Service

RV/Mobile Generator Sets

Models:

4CKM
4CFKM
5CKM
4CKMR
4CFKMR
5CKMR

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-5394 12/94a

Table of Contents

Safety Precautions and Instructions

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to the operation of a generator set follow. Below are some general precautions relating to the operation of a generator set. SAVE THESE INSTRUCTIONS.

⚠ DANGER

Danger indicates the presence of a hazard that *will* cause *severe* personal injury, death, or substantial property damage if the danger is ignored.

⚠ WARNING

Warning indicates the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution indicates the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the caution is ignored.

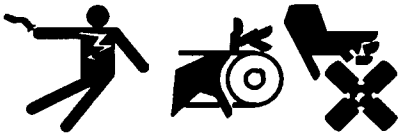
NOTE

Note communicates installation, operation, or maintenance information that is important but not hazard related.

Safety decals are affixed to the generator set in prominent places to advise the operator or service technician of potential hazards. The decals are reproduced here to improve operator recognition. For a further explanation of decal information, refer to the safety precautions throughout this manual. Before operating or servicing the generator set, be sure you understand the messages of these decals. Replace decals if missing or damaged.

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by the remote start/stop switch unless this precaution is followed.

Battery

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Battery acid can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery once the battery has been placed in service. This may result in hazardous spattering of electrolyte.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc., to prevent burns and sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being changed. Always turn battery charger off before disconnecting battery connections. Remove negative lead first and reconnect it last when disconnecting battery.

Engine Backfire/Flash Fire

⚠ WARNING

Fire.
Can cause severe injury or death.

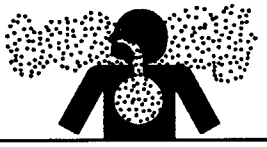
Do not smoke or permit flame or spark to occur near fuel or fuel system.

A flash fire can cause severe injury or death. Do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors. Use a suitable container to catch all fuel when removing fuel line or carburetor.

A sudden backfire can cause severe injury or death. Do not operate with air cleaner removed.

Exhaust System

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

Carbon monoxide can cause severe nausea, fainting, or death. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate in any area where exhaust gas could accumulate and seep back inside an occupied building or vehicle. Be careful when parking your vehicle to avoid obstructing the exhaust outlet. The exhaust gases must discharge freely to prevent carbon monoxide from deflecting into the vehicle. Avoid breathing exhaust fumes when working on or near the generator set. Carbon monoxide is particularly dangerous because it is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short period of time.

Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas which is present in exhaust gases. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If any of these symptoms is experienced and carbon monoxide poisoning is possible, affected persons should seek fresh air immediately. They should remain active. They should not be permitted to sit, lie down, or fall asleep. Alert others to the situation. If the condition of affected persons does not improve within minutes of breathing fresh air, they should seek medical attention.

Carbon monoxide can cause severe nausea, fainting, or death. Install exhaust system tail pipe so discharged exhaust gases will not be drawn into vehicle interior through windows, doors, air conditioners, etc. Do not use flexible tail piping since this type could crack and allow lethal exhaust fumes to enter the vehicle.

Carbon monoxide can cause severe nausea, fainting, or death. In addition to routine inspection of the exhaust system, install a carbon monoxide detector. Consult your coach builder or dealer for installation of approved detectors. Inspect your detector before each generator set use.

Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling and storing fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke or permit flame or spark to occur near potential sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. If any fuel leakage, fuel accumulation, or electrical sparks are noted, DO NOT OPERATE GENERATOR SET. Repair systems before resuming generator set operation

Explosive fuel vapors can cause severe injury or death. Take additional precautions when using the following fuels:

Gasoline—Store gasoline only in approved red containers clearly marked GASOLINE.

Propane (LP)—Adequate ventilation is mandatory. Propane is heavier than air; install gas detectors low in room. Inspect detectors often.

Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining fuel system. Wipe up all spilled fuel after draining system.

Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check LP vapor gas fuel system for leakage using a soap-water solution with fuel system test pressurized to 6-8 ounces per square inch (10-14 inches water column). Do not use test solutions that contain ammonia or chlorine, since the soap will not bubble for an accurate leakage test.

Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check LP liquid withdrawal gas fuel system for leakage using a soap-water solution with fuel system test pressurized not less than 90 psi (621 kPa). Do not use test solutions that contain ammonia or chlorine, since the soap will not bubble for an accurate leakage test.

Hazardous Noise

⚠ CAUTION

Hazardous noise.
Can cause loss of hearing.

Never operate generator set without a muffler or with a faulty exhaust system.

Hazardous Voltage/ Electrical Shock

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING

Hazardous voltage.
Backfeed to utility system can cause severe injury, death, or property damage.

Do not connect to any building electrical system without connecting through an approved device and after building main switch is open.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. High voltage is present at the heat sink of the voltage regulator. Do not touch voltage regulator heat sink when testing or electrical shock will occur. *(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only.)*

Hazardous backfeed voltage can cause severe injury or death. Do not connect generator set to any building/campground electrical system without connecting through an approved device and after building/campground main switch is open. Backfeed connections can cause serious injury or death to utility personnel working to repair a power outage and/or personnel in the vicinity. Unauthorized connection to utility electrical system may be unlawful in some states and/or localities. A transfer switch must be installed to prevent interconnection of generator set power and other sources of power.

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lift can cause severe injury or death or equipment damage.

Do not use lifting eyes.
Use a sling under skid to lift generator set.

Hot Parts

⚠ WARNING

Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on generator set until it is allowed to cool.

Hot parts can cause severe injury or death. Do not touch hot engine parts. An engine gets hot while running and exhaust system components get extremely hot.

Fire can cause severe injury or death. Hot exhaust system can ignite adjacent combustible materials. Do not locate electrical wiring, fuel lines, or combustible material above the exhaust muffler. Exercise caution when parking your vehicle to prevent grass fires started by exhaust system and hot exhaust gases.

Fire can cause severe injury or death. Hot generator set can ignite debris in compartment. Keep the compartment and generator set clean and free of debris and combustible materials to minimize chances of fire. Do not block fuel/oil drain opening in generator set mounting tray. Cut a corresponding hole in the subflooring for drain opening if subflooring is used.

Moving Parts

⚠ WARNING

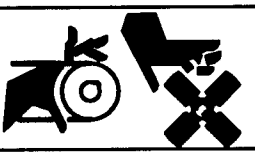
Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, and covers in place.

Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. Do not loosen crankshaft hardware or rotor thrubolt when making adjustments or servicing generator set. Rotate crankshaft manually in a clockwise direction only. Loose hardware can result from turning crankshaft bolt or rotor thrubolt counterclockwise. Personal injury can occur from loose hardware causing hardware or pulley to come off engine when generator set is running.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from belts and pulleys when generator set is running. Replace guards, screens, and covers before operating generator set.

Notes

NOTICE

This generator set has been rewired from its nameplate voltage to:

246242

NOTICE

This is a positive terminal only.
Do not attach negative lead!

NOTE

Affix notice to generator set after reconnecting to a voltage different than the nameplate. Order voltage reconnection decal 246242 from authorized service distributors/dealers.

NOTE

Hardware Damage! Engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of bolt heads and nuts.

NOTE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. American Standard hardware uses a series of markings and metric hardware uses a numeric system to indicate hardness. Check markings on bolt head and nuts for identification.

NOTE

This generator set does not comply with United States Coast Guard (U.S.C.G.) requirements and must not be used for marine applications. Use only generator sets specified for marine use in marine installations. U.S.C.G. Regulation 33CFR183 requires a generator set to be ignition protected when used in a gasoline-fueled environment.

NOTE

Do not tee into fuel injected fuel systems. Use a two dip tube arrangement for fuel supply. Consult an authorized service dealer for further fuel system installation information.

NOTE

Do not leave generator sets equipped with the optional swing-down tray in the tilted position for any extended period (30 minutes or more). Always place unit in the normal mounting position when not performing service.

Introduction

Your vehicle is equipped with a dependable Kohler alternating-current generator set. Service requirements of the generator set are minimal but it is important to perform the required services at the prescribed intervals. Please take a few moments to read through this manual then carefully follow all service recommendations to keep your set in top condition. Keep this manual in your vehicle for future reference. See Figure 1-1 and Figure 1-2 to identify and locate major components.

Service Assistance

Check the yellow pages of your telephone directory under the heading GENERATORS-ELECTRIC for Kohler Generator Service Dealers/Distributors in your area.

KOHLER CO., Kohler, Wisconsin 53044
Phone: 414-565-3381
FAX: 414-459-1646 (North American Sales)
414-459-1614 (International)
For sales and service in U.S.A. and Canada
Phone: 1-800-544-2444

Provide MODEL, SPECIFICATION, SERIAL, and ENGINE numbers from the generator nameplate to receive current parts and information for your generator set.

Model No. _____

Specification No. _____

Serial No. _____

Engine No. _____

Section 1. Specifications

General Specifications

	4CKM/4CKMR (60 Hz)	5CKM/5CKMR (60 Hz)
Dimensions—L x W x H—in. (mm.)	24.83 x 18.46 x 13.98 (631 x 469 x 355)	24.83 x 18.46 x 13.98 (631 x 469 x 355)
Weight—lbs. (kg)	258 (117)	268 (121.5)
Air requirements:		
Combustion—cfm (m^3/min.)	20 (0.6)	20 (0.6)
Cooling—cfm (m^3/min.)	340 (9.6)	340 (9.6)
Free air opening—sq. in. (sq. cm)	85 (548)	85 (548)

	4CFKM/4CFKMR (50 Hz)
Dimensions—L x W x H—in. (mm)	24.83 x 18.46 x 13.98 (631 x 469 x 355)
Weight—lbs. (kg)	258 (117)
Air requirements:	
Combustion—cfm (m^3/min.)	20 (0.6)
Cooling—cfm (m^3/min.)	340 (9.6)
Free air opening—sq. in. (sq. cm)	85 (548)

Fuel Consumption	Gasoline—gph (Lph)			
Load	25%	50%	75%	100%
4CKM/4CKMR (60 Hz)	0.48 (1.8)	0.58 (2.2)	0.70 (2.6)	0.89 (3.4)
4CFKM/4CFKMR (50 Hz)	0.39 (1.5)	0.48 (1.8)	0.59 (2.2)	0.75 (2.8)
5CKM/5CKMR (60 Hz)	0.45 (1.7)	0.58 (2.2)	0.75 (2.8)	1.04 (3.9)
	LP gas—gph (Lph)			
4CKM/4CKMR (60 Hz)	0.46 (1.7)	0.69 (2.6)	0.77 (2.9)	0.99 (3.8)
4CFKM/4CFKMR (50 Hz)	0.39 (1.5)	0.58 (2.2)	0.65 (2.5)	0.82 (3.1)
5CKM/5CKMR (60 Hz)	0.54 (2.0)	0.80 (3.0)	0.90 (3.4)	1.15 (4.4)

Engine

Below lists some general engine specifications. Refer to the appropriate service section and the engine service manual for specific service details.

	4CKM/4CFKM/ 4CKMR/4CFKMR	5CKM/ 5CKMR
Manufacturer	Kohler	
Model	M18	M20
Cycle	4	
Number cylinders	2	
Compression ratio	6.0:1	6.6:1
Displacement—cu. in. (L)	42.18 (0.69)	46.98 (0.77)
Rated horsepower:		
60 Hz	8.9	9.5
50 Hz	7.4	7.9
RPM:		
60 Hz	1800	
50 Hz	1500	
Bore—in. (mm)	3.12 (79.25)	3.12 (79.25)
Stroke—in. (mm)	2.75 (69.85)	3.06 (77.72)
Valve material	Stellite®	
Valve clearance—in. (mm):		
Intake	0.003-0.006 (0.076-0.152)	
Exhaust	0.011-0.014 (0.279-0.355)	
Cylinder block material	Aluminum crankcase with cast iron cylinders (not sleeved)	
Cylinder head tightening torque—ft. lbs. (Nm)	15-20 (20-27)	
Cylinder head material	Aluminum	
Piston rings	2 compression/1 oil	
Crankshaft material	Heat treated ductile iron	
Bearings, number & type	2, replaceable sleeve	
Governor	Electronic	
Governor magnetic pickup air gap in. (mm)	0.040 (1.02) ± 0.005 (0.127)	
Lubrication system	Full pressure	
Oil capacity (with filter)—qts. (L)	1.5 (1.4)	2.5 (2.36)
Oil type (API)	SF or SG	
Oil pressure—psi (kPa)	30-40 (207-276)	

Engine (Continued)

	4CKM/4CFKM/ 4CKMR/4CFKMR	5CKM/ 5CKMR
Fuel type:		
Gasoline (octane rating)	87 octane unleaded (90 research rating method)	
LP vapor gas (inlet pressure)	7-11 in. water column, 4-6 oz. per sq. in.	
LP liquid withdrawal (inlet pressure)	50 psi	
Fuel pump pressure rating (gasoline models only)	2-3.5 psi (14-24 kPa)	
Battery voltage	12	
Battery ground	Negative	
Battery recommendation	290 cold cranking amp @ 0° F (–18° C) 55 amp hr.	
Spark plug type	Kohler part number 52 132 02	
Spark plug gap:		
Gasoline—in. (mm)	0.025 (0.64)	
LP gas—in. (mm)	0.018 (0.46)	
Spark plug tightening torque—ft. lbs. (Nm)	10-15 (13.6-20)	
Ignition system	Electronic	
Ignition module to magnet air gap	0.008-0.012	
Engine firing order	1-2-1	
Ignition timing (@ 1800 rpm)—60 Hz	Ignition module controlled	
Ignition timing (@ 1500 rpm)—50 Hz	Ignition module controlled	
Primary resistance	1.0-1.5 ohms	
High tension leads	22,000-42,000 ohms max. per lead	
Starter motor	Bendix-drive electric starter motor	
Cranking current at 70° F (21° C)	100 amps	
Cooling system	Air cooled	
Intake manifold bolt torque—ft. lbs. (Nm)	12.5 (17)	

Generator

	4CKM/4CKMR	5CKM/5CKMR
Rated kW	4	5
Rated kW (LP liquid withdrawal)	4	4.6
Rated kW (LP liquid withdrawal with battery charging)	3.7	4.3
Frequency—Hz	60	
Rated voltage	120 volt, 2-wire, single phase 120/240 volt, 3-wire, single phase	
Rated amps (120 volt)	33.3	41.7
Rated amps (240 volt)	16.7	20.8
Rated amps 12-volt battery charging system	0-15 amps—regulated	
Generator type	4-pole rotating field	
Shaft rpm, 60 Hz	1800	
Voltage regulation	± 2%	
Frequency regulation	± 0.5%	
Minimum recommended clearance for vibration and cooling—(front, side*, top, rear)	0.6 in. (15.2 mm)	
Number of output leads	4, reconnectable	
Stator resistance (ohms)** leads:		
1-2, 3-4, 33-44	0.34	
55-33	2.8	
B1-B2	0.15	
C1-CP, C2-CP	0.14	
Rotor field voltage/current readings at rated voltage (hot) 240v		
No load	17v/3.1a	17v/ 3.1a
Full load	27v/4.6a	32v/5.3a
Stator output voltages with separately excited rotor using 12-volt battery		
1-2, 3-4, 33-44	90	
33-55	135	
B1-B2	14	
	4CFKM/4CFKMR	
Rated kW	3.3	
Frequency—Hz	50	
Rated voltage	110 volt, 2-wire, single phase 110/220 volt, 3-wire, single phase	
Rated amps (110 volt)	30.0	
Rated amps (220 volt)	15.0	
Generator type	4-pole rotating field	
Shaft rpm, 50 Hz	1500	
Voltage regulation	± 2%	
Frequency regulation	± 0.5%	
Minimum recommended clearance for vibration and cooling—(front, side*, top, rear)	0.6 in. (15.2 mm)	
Number of output leads (single phase)	4, reconnectable	
Number of output leads (three phase)	12, reconnectable	

* If using floor or end free-air opening, refer to the Operation and Installation Manual for correct clearances.

** Most ohmmeters will not give accurate readings when measuring less than 1 ohm. Consider the stator good if obtaining a low resistance reading (continuity) and there is no evidence of shorted windings (discoloration). Do not confuse a low resistance reading with a reading indicating a shorted winding.

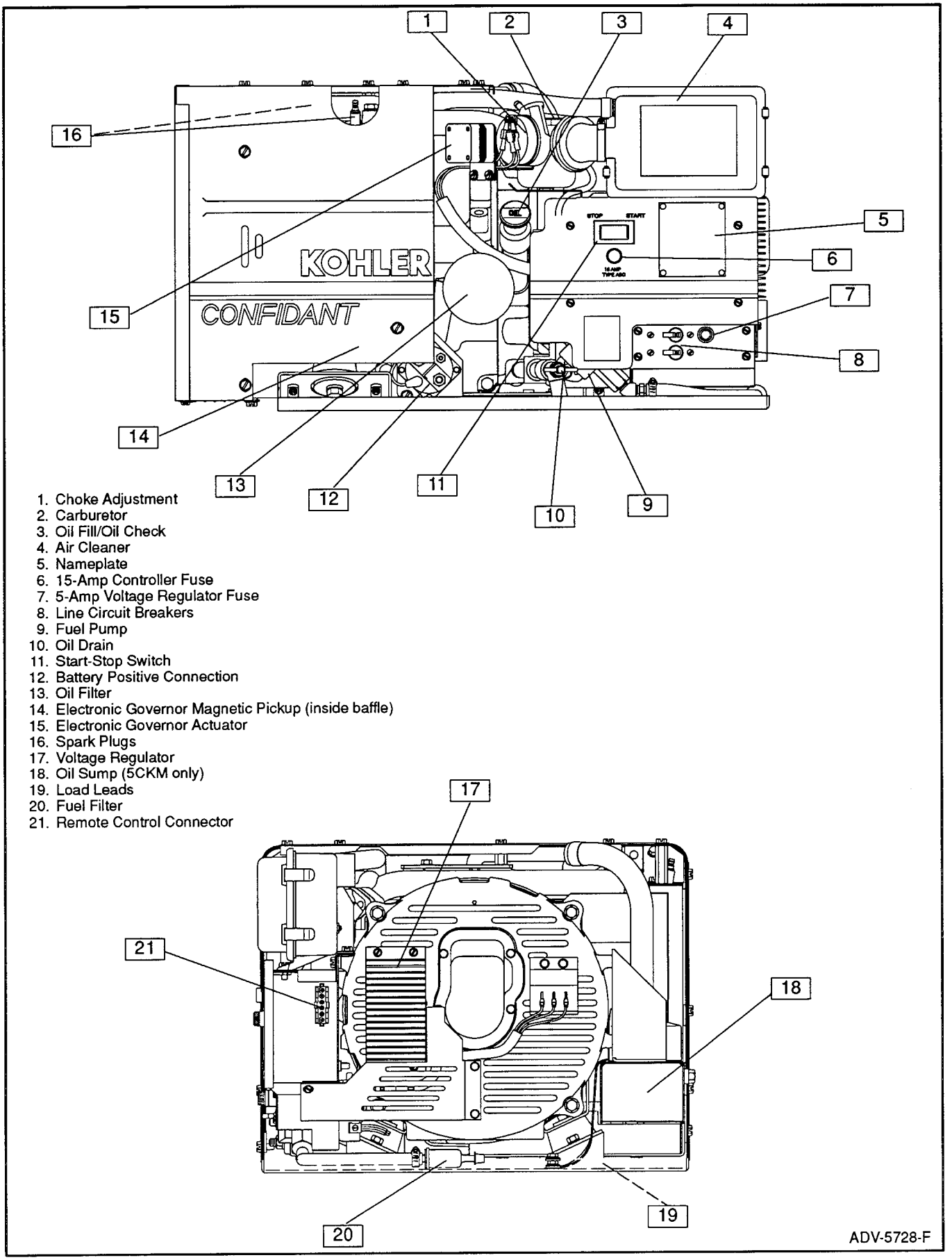
Generator (Continued)

	4CFKM/4CFKMR
Stator resistance (ohms)** leads:	
1-2, 3-4, 33-44	0.40
55-33	2.8
B1-B2	0.15
C1-CP, C2-CP	0.14
Rotor field voltage/current readings at rated voltage (hot) 220v	
No load	21v/3.9a
Full load	33v/5.8a
Stator output voltages with separately excited rotor using 12-volt battery	
1-2, 3-4, 33-44	90
33-55	114
B1-B2	14
	All Models
Rotor resistance (ohms)	3.5-5.5
Excitation method	Solid state brush
Coupling type	Tapered shaft, thrubolt
Overbolt torque—in. lbs. (Nm)	60 (7)
Voltage regulator type (single-phase models)	PowerBoost™ IIIE
Voltage regulator type (three-phase models)	PowerBoost™ V
Insulation (rotor and stator)	Class 155, epoxy varnish, vacuum impregnated
Winding material	Copper
Bearing, number and type	1, replaceable ball
Circuit protection:	
Controller	15-amp fuse
Voltage regulator	5-amp fuse
Battery charging (if equipped)	25-amp circuit breaker
Deicing module (if equipped—newer models)	5-amp fuse

** Most ohmmeters will not give accurate readings when measuring less than 1 ohm. Consider the stator good if obtaining a low resistance reading (continuity) and there is no evidence of shorted windings (discoloration). Do not confuse a low resistance reading with a reading indicating a shorted winding.

