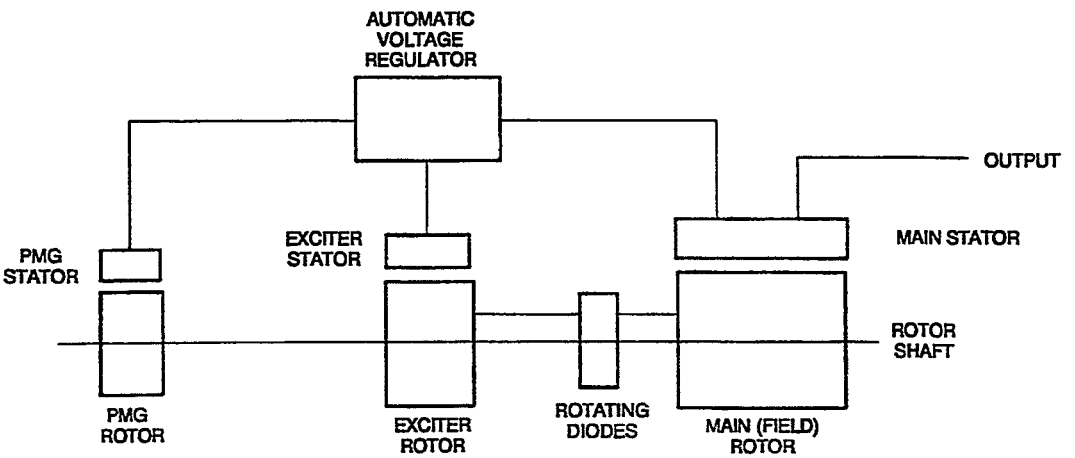


FIGURE 2-1. GENERATOR SCHEMATIC

AUTOMATIC VOLTAGE REGULATOR

The set is equipped with an automatic voltage regulator mounted behind a cover on the back wall of the power output box (Figure 2-2). The following associated components are also mounted on the back.

Field Circuit Breaker (CB21). The field circuit breaker protects the generator from over-excitation.

Output Voltage Trimmer (R21). The output voltage trimmer can be used to adjust output voltage plus or minus five percent of nominal voltage.

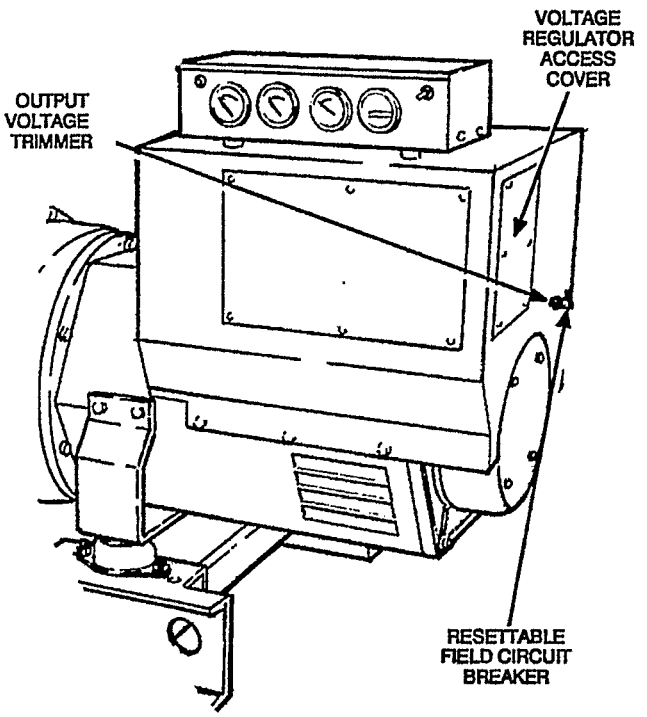


FIGURE 2-2. VOLTAGE REGULATOR ACCESS AND ASSOCIATED COMPONENTS

AUTOMATIC VOLTAGE REGULATOR ADJUSTMENTS

These measurements and adjustments are done while the set is running and require access to uninsulated high voltage parts on the voltage regulator (Figure 2-3 or 2-4). See Page 7-2 for wiring connections.

⚠ DANGER ***HIGH VOLTAGE. Touching uninsulated high voltage components and terminals on the voltage regulator can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching high voltage parts. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and wear elbow length insulating gloves.***

It should be noted that not all of the following adjustments are available on a particular voltage regulator.

Voltage and Voltage Stability Adjustments

1. Use the voltage trimmer for small voltage adjustments. Measure voltage across any line and neutral. The generator should run without load, at the nominal frequency. If the trimmer does not provide enough adjustment, lock it at its midpoint and go on to make the following adjustments on the voltage regulator.

2. Start by turning the **VOLTS** pot fully counterclockwise and the **STABILITY** pot to its midpoint. If the red LED (light emitting diode) on the board lights, refer to Jumper Reconnections and UFRO Adjustment below. Then turn the **VOLTS** pot clockwise until rated voltage is obtained. If voltage becomes unstable when a large load is connected, turn the **STABILITY** pot clockwise until voltage is stable. Check and readjust the **VOLTS** pot, if necessary, each time the **STABILITY** pot is readjusted.

Jumper Reconnections

Various jumpers are provided for reconnections to adapt the voltage regulator to the application. Check the diagram in Figure 2-3 or 2-4. The response jumper should connect terminals **A** and **C** when rated output is less than 90 kW and should connect terminals **B** and **C** when rated output is greater than 90 kW. Frequency jumper connections must correspond to the application frequency.

UFRO Adjustment

The voltage regulator has an under-frequency protection circuit having a threshold frequency that can be preset (typically at 59 Hz for 60 Hz applications and 49 Hz for 50 Hz applications). The red LED on the board lights when frequency dips below the threshold. The threshold frequency is set by turning the **UFRO** (under-frequency roll off) pot clockwise to raise it and counterclockwise to lower it. Determine threshold frequency by lowering generator frequency until the LED lights. Note that Dip and Dwell adjustments, below, are related.

Dip Adjustment

The **DIP** pot adjusts the voltage / frequency slope of the generator for frequencies below the threshold preset by the **UFRO** pot. Turning the **DIP** pot clockwise increases the slope (for greater voltage drop off as frequency drops) , making it easier for the engine to pick up a large load, but also increasing the voltage dip. The generator voltage / frequency slope is the same above and below

the threshold frequency when the pot is turned fully counterclockwise.

Dwell Adjustment

The **DWELL** pot times voltage recovery when frequency dips below the preset threshold. Clockwise adjustment increases dwell time. Full counterclockwise adjustment eliminates dwell, in which case, voltage recovery follows engine speed recovery.

Droop Adjustment

The **DROOP** pot is for power factor correction signal adjustment when generators are operated in parallel. **DROOP** is preset at the factory for five percent droop at full load and zero power factor.

V / Trim Adjustment

The **V / Trim** pot adjusts the auxiliary input signal from a VAR / PF controller. Full clockwise adjustment is normal, resulting in maximum sensitivity. The auxiliary controller has no effect when the pot is turned fully counterclockwise.

STAB / 1, EXC, OVER V, I / LIMIT and RMS

These are factory preset and do not require adjustment.

⚠CAUTION ***The sealed adjustment pots on the voltage regulator board are factory preset. Attempts to adjust them can lead to serious voltage instability and overheating.***

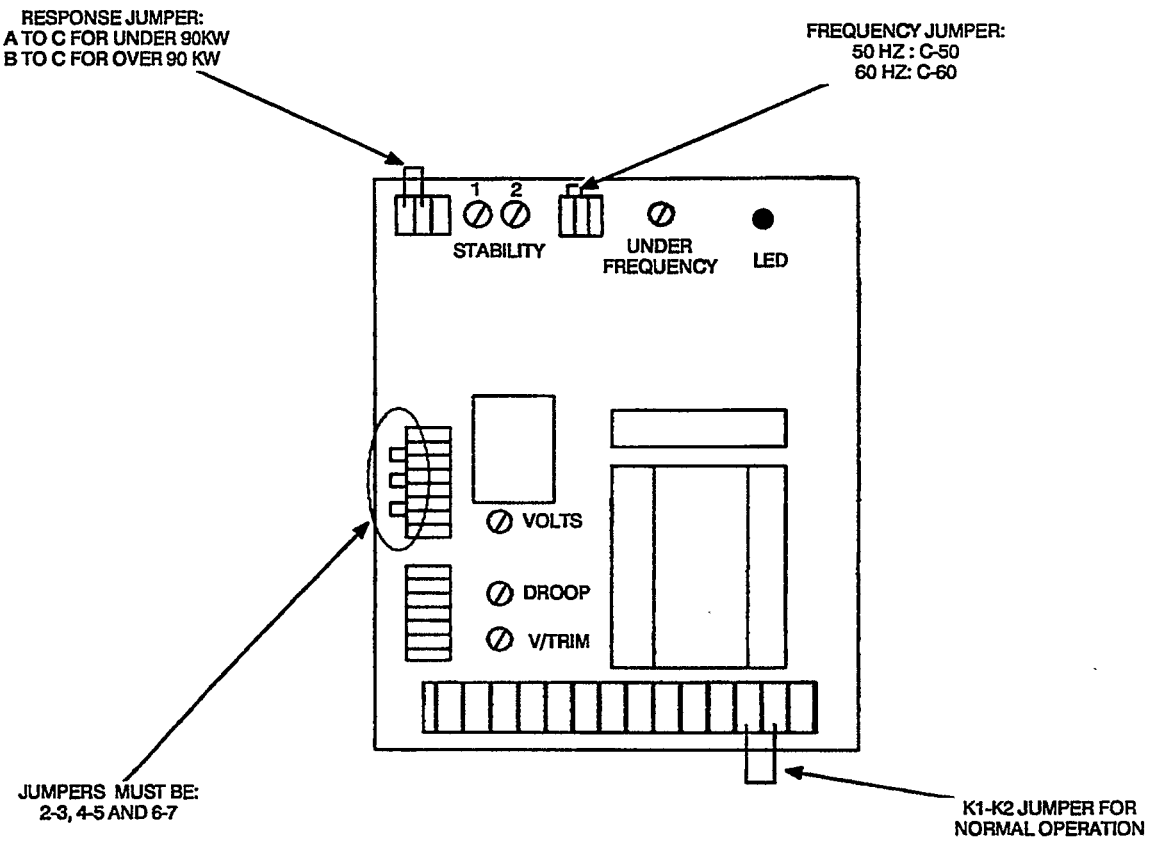


FIGURE 2-3. VOLTAGE REGULATOR FOR SELF-EXCITED GENERATORS

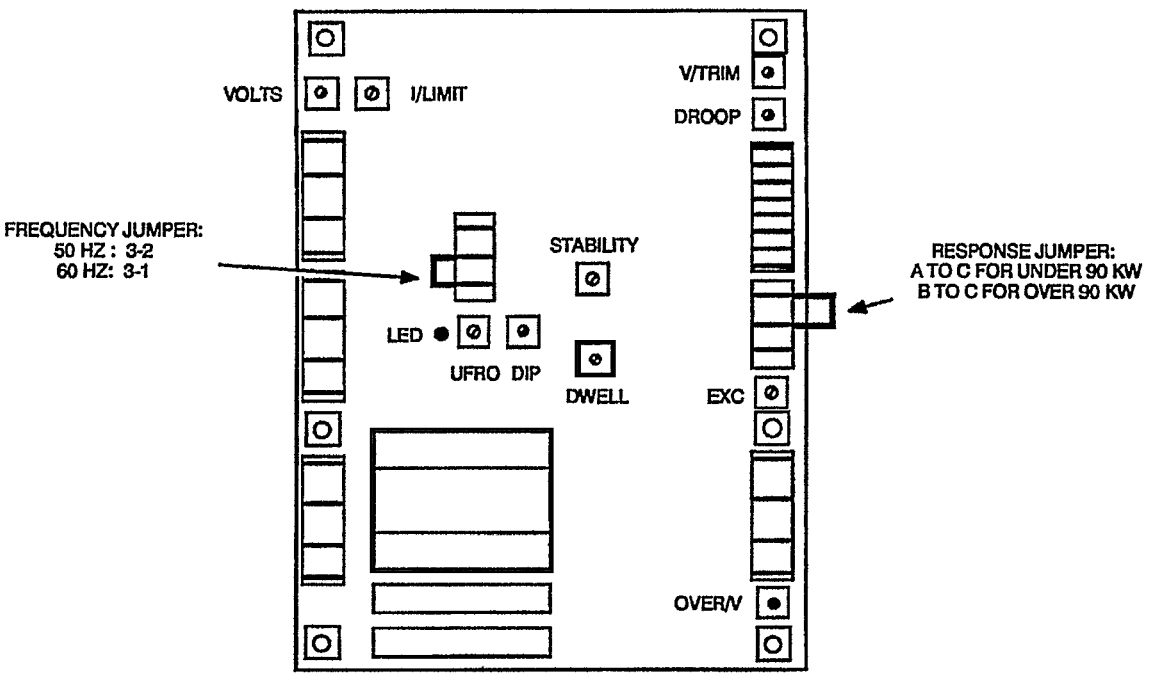


FIGURE 2-4. VOLTAGE REGULATOR FOR PMG-EXCITED GENERATORS

AC METER PANEL

The optional AC meter panel can be mounted on top of the engine control panel or at a convenient location in the generator room, connected by a plug-in harness extension. Page 7-3 is the color-coded wiring diagram. The panel carries the following components.

AC Voltmeter (M21). The voltmeter indicates output voltage for the phase selected.

AC Ammeter (M22). The ammeter indicates output amperage for the phase selected. Input to the ammeter is from current transformers CT21, CT22 and CT23 inside the power output box.

Frequency Meter (M23). The frequency meter indicates output frequency in Hertz (Hz). Note that engine RPM is 30 times Hz.

Phase Selector Switch (S21). The selector switch is used to select the phase for voltage and amperage readings.

Section 3. Engine Control

GENERAL

These sets are started and stopped by a manually operated switch. The control provides automatic start disconnect and safety shutdown. An electronic governor provides isochronous engine governing.