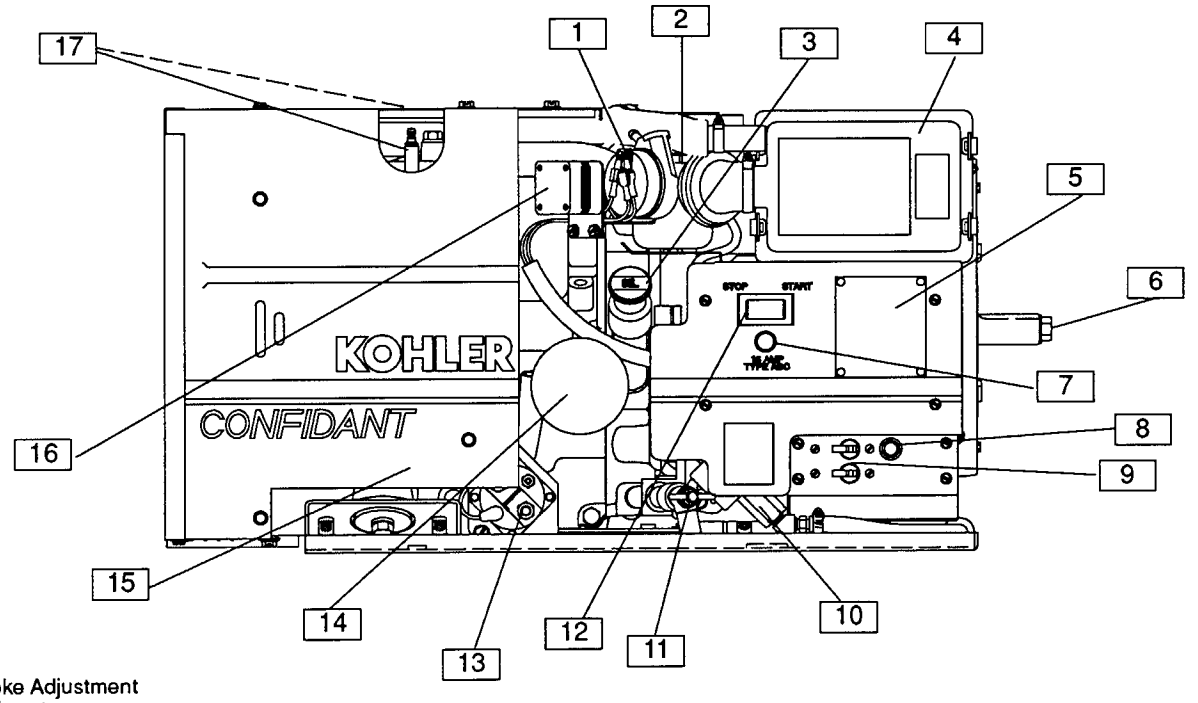
DERATION: All units are rated 1.0 power factor. Derate approximately 4.0% per 1000 ft. (300 m) above sea level and 1% for each 10°F (5.5°C) increase in temperature above 85°F (29°C).

Torque Specifications	
Generator	
Overbolt torque—in. lbs. (Nm)	60 (7)
Thrubolt torque—ft. lbs. (Nm)	40-55 (54-75)
Engine	
Cylinder head torque—ft. lbs. (Nm)	15-20 (20-27)
Spark plug torque—ft. lbs. (Nm)	10-15 (14-20)
Intake manifold bolt—ft. lbs. (Nm)	12.5 (17)

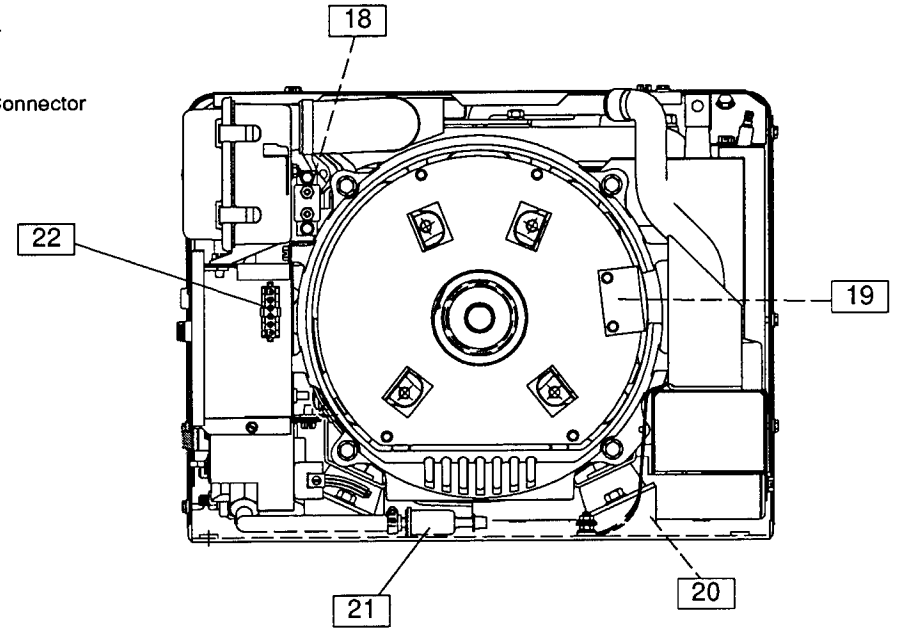


1. Choke Adjustment
2. Carburetor
3. Oil Fill/Oil Check
4. Air Cleaner
5. Nameplate
6. 15-Amp Controller Fuse
7. 5-Amp Voltage Regulator Fuse
8. Line Circuit Breakers
9. Fuel Pump
10. Oil Drain
11. Start-Stop Switch
12. Battery Positive Connection
13. Oil Filter
14. Electronic Governor Magnetic Pickup (inside baffle)
15. Electronic Governor Actuator
16. Spark Plugs
17. Voltage Regulator
18. Oil Sump (5CKM only)
19. Load Leads
20. Fuel Filter
21. Remote Control Connector

Figure 1-1. Service View 4/5CKM-RV or 4CFKM-RV



1. Choke Adjustment
2. Carburetor
3. Oil Fill/Oil Check
4. Air Cleaner
5. Nameplate
6. Extended Shaft (Option)
7. 15-Amp Controller Fuse
8. 5-Amp Voltage Regulator Fuse
9. Line Circuit Breakers
10. Fuel Pump
11. Oil Drain
12. Start-Stop Switch
13. Battery Positive Connection
14. Oil Filter
15. Electronic Governor Magnetic Pickup (inside baffle)
16. Electronic Governor Actuator
17. Spark Plugs
18. 25-Amp Battery Charging Circuit Breaker (Option—auto-resettable)
19. Voltage Regulator
20. Load Leads
21. Fuel Filter
22. Remote Control Connector



ADV-5780-B

Figure 1-2. Service View 4/5CKMR-Mobile or 4CFKMR-Mobile

Accessories

Several accessories are available to finalize the installation or to add convenience to operation and service. Obtain the most current information by contacting your local Kohler dealer/distributor. Following are accessories available at the time of print of this publication.

Remote Panels

Kohler offers optional remote panels for mounting wherever convenient inside the motorhome. Remote panel harness plug has the *four-square* configuration. Remote panels require an extension wiring harness for hookup to the generator set controller.

Remote Start/Stop Panel

Allows starting/stopping from a location remote of the generator set. Overall mounting dimensions are 4 1/16 in. (103 mm) by 2 1/8 in. (54 mm) with a minimum mounting depth of 2 1/4 in. (57 mm).

Remote Start/Stop Panel With Hourmeter

Allows starting/stopping from a location remote of the generator set. Overall mounting dimensions are 4 in. (102 mm) by 2 in. (51 mm) with a minimum mounting depth of 2 5/16 in. (59 mm). Refer to TT-798 instructions for assembly.

Wiring Harnesses

Kohler Co. supplies wiring harnesses of varying lengths to simplify electrical connections between the generator set controller and the remote panel. Top quality gold-plated contacts are used for greatest corrosion resistance. Harnesses of 3 ft. (91 cm), 15 ft. (38 cm), 30 ft. (76 cm), and 40 ft. (102 cm) are offered with keyed (error-proof) plugs for the controller and the Kohler remote panel. One end has the *four-square* plug for connection to remote panel. The other plug end has the *six in-line* configuration for connection to the generator set controller.

Kohler offers a one foot (0.3 m) wiring harness with a keyed plug for the controller and pigtails for connection to customer-supplied start switch, generator ON light, hourmeter, etc. Pigtail harness plug has the *six in-line* configuration for hookup to the generator set controller.

Exhaust Systems

Aluminum coated for durability, all Kohler mufflers are designed for minimal back pressure to allow full rated power output. The U.S. Forestry approves Kohler spark arrestors. All required elbows, clamps, brackets, etc., are provided in kits. Refer to TT-870 instructions for assembly.

Available muffler kits include:
Right-side exhaust outlet for generator set mounted above floor.
Left-side exhaust outlet for generator set mounted above floor.
Front exhaust outlet for generator set mounted below floor.
Rear exhaust outlet for generator set mounted below floor.
Side exhaust outlet for generator set mounted below floor.
Center tap bottom exhaust outlet for generator set mounted below floor.

LP Conversion Kit

An LP vapor withdrawal kit is available with all of the necessary components for installation. This kit applies only to certain models—consult factory. Refer to TT-1034 instructions for assembly.

Below-Floor Mounting Trays

A below-floor mounting kit for use with the standard tray is available. Housing kit and hinge kit for use with the below-floor mounting kit are also available. Refer to TT-802 instructions for enclosure and hinge kit assembly and TT-835 instructions for mounting tray assembly.

Section 2. Operation

Prestart Checklist

To ensure continued satisfactory operation; check the following items before each startup.

Oil Level: Keep at or near full mark (not over).

Air Inlets: Keep clear and unobstructed.

Compartment: Maintain a clean interior.

Air Cleaner: Clean and properly installed.

Air Shrouding: Keep tight and in proper position.

Exhaust: Clear and unobstructed tail pipe. Tight muffler and piping connections.

Electrical: Tighten connections (including battery).

Controller

The Kohler relay controller, located on the generator set, includes the components required for generator set operation. See Figure 2-1 for components and the paragraphs below for component description. If the generator set stops automatically during operation, determine if the shutdown is due to low oil pressure. If so, determine and correct the cause of the low oil pressure shutdown before restarting the set.

1. **Generator Start/Stop Switch.** Placing this switch in the Start position starts the generator set engine. Placing switch to Stop position stops the engine. In either case, switch returns to neutral center position when released.

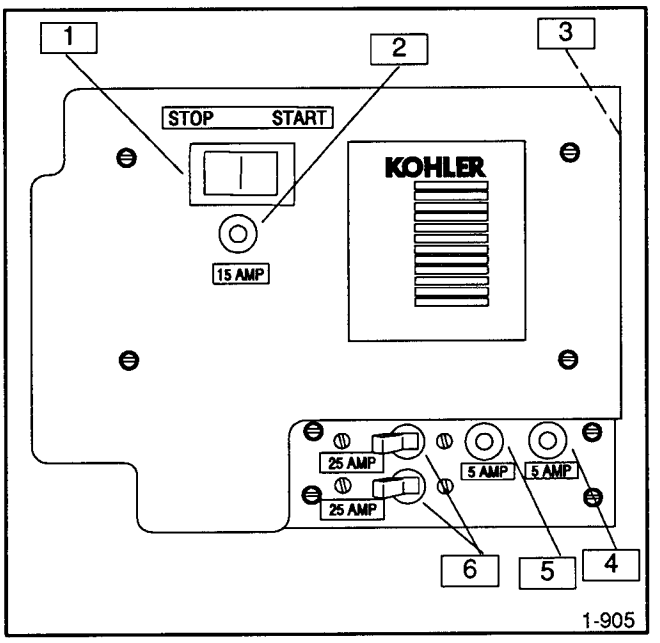
2. **Controller Fuse.** A 15-amp fuse protects controller circuitry against damage in the event of a short circuit.

3. **Remote Panel Connector.** A 6-pin connector on controller side panel allows connection of remote panels to controller.

4. **Deicing Module Fuse.** A 5-amp fuse protects the deicing module in the event of a short circuit. (Newer gasoline models only.)

5. **Voltage Regulator Fuse.** A 5-amp fuse protects the voltage regulator circuitry against damage in the event of a short circuit.

6. **AC Circuit Breaker(s).** The circuit breakers protect the generator against damage in the event of a sustained overload. These circuit breakers are also used to disconnect the load from the generator set. To close the circuit to the load, place the circuit breaker(s) in the ON position.



1. Generator Start/Stop Switch
2. Controller Fuse
3. Remote Panel Connection
4. Deicing Module Fuse
5. Voltage Regulator Fuse
6. AC Circuit Breaker(s)

Figure 2-1. Controller

Starting Procedure

Place the Start/Stop switch in the start position and hold in this position until the engine is running, then release. Do not crank engine continuously for more than 10 seconds at a time. Allow a 60-second cooldown period between cranking attempts if the engine does not start. If the unit fails to start after three attempts, contact an authorized service dealer/distributor for repair. Follow the instructions below to start/stop the generator set. The starter motor may burn out if these instructions are not followed.

NOTE

If the engine starts and then stops, allow the engine to come to a complete stop before making a restart attempt. If the flywheel ring gear is still rotating when the starter pinion gear is engaged, the pinion gear will clash which may damage the ring gear teeth.

Stopping Procedure

Whenever possible, allow a brief cooling period by running the set at low or no load for a few minutes just prior to shutdown. To stop, rock the switch to the stop position and hold until the set comes to a complete halt. If the generator set shuts down automatically, identify and correct the problem before attempting to restart.

Anti-icing (For Gasoline Models Only)

When operating the generator set in cold conditions, moisture in the incoming air may condense in the carburetor assembly, especially after stopping the generator set. The condensed moisture can then freeze, creating ice crystals that inhibit normal carburetor operation. To avoid these conditions, each generator set has one of three types of anti-icing systems detailed in the following paragraphs.

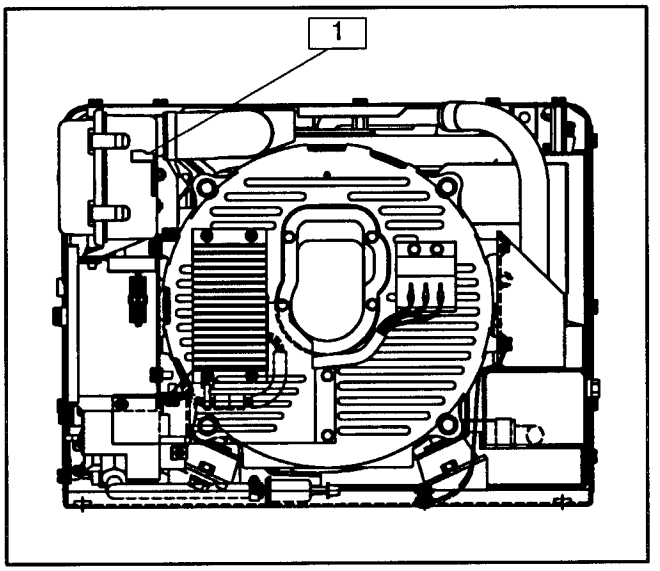
Manual Anti-icing System (Air Cleaner Preheat)

The manual anti-icing system permits the user to route heated manifold air to the carburetor intake when ambient temperatures are low. The manual system is identified by the anti-icing adjustment lever found on the air cleaner. See Figure 2-2.

When operating a generator with manual anti-icing at temperatures of approximately 40° F (4° C) or less, move the anti-icing lever up to the winter position. At temperatures of approximately 70° F (21° C) or above, move the anti-icing lever down to the summer position. For ambient temperatures between 40° and 70° F (4° and 21° C), the anti-icing lever may be left in either position.

NOTE

Be aware of reduced generator output if operating the set in temperatures above 70° F (21° C) with the adjustment lever in the winter position.



1. Winter/Summer Lever

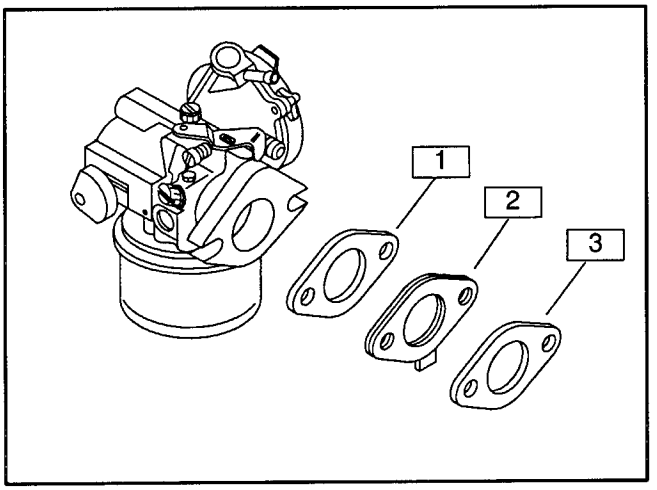
Figure 2-2. Manual Anti-icing System

Positive Temperature Coefficient Plate Anti-icing System (Anti-icing Plate) Early Models

The positive temperature coefficient (PTC) anti-icing system consists of an electric-heating element mounted between the intake manifold and the carburetor. See Figure 2-3. This device operates at 12 vdc.

The heater within the PTC runs whenever the generator set is running. A thermistor, also within the PTC, controls the amount of heat produced by the electric heater. When it is cold, the thermistor automatically allows maximum current (approximately 3 amperes) to flow through the heater and thus produces the maximum amount of heat. As the thermistor temperature increases, current flow to the heater decreases (to a minimum of 0.75 amperes), reducing the heater output.

No manual operation is required because the operation of this anti-icing system is completely automatic.



1. Graphite Spacer
2. Heater
3. Gasket

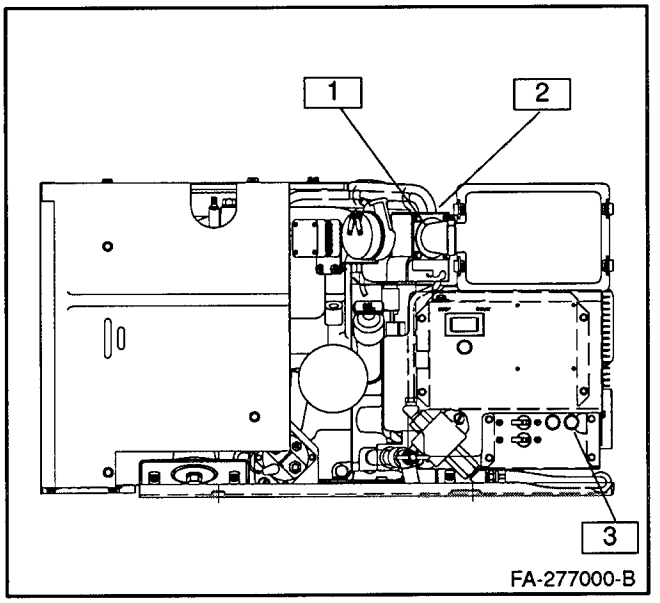
Figure 2-3. PTC Anti-icing System

Automatic Deicing System (Combustion and Preheater) Current Models

The automatic deicing system consists of a deicing module and two temperature switches. An electric heater within the module automatically warms the incoming air when the generator set is running and the ambient temperature is low. This device operates at 120 vac. The system can be recognized by the module mounted between the carburetor air horn and air cleaner. See Figure 2-4.

Two temperature switches control the operation of the heater. A low-level switch turns on power to the heater only when the ambient air temperature is approximately 60° F (16° C) or less. A high-level switch cycles off heater power when the deicing module temperature climbs to approximately 185° F (85° C).

No manual operation is required because the operation of this anti-icing system is completely automatic.



1. Deicing Module (includes high-limit thermostat and heater)
2. Low-Limit Thermostat (located on manifold)
3. 5-amp Deicing Fuse

Figure 2-4. Automatic Deicing System

Circuit Protection

Refer to Figure 2-5 and the following descriptions to identify circuit protection components.

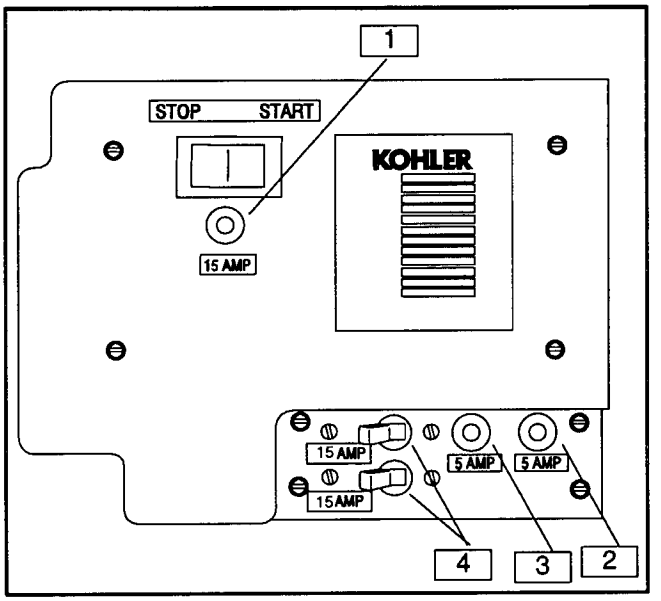
1. **Input (Controller) Fuse (15 Amp).** A replaceable 15-amp fuse protects the controller circuitry. If the generator engine will not crank and the battery and/or other connections are tight, the controller fuse may be blown.

2. **Deicing Module Fuse (5 Amp) (on newer gasoline models only).** A replaceable 5-amp fuse protects the controller circuitry against shorts in the deicing module. If fuse blows again after replacement, check and repair the deicing module and its wiring.

3. **Voltage Regulator Fuse (5 Amp).** A replaceable 5-amp fuse protects the voltage regulator circuits. If the fuse is blown, the generator will not continue running.

4. **AC Circuit Breakers.** These circuit breakers trip when faults occur in the AC output (load) circuits to protect the generator stator windings. If a circuit breaker trips, check the load circuits for shorts or excessive wattage requirements. After fault is corrected, reset AC circuit breaker to the ON position.

5. **Battery-Charging Circuit Breaker (25 Amp).** This circuit breaker trips to protect the battery-charging circuit, including the battery-charging windings of the generator stator, in the event of a short. If this circuit breaker trips, refer to the troubleshooting procedures to isolate and repair the problem. This breaker automatically resets. See Figure 1-2 for location.



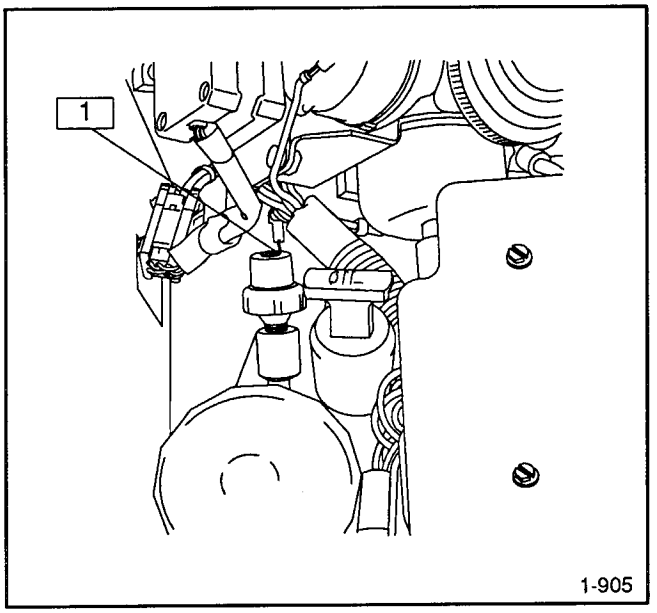
1. Controller Fuse
2. Deicing Module Fuse
3. Voltage Regulator Fuse
4. AC Circuit Breaker(s)

Figure 2-5. Controller Circuit Protection Components

Engine Safety Shutdowns

Low Oil Pressure Shutdown

The low oil pressure shutdown feature protects the engine against internal damage if the oil pressure drops below 3 1/2 psi ± 1 1/2 psi (24.1 kPa) due to oil pump fault or other malfunction. It does not protect against damage due to operating with the oil level below the safe range—*it is not a low oil level shutdown.* The only protection against running out of oil is checking the level regularly and adding oil as needed. Figure 2-6 shows the location of the low oil pressure (LOP) switch.



1. Low Oil Pressure Switch

Figure 2-6. Low Oil Pressure Switch

Overspeed Shutdown

The generator set employs an electronic governor to regulate the engine speed. This regulation assures that generator output remains within ±0.25 percent of the specified frequency (50 or 60 Hz). The electronic governor also monitors for overspeed conditions in order to prevent engine runaway. The governor shuts down the generator set engine if the output frequency exceeds 60 Hz (for 50 Hz models) or 72 Hz (for 60 Hz models).

Optional Remote Panels

Remote Start Panel

The remote start panel (Figure 2-7) allows starting/stopping from a location remote of the generator set. A 6-pin connector on the controller permits connection of the panel to the generator set. Procedures for starting and stopping from the remote panel are the same as those given for the controller panel.

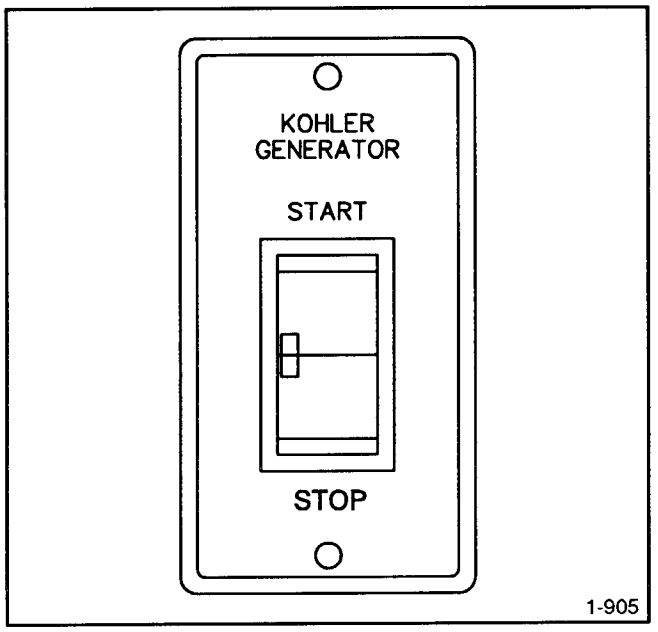


Figure 2-7. Remote Start Panel

Remote Start Panel With Hourmeter

The remote start panel with hourmeter (Figure 2-8) allows starting/stopping from a location remote of the generator set. The hourmeter on the panel records total generator operating time to facilitate scheduling of maintenance. The panel also includes a light. If the light is lit, the generator is running. A 6-pin connector on the controller permits connection of this panel to the generator set. Procedures for starting and stopping from the remote panel are the same as those given for the controller panel.

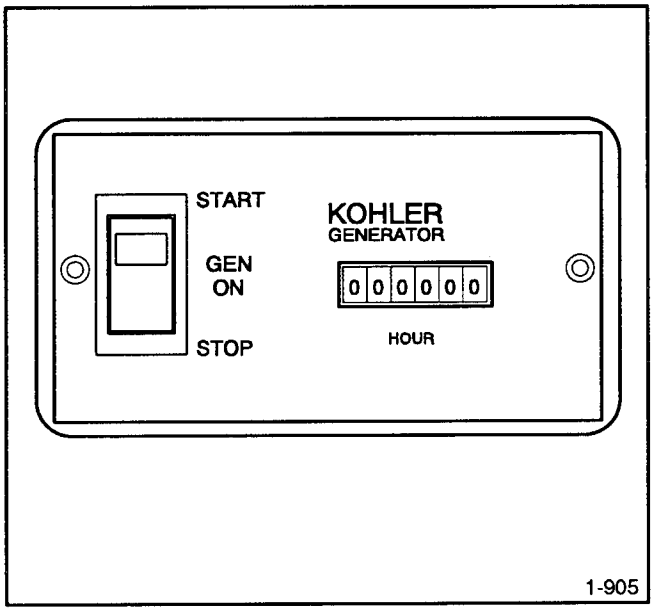


Figure 2-8. Remote Start Panel With Hourmeter

Section 3. Scheduled Maintenance

General

Schedule routine maintenance according to the Service Schedule following and the hourmeter located on the controller. If subjecting the generator to extreme operating conditions, service the unit more frequently. The following pages provide instructions for performing most of the scheduled services. If tools and instruments required for these services are not available to the generator set owner, the set should be returned periodically to an authorized service dealer/distributor for complete servicing and tune-up. The benefits of such service will be improved performance and continuous satisfactory operation during a long trouble-free service life.

⚠ WARNING

Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by the remote start/stop switch unless this precaution is followed.

NOTE

Perform the items listed in the service schedule at the designated intervals for the life of the generator. For example, an item to be serviced "every 50 hours or 6 months" must also be serviced after 100 hours or 12 months, 500 hours or 2 years, etc. The generator will eventually accumulate enough hours to warrant a complete overhaul. The exact time at which extensive service will be necessary cannot be predicted. However, rough operation, lack of power, and excessive oil use indicate serious generator set problems. As part of a preventive maintenance program, service the engine (clean cylinder head, inspect valves, check compression, etc.) and generator (replace bearing, inspect wiring, remove debris, etc.) at the earliest indication that a problem exists.

NOTE

Do not leave generator sets equipped with the optional swing-down tray in the tilted position for any extended period (30 minutes or more). Always place unit in the normal mounting position when not performing service.

Service Schedule

Perform Service at Intervals Indicated (•)	Before Each Startup	Every 50 Hours or 6 Months	Every 100 Hours or 12 Months	Every 500 Hours or Two Years
Check exhaust outlet	•			
Check oil level	•			
Check fuel supply	•			
Keep cooling air inlets and outlets clean and unobstructed	•			
Remove loose dirt from compartment	•			
Check electrolyte level in battery	•			
Check air cleaner (replace if dirty)		•		
Drain collection pipe (LP liquid-fueled units only—if equipped)		•		
Change lube oil (change oil initially after first five hours of operation)		• *	• **	
Replace lube oil filter		• *	• **	
Service or replace spark plugs			•	
Check battery specific gravity			•	
Check and tighten electrical connections			•	
Check and tighten mounting bolts and vibromounts			•	
Blow dust out of generator			•	
Clean spark arrestor			•	
Check for stepper motor/throttle shaft coupling wear				• (250 hours)
Check valve-tappet clearance				•
Service cylinder heads				• ***
Check compression				• ***
Inspect liquid withdrawal LP fuel filter				•
Replace fuel filter				•

* Applies to 5 kW

** Applies to 4 kW

*** Performed by an authorized Kohler service dealer/distributor

NOTE

Unleaded gasoline is recommended. If using leaded gasoline, service cylinder heads every 250 hours.

Lubrication System

Description

The engine has a positive-pressure lubrication system that includes an internal oil pump, a replaceable oil filter, and a low oil pressure shutdown switch.

Oil Check

Check crankcase oil level daily or before each start. To check oil level, remove oil cap/dipstick assembly and wipe dipstick clean. See Figure 3-1. Reposition dipstick in crankcase and insert it all the way down into the tube. Remove dipstick and check the level. Oil level should read between max and min marks on dipstick. See Figure 3-2. Do not operate set if oil level exceeds the max mark or registers below the min mark on dipstick.

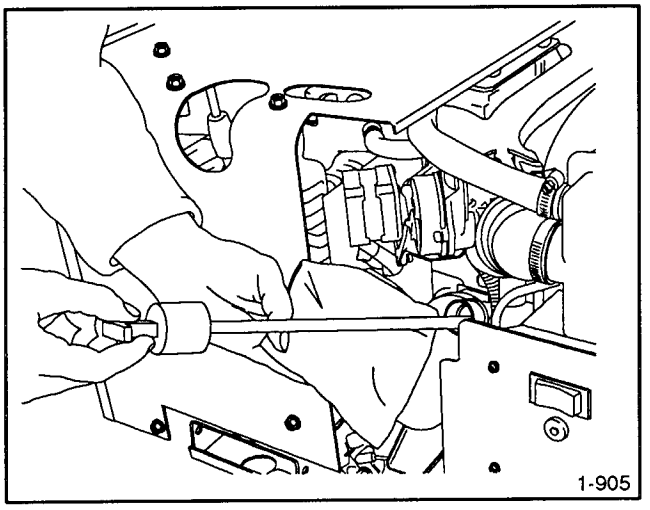
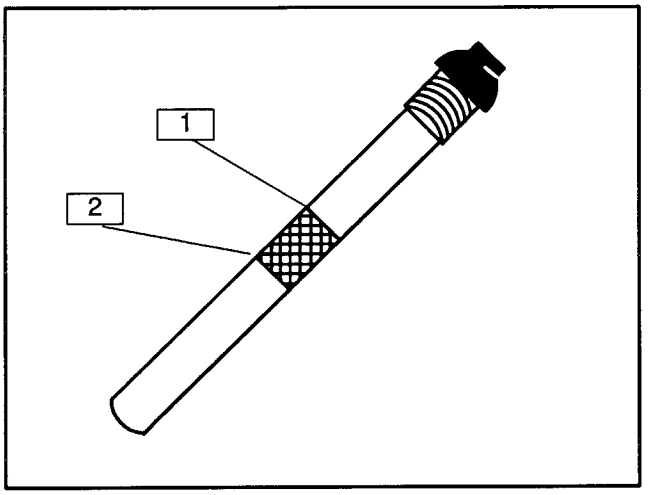


Figure 3-1. Oil Check



1. Max Mark
2. Min Mark

Figure 3-2. Lube Oil Level

NOTE

Do not check oil level when the set is in operation. The engine must be stopped and on a level surface when checking oil. Shut down the generator and wait several minutes before checking oil to ensure an accurate oil reading.

Oil Specifications

Oil used in factory generator set testing is drained before shipping. Before operating a new set, fill the engine crankcase to the specified capacity with a straight-weight oil having a viscosity appropriate for your particular climate. Do not use synthetic oils during the first five hours of operation or the rings may not seat properly. Change the oil immediately after the first five hours of operation.

Use high-quality detergent oils meeting the requirements of SAE service class SF or SG in Kohler M18 and M20 engines. Straight-weight 30 oil is preferred. If using multi-viscosity oil in temperatures above 32° F (0° C), be aware of the resulting increase in oil consumption and combustion deposits. Base oil type selection on air temperature at time of operation. Consult the SAE viscosity grade chart (see Figure 3-3).

Do not mix different brands of oils. Possible incompatibility could cause a breakdown of lubricating ingredients and reduce engine protection.

RECOMMENDED SAE VISCOSITY GRADES

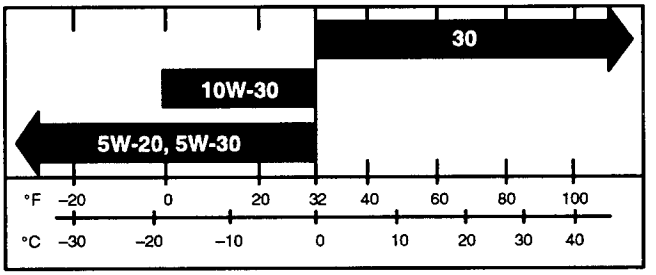


Figure 3-3. Temperature Range Expected Before Next Oil Change

Adding Oil

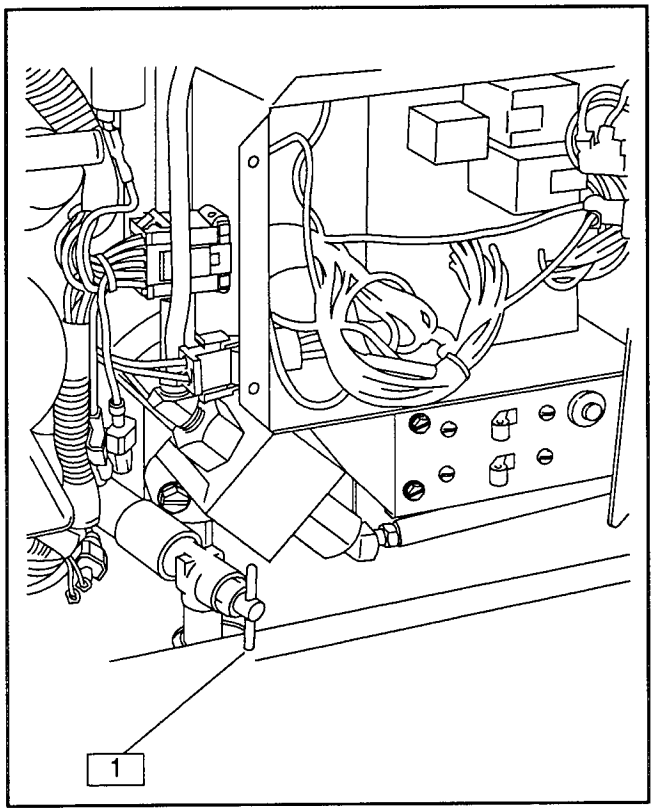
It is normal to add some oil between oil changes. The amount will vary with the usage. Open fill cap and pour in a small amount of oil using a funnel or other suitable pouring device. Wait a few minutes and check level. If necessary, add more oil and then check again. Each time add small quantities and check to prevent overfilling.

OIL CAPACITY (with Filter)	
Generator Model	Qts. (L)
4 kW	1.5 (1.4)
5 kW	2.5 (2.4)

Figure 3-4. Engine Oil Capacity

Oil Change

On a new engine, change the oil after the first 5 hours of operation and thereafter at the intervals specified in the service schedule. Whenever possible, change oil while the engine is still warm.



1. Oil Drain Petcock

Figure 3-5. Oil Drain Petcock

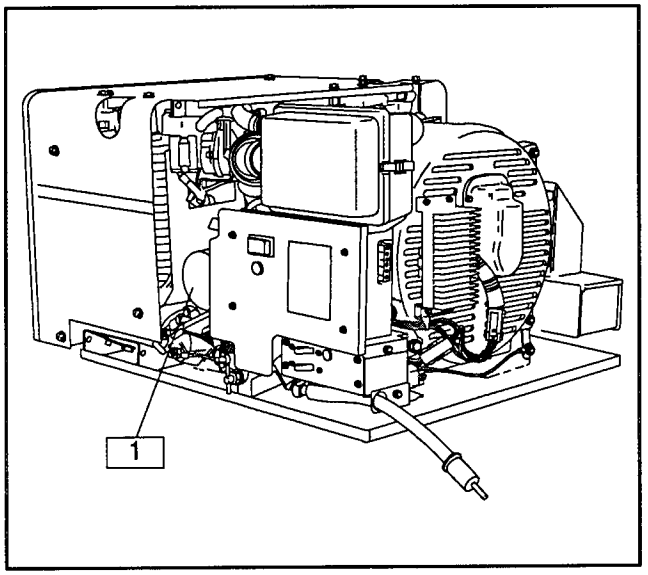
1. Place a container below the oil drain hole and open the oil drain petcock (located beneath the dipstick). See Figure 3-5. Allow sufficient time for the old oil to drain completely. Close oil drain petcock. Dispose of used engine oil in an environmentally safe manner.
2. Remove oil fill cap dipstick. See Figure 3-1.
3. If the engine oil filter is to be replaced, see Oil Filter following.
4. Fill crankcase with amount and type of oil as specified in Figure 3-3 and Figure 3-4.
5. Start the generator set and check for oil leaks.
6. Stop the generator set. Remove the dipstick and wipe clean, reinsert as far as possible, and remove to check oil level. Add oil, as necessary, to bring level up to max mark.

NOTE

Too high an oil level causes high oil consumption and carbonizing in the engine. Low oil level will cause engine damage.