The engine control and speed governing systems are powered by the cranking battery. Check the nameplate to determine whether system voltage is 12 VDC or 24 VDC and whether the system has a negative ground or isolated ground. The system is protected by 30 amp cartridge fuse **F101**, which has a twist-lock holder tied into the engine wiring harness above the flywheel housing.

The engine control panel can be mounted on top of the generator, or off the set using a plug-in extension harness. A supplementary pilot house control panel is available and can be connected to the set by plug-in extension harnesses available in lengths of 20 feet(6 M). Page 7-5 is a color-coded engine control wiring diagram.

STANDARD CONTROL COMPONENTS

The standard engine control includes four gauges (Figure 1-1), crank relay **K104**, run relay **K105**, start disconnect relay **K132** (located in the AC output box) and two safety shutdowns.The following components are standard.

Start / Run / Stop Switch (S103). The set will start up when this switch is held in the **Start** position and will continue to run when the switch is released to the **RUN** position. (Start-disconnect relay K132 automatically disconnects the starter motor even if the switch is held in the **Start** position.) The set will come to a stop when the switch is momentarily pushed to **Stop.**

Oil Pressure Gauge (M124). This gauge indicates engine oil pressure.

Coolant Temperature Gauge (M127). This gauge indicates engine coolant temperature.

DC Voltmeter (M121). This meter indicates battery charging voltage.

Running Time Meter (M119). This meter indicates the accumulated number of hours the set has run. It cannot be reset.

Common Fault Circuit Breaker (CB115). This fault circuit breaker shuts down the engine (de-energizes fuel solenoid K118) when any fault shutdown switch functions (contacts close). Fault shutdown is indicated when the breaker reset button extends out past normal. Push the button to restore operation (after the engine has been properly serviced).

Oil Pressure Latching Switch (S107). This switch keeps run relay K105 energized as long as oil pressure is at least 4 psi and the fault breaker has not tripped.

Low Oil Pressure Switch (S110). This switch causes a fault shutdown if engine oil pressure drops below 14 psi.

High Engine Temperature Switch (S111). This switch causes a fault shutdown if engine coolant temperature rises above 219°F.

OPTIONAL CONTROL COMPONENTS

The following components are optional.

Oil Temperature Gauge (M129). This gauge indicates engine oil temperature.

Tachometer (M131). This meter indicates engine speed in RPM.

Individual Fault Circuit Breakers (CB109 through CB114). An individual fault circuit breaker is provided in connection with each fault shutdown switch to shut down the engine (de-energize fuel solenoid K118) when the switch functions (contacts close). Each breaker is identified according to fault by the marking next to it on the panel. Fault shutdown is indicated when the breaker reset button extends out past normal. Push the button to restore operation (after the engine has been properly serviced).

Low Coolant Level Switch (S112). This switch is mounted on the expansion tank and causes a fault shutdown if engine coolant level drops below the level of the switch.

Low Oil Level Switch (S113). This switch causes a fault shutdown if engine oil level drops below a predetermined level.

High Exhaust Temperature Switch (S114). This switch is mounted on the exhaust wet elbow and causes a fault shutdown if engine exhaust outlet temperature exceeds a predetermined temperature. It is provided when the optional wet exhaust system is provided.

Low Sea Water Flow Switch (S115). This switch causes a fault shutdown if sea water flow drops below a predetermined rate. It is provided when the optional wet exhaust system is provided.

Fault Bypass Switch (S117). This switch is used to bypass the fault shutdown circuit to keep the set running for

the sake of a critical operation. Visual indication of the fault is provided, while the set is running, by the fault circuit breaker and by a fault indicating lamp on the optional pilot house control panel. A remote alarm can also be activated by optional alarm relay K109.

⚠CAUTION ***This switch is for emergencies only—where it has been decided that the generator set must run to continue a critical operation, even though it might result in destruction of the set. Read the Warranty regarding possible exclusions when operating the set under these conditions.***

Alarm Relay (K109). This relay closes a set of contacts when a fault shutdown occurs so that a remote alarm can be activated.

Overspeed Module (S116). PMG-excited generators can be equipped with this electronic overspeed module mounted in the AC output box. The module senses PMG output frequency to determine generator speed (frequency). Overspeed cutout is adjustable by means of a small flat bladed screwdriver through an access hole in the front face of the AC output box (Figure 3-1). Adjust 50 Hz sets to cutout at 1800 to 1900 RPM and 60 Hz sets to cutout at 2100 to 2200 RPM. The left hole is for factory adjustments only.

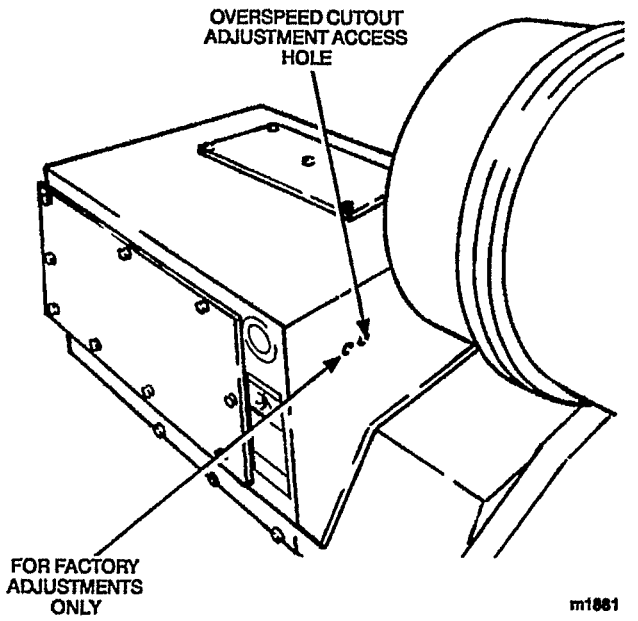


FIGURE 3-1. OVERSPEED CUTOUT ADJUSTMENT ACCESS HOLE

ENGINE SENSOR LOCATIONS

Figure 3-2 shows the locations of the engine mounted gauge sensors and fault shutdown switches.

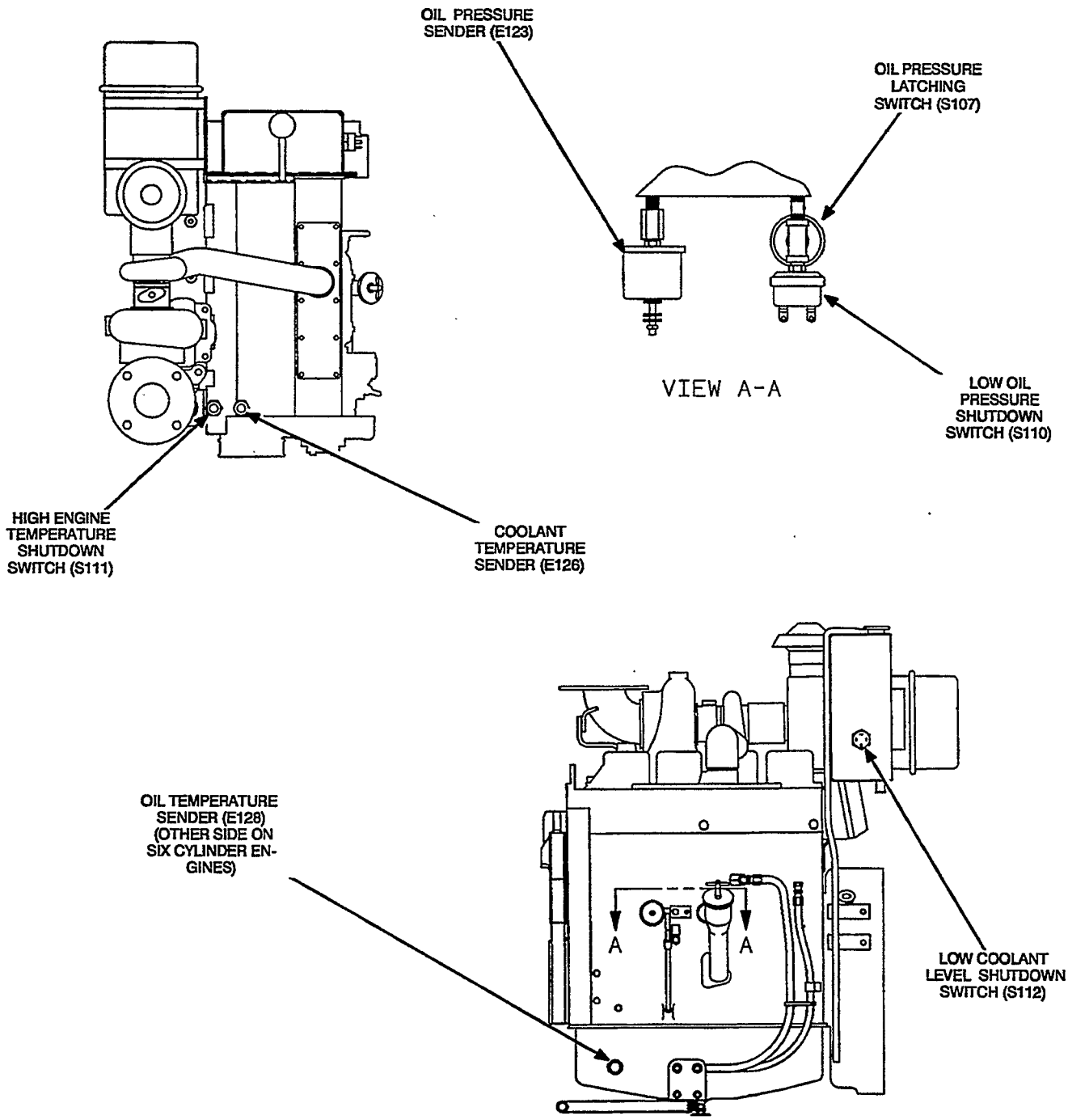


FIGURE 3-2. ENGINE SENSOR LOCATIONS

SEQUENCE OF OPERATION

Refer to the wiring schematic and notes on page 7-4 while working through this description.

1. When either the local or pilot house **Start / Run / Stop** switch (S102 or S103) is pushed to the **Start** position and held, crank relay K104 is energized.
2. Run relay K105 is energized when crank relay K104 contacts 1-2 close.
3. The engine should start and accelerate to governed speed in a matter of seconds because starter B108 and fuel solenoid valve K118 are energized through run relay K105 contacts 3-4 and crank relay K104 contacts 3-4. The engine gauges and the voltage regulator in battery charging alternator G102 (terminal SW) are also energized.
4. Start disconnect relay K132 is connected to the AC output terminals. Contacts 1-2 close when output voltage reaches a prescribed level, de-energizing crank relay K104 by connecting coil terminal 6 to B+, thereby disconnecting the starter, even if the control switch is still being held in the **Start** position.
5. Run relay K105 continues to be energized through self latching contacts 1-2 and start disconnect relay K132 contacts 3-4. The engine will continue to run when the control panel switch is released to the **Run** position.
6. Oil pressure latching switch S107 closes to keep the engine running even if generator AC output voltage fails, causing relay K132 to drop out.
7. Fuel solenoid valve K118 is energized through the common fault circuit breaker(Detail 1 of the schematic) or through all the fault circuit breakers, which are connected in series (Detail 2 of the schematic). When any fault switch closes, the common or individual circuit breaker opens the fuel solenoid valve circuit to shut down the engine. The circuit breaker has to be reset to restore operation.
8. Fault bypass switch S117 allows the operator to bypass the fault circuit breakers to keep fuel solenoid valve K118 energized.
9. Alarm relay K109 is energized when any fault circuit breaker trips. It has two sets of contacts for remote fault annunciation. The contacts remain closed even when the fault bypass switch is in the bypass position. The alarm relay will de-energize on the next start attempt after resetting the fault breaker.
10. Momentarily pushing the control panel switch (S102 or S103) to **Stop**, de-energizes run relay K105 by connecting coil terminal 6 to B+, thereby causing the engine to come to a stop.

ELECTRONIC GOVERNOR

An electronic governor provides isochronous engine speed governing. It consists of three units: control, magnetic speed pickup and linear actuator. See Figure 3-3.

Run relay K105 engergizes the governor control unit at startup. The governor drives the fuel injection pump unit to the full power fuel position. When governed speed is reached, the fuel position is modulated to maintain the speed as the load varies.

Frequency (Speed) Adjustment

Adjust the electronic governor as follows.

1. Warm up the set under partial load (at least 1/4 rated load).
2. Turn the **Speed** potentiometer to obtain specified power supply frequency (60 Hertz - 1800 RPM or 50 Hertz - 1500 RPM).
3. Turn the **Gain** potentiometer clockwise until the governor begins to hunt. Turn it back until there is no audible hunting.
4. Connect 1/4 rated load and readjust the **Gain** potentiometer (Step 3), if necessary.
5. Connect rated load in one step. Shut down the set if it cannot pick up the load. Lengthen the governor rod by half turns of the swivel ends and repeat the test until the set is able to pick up rated load in one step. Back off the governor full speed stop screw if necessary.
6. Check for stability (no audible hunting) under various loads.
7. Stop the set and wait for 30 seconds for the turbo to coast down (if so equipped). Restart the set and check for speed overshoot. Check for binding in the governor rod if overspeed shutdown occurs.

Governor Service

1. If the governor does not drive the injection pump unit to the full power fuel position during cranking (see *Troubleshooting*), service the governor as follows.
   A. Push the fuel injection pump unit lever to the full power position by hand. There should not be any binding in the linkage. (The movement will be resisted by a spring in the actuator, which is normal.)
   B. Follow each lead out of the governor control unit to the connector on its end. Tighten or repair any connector that is loose, dirty or corroded and try to start the set.
   C. If the set does not start, disconnect the two actuator leads and connect battery voltage

across them. Replace the actuator if it does not drive to the full power position. If the actuator is good, replace the control unit.

2. If speed adjustment does not result in stable engine speed, the magnetic speed pickup might be improperly installed or faulty. Service as follows.

   A. Disconnect the two pickup leads, loosen the lock nut and remove the unit. Bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the unit or its replacement back into the flywheel housing by hand until it just touches the gear tooth. Back it out one quarter turn and set the lock nut.