Oil Filter

Replace the oil filter every time the oil is changed. See Figure 3-6 and refer to the following procedure.



1. Oil Filter

Figure 3-6. Oil Filter Location

1. Loosen oil filter by turning it with a filter wrench in a counterclockwise direction. Oil filter is 3 in. (76 mm) dia. and has 14 flutes (sides). Use rags to clean up spilled oil. Remove and discard.
2. Clean contact surface on oil filter adapter.
3. Lightly lubricate the gasket surface of the new oil filter with the fresh engine oil. Thread oil filter to adapter until gasket makes contact, hand tighten an additional one-half turn.
4. Fill crankcase with fresh oil and check for leaks as detailed in steps 4-6 of Oil Change procedure on previous page.

Cooling System

To prevent generator set overheating damage, keep the compartment cooling air inlets clean and unobstructed at all times.

A fan on the rotor of the generator draws cooling air into the compartment through the generator cooling slots and expels it at the engine-generator adapter. The engine of the generator set features an Air-Vac™ reverse-flow cooling system. Fins on the engine flywheel pull cooling air past the fins of the cylinder heads and heated air is discharged downward and out of the compartment through the discharge chute. See Figure 3-7.

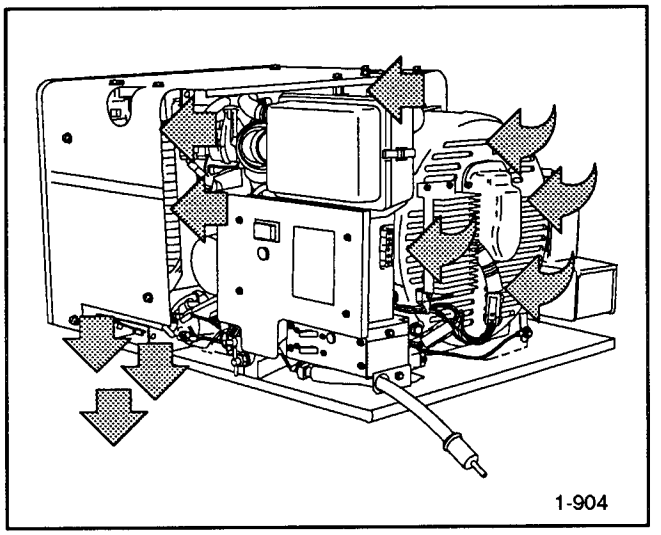


Figure 3-7. Cooling Air Circulation

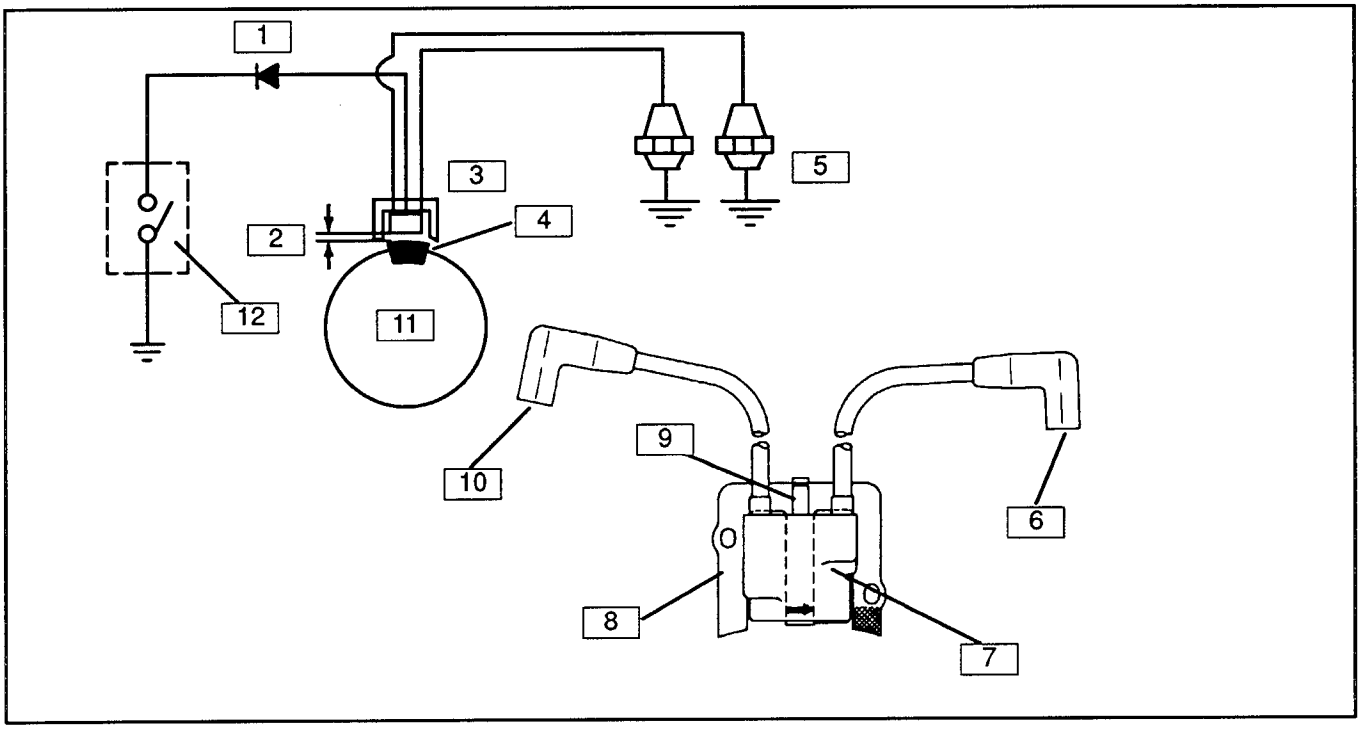
Ignition System

Description

The 4 kW and 5 kW generator sets are equipped with a dependable electronic magneto ignition system (Figure 3-8) containing the following:

- A magnet assembly permanently affixed to the flywheel.
- An electronic magneto ignition module mounted to the #1 side cylinder barrel.
- A controller which stops the engine by grounding the ignition module.

As the flywheel rotates and the magnet assembly moves past the ignition module, a low voltage is induced in the primary windings of the module. When the primary voltage is precisely at its peak, the module induces a high voltage in its secondary windings. This high voltage creates a spark at the tip of the spark plugs, igniting the fuel-air mixture in the combustion chambers. Other than periodically checking/replacing the spark plugs, no maintenance, timing, or adjustments are necessary with this ignition system.



1. Diode
2. 0.008/0.012 in. (0.20 /0.30 mm) Air Gap
3. Ignition Module
4. Magnet
5. Spark Plugs
6. High Tension Lead
7. Coil Assembly
8. Laminations
9. Terminal
10. High Tension Lead
11. Flywheel
12. Controller

Figure 3-8. Electronic Magneto Ignition System

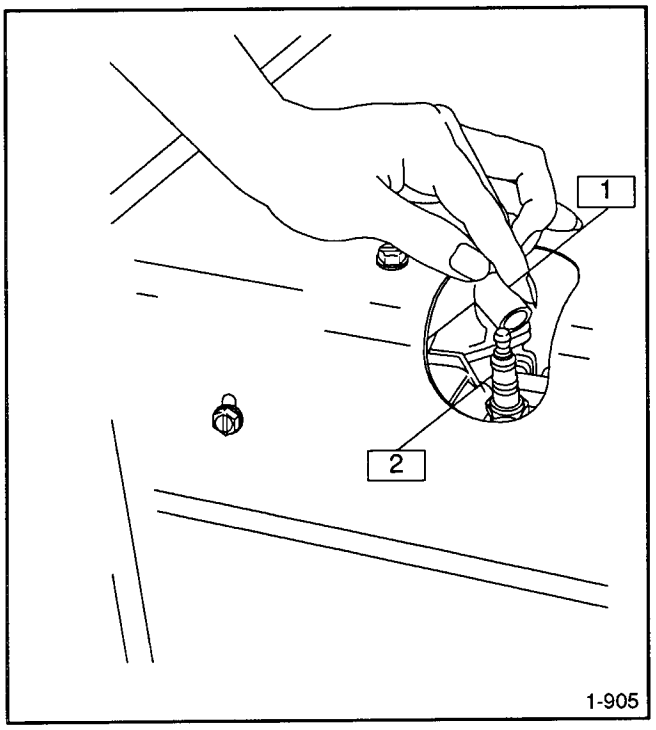
Spark Plugs

At the interval recommended in the service schedule, service spark plugs as follows:

1. Remove spark plug wires by grasping boot and turning slightly while pulling. Do not pull on wire. See Figure 3-9.

NOTE

Pulling wire rather than boot may cause damage to wire or terminal.



1. Boot
2. Spark Plug

Figure 3-9. Removing Spark Plug Boot

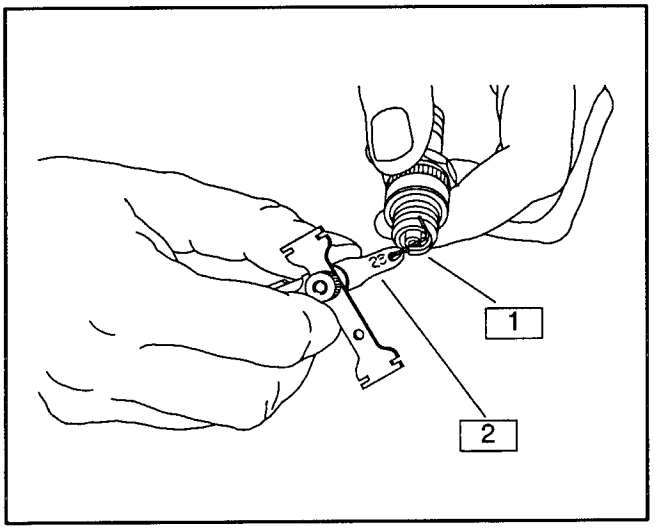
2. Loosen spark plug with a ratchet and spark plug socket with a rubber insert to prevent damage to spark plug. If possible, use compressed air to remove dirt around each spark plug before completing spark plug removal. This procedure will prevent dirt from falling into combustion chamber.
3. Remove and examine each spark plug for conditions described in Figure 3-12.
4. Wipe spark plugs clean with a rag. Then file center electrode so its top is flat and perpendicular to the spark plug axis. Should replacement be necessary, see Specifications, Engine in Section 1 for spark plug type.

NOTE

Do not sandblast, wire brush, scrape, or otherwise service spark plug in poor condition. For best results replace the plug.

5. Before installing any spark plug, check the gap. See Figure 3-10. The proper gap is attained when the feeler gauge (or wire) passes between the spark plug electrodes. It should pass easily, but with some resistance or drag; otherwise, adjust as necessary.

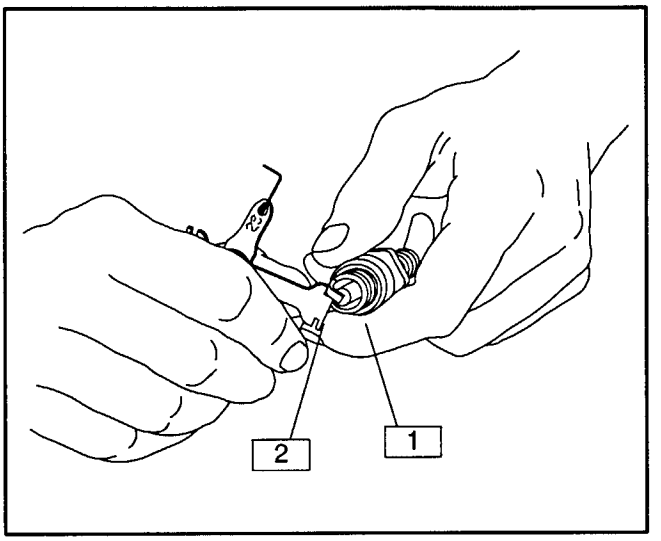
   The correct gap is 0.025 in. (0.64 mm) for gasoline models and 0.018 in. (0.46 mm) for LP gas models.



1. Spark Plug
2. Gap Gauge

Figure 3-10. Checking Spark Plug Gap

6. If necessary use gapping tool to gently bend side electrode in order to correct gap. See Figure 3-11. Be sure side electrode remains centered over center electrode. Repeat steps 5 and 6 until gap is properly adjusted.



1. Spark Plug
2. Gapping Tool

Figure 3-11. Adjusting Spark Plug Gap

7. Install spark plug in cylinder head, be careful not to bump electrode and alter gap. Rotate spark plug clockwise until resistance is felt.
8. Tighten each spark plug with a torque wrench to a torque of 10-15 ft. lbs. (14-20 Nm). If a torque wrench is not available, tighten each spark plug until resistance is felt; then tighten with a ratchet an additional 1/4 turn. Do NOT overtighten as this may strip the cylinder head threads or alter the gap setting.
9. Check spark plug wire connector in boot for accumulated dirt, grease, etc., and clean as necessary. Firmly push spark plug boot onto spark plug.

Timing

The timing of the spark is automatically controlled by the ignition module. No ignition timing adjustments are necessary or possible with this system. If timing problems are encountered, check ignition module air gap. See Engine Service Manual for details.

Spark Plug Condition	Means of Identification	Possible Cause/ Recommended Action
Normal	Light gray or tan deposit on firing tip.	Good operating conditions and maintenance.
Gap bridged	Built-up deposits closing gap between electrodes.	Oil or carbon fouling. Clean and regap plug.
Oil fouled	Wet black deposits on the insulator shell bore electrode.	Excessive oil entering combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Replace plug.
Carbon fouled	Black, dry fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes.	Using too cold range plug, weak ignition, clogged air intake or improper carburetor adjustments, defective fuel pump, overrich fuel mixture, or excessive no-load operation. Clean and regap plug.
Lead fouled	Dark gray, black, yellow, or tan deposits; or a glazed coating on the insulator tip.	Highly leaded fuel. Replace plug.
Preignition	Melted electrodes and possibly blistered insulator. Metallic deposits on insulator suggest internal engine damage.	Wrong type of fuel, incorrect timing or advance, too hot of a plug, burnt valves or engine overheating. Replace plug.
Overheating	White or light gray insulator with small black or gray/brown spots with bluish (burnt) appearance on electrode.	Engine overheating, wrong type of fuel, loose spark plugs, too hot of a plug, low fuel pump pressure or incorrect ignition timing. Replace plug.
Worn	Severely eroded or worn electrodes.	Caused by normal wear and failure to replace plug at prescribed interval. Replace plug.

Figure 3-12. Evaluating Spark Plug Condition

Gasoline Fuel System

Description

An electric fuel pump draws gasoline from the fuel tank through a replaceable fuel filter. The output of the pump is connected to the engine's carburetor.

Specification—Gasoline

For best results use only clean, fresh, regular grade, unleaded gasoline with a pump sticker octane rating of 87 or higher in the U.S.A. In countries using the research rating method, use 90 octane minimum.

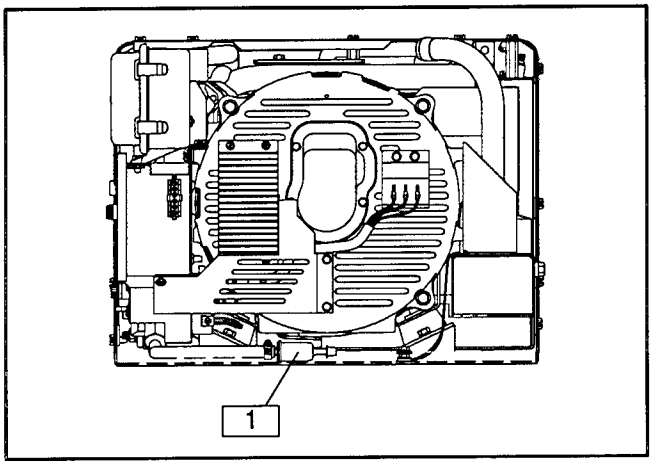
Use unleaded gasoline, since it leaves fewer combustion chamber deposits. Regular grade leaded gasoline may be used; however, be aware that the combustion chamber and cylinder head will require more frequent service. Gasohol containing no more than 10% ethanol can be used if unleaded gasoline is unavailable. Never use gasohol containing more than 10% ethanol or gasoline containing methanol. Do not mix oil with the fuel.

Do not use gasoline left over from the previous season. Use fresh gasoline to ensure it is blended for the season, and to avoid the formation of gum deposits which could clog the fuel system.

Gasoline Fuel Filter

Replace the fuel filter every 500 hours of running time or when rough operation indicates an engine tune-up may be necessary. Fuel filter location is shown in Figure 3-13.

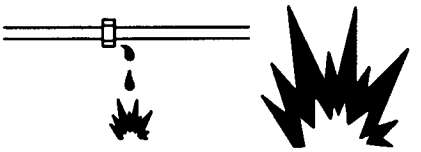
To change fuel filter, shut off fuel flow from tank. Then loosen clamps and remove hoses, draining any fuel into suitable container. Install new filter in hoses. Then reinstall and tighten hose clamps. Be sure to check for leaks.



1. Fuel Filter

Figure 3-13. Gasoline Fuel Filter

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling and storing fuels. Store fuel in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke or permit flame or spark to occur near potential sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. If any fuel leakage, fuel accumulation, or electrical sparks are noted, DO NOT OPERATE GENERATOR SET. Repair systems before resuming generator set operation

Explosive fuel vapors can cause severe injury or death. Take additional precautions when using the following fuels:

Gasoline—Store gasoline only in approved red containers clearly marked GASOLINE.

Propane (LP)—Adequate ventilation is mandatory. Propane is heavier than air; install gas detectors low in room. Inspect detectors often.

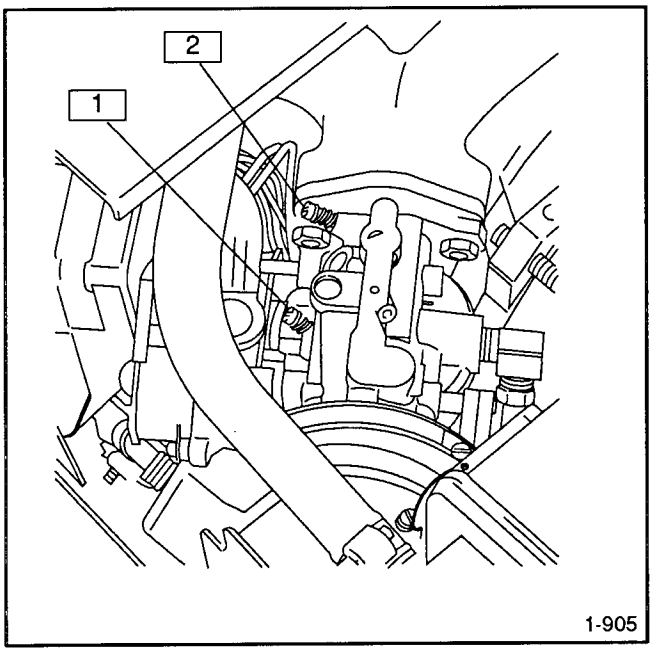
NOTE

Replace inline gasoline-type fuel filter with a metal-encased type filter. (Kohler Part No. 228269—1/4-in. inlet or Kohler Part No. 227647—5/16-in. inlet).

Gasoline Carburetor Description

This generator set uses a single venturi, sidedraft carburetor with antidieseling solenoid and electric choke. The antidieseling solenoid provides a positive fuel shutoff when the unit is shut down. This helps prevent dieseling at shutdown after running with a heavy load.

Lack of power and black sooty exhaust smoke usually indicate that the fuel mixture is too rich. A clogged air cleaner or improperly adjusted choke may cause an overrich mixture. Always check the air cleaner before readjusting the choke or carburetor. A lean fuel mixture may cause the engine to skip (miss) or backfire. See Figure 3-14 for location of adjustment needles.



1. Main Fuel Needle
2. Idle Fuel Needle

Figure 3-14. Carburetor Adjustment Needles

NOTE

Turning the adjusting needles in (clockwise) decreases the supply of fuel to the carburetor. This gives a leaner fuel/air mixture. Turning the adjusting needles out (counterclockwise) increases the supply of fuel to the carburetor. This provides a richer fuel/air mixture.

Main and Idle Fuel Mixture

1. Stop the engine. Turn the main fuel and idle fuel adjusting needles **in** (clockwise) until they bottom *lightly*. Do not force.

NOTE

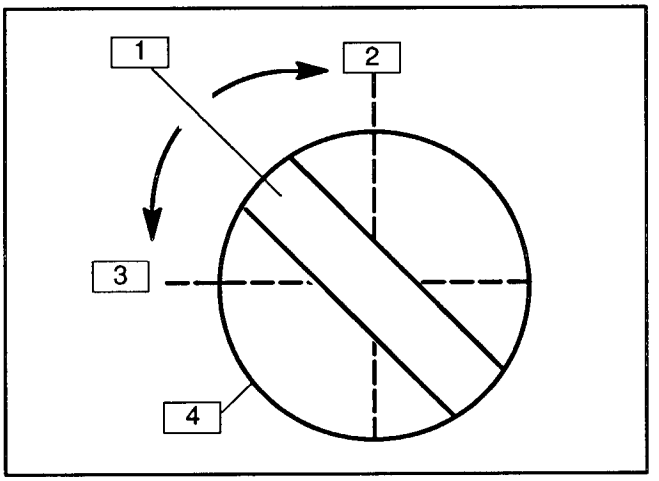
The ends of the main fuel and idle fuel adjusting needles are tapered to critical dimensions. Forcing needles can cause needle and seat damage.

2. Preliminary Settings: Turn the main fuel and idle fuel adjusting needles out (counterclockwise) from lightly bottomed as follows:
   Main Fuel Needle 2 1/4 Turns
   Idle Fuel Needle 1 1/2 Turns
3. Start the engine and run at half load for 5-10 minutes to warm up. The engine must be warm before making final settings.
4. Final Setting—Main Fuel: Run engine at 3/4 to full load. Turn main fuel adjusting needle in (clockwise) from preliminary setting until the engine does not operate smoothly. Note the position of the needle. Then turn the adjusting needle out (counterclockwise) 1/4 turn. See Figure 3-15.

NOTE

At higher elevations the main fuel adjustment needle will require leaning.

5. Final Setting—Idle Fuel: Set idle fuel adjusting needle using the same procedure as in step 4.



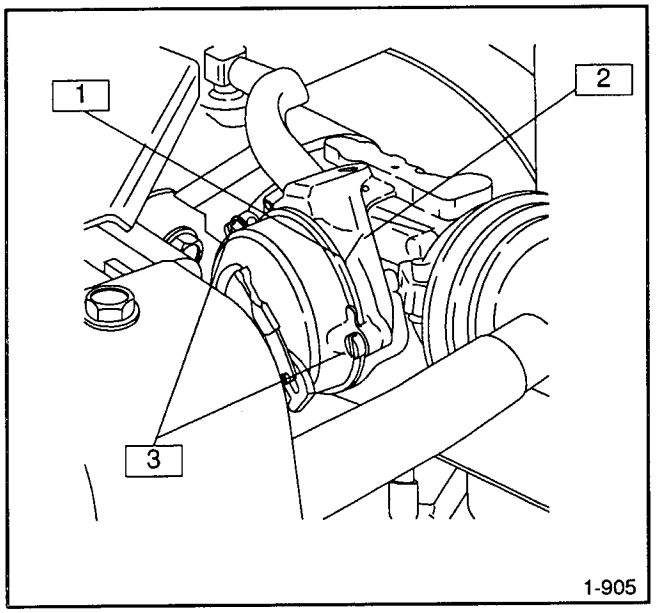
1. Adjust 1/4 turn richer than lean operating limit.
2. Lean
3. Rich
4. Fuel Adjusting Screw

Figure 3-15. Carburetor Adjustment

Gasoline Choke

Description

A Kohler thermo-electric automatic choke enriches the gasoline fuel mixture during starting. The choke automatically closes as the ambient temperature cools or as the engine temperature decreases. As the engine warms, the coils inside the choke allow the choke plate to open. If readjustment is needed, loosen the two screws securing the choke bracket to the carburetor and shift the position of the choke assembly (Figure 3-16). The choke plate should be within 5 to 10 degrees of full open at approximately 70° F (21° C).



1. Scribe Mark
2. Casting Mark
3. Adjusting Screws

Figure 3-16. Automatic Choke Adjustment

Choke-Adjustment Procedure for Operation Above 10° F (–12.2° C) (From original factory-set position)

1. Where the choke casting mark meets the black plastic cover of the choke, make a scribe mark on the choke's black cover. See Figure 3-16.
2. Loosen the two choke-adjusting screws and rotate choke cover counterclockwise toward leaner setting (follow direction of arrow on choke).
3. When the distance between the scribe mark on the black cover and the casting mark is 5/16 in. (8 mm), tighten the two choke adjusting screws.

Choke-Adjustment Procedure for Operation Below 10° F (–12.2° C)

NOTE

If not previously adjusted, leave as factory set. Otherwise, follow procedure below.

1. If scribe mark has been made on the choke's black cover, loosen the two choke-adjusting screws and rotate choke cover clockwise (opposite direction of arrow on choke).
2. When the scribe mark on the black plastic cover of the choke and the choke casting mark line up, tighten the two adjusting screws.

LP Fuel System

Description

This model generator set uses a vapor- or liquid-withdrawal LP gas system. In a vapor-withdrawal system, fuel in the form of a vapor is drawn from the top of the LP gas tank. Two regulators reduce the gas pressure to a level usable in the carburetor. See Figure 3-17.

In a liquid-withdrawal system, the fuel is drawn from the bottom of the LP gas tank. The liquid fuel is then routed through a vaporizing tube (converter) mounted near the engine's exhaust manifold. Heat from the engine aids the conversion of the liquid LP to a vapor. Two regulators then reduce the gas pressure to a level usable in the carburetor. See Figure 3-18.

Components of the systems shown in Figure 3-17 and Figure 3-18 include a:

- Tank: Provide storage for adequate supply of LP gas
- Fuel Solenoid: Provide positive fuel shutoff when the engine is stopped
- Dry Gas Filter (Liquid System Only): Traps pipe scale and other impurities
- Primary Regulator: Reduce gas pressure to nominal 11 in. water column
- Secondary Regulator: Sense and meter fuel to carburetor
- Carburetor: Mix gas vapors and air for proper combustion

NOTE

If using a removable fuel container as a fuel source, use a quick-close coupling on the fuel line or a check valve installed in the fuel line to prevent fuel leakage during a container change.

NOTE

A hydrostatic relief valve is also required between the container shutoff valve and the automatic shutoff solenoid on the generator set.

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

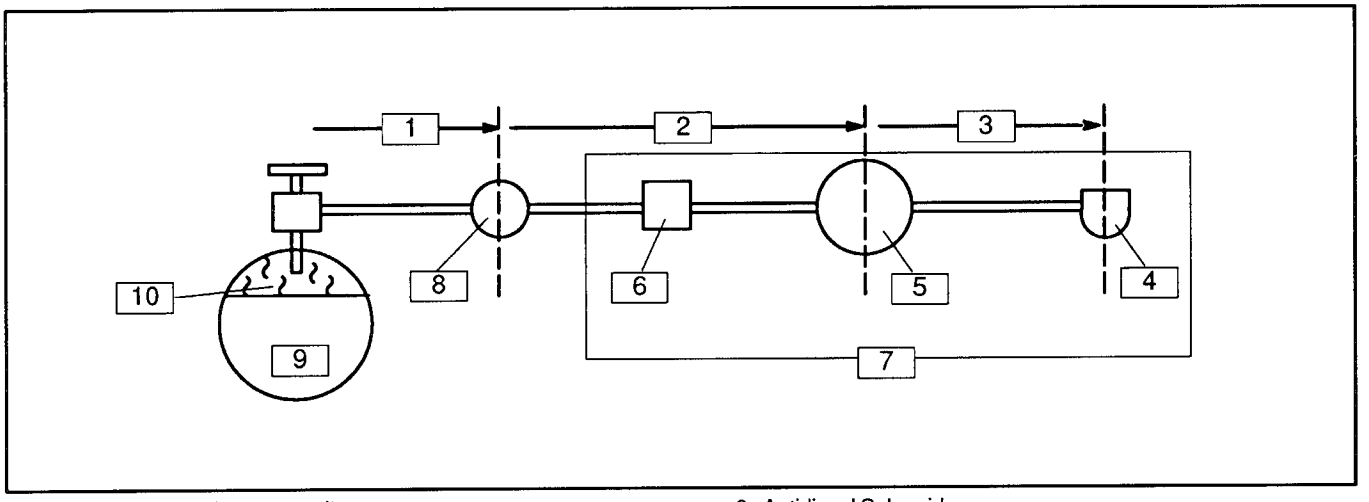
Use extreme care when handling, storing, and using fuels.

Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check LP liquid withdrawal gas fuel system for leakage using a soap-water solution with fuel system test pressurized not less than 90 psi (621 kPa). Do not use test solutions that contain ammonia or chlorine, since the soap will not bubble for an accurate leakage test.

Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check LP vapor gas fuel system for leakage using a soap-water solution with fuel system test pressurized to 6-8 ounces per square inch (10-14 inches water column). Do not use test solutions that contain ammonia or chlorine, since the soap will not bubble for an accurate leakage test.

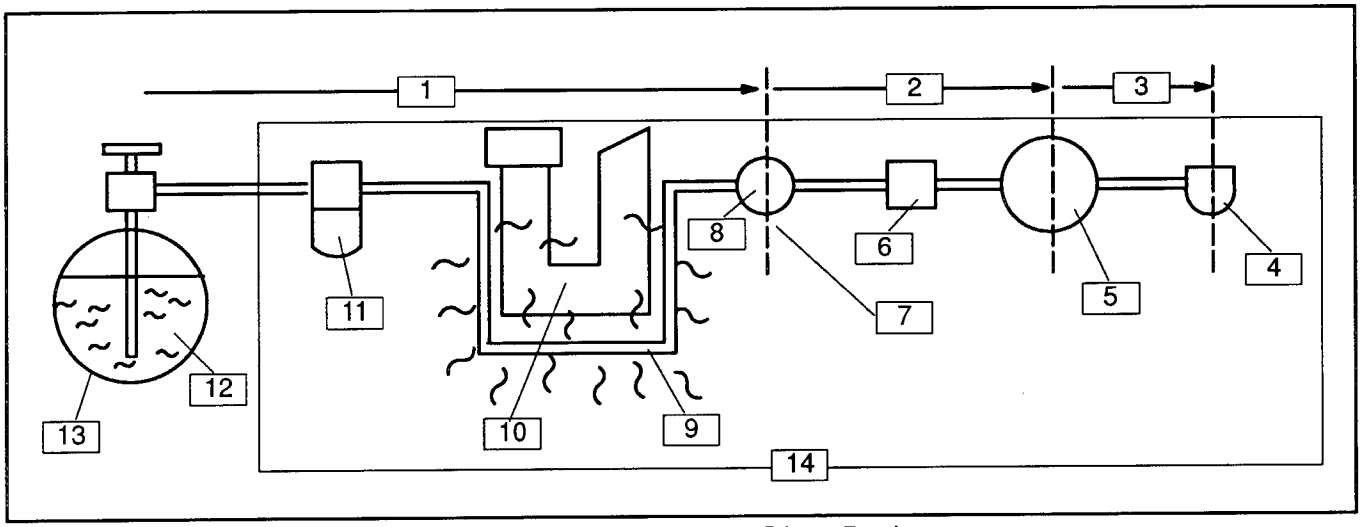
Specification—LP Fuel

Ensure that the fuel for a liquid withdrawal system is blended for the season and geographic location of generator set operation.



1. High Pressure (Up to 250 psi)
2. Low Pressure (nominally 11 in. water column)
3. Atmospheric Pressure (nominally 0 psi)
4. Carburetor
5. Secondary Regulator
6. Antidiesel Solenoid
7. Components on Generator Set
8. Primary Regulator (Located at the tank)
9. Tank
10. Vapor

Figure 3-17. Typical Vapor-Withdrawal LPG Fuel System



1. High Pressure (Up to 250 psi)
2. Low Pressure (nominally 11 in. water column)
3. Atmospheric Pressure (nominally 0 psi)
4. Carburetor
5. Secondary Regulator
6. Antidiesel Solenoid
7. Liquid turns into vapor
8. Primary Regulator
9. Fuel Vaporizer Line (Converter)
10. Exhaust Manifold
11. Fuel-Shutoff Solenoid and Filter
12. Liquid
13. Tank
14. Components on Generator Set

Figure 3-18. Typical Liquid-Withdrawal LPG Fuel System

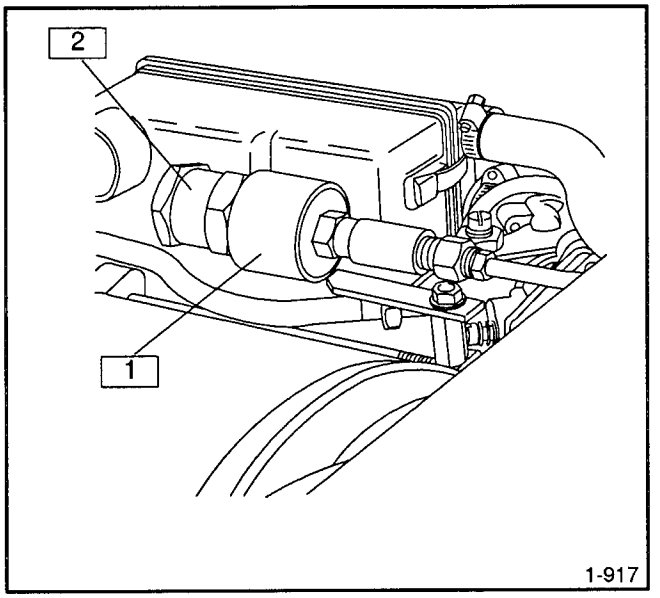
LP Gas System Component Description and Adjustment Procedures

Fuel-Shutoff Solenoid (LP Liquid Units Only)

This 12-volt solenoid turns the fuel on or off when the start/stop switch is activated. Liquid LP fuel flows through it and into the fuel vaporizer line at normal pressures of 100/125 psi, or up to 250 psi.

ADJUSTMENT: The 12-volt fuel shutoff solenoid requires no adjustments. The filter may require replacing (see below).

The LP fuel-shutoff solenoid contains a replaceable filter which should be inspected yearly or after every 100 hours of operation. Normally, the filter requires replacement only after accumulation of filtered debris restricts fuel flow to the regulator/vaporizer. Replace filter when generator operation is rough or when frost appears on the surface of the fuel shutoff solenoid. Figure 3-19 shows location of the LP gas fuel-shutoff solenoid.



1. Fuel-Shutoff Solenoid
2. Fuel Filter

Figure 3-19. LP Gas Fuel-Shutoff Solenoid Assembly (LP Liquid Units)

Fuel Vaporizer Line

Fuel begins to vaporize as soon as the fuel solenoid opens and continues to vaporize through the length of the line. The line is heated by radiated heat from the exhaust manifold and the engine block. The rate of vaporization is dependent upon the operating load and the heat available.

ADJUSTMENT: No adjustment required.

Primary Regulator (High-Pressure Regulator)

This regulator reduces the tank pressure from 100/125 psi to 7-11 in. (4-6 oz) water column. At this point the fuel is no longer a liquid but a vapor. It is reasonable to see an oily residue from the fuel vaporizing process at this point. A vent line installed at this regulator is routed out of the compartment through the generator set tray. The vent enables the regulator to reduce the accumulated pressure and vent out any accumulated water vapor.

NOTE

Newer units have the primary regulator positioned vertically with an attached collection pipe. Service every 50 hours of operation by draining the contaminants from the collection pipe into a suitable container and disposing of them in an environmentally safe manner.

ADJUSTMENT:

1. Energize both solenoids to allow full fuel flow by removing lead #71 from the starter solenoid. Refer to Figure 3-24. This will disable the engine starting circuit but will leave the other circuits powered. When the start switch is energized, the solenoids will also be energized. Disconnect J9 connector from P9 connector to disable the carburetor stepper motor. Disconnect P20 connector from J20 connector (near antidiesel solenoid). Connect 12 volts DC high to pin 1 of J20 connector and 12 volts DC low to pin 2 of J20 connector to keep the antidiesel solenoid energized. Connect a fuel source to the generator set.

NOTE

The antidiesel solenoid will de-energize after a few seconds. This solenoid must be wired directly to a 12-volt source to keep it open.

NOTE

These checks/adjustments can be performed with pressurized air in lieu of LP fuel.

2. Depress the prime button on the secondary regulator. See Figure 3-21. This forces the diaphragm down and opens the orifice so full fuel flows through the regulator.
3. Connect a manometer into the fuel line between the secondary regulator and the carburetor. Remove the pipe cap from the tee in the fuel line and install manometer. Disconnect the fuel line from the tee and cap. (Older units have a flared fitting located off the secondary regulator. Attach another flared fitting with a pipe thread and connect hose and manometer.)
4. Each regulator is individually factory set to deliver 11 inches water column. With the start switch energized and the secondary regulator prime button depressed, the manometer should read 7-11 in. (4-6 oz) water column. Make the following adjustment if this reading is not obtained.
   a. To increase the outlet pressure, remove the closing cap and turn the adjusting screw clockwise. See Figure 3-21. Turn the adjusting screw counterclockwise to decrease the outlet pressure. A pressure gauge or water manometer is needed to determine the regulator's outlet setting after adjustment. Always replace the closing cap after adjustment.
   b. Overpressure Protection: The regulators have an internal relief valve that opens when downstream pressure reaches approximately 1 psig on regulators set at 11 inches water column. When the internal relief valve opens, gas escapes to the atmosphere through the regulator's vent. The internal relief valve gives overpressure protection against excessive buildup resulting from seat leakage due to worn parts or chips of foreign material on the orifice.
5. Disconnect the 12 volts DC power from the J20 connector. Reconnect P20 connector to J20 connector. Reconnect P9 connector to J9 connector. Reconnect lead #71 to the starter solenoid. Start and run the generator set. Adjust the carburetor if needed per instructions described later.

Antidiesel Solenoid

This 12-volt solenoid turns the fuel on or off when the start/stop switch is activated. This solenoid functions to limit the amount of fuel burned once the stop switch is activated to reduce the run-on time.

ADJUSTMENT: The 12-volt antidiesel solenoid requires no adjustments.

Secondary Regulator (Low Pressure Regulator Lock-Off Device)

This regulator does not really regulate pressure but acts as a lock-off device which allows the fuel to flow only if there is a vacuum from the engine or if the prime button is pressed.

NOTE

If the secondary regulator's diaphragm is damaged then gas pressure will blow out of the elbow fitting on the secondary regulator.

NOTE

The secondary regulator can be checked with a manometer. If the engine is not running, the manometer pressure reading will be zero. If the engine is running, negative pressure should be read in the range of 0.2/0.5 in. water column.

ADJUSTMENT:

1. Energize both solenoids to allow full fuel flow by removing lead #71 from the starter solenoid. Refer to Figure 3-24. This will disable the engine starting circuit but will leave the other circuit powered. When the start switch is energized, the solenoids will also be energized. Disconnect J9 connector from P9 connector to disable the carburetor stepper motor. Disconnect P20 connector from J20 connector (near antidiesel solenoid). Connect 12 volts DC high to pin 1 of J20 connector and 12 volts DC low to pin 2 of J20 connector to keep the antidiesel solenoid energized. Connect a fuel source to the generator set.
2. Locate the lock-off adjusting screw and the lock nut. See Figure 3-21. Turn the screw in (clockwise) to increase pressure or turn the screw out (counterclockwise) to decrease pressure. To aid adjustment, apply a soap solution to the outlet. Turn the adjusting screw out to the point that a bubble is formed and holds there without getting any larger.

NOTE

The further the screw is turned in the more engine vacuum will be required to open the diaphragm. This could result in hard starting. Bring the screw out as far as possible without having fuel flow.