   B. If engine speed is still unstable, measure the speed pickup unit output voltage using an AC voltmeter with at least 5000 ohms/volt impedance. For this purpose, disconnect the two leads from the speed pickup unit and reconnect them to the control unit with bare wire links between the connectors. Also disconnect fuel solenoid K118 so that the engine can be cranked without starting. Measure voltage across the bare wire links while cranking the engine. Replace the speed pickup unit if the meter indicates less than 2.5 volts. Replace the control unit if voltage is at least 2.5 volts.

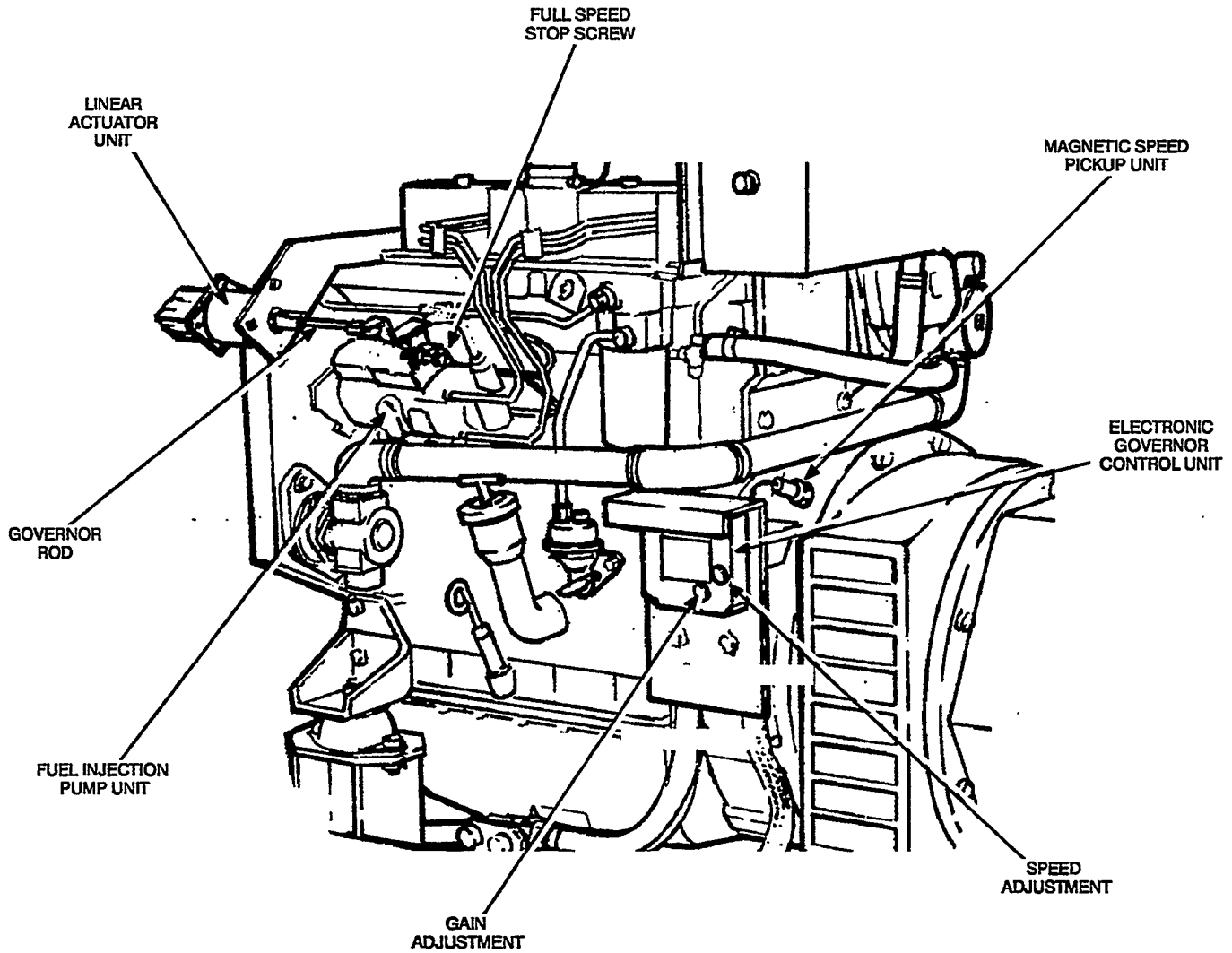


FIGURE 3-3. ELECTRONIC ENGINE GOVERNOR

Section 4. Troubleshooting

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

The following tables and charts are a guide to help you think through problems with the engine and generator. You can save time if you read this manual ahead of time. Call your Distributor if you have questions.

Try to think through the problem. Go over what was done during the last service call. The problem could be as simple as an unconnected wire or a blown fuse.

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ENGINE DOES NOT CRANK

POSSIBLE CAUSE	REMEDY
1. The batteries are worn out or discharged, the terminal connectors are loose or corroded or the battery cables are corroded.	Service or replace the batteries, terminal connectors and cables. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). Service the engine-driven battery charging alternator in accordance with the engine service manual if normal battery charging voltage is not between 13 and 14 volts for 12 volt systems and between 26 and 28 volts for 24 volt systems.
2. Control circuit fuse **F101** is blown.	Replace the fuse with one of the same type and amp rating.
3. The local or pilot house **Start / Run / Stop** switch is faulty.	Remove the control box cover and and push the control switch to **Start** and hold it there. Replace the switch if it is open (infinite resistance) between terminals **2** and **3**.
4. Crank relay **K104** or run relay **K105** is faulty.	Remove the control box cover and push the control switch to **Start**. Replace either relay if it does not "click". Repeat the test to make sure.
5. The starter motor, motor solenoid, wire or connector is faulty.	Push the control switch to the **Start** position and hold it there. Check for battery voltage at the starter motor solenoid terminal. Service the starter motor or solenoid in accordance with the engine service manual if there is battery voltage at the terminal. If there is no voltage repair the wire (yellow / orange) or terminal 8 of connector J1 / P1.

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ENGINE CRANKS BUT DOES NOT START

POSSIBLE CAUSE	REMEDY
1. The fuel supply tank is empty.	Fill the fuel supply tank with the appropriate grade of fuel.
2. The electronic governor or fuel solenoid valve **K118** does not function.	The fuel solenoid valve (threaded into the fuel injection pump unit) should "click" when the panel switch is pushed to the **Start** position. The electronic governor should also drive the fuel injection pump unit to the full power fuel position. Both are powered through engine block terminal **T26** (located just below the injection unit). Service the electronic governor if there is battery voltage at terminal **T26** during cranking but it does not function. See *Engine Control.* Replace the fuel solenoid if it does not function. If there is no voltage at terminal **T26**, check wires and connectors. Remove the control box cover, if necessary, to checkout run relay **K105**. It should "click" when the control switch is pushed to **Start**. Repeat the test to make sure.
3. Engine temperature is too low for starting.	Plug in, repair or install engine coolant and engine oil heaters. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature.
4. Cranking speed is too slow because of low battery charge, loose or corroded terminal connectors, corroded battery cables or too much starter solenoid contact resistance.	Service the batteries, terminal connectors, cables or starter solenoid. Cable, terminal or solenoid contact resistance is too high if there is more than 1 volt drop between battery and motor terminals for 12 volt systems and 2 volts drop for 24 volt systems while the engine is cranking. Service the engine-driven battery charging alternator in accordance with the engine service manual if normal battery charging voltage is not between 13 and 14 volts for 12 volt systems and 26 and 28 volts for 24 volt systems.
5. The fuel system has lost prime, the fuel lines or filters are plugged, the fuel lift pump is not working, the fuel is contaminated or the air filter is plugged.	Bleed the fuel system in accordance with the Operator's Manual. If the engine still does not start, check out each of the other possibilities thoroughly and service.
6. The engine fuel injection system is faulty.	Service according to the appropriate engine service manual.

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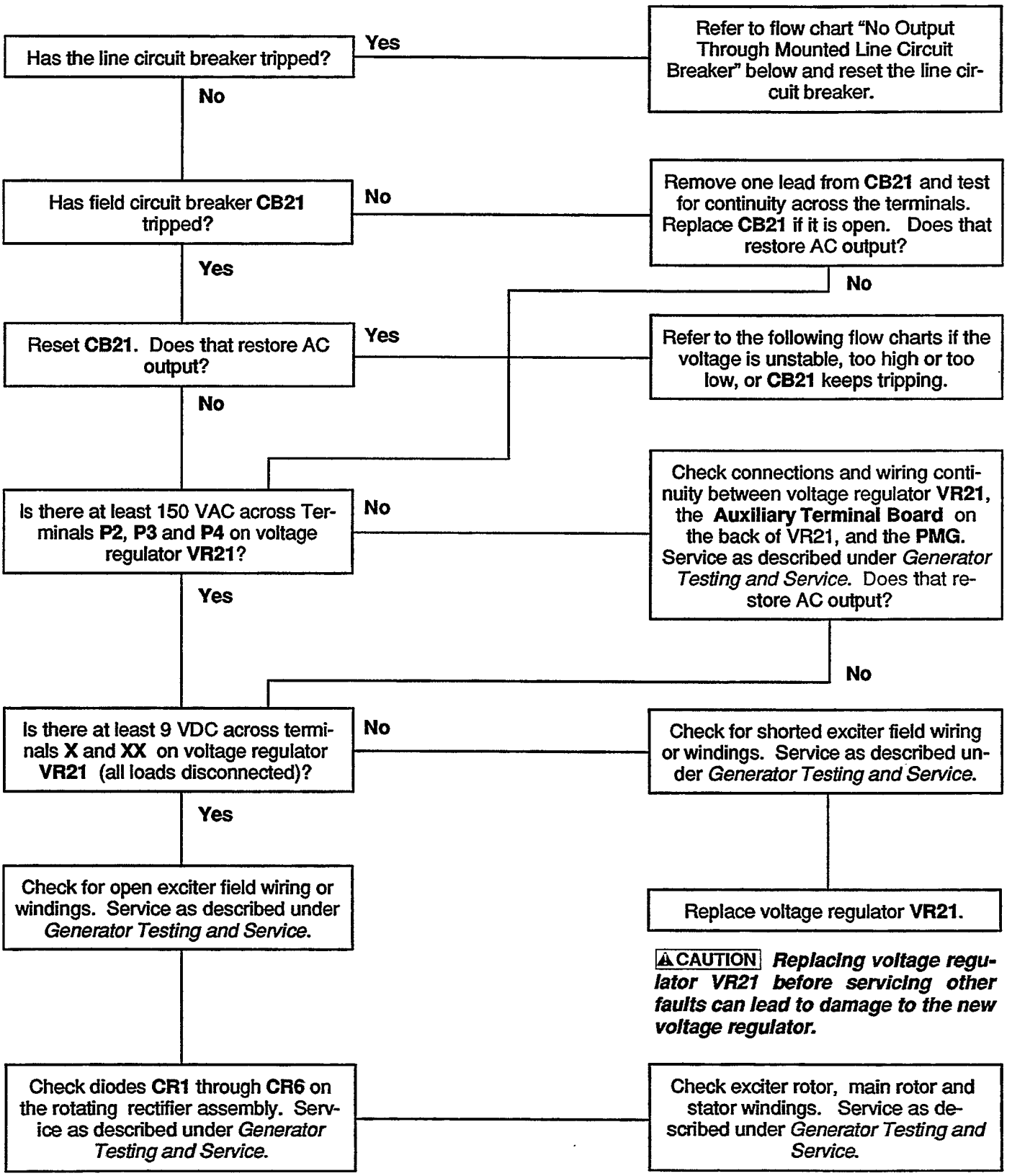
ENGINE RUNS UNTIL FAULT SHUTDOWN

POSSIBLE CAUSE	REMEDY
1. The **Overspeed** circuit breaker has tripped.	Service and adjust the engine governor. See *Engine Control.* If the governor is functioning properly, readjust the electronic overspeed module to the proper setting. See *Engine Control.*
2. The **Low Oil Pressure** or **Low Oil Level** circuit breaker has tripped.	Refill with as much engine oil as necessary and repair any leaks before putting the set back into service. Start the engine and note the pressure indicated by the control panel gauge. If engine oil pressure is greater than 15 PSIG, the low oil pressure cutout switch is faulty and must be replaced. If engine oil pressure is less, service the lubricating oil system according to the engine service manual.
3. The **High Engine Temperature** or **Low Coolant Level** circuit breaker has tripped.	Refill with as much engine coolant as necessary and repair any leaks before putting the set back into service. Clean out the sea water strainer and make sure the sea water cock is fully open if the engine has a heat exchanger. Start the engine and note the temperature indicated by the control panel gauge. If engine temperature is less than 205 F, the high engine temperature cutout switch is faulty and must be replaced. If engine temperature is greater, service the engine cooling system according to the applicable engine service manual.
4. The **High Exhaust Temperature** or **Low Water Flow** circuit breaker has tripped.	Clean out the sea water strainer, make sure the sea water cock is fully open, replace the sea water pump impeller and clean out the heat exchanger in accordance with the engine Operation Manual. **Inspect the entire exhaust system and replace any damaged parts.**

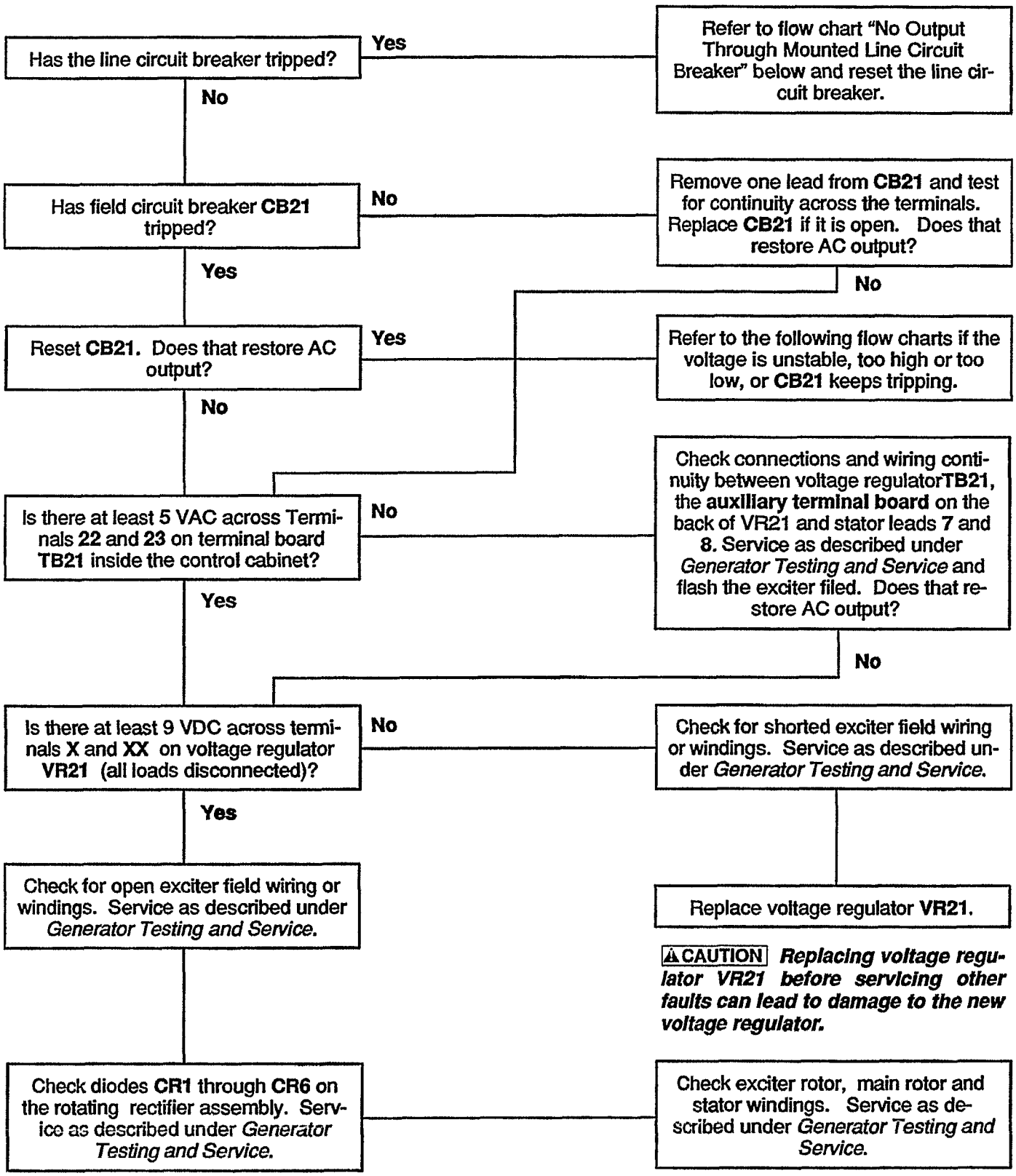
⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

NO OUTPUT VOLTAGE AT STABLE OPERATING SPEED (PMG-EXCITED GENERATORS)



⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

NO OUTPUT VOLTAGE AT STABLE OPERATING SPEED (SELF-EXCITED GENERATORS)



⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

UNSTABLE OUTPUT VOLTAGE AT STABLE OPERATING SPEED

Adjust voltage regulator **VR21** as described under *AC Control.*

Check connections and wiring continuity in all circuits connected to the voltage regulator (exciter, alternator, PMG, voltage trimmer and field circuit breaker). Service as necessary. Replace voltage adjusting rheostat **R21** if it is open.

Replace voltage regulator **VR21** if the connected circuits are okay.

⚠CAUTION ***Replacing voltage regulator VR21 before servicing other faults can lead to damage to the new voltage regulator.***

OUTPUT VOLTAGE TOO HIGH OR TOO LOW

Adjust engine speed as described under *Engine Control.*

Check the alternator output terminals and reconnect, if necessary, per the appropriate reconnection diagram (Page 7-6).

Adjust voltage regulator **VR21** as described under *AC Control.*

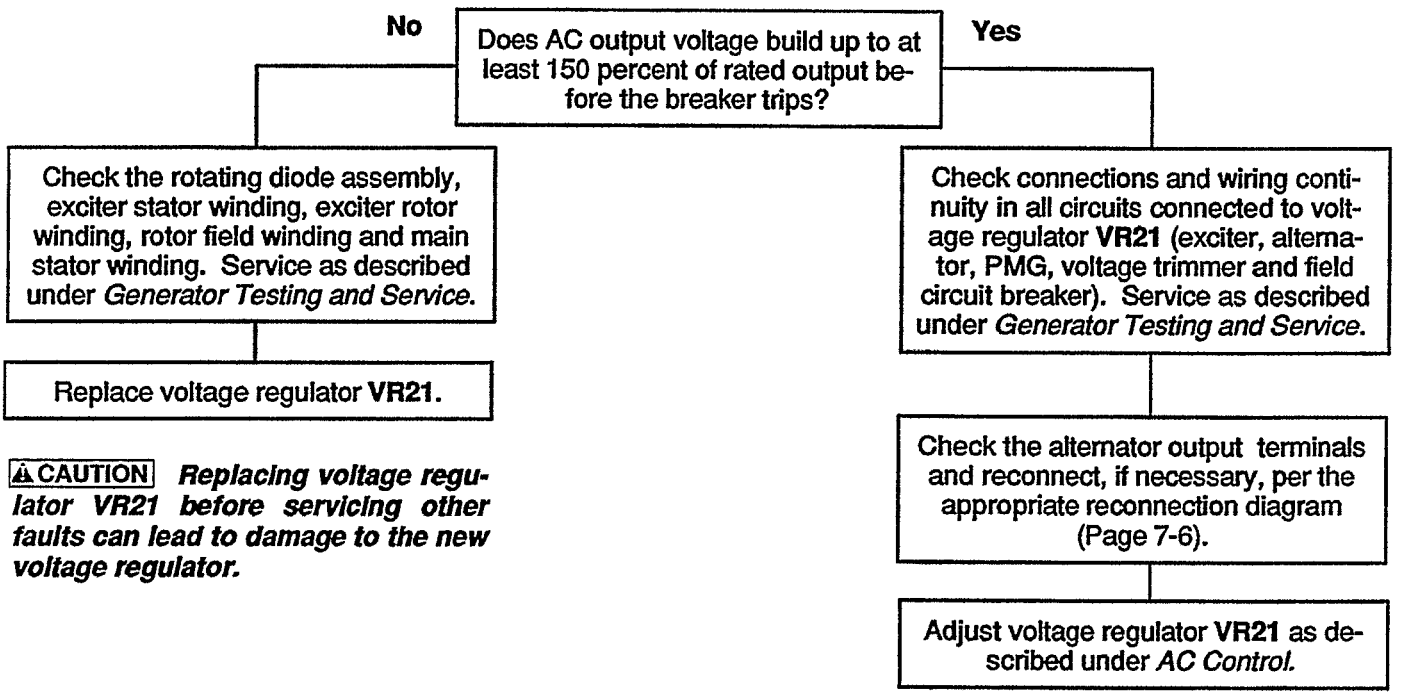
Check and service the rotating diode assembly as described under *Generator Testing and Service.*

Replace voltage regulator **VR21.**

⚠CAUTION ***Replacing voltage regulator VR21 before servicing other faults can lead to damage to the new voltage regulator.***

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

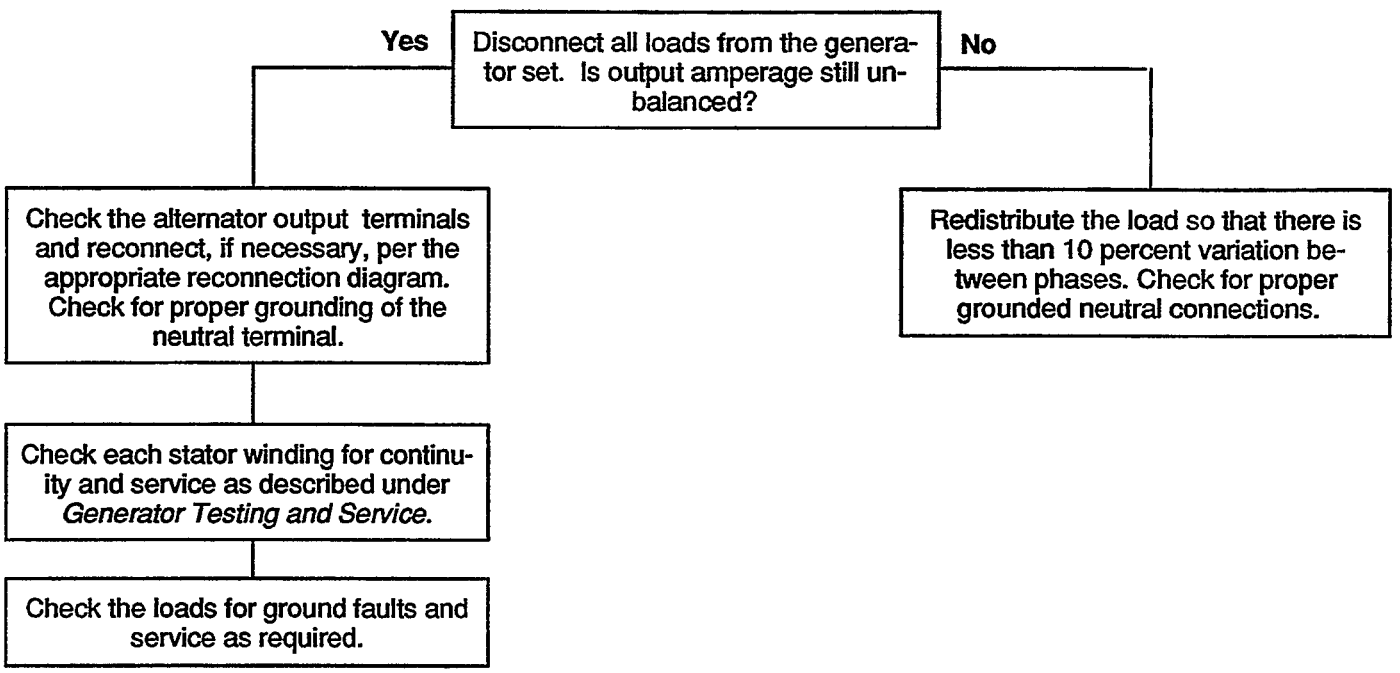
FIELD CIRCUIT BREAKER KEEPS TRIPPING



⚠CAUTION ***Replacing voltage regulator VR21 before servicing other faults can lead to damage to the new voltage regulator.***

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions inside the front cover and carefully observe all instructions and precautions in this manual.***

UNBALANCED OUTPUT VOLTAGE



NO OUTPUT THROUGH MOUNTED LINE CIRCUIT BREAKER

Section 5. Generator Service

TESTING THE GENERATOR

These tests can be performed without removing the generator. Before starting tests, disconnect the starting battery cables (negative (-) first) to make sure the engine will not start while performing these tests.

WARNING ***Accidental starting of the generator set while working on it can cause severe injury or death.***

Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).

Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.

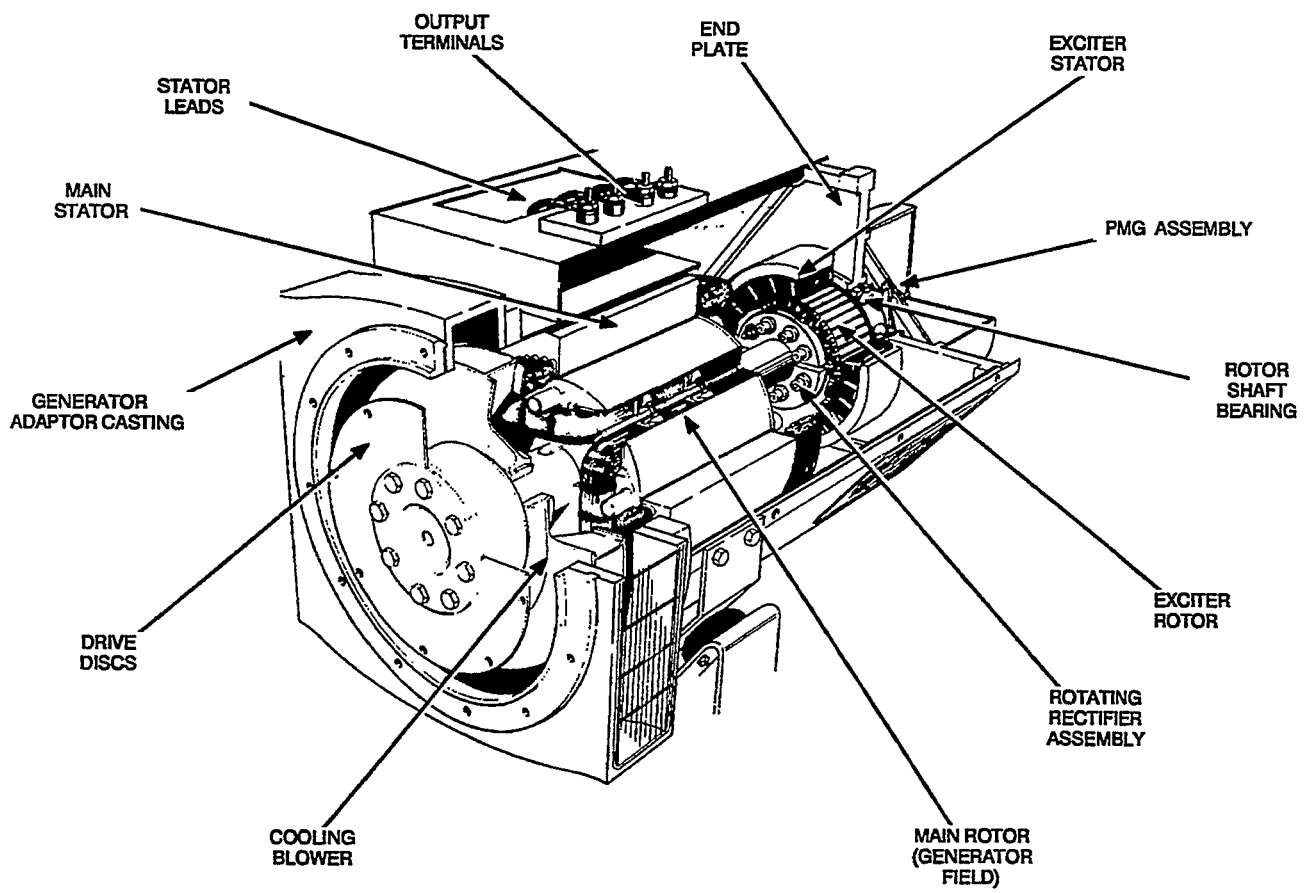


FIGURE 5-1. GENERATOR

Exciter Stator

Testing Winding Insulation Resistance: Disconnect the exciter stator leads from terminals **X** and **XX** on the auxiliary terminal board in the generator output box. Using an ohmmeter, measure resistance between either lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm (1,000,000 ohms)

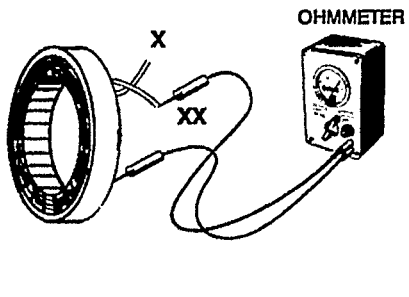


FIGURE 5-2. TESTING EXCITER STATOR INSULATION RESISTANCE

Testing Winding Resistance: Measure winding resistance with a Wheatstone bridge or digital ohmmeter. Replace the stator if winding resistance is not as specified by Table 5-1.