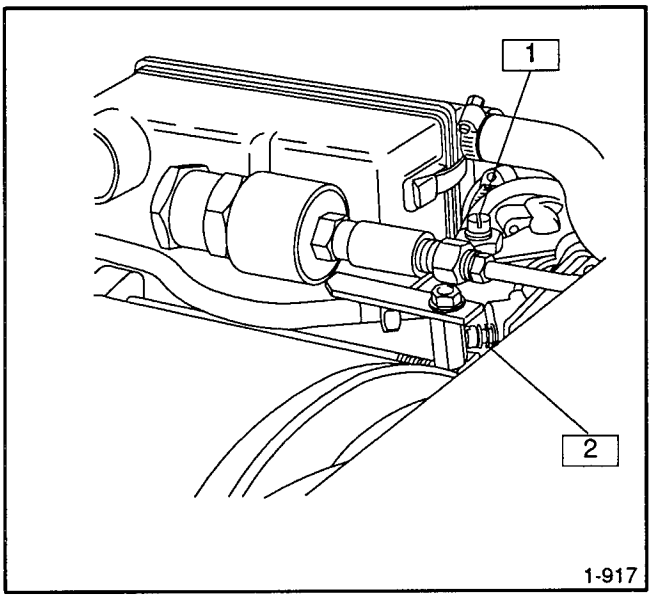
3. Reconnect the fuel line to the secondary regulator. Disconnect the 12 volts DC power from J20 connector. Reconnect P20 connector to J20 connector. Reconnect P9 connector to J9 connector. Reconnect lead #71 to the starter solenoid. Start and run the generator set. Adjust the carburetor if needed per instructions following.

LP Carburetor

Venturi-type carburetor with an idle and main adjustment.

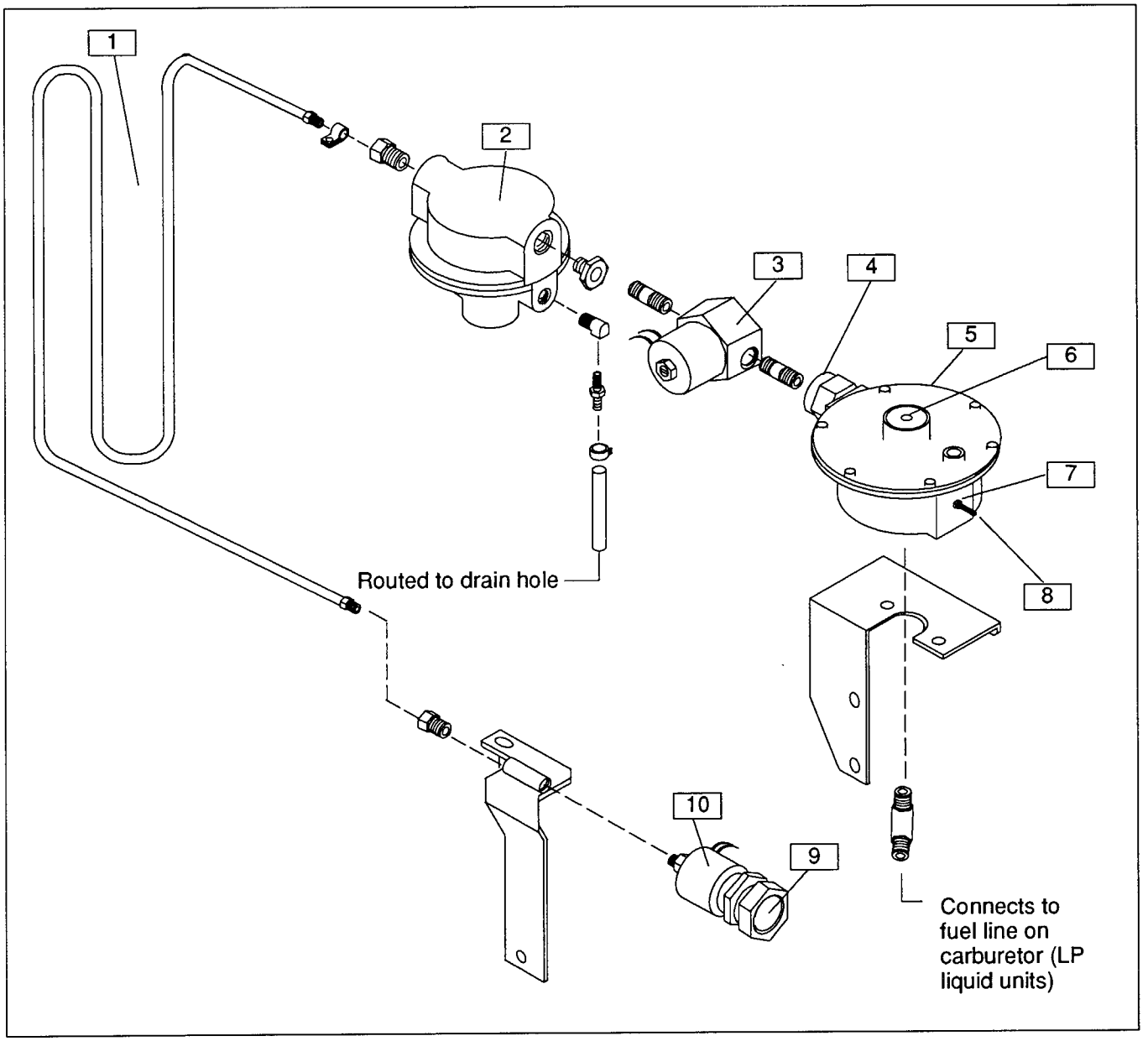
ADJUSTMENT:

1. Main Fuel Adjustment: For preliminary setting (before running the unit) turn the main fuel valve clockwise until it bottoms lightly (do not force), then back out 1 turn (360°). See Figure 3-20. With the engine thoroughly warmed up and running at rated rpm under full load, turn main fuel valve in until the engine slows down (lean setting) then turn valve out until the engine regains full speed (about 1/8 turn). When properly adjusted, the engine will operate with steady governor action. Improper adjustment (rich setting) causes improper operation of the vaporizer and excess fuel consumption.
2. Idle Fuel Adjustment: The idle system functions only under low- and no-load conditions. For this reason, the idle setting has only a momentary effect. To adjust, stop the engine and then turn the idle fuel screw all the way in (clockwise), then back out 1/4 turn. See Figure 3-20. Adjust for proper no-load operation.



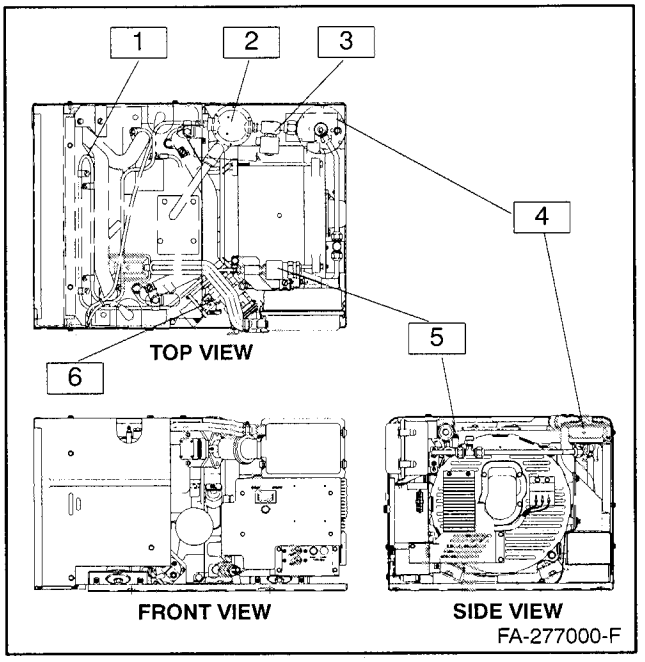
1. Main Fuel Adjustment
2. Idle Fuel Adjustment

Figure 3-20. LP Gas Carburetor Adjustments



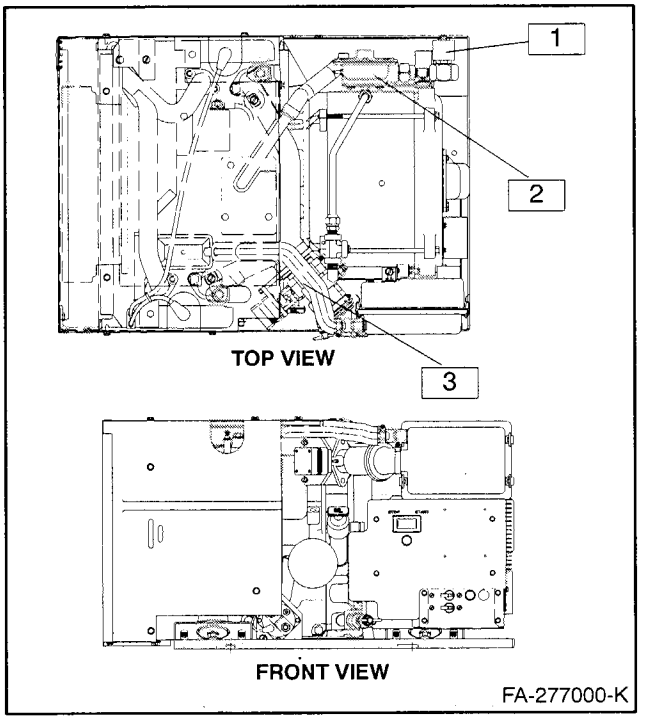
1. Fuel Vaporizer Line
2. Primary Regulator (Located at tank for LP Vapor Units)
3. Antidiesel Solenoid
4. Outlet
5. Secondary Regulator
6. Prime Button
7. Locknut
8. Adjustment Screw
9. LP Input
10. Fuel-Shutoff Solenoid (LP Liquid Units Only)

Figure 3-21. LP Gas System Overview (Typical)



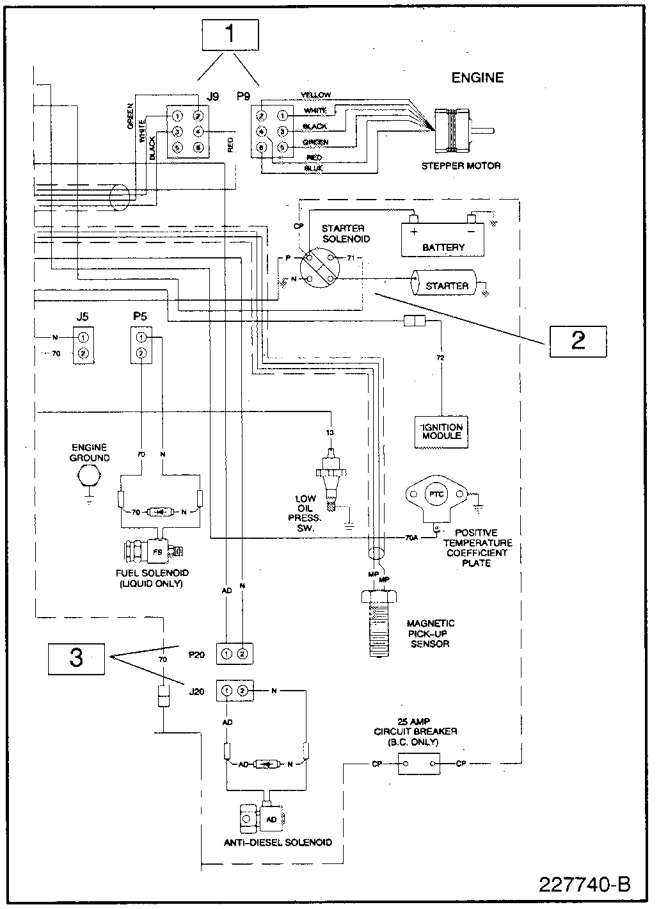
1. Fuel Vaporizer Line
2. Primary Regulator
3. Antidiesel Solenoid
4. Secondary Regulator
5. Fuel-Shutoff Solenoid and Filter
6. Carburetor

Figure 3-22. LP Liquid Unit



1. Antidiesel Solenoid
2. Secondary Regulator
3. Carburetor

Figure 3-23. LP Vapor Unit

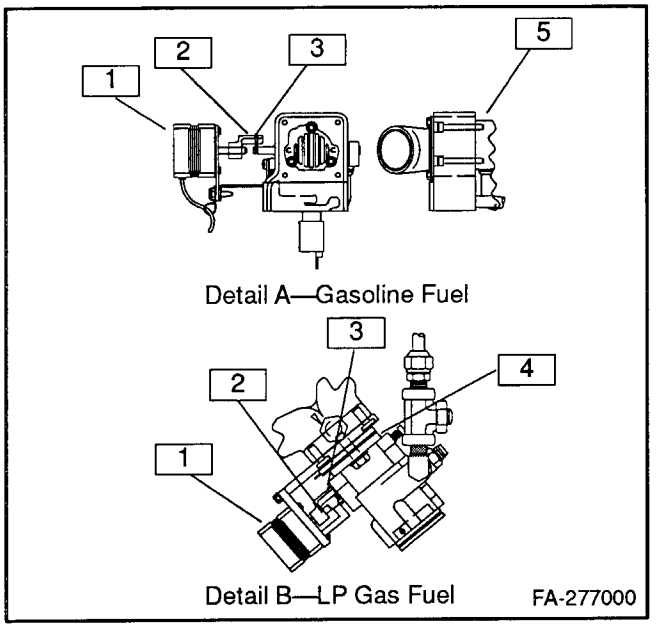


1. P9/J9 6-Pin Connector
2. 71 Lead to Starter Solenoid
3. P20/J20 2-Pin Connector

Figure 3-24. Typical LP Gas System Wiring Diagram

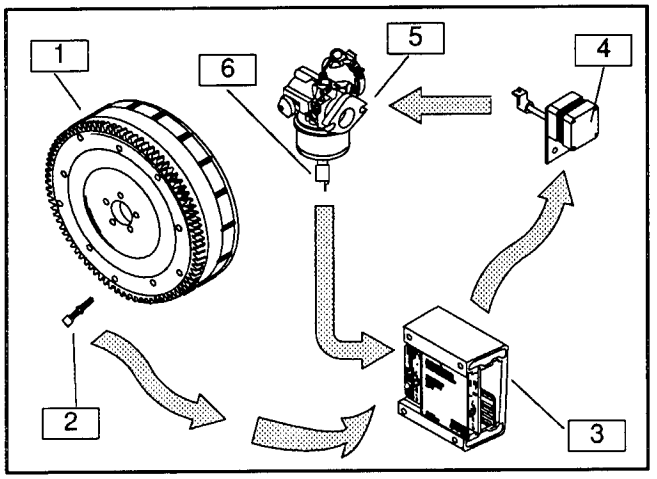
Electronic Governor

The electronic governor regulates engine speed to maintain the electrical output at the desired frequency. With this governor, a stepper motor actuates the throttle plate of the carburetor. Inspect the slot on the stepper motor actuator and the mating pin on the throttle plate shaft. If there is excessive wear, replace the worn parts to ensure proper functioning. Also, ensure that the actuator and throttle shafts are concentric, and that throttle-shaft pin is at midpoint of the actuator slot.



1. Stepper Motor
2. Actuator
3. Pin
4. Carburetor
5. Air Cleaner

Figure 3-25. Governor Actuator Mechanism



1. Flywheel
2. Magnetic Pickup
3. Electronic Governor
4. Stepper Motor
5. Carburetor
6. Antidieseling Solenoid

Figure 3-26. Governor Overview

Air Cleaner

The engine is equipped with a dry-type (flame-proof) air cleaner. See Figure 3-27. Every 50 hours (more often if operating under dusty or dirty conditions), remove element and service by tapping element lightly against flat surface to dislodge loose surface dirt. Do not clean in any liquid or blow out with compressed air as this will ruin filter material in element. Service air cleaner after each 50 hours of operation. If element is dirty, bent, or damaged, replace with genuine Kohler replacement part.

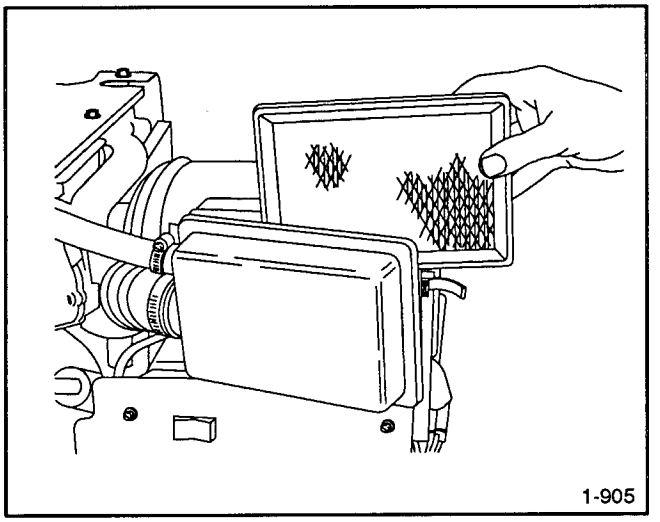


Figure 3-27. Air Cleaner Service

NOTE

U.S. codes and regulations require that the air filter material be made of a self-extinguishing material. Use Kohler part number 278612 as a service part.

Battery

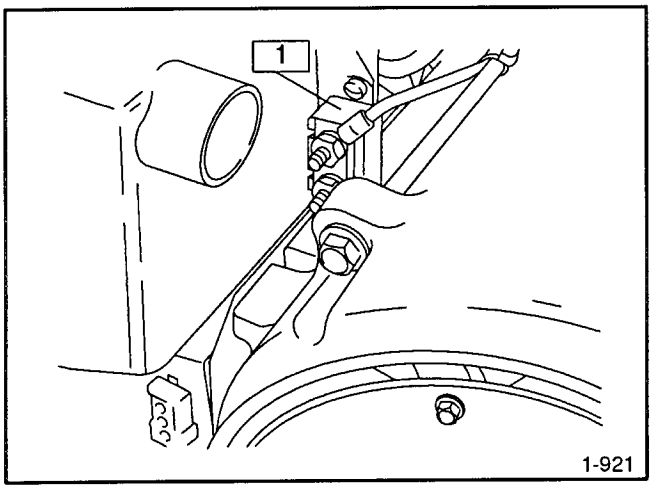
If generator set is equipped with battery-charging feature, refer to the following section for general maintenance. Use a 12-volt battery with a rating of at least 290 cold cranking amps/55 amp hr. at 0° F (–18° C). When using a maintenance-free battery, it is not necessary to check the specific gravity or electrolyte level. Otherwise, the following procedures should be done at the intervals specified in the Service Schedule. A negative-ground system is used. The wiring diagram shows battery connections. Make sure battery is properly connected and terminals are tight.

Battery Charging (if equipped)

The generator is equipped with a battery-charging system to keep the starting battery fully charged. The system requires no maintenance. Be sure to observe battery polarity when connecting battery to generator set. See Figure 3-28 for location of the battery-charging circuit.

NOTE

The generator set will not start if the battery connections are made in reverse.



1. Battery-Charging Circuit (auto resettable)

Figure 3-28. Battery-Charging Circuit

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Battery acid can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash-proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery once the battery has been placed in service. This may result in hazardous spattering of electrolyte.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc., to prevent burns and sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being changed. Always turn battery charger off before disconnecting battery connections. Remove negative lead first and reconnect it last when disconnecting battery.

Cleaning Battery

Keep battery clean by wiping it with a damp cloth. Keep all electrical connections dry and tight. If corrosion is present, disconnect cables from battery and remove corrosion with a wire brush. Clean battery and cables with a solution of baking soda and water. Be careful that cleaning solution does not enter battery cells. When cleaning is complete, flush battery and cables with clean water and wipe with a dry cloth. After the battery cables are reconnected, coat terminals with petroleum jelly or other nonconductive grease.

Checking Electrolyte Level

Check the level of electrolyte before each start-up. Remove filler caps and check to see that electrolyte level is up to bottoms of filler holes. Refill as necessary with distilled water or clean tap water. DO NOT add fresh electrolyte. Be sure filler caps are tight.

Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. While holding the hydrometer vertical, read the number on the glass bulb at the top of the electrolyte level. If the hydrometer used does not have a correction table, use the one in Figure 3-29. Determine specific gravity and electrolyte temperature of battery cells. Locate temperature in Figure 3-29 and adjust specific gravity by amount shown. The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 80°F (26.7°C). The difference between specific gravities of each cell should not exceed ±0.01. Charge the battery if the specific gravity is below 1.215 at an electrolyte temperature of 80°F (26.7°C).