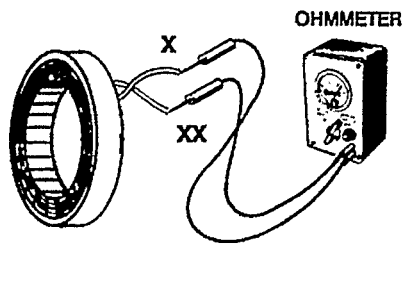


FIGURE 5-3. TESTING EXCITER STATOR WINDING RESISTANCE

Exciter Rectifier Bridge (Rotating Rectifier Assembly)

The exciter rectifier bridge is mounted on the exciter rotor, inboard, facing the main rotor. It consists of a positive plate and a negative plate, split diametrically. Each carries three diodes, three terminal posts for connecting exciter rotor leads to the diode pigtails and a terminal for the main rotor (generator field) lead. A surge suppresser is connected across the two plates to prevent transient voltages that could damage the diodes.

Testing Diodes: Disconnect the diode pigtails from the terminal posts. Using an ohmmeter, measure electrical resistance between each diode pigtail and the plate on which the diode is mounted. Reverse the meter test probes and repeat the tests. The electrical resistance across each diode should be high in one direction and low in the other. If the resistance is high or low in both directions, replace the diode.

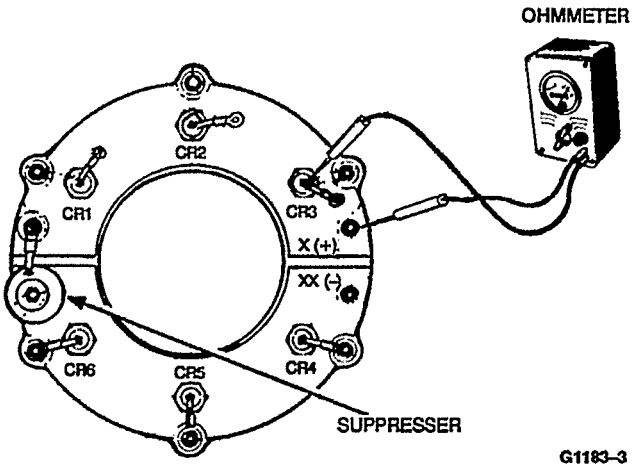


FIGURE 5-4. TESTING THE ROTATING RECTIFIER ASSEMBLY

Replacing Diodes: Make sure the replacement diode is of the correct polarity. Disconnect the pigtail from the terminal post and unscrew the old diode. Apply heat-sink compound under the head of the diode. Make sure the compound does not get on the threads. Torque the diodes to 36 to 42 in-lbs (4 to 4.8 Nm) and the pigtail terminals to 24 in-lbs (2.7 Nm) when reassembling.

Surge Suppresser Testing and Replacement: Remove the suppresser. Replace the suppresser if it appears to have overheated or if ohmmeter readings indicate less than infinite resistance (end of scale) in both directions. Torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

⚠CAUTION ***Layers of dust can cause diodes to overheat and fail. Brush dust off regularly.***

Exciter Rotor

Testing Winding Insulation Resistance: Disconnect the two main rotor (generator field) leads from the rotating rectifier assembly. Using an ohmmeter, measure the resistance between any exciter rotor lead terminal and the rotor laminations. Replace the whole rotor shaft assembly if insulation resistance is less than 1 megohm.

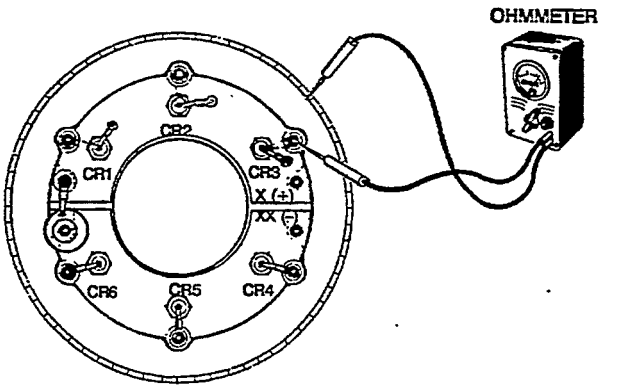


FIGURE 5-5. TESTING EXCITER ROTOR INSULATION RESISTANCE

Testing Winding Resistance: Disconnect the six diode pigtails from the terminal posts on the rectifier assembly. Measure electrical resistance across each pair of rotor leads (U6-V6, V6-W6 and U6-W6) with a Wheatstone bridge. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 5-1.

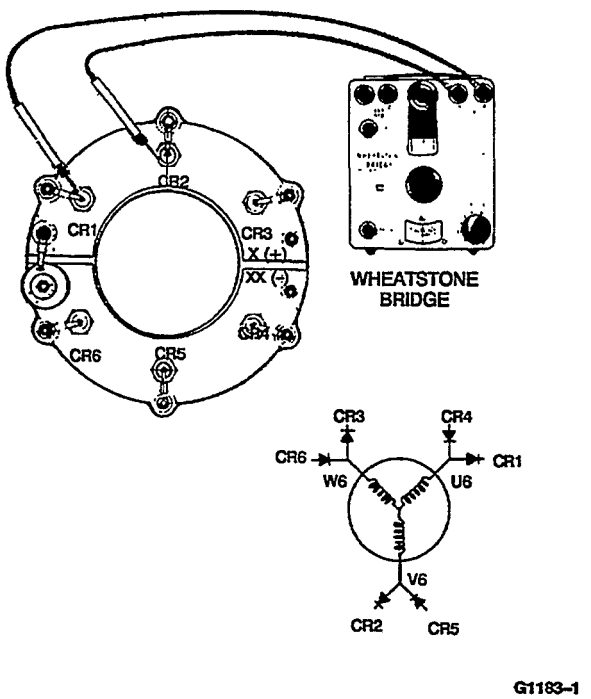


FIGURE 5-6. TESTING EXCITER ROTOR WINDING RESISTANCE

Main Rotor (Generator Field)

Testing Winding Insulation Resistance: Disconnect the two rotor leads from the rotating rectifier assembly. Using an ohmmeter, measure the resistance between either lead and the rotor laminations. Replace the rotor if insulation resistance is less than 1 megohm.

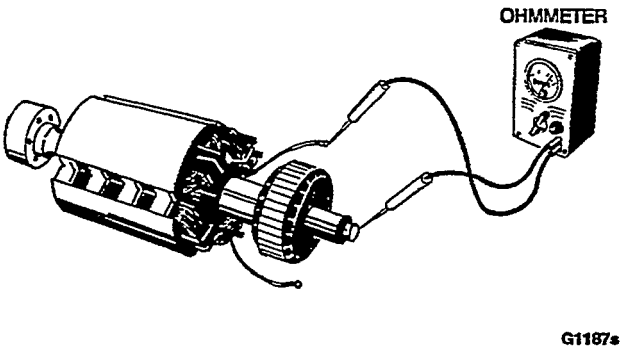


FIGURE 5-7. TESTING MAIN ROTOR INSULATION RESISTANCE

Testing Winding Resistance: Measure electrical resistance between the two leads with a Wheatstone bridge or digital ohmmeter. Replace the rotor if the resistance is not as specified in Table 5-1. Connect the rotor leads and torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

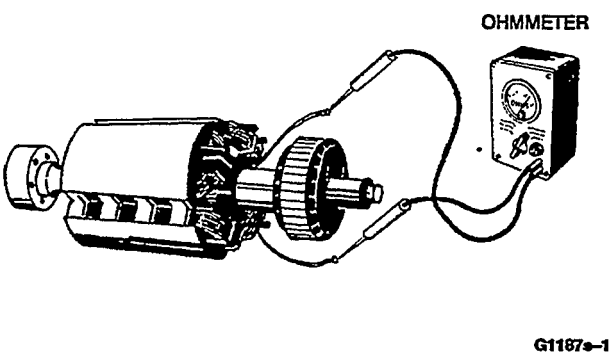


FIGURE 5-8. TESTING MAIN ROTOR WINDING RESISTANCE

Main Stator

Testing Winding Insulation Resistance: Disconnect all stator leads and winding taps from their respective terminals and make sure the ends do not touch the generator frame. Using an ohmmeter, measure electrical resistance between any stator lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm.

Testing Winding Resistance: Measure electrical resistance across each pair of stator leads (U1-U2, U5-U6, VI-V2, V5-V6, W1-W2 and W5-W6) with a Wheatstone bridge or ohmmeter having at least 0.001 ohm precision. Replace the stator if the resistance of any winding is not as specified in Table 5-1.

TABLE 5-1. GENERATOR WINDING RESISTANCES*

MAIN STATOR PART NUMBER**	MAIN STATOR (OHMS)	MAIN ROTOR (OHMS)	EXCITER STATOR (OHMS)	EXCITER ROTOR (OHMS)
220-4289-31	0.170	0.57	20.3	0.167
220-4289-32	0.129	0.64	20.3	0.167
220-4289-33	0.110	0.67	19.5	0.180
220-4289-34	0.069	0.80	19.5	0.180
220-4289-35	0.055	0.93	19.5	0.180
220-4298-31	0.062	1.11	19.5	0.180
220-4298-32	0.047	1.20	19.5	0.180
220-4298-33	0.033	1.31	19.5	0.210
220-4298-34	0.025	1.50	19.5	0.210
220-4298-35	0.022	1.66	19.5	0.210
220-4298-36	0.016	1.80	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - See Figure 5-9 for the location of the stator part number.

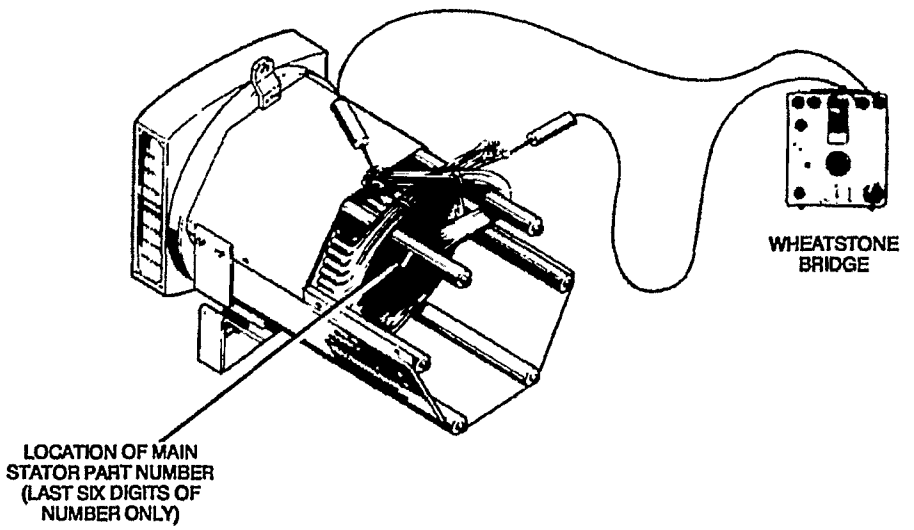


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FIGURE 5-9. TESTING GENERATOR STATOR

REMOVING AND DISASSEMBLING THE GENERATOR

The generator is heavy. You will need an assistant and a hoist of sufficient capacity to remove and service the generator.

⚠WARNING ***Accidentally dropping the generator can damage it and cause severe personal injury and death. The hoist, straps and chains must have sufficient capacity and be attached properly so that the load cannot shift.***

Before starting, disconnect the starting battery cables (negative (-) first) to make sure the set will not start while working on it.

⚠WARNING ***Accidental starting of the generator set while working on it can cause severe injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).***

Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.

Removing The Generator Output Box

1. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.

2. Disconnect the remote control plug-in extension harness, if provided.

3. Disconnect the engine wiring harness plug-in connector.

4. Disconnect all generator control leads (winding taps) from connections in the output box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.

5. If the set has a mounted line circuit breaker, disconnect the cables to the circuit breaker. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.

6. Attach a hoist to the generator output box, loosen the mounting bolts on the sides of the generator and remove the box.

Withdrawing The Generator From The Set

1. The rotor will be carried inside the stator when the generator is withdrawn from the engine. Bar the engine until one of the four poles of the rotor points straight down so that the rotor will rest on the face of the pole when the generator is withdrawn.

   ⚠CAUTION ***The rotor can be damaged if it rests on the edges of the winding slot between two poles.***

2. Attach lifting eyes and a hoist of sufficient capacity (Figure 5-10).

3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts.

4. Raise the generator end approximately one inch (12 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.

5. Remove the bolts securing the generator drive discs to the flywheel.

6. Loosen all the bolts securing the generator adapter casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

   ⚠CAUTION ***Never withdraw the generator leaving the rotor to hang by the drive discs. The weight of the rotor will damage the drive discs.***

Withdrawing the Rotor From the Generator

1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.

2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by hand and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and re-cinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on both ends to prevent contact with the stator windings

3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, blower or exciter.

4. Remove the retaining clip if the rotor shaft bearing is to be removed.

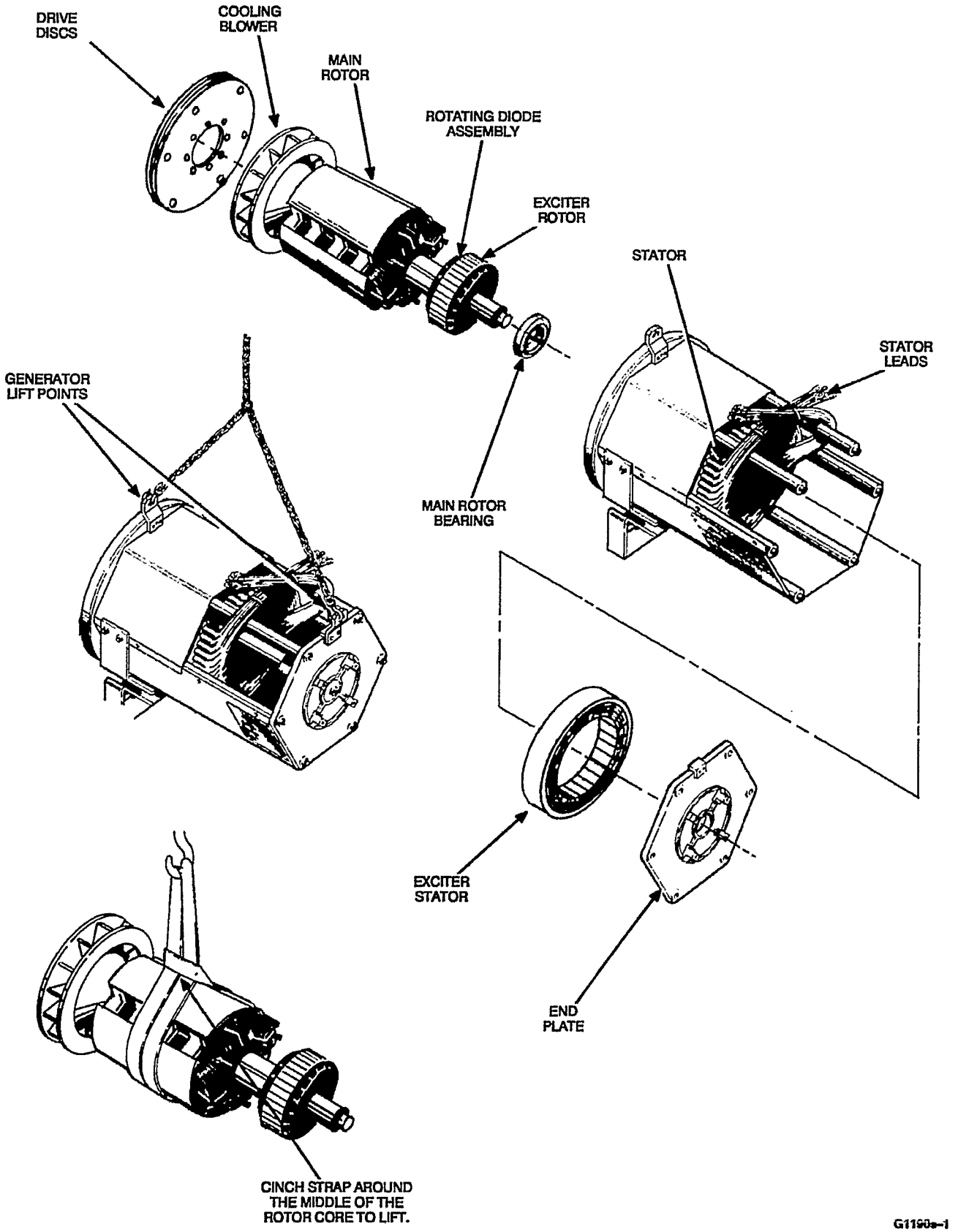


FIGURE 5-10. GENERATOR ASSEMBLY

REASSEMBLING THE GENERATOR

Reassembling is the reverse of disassembling. Note the following.

1. Apply force to the inner race of the rotor bearing when pressing it onto the shaft, otherwise, it will be damaged. Be sure to secure the retaining clip.

2. The drive disc-to-rotor bolts should be torqued to 190 ft-lbs (257 Nm).

3. The drive disc-to-flywheel bolts should be torqued to 50 ft-lbs (67 Nm).

4. The exciter stator mounting screws should be torqued to 7 ft-lbs (10 Nm).

5. The generator end plate mounting bolts should be torqued to 25 ft-lbs (34 Nm).

6. Make sure the rubber O-ring is in place in the bearing bore in the generator endplate.

7. The generator mounting bracket bolts should be torqued to 65 ft-lbs (88 Nm) if M12 or 35 ft-lbs (47 Nm) if M10.

8. The generator-to-adaptor bolts should be torqued to 40 ft-lbs (55 Nm).

9. The adaptor-to-engine bolts should be torqued to 35 ft-lbs (48 Nm).

10. Reconnect the generator as required. See Page 7-6.

SERVICING THE PMG

The following is applicable if the generator is equipped with a PMG (permanent magnet) exciter (Figure 5-11).

Testing

1. Remove the PMG cover and disconnect the leads at the connector.

2. Start the engine at the set and let the speed stabilize.

   ⚠CAUTION ***Release the Start switch as soon as the engine fires to prevent damage to the starter. Because the PMG has been disconnected, there will be no generator voltage, and therefore, the start disconnect relay will not function to automatically disconnect the starter.***

3. Measure voltage across leads P2-P3, P2-P4 and P3-P4. Voltage should be at least 150 VAC for 50 Hz sets and 180 VAC for 60 Hz sets, and should be approximately the same for each set of leads.

4. Push the control panel switch to **STOP** and let the set come to a complete stop.

5. Measure electrical resistance across leads P2-P3, P2-P4 and P3-P4 with a Wheatstone bridge. Each winding should have a resistance of approximately 4.4 ohms.

Disassembling the PMG

1. Disconnect the starting battery cables (negative (-) first) to make sure the set will not start while working on it.

   ⚠WARNING ***Accidental starting of the generator set while working on it can cause severe injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).***

   Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.

2. Remove the PMG cover and disconnect the leads at the connector.

3. Remove the bolts and clamps that secure the PMG stator to the generator frame and carefully pull away the stator.

   The rotor is magnetic and will attract the stator. Hold the stator firmly so that the windings are not damaged by striking the stator support lugs.

4. Remove the rotor center bolt and pull away the rotor. The rotor is magnetic and will attract iron filings. Put it in a clean plastic bag until it is remounted. Do not take it apart or it will lose its magnetism.

Reassembling the PMG

Reassembling is the reverse of disassembling. Torque the rotor center bolt to 40 ft-lbs (54 Nm). The stator leads must be at 12 o'clock.

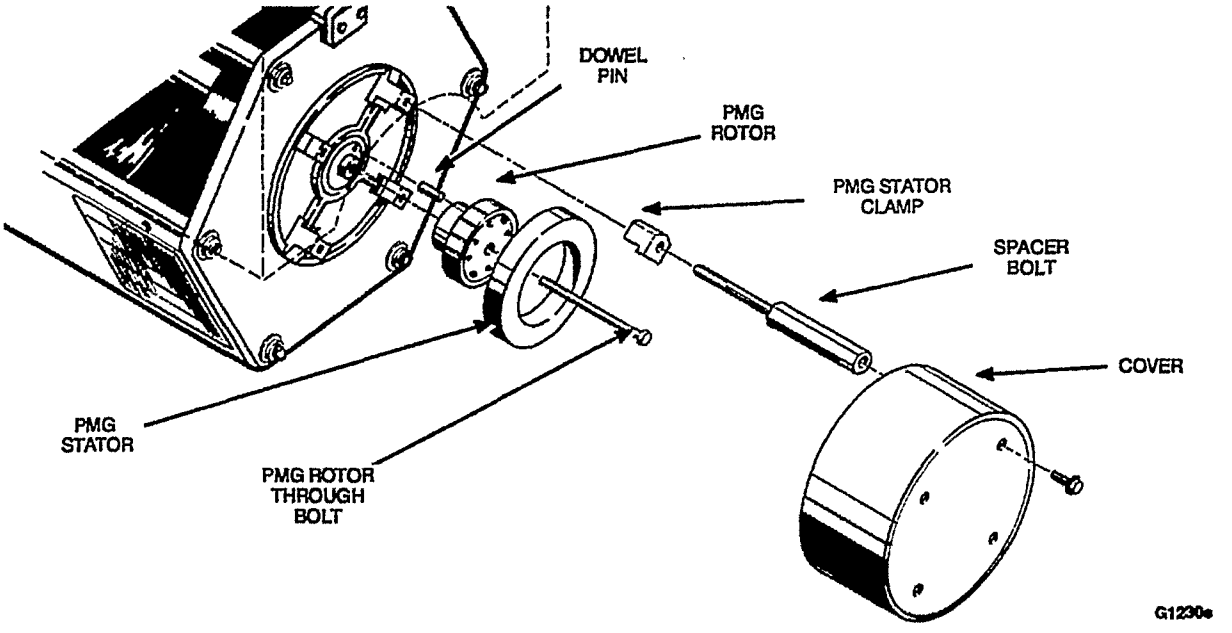


FIGURE 5-11. PMG ASSEMBLY

Section 6. Miscellaneous

HEAT EXCHANGER

Refer to the engine Operation Manual to service the heat exchanger and sea water pump when they are provided.

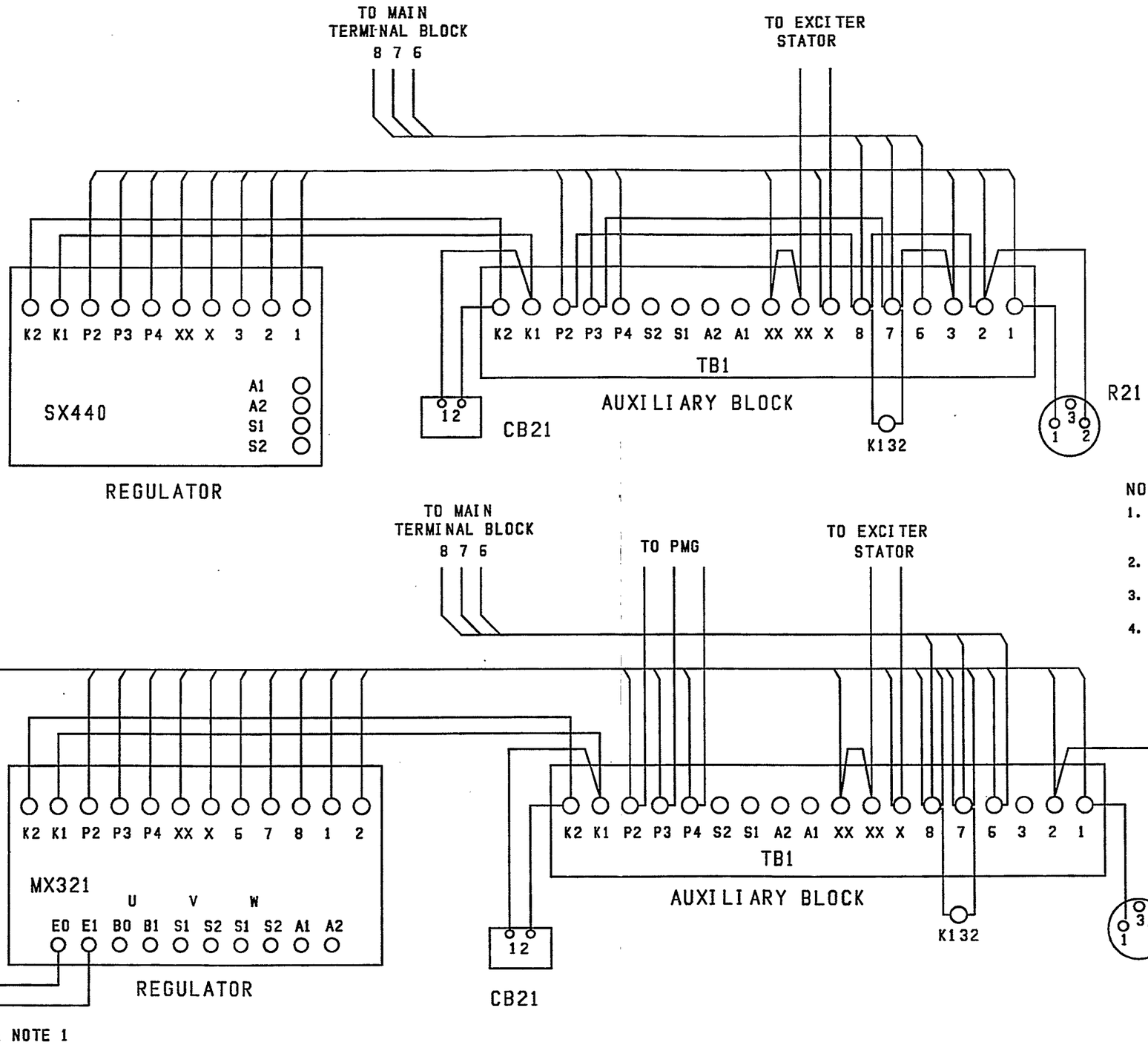
POWER TAKEOFF UNIT

Refer to the appropriate component service manuals when a power takeoff unit and accessories are provided.

Section 7. Wiring Diagrams

This section consists of the schematic and connection wiring diagrams referenced in the text. It should be noted that they are typical, and that wiring and component specifications are subject to change. Contact your Distributor if you do not have the wiring diagrams applicable to your equipment.