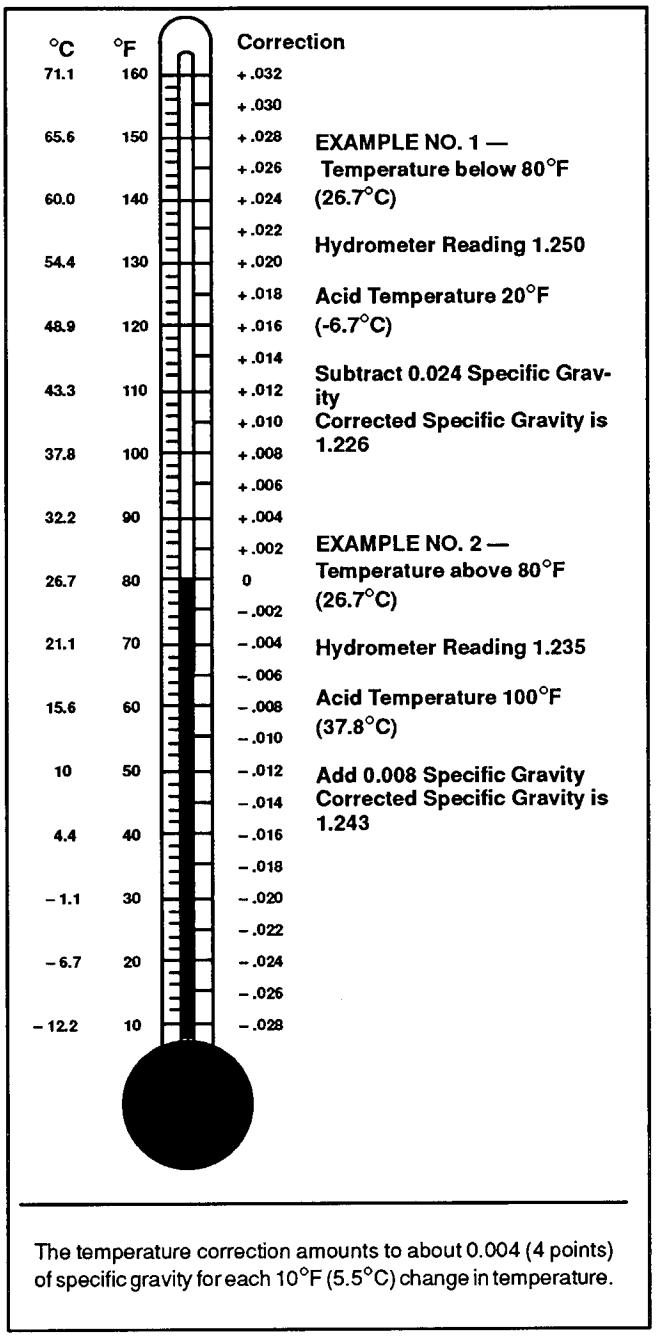


Figure 3-29. Specific Gravity Temperature Correction

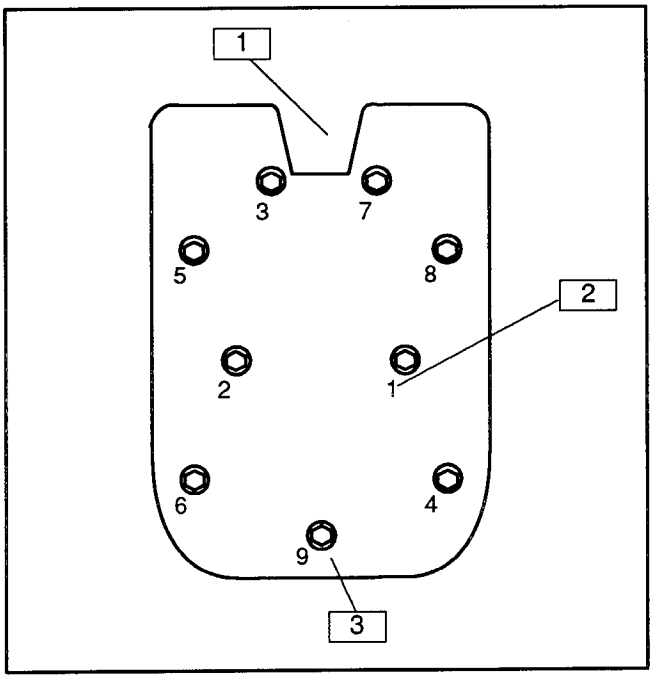
Cylinder Head Service

Cleaning Head Deposits

After each 500 hours of operation, service the cylinder heads. Remove carbon deposits from combustion chamber in head. Scrape and remove carbon with a sharp piece of wood or plastic. Use wood or similar material to avoid scratching aluminum surfaces of the cylinder head. Always replace cylinder head gaskets. Tighten head bolts in the following sequence and to the torque value specified. See Figure 3-30.

NOTE

If the engine is operated on leaded fuel or under continued light load or relatively constant speed, carbon may build up more rapidly. If there are heavy deposits of carbon on spark plug electrodes, service the heads at 250-hour intervals.



1. Use new gaskets when reinstalling heads.
2. Tightening sequence
3. Tighten head bolts to 15-20 ft. lbs. (20-27 Nm.)

Figure 3-30. Cylinder Head Fastener Tightening Sequence

Adjusting Valve Clearance

After each 500 hours of operation (or sooner if a loose valve is detected), check clearance between the valve stems and tappets. Stop and cool the engine to normal ambient temperatures to accurately gauge and adjust valve clearances. Use the following procedure or refer to the engine service manual to adjust.

NOTE

Set piston to top dead center (TDC) of the compression stroke to measure valve-to-tappet clearance. Rotate the flywheel and observe the valves and tappets for movement to determine if a cylinder is at TDC.

If, for example, the flywheel is rotated and movement is observed in the #2 side valve box—the opposite cylinder (#1 side) will be at TDC. Measure valve-to-tappet clearance.

Rotating the flywheel one complete revolution (360°) will then cause movement in the #1 side valve box—the #2 side cylinder will be at TDC, enabling measurement of valve-to-tappet clearance for that side.

Valve Clearance Specifications

Intake Valve Clearance

0.003-0.006 in. (0.076-0.152 mm)

Exhaust Valve Clearance

0.011-0.014 in. (0.279-0.355 mm)

1. Rotate the flywheel and look into the valve boxes. The valves and tappets will move in only one of the boxes. Use a flat feeler gauge to measure the valve-to-tappet clearance for the cylinder in which no movement was observed.
2. Rotate the flywheel 360° and measure the valve-to-tappet clearance for the remaining cylinder.
3. If the clearance is insufficient, grind the valve stems to correct clearance. Make sure the valve stems are ground perfectly flat and smooth.

   If the clearance is excessive, replace the valves and recheck clearance.

Wattage Requirements

The controller circuit breaker(s) will trip to protect the generator if the rated capacity of the generator is exceeded. A short in the AC circuit in the vehicle or excessive power requirements may result in an overload condition. If the circuit breaker(s) trip, the set may continue running but there will be no AC output to the protected circuit. Before resetting the circuit breaker(s), turn off some of the appliances and lights inside the vehicle to reduce the load to within the rated limits of the set. If this is done and the circuit breaker(s) trips again after being reset, there may be a short circuit. In this event, turn off the set and have a qualified electrician locate and correct the cause of the short circuit.

The average wattage requirements of some common appliances/tools and motor loads are listed in Figure 3-31 and Figure 3-32. Use these figures to calculate the total load on the set to avoid the inconvenience of having the circuit breaker trip due to overload. The lighting load is easily determined by adding the wattage rating of each bulb in the circuit. Check the nameplate rating on motors and appliances/tools in the vehicle for exact wattage requirements.

Electrical Appliance	Running Watts
Blanket	50-250
Blender	600
Broiler	1350
Fan, Air Circulating	25-100
Fan, Furnace	270
Heater, Space	750-1500
Heater, Water	1500
Pan, Frying	1200
Percolator, Coffee	650
Radio	50-100
Television	300-750
Toaster	750-1200

Figure 3-31. Appliance Average Wattage Ratings

Construction Tools	Motor Starting Watts	Running Watts
Air Compressor (Small)	1500	725
Air Compressor 3/4 hp	4000+	2000
Drill, 1/4 in.	500	250
Drill, 3/8 in.	600	350
Drill, 1/2 in.	800	600
Grinder, 1/2 hp	1500	1200
Hammer, Demolition	2000	1800
Hammer, HD Rotary	1500	1200
Paint Sprayer (Airless)	400	240
Polisher, Orbit	500	360
Power Paint Roller	120	90
Power Plane	600	450
Router	900	700
Saw, Circular 6 1/2 in.	2200	1000
Saw, Circular 7 1/4 in.	2500	1200
Saw, Table 10 in.	4000	1500
Saw, Sabre (Worm Drive)	2500	1200
Sander, Belt	1500	600
Sander, Finishing	900	360
Screwdriver, Power	1000	530
Shear, 12 gauge	1800	720
Soldering Gun	—	250
Vacuum Cleaner, Wet/Dry	1500	1260
Wrench, Impact 1/2 in.	2000	840

Figure 3-32. Construction Tool Average Wattage Ratings

Generator Service

General

Under normal conditions, regular generator service will not be required. If operating under dusty and dirty conditions, use dry compressed air to blow dust out of the generator at frequent intervals. Do this with the generator set operating and direct the stream of air in through the cooling slots at the end of the generator.

Storage Procedure

If the generator set is to be out of service for 2 months or more, perform the following steps to preserve the set before placing it in storage.

1. Change the oil and filter when the engine is still warm from operation. Refer to Oil Change. Run the engine for a few minutes after oil change to distribute the clean oil.
2. Gasoline-fueled generators—Drain the carburetor bowl (or run unit until empty) to prevent gum formation caused by operating on stale fuel. Remove the bowl by unscrewing the retaining bolt on the bottom of the bowl. Replace the bowl after draining the fuel. Use a gas stabilizer in lieu of draining the carburetor bowl; add the gas stabilizer to the fuel following recommendations of the gas stabilizer manufacturer.

   LP gas-fueled generators—with the generator running, shut off the LP gas fuel supply. Run the generator set until the set stops from lack of fuel.
3. Gasoline-fueled generators only—remove the fuel line at the pump outlet to drain fuel line to carburetor. Reconnect fuel line. The pump itself requires no additional maintenance.
4. Remove the spark plugs. Pour about 1 tablespoon of clean engine oil into each spark plug hole. Install the plugs, but do not connect the plug leads. Crank the engine two or three revolutions to lubricate the cylinders.
5. Clean the exterior surface of the generator set; then spread a light film of oil over unpainted metallic surfaces which could rust or corrode.

Section 4. General Troubleshooting

Use the following tables as a quick reference in troubleshooting problems. Generator set faults are listed by groups and include likely causes and remedies. The source of more detailed information needed to correct a problem is indicated. These sources include various sections of this manual, the Operation and Installation Manual (TP-5393), and the Kohler Engine Service Manual (TP-2204).

When troubles occur, don't overlook simple causes. Improper fuel or an empty fuel tank could cause a starting problem. Make sure all electrical connections are secure. Remember that the battery negative must have a good ground.

Corrective action and testing in many cases requires knowledge of electrical and electronic circuits. Service should be done only by authorized service dealers/distributors. Improper repair by unqualified personnel can lead to additional failures.

Problem	Possible Cause	Corrective Action	Reference
ENGINE			
Will not crank (dead)	Controller 15-amp supply fuse blown	Replace fuse. If fuse failure continues, replace fuse and troubleshoot DC circuit and wiring.	Section 7. Engine/ Generator Components or Section 9. Wiring Diagrams
	Battery disconnected or improperly connected	Check connections	Section 9. Wiring Diagrams Section 3. Battery
	Dead battery	Check electrolyte level and specific gravity (batteries with filler caps only). Perform load test	Section 3. Battery
	Corroded or loose battery connections	Clean or replace battery connections	Section 3. Battery
	Open wiring, terminal, pin, foil, etc.	Check continuity	Section 7. Component Testing or Section 9. Wiring Diagrams
	Defective starter	Service or replace	Engine Service Manual
	Defective starter solenoid	Check continuity of circuit. Bypass solenoid using jumper wire. If starter cranks, replace solenoid.	Section 7. Engine/ Generator Components. Section 9. Wiring Diagrams Engine Service Manual
	Defective start/stop switch	Check continuity	Section 7. Component Testing or Section 9. Wiring Diagrams
	Defective K2 or K3	Check/replace defective relay	Section 7. Controller Circuit Board
	Defective remote start/stop switch	If start/stop switch on controller functions, replace or repair remote switch and/or wiring.	Section 9. Wiring Diagrams or Section 7. Component Testing

Problem	Possible Cause	Corrective Action	Reference
Will not start (cranks okay)	No fuel in tank	Replenish	
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Defective fuel solenoid	Check continuity	
	Defective fuel pump (gasoline fuel only)	Verify operation with 12 volts DC applied. Check fuel pressure is 2-3.5 psi (14-24 kPa).	Engine Service Manual
	Clogged fuel filter	Replace filter	Section 3. Fuel Filter Service
	Water, dirt in fuel system	Drain, flush fuel system	
	Defective antidieseling solenoid	Check operation	Section 7. Engine/Generator Components
	Carburetor adjustment wrong	Adjust carburetor	Section 3. Carburetor Adjustment
	Defective/misadjusted spark plug(s)	Regap or replace	Section 3. Ignition System—Spark Plugs
	Loose spark plug wires	Reconnect wires	Section 3. Ignition System—Spark Plugs
	Defective ignition module	Test. If defective, replace	Engine Service Manual
	Electronic governor overspeed setting too low	Adjust electronic governor	Section 7. Electronic Governor
	Engine malfunction	Troubleshoot engine	Engine Service Manual
	Open wiring, terminal, or pin (P2 connector)	Check continuity	Section 9. Wiring Diagrams
	K4 relay contact(s) defective	Check relay contact continuity	Section 7. Controller Circuit Board or Section 9. Wiring Diagrams
	K2 (normally closed) defective relay contact	Check relay contact continuity	Section 7. Controller Circuit Board or Section 9. Wiring Diagrams
	K3 relay defective (K2 relay must be energized for K3 to function)	Check relay coil continuity	Section 7. Controller Circuit Board or Section 9. Wiring Diagrams

Problem	Possible Cause	Corrective Action	Reference
Will not start (cranks okay) (continued)	K5 contact defective	Check relay contact continuity.	Section 7. Controller Circuit Board or Section 9. Wiring Diagrams
	Weak battery	Recharge battery. Check electrolyte level and specific gravity (batteries with filler caps only). Perform load test, or replace battery.	Section 3. Battery
	Fuse blown on voltage regulator circuit	Replace fuse	Section 9. Wiring Diagrams
	Defective gas valve (LP fuel only)	Test. If defective, replace	Section 3. Fuel System

Problem	Possible Cause	Corrective Action	Reference
Engine starts, but stops after start switch is released	Incorrect generator output voltage	Check AC output voltage.	Section 9. Wiring Diagrams or Section 7. Component Testing—Separate Excitation
	Open wiring (P1 or P2 connector)	Check continuity	Section 9. Wiring Diagrams
	K1 relay coil defective	Check continuity	Section 7. Controller Circuit Board or Section 9. Wiring Diagrams
	If LED1 is not lit, K1 relay is not receiving power from stator B1/B2 winding	Test stator	Section 7. Stator or Section 7. Engine/ Generator Components
	No/low oil pressure	Check oil level, oil pressure, oil pump, and low oil pressure shutdown switch	Section 3. Lubrication System Engine Service Manual
	Defective low oil pressure switch	Disconnect lead from low oil pressure switch and isolate the lead from ground. If engine starts and continues to run, replace low oil pressure switch. LOP switch contacts close at approx. 3.5 psi (24 kPa). **NOTE:** Verify pressure before replacing switch.	

Problem	Possible Cause	Corrective Action	Reference
Hard starting	Stale or bad fuel	Replace	
	Fuel vapor lock (hot engine only)	Check fuel line routing	Operation and Installation Manual—Fuel Systems
	Carburetor adjustment wrong	Adjust carburetor	Section 3. Carburetor Adjustment
	Choke out of adjustment	Repair/replace	Section 7. Carburetor Choke or Section 7. Engine/ Generator Components
	Defective ignition module	Test and/or replace	Engine Service Manual
	Defective spark	Replace spark plugs	Section 3. Ignition System
	Air cleaner clogged	Clean or replace element	Section 3. Service Air Cleaner
	Worn piston rings, valves, etc.	Check compression and oil consumption	Engine Service Manual
	Improper cooling (hot engine only)	Check air flow cooling system	Section 3. Cooling System
	Defective anti-icing plate (thermistor)	Test and/or repair	Section 7. Component Testing

Problem	Possible Cause	Corrective Action	Reference
Generator set shuts down by itself	No fuel in tank	Replenish	
	Fuel line restriction	Inspect fuel lines and tank	
	Clogged fuel filter	Replace filter	Section 3. Fuel System
	Defective fuel pump (gasoline fuel only)	Verify operation with 12 VDC applied. Check fuel pressure is 2-3.5 psi (14-24 kPa)	Section 7. Engine/Generator Components
	Engine overloaded	Reduce electrical load	Section 3. Wattage Requirements
	Engine overheated (hot engine only)	Check air intake, carburetor adjustment, oil level, etc.	Section 3. Scheduled Maintenance Engine Service Manual
	Loss of generator output voltage to K1 relay (LED1 not lit)	Check AC voltage at B1/B2 winding Check continuity of B1/B2 stator leads	Section 9. Wiring Diagrams Section 7. Stator
	Air cleaner clogged	Clean or replace element	Section 3. Servicing Air Cleaner
	Fuel vapor lock (hot engine only)	Reroute fuel lines away from heat source (exhaust system)	Operation and Installation Manual—Fuel Systems
	Faulty carburetor shutdown solenoid	Replace solenoid	Section 7. Fuel System—Carb. Shutdown Solenoid
	Faulty spark plug(s)	Replace spark plug(s)	Section 3. Ignition System—Spark Plugs
	Defective ignition module	Test and/or replace	Engine Service Manual
	Deicing module fuse blown (gasoline models)	Replace fuse	

Problem	Possible Cause	Corrective Action	Reference
Generator set shuts down by itself (continued)	No/low oil pressure	Check oil level, oil pressure, oil pump, and low oil pressure shutdown switch	Engine Service Manual
	Defective low oil pressure switch	Disconnect lead from low oil pressure switch and isolate the lead from ground. If engine starts and continues to run, replace low oil pressure switch. LOP switch contacts close at approx. 3.5 psi (24 kPa). **NOTE:** Verify pressure, before replacing switch.	
	Carburetor icing problem.	Check/repair manual or automatic deicing system as applicable.	Section 5. Anti-Icing or Section 9. Wiring Diagrams
	Controller fuse blown	Replace fuse	Section 7. Engine/ Generator Components or Section 9. Wiring Diagrams

Problem	Possible Cause	Corrective Action	Reference
Will not carry load or runs rough	Excessive load connected to generator	Reduce electrical load	Section 3. Wattage Requirements
	Improper cooling (hot engine only)	Check air flow cooling system	Section 3. Cooling System
	Governor not properly adjusted or defective (Engine not operating at rated rpm)	Check speed using tachometer or frequency meter. **NOTE:** For 60 Hz-1800 RPM For 50 Hz-1500 RPM	Section 7. Governor or Section 3. Electronic Governor
	Engine in need of overhaul	Contact authorized Kohler dealer/distributor	Engine Service Distributor

Problem	Possible Cause	Corrective Action	Reference
Will not carry load or runs rough (continued)	Fuel line restriction	Inspect fuel lines and tank.	
	Vent in fuel tank cap obstructed (gasoline fuel)	Clean cap in solvent, blow dry	
	Dirty fuel filter (gasoline fuel only)	Replace fuel filter	Section 3. Fuel System
	Improper type of fuel	Use specified type of fuel; consult fuel supplier	Section 3. Fuel System
	Defective fuel pump	Check fuel pump pressure is 2-3.5 psi (14-24 kPa)	Engine Service Manual
	Governor not properly adjusted or defective (Engine not operating at rated rpm)	Check speed using tachometer or frequency meter. **NOTE:** Hz x 120/ No. of rotor poles=rpm **(Example:** 60 x 120/4=1800)	Section 7. Electronic Governor or Section 3. Electronic Governor
	Carburetor not adjusted or defective	Check and/or adjust	Section 3. Carburetor Adjustments
	Defective ignition module	Test and/or replace	Engine Service Manual
	Defective/misadjusted spark plug	Regap or replace	Section 3. Spark Plug Service
	Carburetor choke	Test and/or replace	Section 7. Carburetor Choke or Section 7. Engine/ Generator Components
	Fuel leak	Tighten fittings	Engine Service Manual
	Valves not sealing	Compression test	Engine Service Manual
	Improper valve clearance	Adjust proper valve clearance	Section 3. Valve Clearance Engine Service Manual
	Excessive carbon buildup	Clean cylinder head	Engine Service Manual
	Fuel vapor lock (hot engine only)	Reroute fuel lines away from heat.	Operation and Installation Manual—Fuel Systems