The following drawings are included:



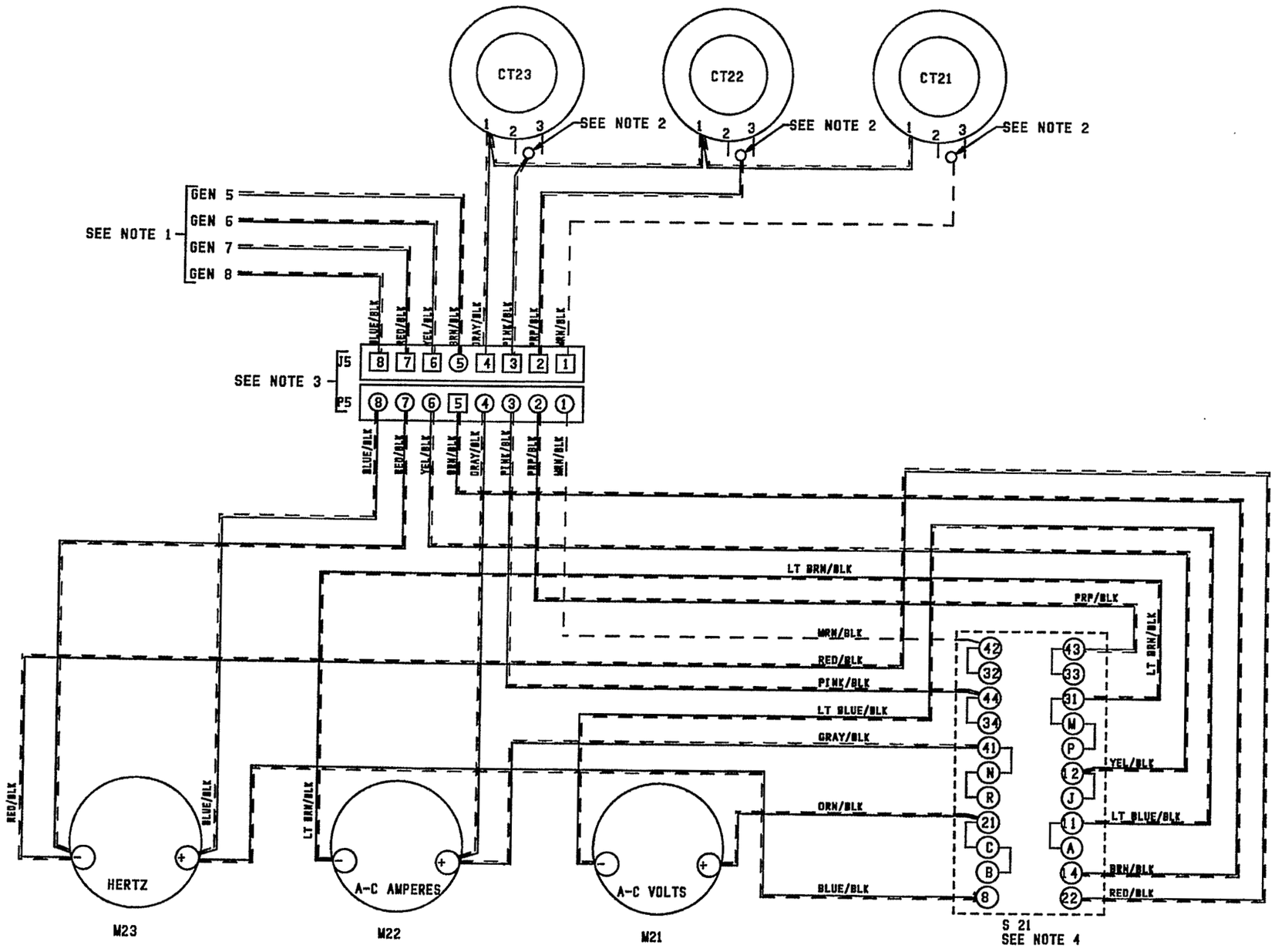
NOTE:

1. USE LEAD 226-4162 TO CONNECT E0 TO AUX 7 AND E1 TO AUX 8.
2. K132 IS THE AC DISCONNECT RELAY.
3. R21 IS THE VOLTAGE ADJUST POT.
4. CB21 FIELD BREAKER.

625-2330

VOLTAGE REGULATOR WIRING CONNECTIONS

630-1434 D



97150	A	1	PRODUCTION RELEASE	-	LAE	

COLOR CODE

BLUE/BLK - GEN 8
LT BLUE/BLK - AC VOLTMETER (-)
RED/BLK - GEN 7
YEL/BLK - GEN 6
BRN/BLK - GEN 5
LT BRN/BLK - AC AMMETER (-)
GRAY/BLK - AC AMMETER (+)
PINK/BLK - CT23
PRP/BLK - CT22
WHN/BLK - CT21
ORN/BLK - AC VOLTMETER (+)

NOTES:

1. SEE GENERATOR RECONNECT DRAWING FOR GENERATOR LEAD CONNECTIONS.
2. FOR HIGH VOLTAGE SYSTEM CONNECT WIRES TO TERMINAL #2. FOR LOW VOLTAGE SYSTEM CONNECT WIRES TO TERMINAL #3.
3. EXTENSION HARNESS MAY BE USED BETWEEN PLUGS FOR REMOTE MOUNTING OF CONTROL.
4. S21 SWITCH LOGIC:

	11-11	22-C	A1-21	B-32	A1-42	P-43	12-A	J-B	21-34	B-44	B-33
L1-L2 3Ø	X	X		X						X	X
L2-L3 3Ø		X			X	X	X			X	
L3-L1 3Ø	X				X			X	X		X
L1-LO 3Ø	X		X		X					X	X
OFF					X					X	X
L1-L2 1Ø	X	X		X						X	X
L1-L2 1Ø	X	X			X	X				X	

EXTERNAL JUMPERS	INTERNAL JUMPERS
M-P	N-41
34-44	M-31
C-21	A-11
32-42	B-C
12-J	33-43
N-R	

S21	7	REF	-	-	SWITCH-ROTARY (SEL)	
M23	6	REF	-	-	METER-FREQUENCY	
M22	5	REF	-	-	AMMETER	
M21	4	REF	-	-	VOLTMETER-AC	
CT23	3	REF	-	-	TRANSFORMER-CURRENT	
CT22	2	REF	-	-	TRANSFORMER-CURRENT	
CT21	1	REF	-	-	TRANSFORMER-CURRENT	

CADAM DWG

RICK EVENSON 10-C-96

MODEL(S) MDGBA, CA, CB, GA, HA, HB

NONE

MINNEAPOLIS, MINNESOTA 55440

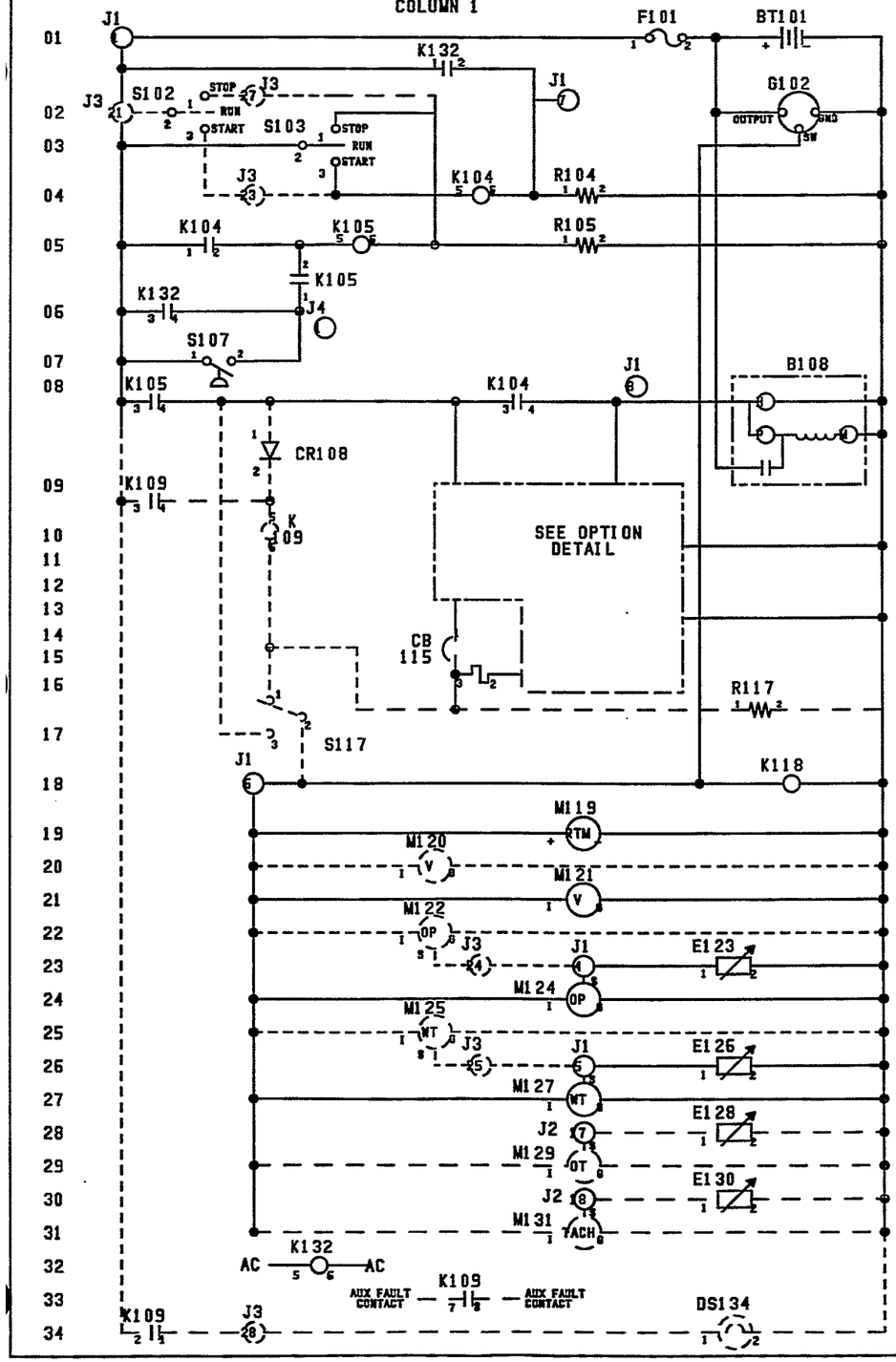
TITLE WD-AC INTERCONNECT

DWG NO. 630-1434 SHT 1 REV D

COLOR-CODED AC METER WIRING DIAGRAM

612-6568

SCHEMATIC
COLUMN 1



01 BT101-BATTERY
F101-FUSE 30 AMP

02 S102-START/RUN/STOP SWITCH(PILOT HOUSE)
G102-ALTERNATOR

03 S103-SWITCH, START/RUN/STOP

04 K104-CRANK RELAY- 03,08

05 K105-RUN RELAY- 04,08

06

07 S107-OIL PRESSURE LATCH

08 B108-STARTER

09 K109-ALARM RELAY- 09,33,34

10 S110-LOW OIL PRESSURE SWITCH

11 S111-HIGH ENGINE TEMPERATURE SWITCH

12 S112-LOW COOLANT LEVEL SWITCH

13 S113-LOW OIL LEVEL SWITCH

14 S114-HIGH EXHAUST TEMPERATURE SWITCH

15 S115-SEA WATER FLOW SWITCH
CB115 - FAULT BREAKER

16 S116-OVERSPEED SWITCH

17 S117-FAULT BYPASS SWITCH (NOTE 3)

18 K118-FUEL SOLENOID VALVE

19 M119-RUNNING TIME METER

20 M120-D.C. VOLTMETER (PILOT HOUSE)

21 M121-D.C. VOLTMETER

22 M122-OIL PRESSURE GAUGE (PILOT HOUSE)

23 E123-OIL PRESSURE SENDER

24 M124-OIL PRESSURE GAUGE

25 M125-WATER TEMPERATURE GAUGE (PILOT HOUSE)

26 E126-WATER TEMPERATURE SENDER

27 M127-WATER TEMPERATURE GAUGE

28 OIL TEMPERATURE SENDER

29 OIL TEMPERATURE GAUGE

30 TACHOMETER SENDER

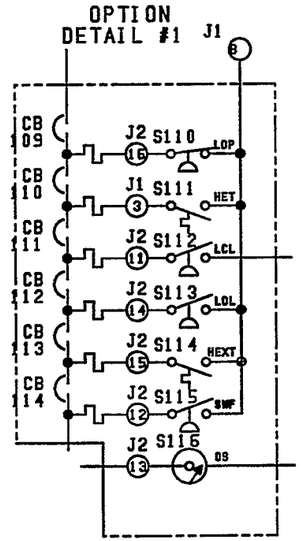
31 TACHOMETER GAUGE

32 K132-STAR/DISC RELAY -06

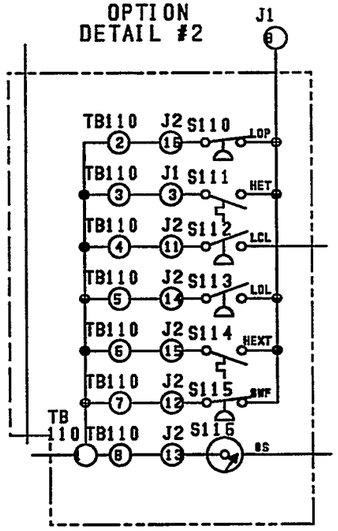
33

34 DS134-FAULT LAMP (PILOT HOUSE)

OPTION DETAIL #1

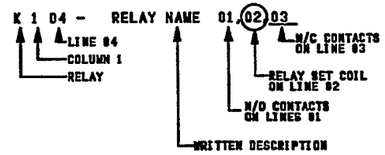


OPTION DETAIL #2



NOTES:

1. SCHEMATIC KEY:
   EACH COMPONENT IS LOCATED BY ITS DESIGNATION. ITS DESCRIPTION AND ITS COMPONANTS ARE LISTED TO THE RIGHT OF THE SCHEMATIC.



2. DASHED LINES INDICATE OPTIONS

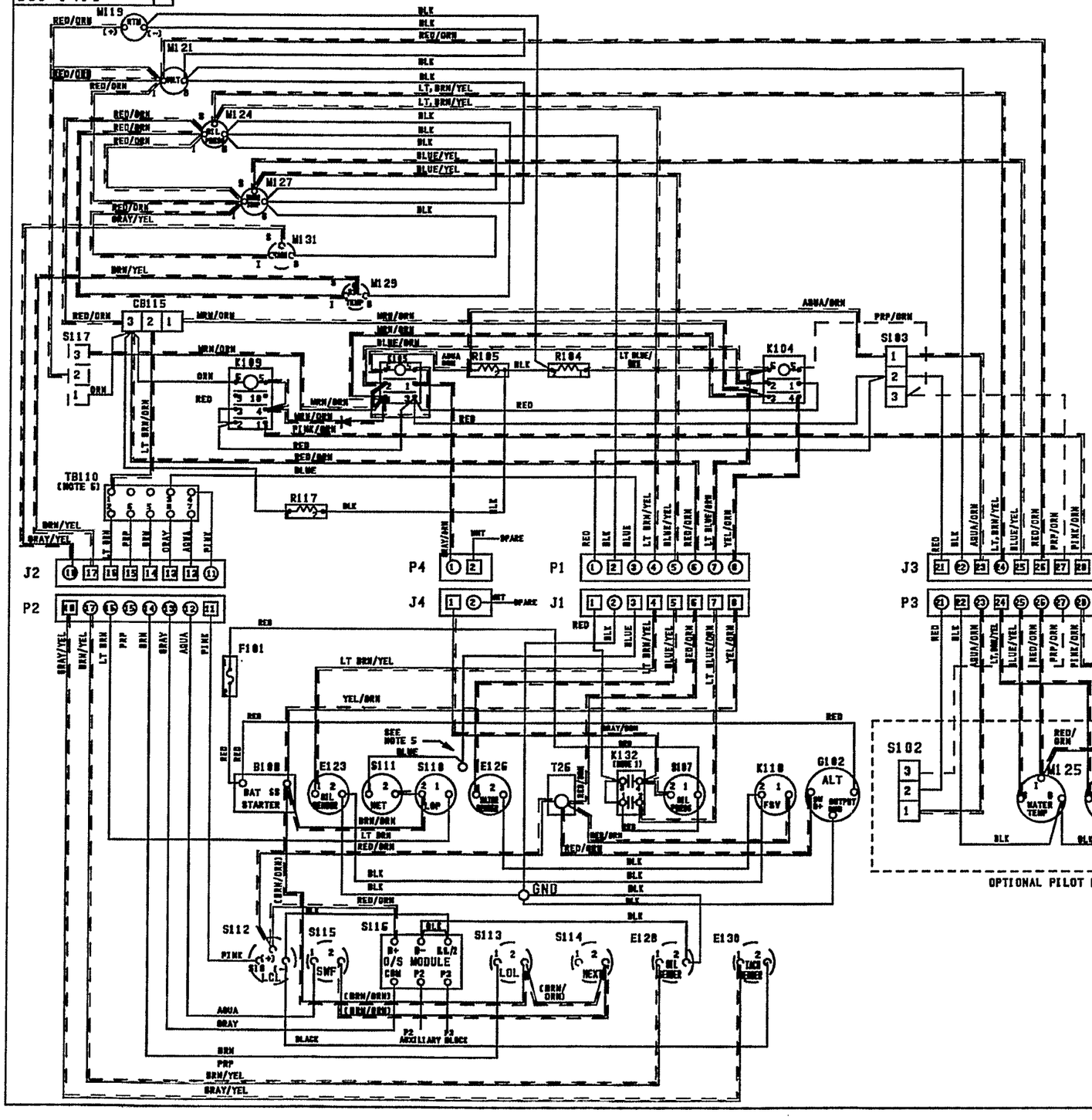
3. WHEN S117 IS USED, CR108 AND R117 ARE ADDED AND THE CONNECTION BETWEEN CB115-3 AND LINE 18 IS NOT USED.

4. WIRING DIAGRAM ON SHEET 1 DIAGRAMS ONLY THE STANDARD CONTROL WITH NO OPTIONS. SEE INDIVIDUAL INSTALLATIONS FOR PART NO.'S OF COMPONENTS AND WIRING OF OPTIONS.

WD-GENSET DC CONT STD
612-6568

ENGINE WIRING SCHEMATIC

630-1413



COLOR CODE

RED - B+
BLACK - B-
LT BROWN - LOP SWITCH
BROWN - LOL SWITCH
BLUE - HET SWITCH, LOP SWITCH
GRAY - OS SWITCH
AQUA - SEAWATER FLOW SWITCH
PINK - LOW COOLANT LEVEL SWITCH
PURPLE - HIGH EXHAUST SWITCH

RED/ORN - SWITCHED B+ (T26)
YELLOW/ORN - LINK FROM K104 TO STARTER
MAROON/ORN - SWITCHED B+ (LINE SIDE OF CB115)
LT BROWN/ORN - CB SHUNT TO TERMINAL BLOCK
BROWN/ORN - DELAYED GROUND
LT BLUE/ORN - LOAD SIDE OF K132
BLUE/ORN - CONTROL LINK - K104-K105
LT GRAY/ORN - AIR SHUTDOWN
AQUA/ORN - STOP CIRCUIT
PINK/ORN - FAULT LAMP
PURPLE/ORN - START CIRCUIT
GRAY/ORN - OIL PRESSURE LATCH

LT. BROWN/YEL - OIL PRESSURE SENDER
BROWN/YEL - OIL TEMPERATURE SENDER
BLUE/YEL - WATER TEMPERATURE SENDER
GRAY/YEL - TACHOMETER SENDER

CB - CIRCUIT BREAKER
FSV - FUEL SOLENOID VALVE
ALT - ALTERNATOR
LOP - LOW OIL PRESSURE
HET - HI ENGINE TEMPERATURE
OS - OVERSPEED
SWF - SEA WATER FLOW
HEXT - HIGH EXHAUST
LWL - LOW OIL LEVEL
LCL - LOW COOLANT LEVEL

36116	A	1	PRODUCTION RELEASE	-	JC	BY	BAM	12-15-90
36306	B	1	REVISED PER ER	-	JC			

NOTES:
1. K132 COIL CONNECTION IS MADE TO AC TERMINALS 7 & 8 IN GENERATOR AND IS USED AS AC START DISCONNECT.
2. BLUE WIRE CONNECTED TO TB110-3 IS CONNECTED TO CB115-2 WHEN TB110 IS NOT USED.
3. WIRE LEAD FROM P1-6 AND M124-I IS REMOVED FROM CB115-3 AND TIED BACK WHEN THE FAULT OVERRIDE SWITCH OPTION IS INSTALLED.
4. EXTENSION HARNESS MAY BE USED BETWEEN PLUGS FOR REMOTE MOUNTING OF CONTROL.
5. CONNECTIONS TO S110-1 WHEN OPTION HARNESS IS NOT USED.

TB110	39	REF	-	-	TERMINAL BLOCK
T26	38	REF	-	-	TERMINAL-SWITCHED B+
S117	37	REF	-	-	SWITCH-FAULT BYPASS
S116	36	REF	-	-	SWITCH-OVERSPEED (OPTION)
S115	35	REF	-	-	SWITCH-SEA WATER FLOW (OPTION)
S114	34	REF	-	-	SWITCH-HI EXH TEMP (OPTION)
S113	33	REF	-	-	SWITCH-LOW OIL LEVEL (OPTION)
S112	32	REF	-	-	SWITCH-LOW COOLANT (OPTION)
S111	31	REF	-	-	SWITCH-HI TEMP
S110	30	REF	-	-	SWITCH-LOP (SHUTDOWN)
S107	29	REF	-	-	SWITCH-OIL PRESS (LATCH)
S103	28	REF	-	-	SWITCH-START/RUN/STOP
S102	27	REF	-	-	SWITCH-START/RUN/STOP (OPTION)
R117	26	REF	-	-	RESISTOR (50W)
R105	25	REF	-	-	RESISTOR (24V/50W, 12V/12W)
R104	24	REF	-	-	RESISTOR (24V,50W, 12V/12W)
M131	23	REF	-	-	GAUGE-TACH (OPTION)
M129	22	REF	-	-	GAUGE-OIL TEMP (OPTION)
M127	21	REF	-	-	GAUGE-WATER TEMP
M125	20	REF	-	-	GAUGE-WATER TEMP (OPTION)
M124	19	REF	-	-	GAUGE-OIL PRESS
M122	18	REF	-	-	GAUGE-OIL PRESS (OPTION)
M121	17	REF	-	-	VOLTMETER-DC
M120	16	REF	-	-	VOLTMETER-DC (OPTION)
M119	15	REF	-	-	HOURMETER
K132	14	REF	-	-	RELAY (AC DISCONNECT)
K118	13	REF	-	-	FUEL SOLENOID
K109	12	REF	-	-	RELAY (ALARM)
K105	11	REF	-	-	RELAY (RUN)
K104	10	REF	-	-	RELAY (CRANK)
G102	9	REF	-	-	ALTERNATOR
F101	8	REF	-	-	FUSE
E130	7	REF	-	-	SENDER-TACH (OPTION)
E128	6	REF	-	-	SENDER-OIL TEMPERATURE (OPTION)
E126	5	REF	-	-	SENDER-WATER TEMPERATURE
E123	4	REF	-	-	SENDER-OIL PRESSURE
DS134	3	REF	-	-	LIGHT-FAULT
CB115	2	REF	-	-	CIRCUIT BREAKER (FAULT)
B108	1	REF	-	-	STARTER

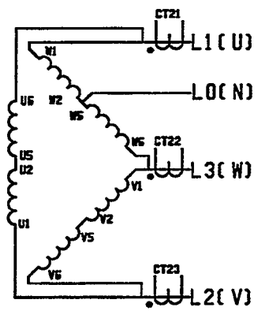
WD-INTERCONNECT
630-1413

COLOR-CODED INTERCONNECTION WIRING DIAGRAM

3 PHASE RECONNECTABLE, 12 LEAD

SECONDARY TRANSFORMER CONN 1-3

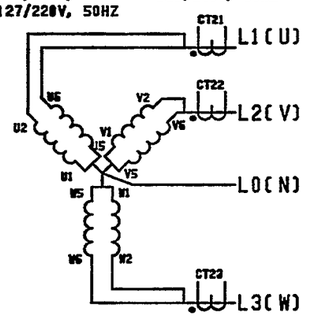
110/220V, 50HZ
115/230V, 50HZ
120/240V, 60HZ



SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U. V. W. N.

110/190V, 50HZ
115/200V, 50HZ
120/208V, 50HZ
127/220V, 50HZ

120/208V, 60HZ
127/220V, 60HZ
139/240V, 60HZ

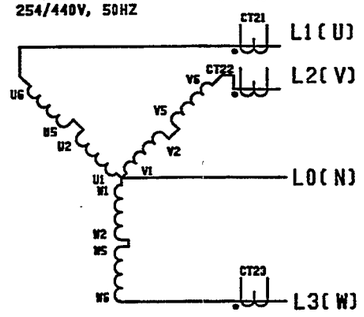


PARALLEL STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U. V. W. N.

SECONDARY TRANSFORMER CONN 1-2

220/ 380V, 50HZ & 60HZ
230/400V, 50HZ
240/416V, 50HZ
254/440V, 50HZ

240/416V, 60HZ
254/440V, 60HZ
277/480V, 60HZ

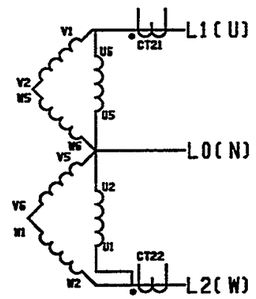


SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U. V. W. N.

1 PHASE RECONNECTABLE, 12 LEAD

SEC XFMR CONN 1-3

110/220V, 50HZ
115/230V, 60HZ
120/240V, 60HZ

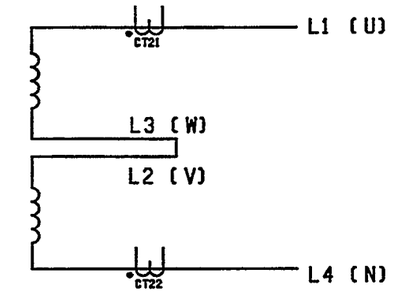


DOUBLE DELTA
1 PHASE 3 WIRE
OUTPUT TERMINALS
U. W. CENTER TAP N.

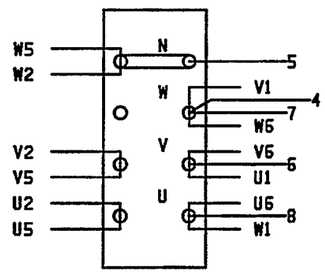
1 PHASE NON-RECONNECTABLE, 4 LEAD

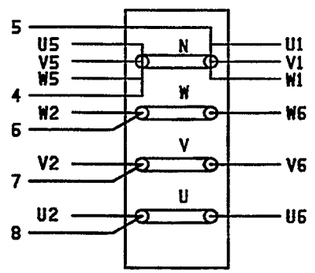
SEC XFMR CONN 1-3

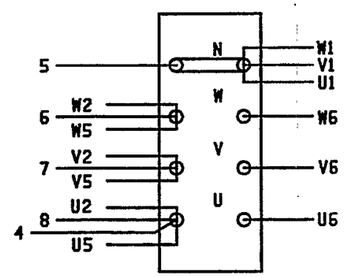
110/220V, 50HZ
115/230V, 50HZ
120/240V, 60HZ

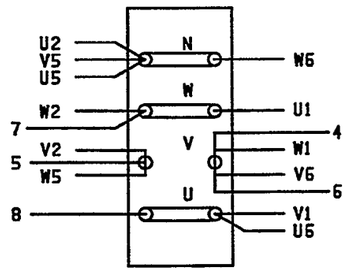


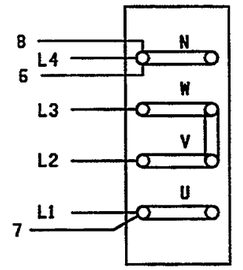
1 PHASE 3 WIRE
OUTPUT TERMINALS
U, N











NOTE:

1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.

CONTROL INPUT				
CONTROL INPUT TB21	SERIES DELTA	PARALLEL STAR	SERIES STAR	DOUBLE DELTA
22	8	8	8	8
23	7	7	7	7
24	4	4	4	4
25	6	6	6	6
26	5	5	5	5
JUMPER	—	—	—	—

625-2164

AC RECONNECTION DIAGRAM

Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
Telex: 275477
Fax: 612-574-8087