Problem	Possible Cause	Corrective Action	Reference
Lacks power	Governor not properly adjusted or defective (Engine not operating at rated RPM)	Check engine speed using frequency meter or tachometer. **NOTE:** For 60 Hz-1800 RPM For 50 Hz-1500 RPM	Section 7. Electronic Governor
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Improper cooling	Check air flow cooling system	Section 3. Cooling System
	Engine overloaded	Reduce electrical load	Section 3. Wattage Requirements
	Stale or bad fuel	Replace	
	Fuel line restriction	Check fuel lines and tank	
	Dirty fuel filter (gasoline fuel only)	Replace fuel filter	Section 3. Fuel System
	Carburetor adjustment wrong	Adjust carburetor	Section 3. Carburetor Adjustment
	Choke misadjusted or defective	Check and/or adjust	Section 7. Carburetor Choke or Section 7. Engine/ Generator Components
	Carbon buildup	Clean cylinder heads	Engine Service Manual
	Faulty spark plug(s)	Replace spark plug(s)	Section 3. Spark Plug Service
	Defective ignition module	Test and/or replace coil	Engine Service Manual

Problem	Possible Cause	Corrective Action	Reference
Overheats	Improper cooling	Check cooling system air flow	Section 3. Cooling System
	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Carburetor adjusted too lean	Adjust carburetor	Section 3. Carburetor Adjustments
	Faulty spark plug(s)	Replace spark plug(s)	Section 3. Ignition System Spark Plugs
	Carburetor adjustment wrong	Adjust carburetor	Section 3. Carburetor Adjustment

Problem	Possible Cause	Corrective Action	Reference
Operates erratically	Air cleaner clogged	Clean or replace element	Section 3. Air Cleaner Service
	Stale or bad fuel	Replace	
	Governor not properly adjusted or defective (Engine not operating at rated RPM)	Check engine speed using frequency meter or tachometer **NOTE:** For 60 Hz-1800 RPM For 50 Hz-1500 RPM	Section 3. Electronic Governor
	Fuel line restriction	Inspect fuel lines and tank. Check fuel pump pressure of 2-3.5 psi (14-24 kPa)	
	Faulty spark plug(s)	Replace spark plug(s)	Section 3. Ignition System Spark Plugs
	Carburetor adjustment wrong	Adjust carburetor	Section 3. Carburetor Adjustment

Problem	Possible Cause	Corrective Action	Reference
Unit is noisy	Exhaust system leak	Check and replace as necessary	Operation and Installation Manual—Exhaust Systems
	Broken or damaged vibromounts	Check and replace as necessary	Section 8. Disassembly/ Reassembly
	Loose or vibrating sheet metal/housing	Retighten screws	
	Inadequate compartment clearances	Check clearances	Operation and Installation Manual—Compartment Size
	Exhaust piping or air inlets/outlets not securely installed	Inspect for loose parts	Operation and Installation Manual—Exhaust Systems
	No compartment sound insulation	Install fireproof insulation	Operation and Installation Manual—Compartment Size
	Excessive vibration—engine/generator	Check rotor, crankshaft, bearing, etc. (Disassembly of engine and/or generator may be required)	Section 8. Disassembly/ Reassembly or Engine Service Manual Contact authorized Kohler dealer/distributor

Problem	Possible Cause	Corrective Action	Reference
ELECTRICAL SYSTEM			
Battery will not charge or goes dead	Loose or corroded connections	Clean and tighten connections	Section 3. Battery
	Sulfated or damaged battery	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Defective battery charging circuit	Check battery charging circuit	Coach Operation/ Service Manual or Section 9. Wiring Diagrams

Problem	Possible Cause	Corrective Action	Reference
Starter does not work properly	Loose or corroded connections	Clean and tighten loose connections	Section 3. Battery
	Low battery output	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Defective starter solenoid	Check starter solenoid. Replace starter solenoid, as necessary	Section 7. Component Testing or Engine Service Manual
	Defective start/stop switch	Replace switch	Section 7. Component Testing
	Defective wiring	Check wiring	Section 9. Wiring Diagrams
	Defective starter	Replace starter	Engine Service Manual

Problem	Possible Cause	Corrective Action	Reference
Starter cranks slowly	Low battery output	Check electrolyte level and specific gravity (batteries with filler caps only)	Section 3. Battery
	Too heavy viscosity lube oil	Use specified viscosity oil	Section 3. Lubrication System
	Loose or corroded wiring	Clean and tighten loose connections	Section 3. Battery
	High starter current draw	Repair/Replace starter	Engine Service Manual
	Battery cable undersize	Select specified size cable	Operation and Installation Manual—Electrical Systems

Problem	Possible Cause	Corrective Action	Reference
GENERATOR			
No generator output voltage	AC output circuit breaker open or defective	Check position of circuit breaker. Check AC voltage on generator side of circuit breakers	Section 2. Circuit Protection or Section 9. Wiring Diagrams
	AC circuit breaker tripping due to overload on unit	Reduce load. Reset and attempt startup	Section 3. Wattage Requirement
	Short circuit in vehicle wiring causing circuit breaker to trip	Reset circuit breaker. If breaker trips again, check wiring.	Section 9. Wiring Diagrams Load Wiring Diagram
	Transfer switch in off or other power position	Reset	
	No battery voltage to field during cranking	Check flashing current	Section 7. Separate Excitation Test
	Open flashing diode (D4 or D7)	Check for open or shorted diode (a good diode has high resistance one way and low resistance the other way when tested with ohmmeter)	Section 9. Wiring Diagrams or Section 7. Circuit Board
	K1 relay (normally closed) contacts open	Check continuity	Section 9. Wiring Diagrams or Section 7. Circuit Board
	Open wire or pin in flashing current circuit	Check continuity	Section 9. Wiring Diagrams
	Defective rotor (open, grounded, or shorted windings)	Test and/or replace	Section 7. Rotor
	Defective stator (open, grounded, or shorted windings)	Test and/or replace	Section 7. Stator
	Brushes sticking in holder	Check alignment	Section 8. Brushes

Problem	Possible Cause	Corrective Action	Reference
GENERATOR No generator output voltage (continued)	Rotor slip rings dirty or corroded	Check and/or service	Section 8. Brushes
	Broken, weak, or missing brush spring	Check condition	Section 8. Brushes
	Fuse blown in voltage regulator circuit (lead 55)	Replace fuse. If fuse blows again, check voltage regulator and stator windings	Section 7. Voltage Regulator or Section 9. Wiring Diagrams
	Defective voltage regulator. Misadjusted voltage regulator	Excite rotor separately	Section 7. Separate Excitation or Section 7. Voltage Regulator Test/ Adjustment

Problem	Possible Cause	Corrective Action	Reference
Low generator output voltage	Low engine rpm	Check engine speed using frequency meter or tachometer. **NOTE:** For 60 Hz-1800 RPM For 50 Hz-1500 RPM	Section 7. Electronic Governor Adjustments
	Set overloaded	Make sure capacity is not being exceeded	Section 3. Wattage Requirements
	Defective rotor	Test and/or replace	Section 7. Rotor
	Defective stator	Test and/or replace	Section 7. Stator
	Defective voltage regulator	Test and/or replace	Section 7. Voltage Regulator
	Improperly adjusted voltage regulator	Readjust	Section 7. Voltage Regulator

Problem	Possible Cause	Corrective Action	Reference
High generator output voltage	Defective voltage regulator	Test and/or replace	Section 7. Voltage Regulator
	Voltage regulator misadjusted	Readjust	Section 7. Voltage Regulator
	Open or poor splice connection at regulator sensing terminals on stator or poor pin connection at voltage regulator	Check continuity and clean connections	Section 7. Stator or Section 9. Wiring Diagrams

Section 5. Controller Troubleshooting

Data in this section describes the controller sequence of operation during cranking, starting, running, and stopping of the generator set. Use this data as a starting point for sequencing fault identification.

NOTE

Diagrams in this section have been simplified to support the level of detail covered in the text. For complete diagrams, refer to Section 9—Wiring Diagrams.

Cranking

Circuits shown in Figure 5-1 control engine cranking. Before starting the cranking sequence, turn off and stop the engine to ensure that all the relays are de-energized and that the starter motor and flywheel gear teeth do not clash.

Initiate cranking by placing the Start/Stop switch in the Start position. This action energizes the K2 relay (LED2 on). With the K2 relay energized, power is routed through the normally open K2 relay contacts to energize the K3 relay (LED3 on).

Energizing the K3 relay causes the normally open K3 relay contacts to close and energize the S (starter solenoid) relay. Energizing the S relay closes the normally open S relay contacts. The starter motor is energized, causing the starter motor gear to engage the ring gear on the flywheel and begin turning the engine.

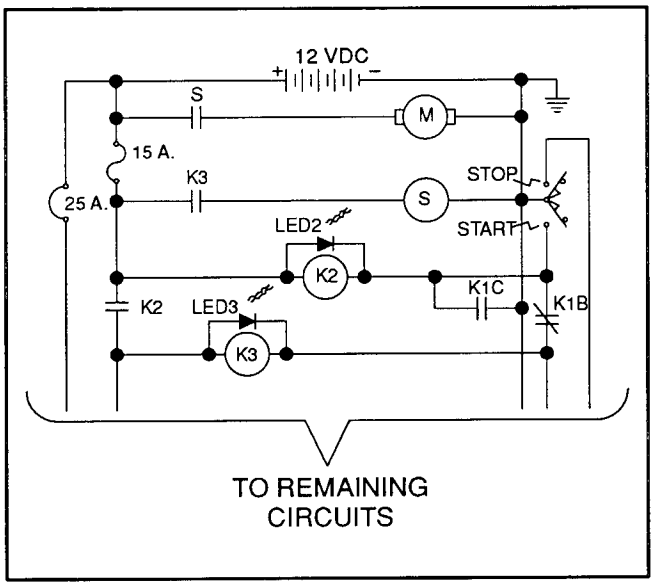


Figure 5-1. Cranking Sequence of Operation

Starting

To start the engine, enable the ignition and supply fuel to the carburetor while the engine is cranking. These actions are controlled by the circuits shown in Figure 5-2.

Cranking the engine, as explained on the previous page, causes the K2 relay, the K3 relay, and the S relay to energize in order to supply battery power to the starter motor. Energizing the K2 relay opens the normally closed K2 relay contacts, removing the ground connection to the ignition module and the K4 relay. With the ground connection removed, the ignition module is enabled.

Removing the ground connection to the K4 relay prevents the K4 relay from energizing when the normally open K2 contacts close. With the K4 relay de-energized (LED4 off), the normally closed K4 contacts remain closed and continue to energize the fuel pump (FP) or fuel solenoid (FS). Energizing the FP fuel pump or FS fuel solenoid in this manner allows fuel to flow to the carburetor, completing the conditions necessary for the engine to start.

An automatic choke enriches the fuel/air mixture when starting a cold engine. A choke heater quickens the return of the choke plate to a fully open position. The CH (choke heater) receives power whenever the normally open K2 relay contacts are closed.

Releasing the Start/Stop switch allows the switch to return to its center neutral position. If the switch is released before the generator set is running (before the K1 relay energizes), the K2 relay de-energizes. The normally open K2 contacts then open to remove power from the engine cranking and starting circuits. As a result, the starter motor and the FP motor or the FS fuel solenoid all de-energize to cease engine starting.

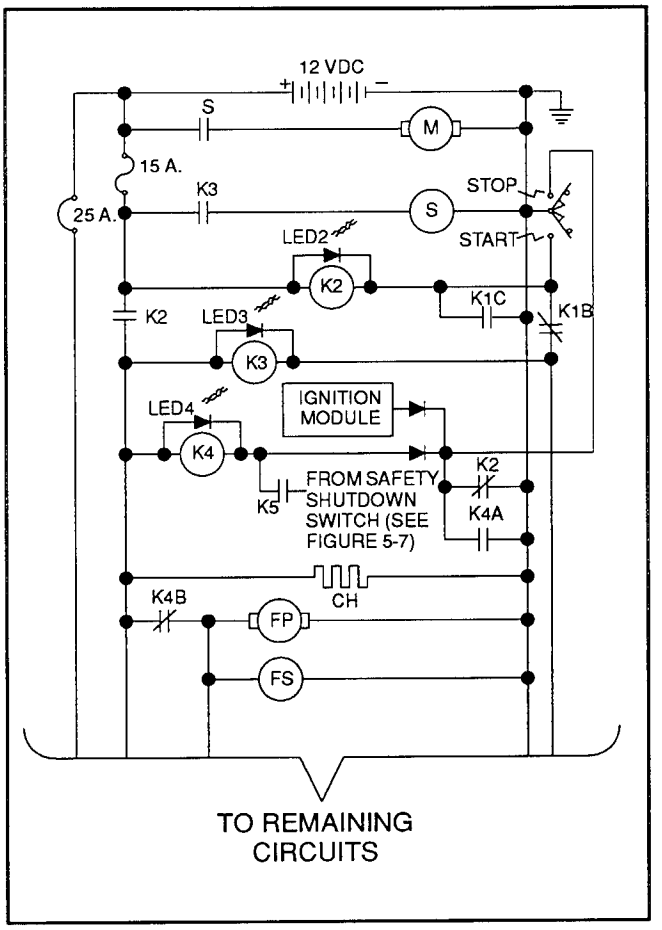


Figure 5-2. Sequence of Operation, Starting

Running

During engine startup, flashing current is provided to the generator field through the normally open K2 contact, two diodes, and the normally closed K1A and K1B contacts. The flashing current combined with the rotation of the generator rotor induces electrical currents in the generator stator windings. The resulting output from one stator winding (the battery charging winding), rectified and limited to a 12 VDC level, energizes the K1 relay (LED1 on). When the K1 relay is continuously energized for 5 to 10 seconds, the K5 relay energizes (LED5 on). Both relays remain energized during normal running of the generator.

Energizing the K1 relay opens the normally closed K1A and K1B contacts that supply flashing current to the generator field. Field current for continued operation is then supplied by the voltage regulator, operating from power generated by one stator winding (auxiliary winding) and voltage sensed from another stator winding (main output), to maintain the desired output voltage(s).

Opening the normally closed K1B contacts also de-energizes relay K3 (LED off). As a result the S (starter) solenoid de-energizes to disengage and de-energize the starter motor even when the Start/Stop switch is held in the Start position.

Energizing the K1 relay also closes the normally open K1C contacts to supply power to the K2 relay. The circuit remains closed, keeping the K2 relay energized and the generator set running when the Start/Stop switch is released.

Energizing the K1 relay also closes the normally open K1D contacts. This action supplies power to the hourmeter and ON light on any optional remote panels.

Electronic Governor

Whenever the generator set is running, an electronic governor system regulates the engine speed to ensure that the frequency of the generator output is maintained. The main components of the system include a magnetic pickup (MP), an electronic governor circuit board, and a stepper motor. The MP produces a pulse each time one of the ring gear teeth on the engine flywheel passes the pickup. The resulting pulse train, with a frequency proportional to the engine rpm and generator output frequency, is compared to a preset frequency by the electronic governor. When the pulse train and preset frequencies differ, the electronic governor produces an output that operates the stepper motor to correct the carburetor throttle position. With this closed loop control, output frequency is maintained to within ± 0.25 percent of the desired frequency. To prevent dieseling of the engine after shutdown, the electronic governor also operates the AD (antidieseling) solenoid. The solenoid, energized whenever the electronic governor is energized, allows the electronic governor to control the throttle, de-energizes at engine shutdown.

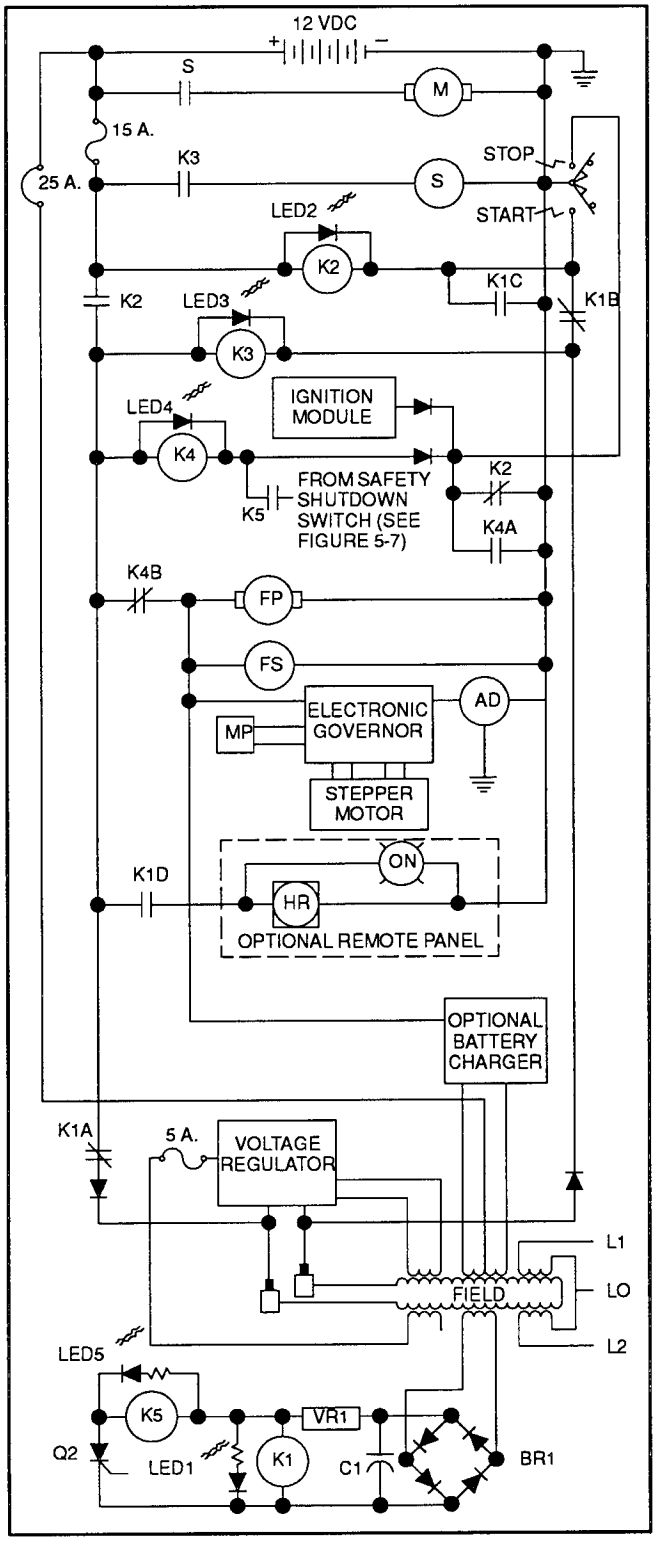


Figure 5-3. Sequence of Operation, Running

Anti-Icing

Early models of the generator set employ a manual anti-icing system. Later models use electrically operated automatic anti-icing systems, either a PTC (positive temperature coefficient), or a deicing module. Both automatic systems operate whenever the generator set is running. Refer to Section 2 for descriptions and views.

The PTC anti-icing system consists of a heater and thermostat switch mounted in the air intake duct of the carburetor. Power routed through the normally open contacts of relay K2 in the controller is applied to the heater and thermistor. See Figure 5-4. When it is cold, thermistor resistance is low and the heater current of approximately 3 amperes produces maximum heat. As the temperature increases, the thermistor resistance increases and the heater current decreases to an eventual minimum of 0.75 amperes, producing minimum heat.

The automatic deicing system includes a module consisting of a heater, high-level thermostat switch, low-level thermostat switch, and fuse that are separate from the module. See Figure 5-5. When the ambient air temperature is 60° F (16° C) or less, the low-level thermostat switch is closed to apply power to the deicing module. Current flowing through the module heater produces heat to warm the incoming air for the carburetor. Heating continues at the same level until the temperature in the module reaches 185° F (85° C) and the internal high-level thermostat switch opens. When the temperature drops, the high-level thermostat switch closes again to resume heating.

Battery Charging

Some generator sets are equipped with an optional battery charger. See Figure 5-3. An output generated by a separate stator winding whenever the generator set is running is rectified and regulated by the optional battery charger. The output of the winding is then routed through a 25-ampere circuit breaker to recharge the battery.

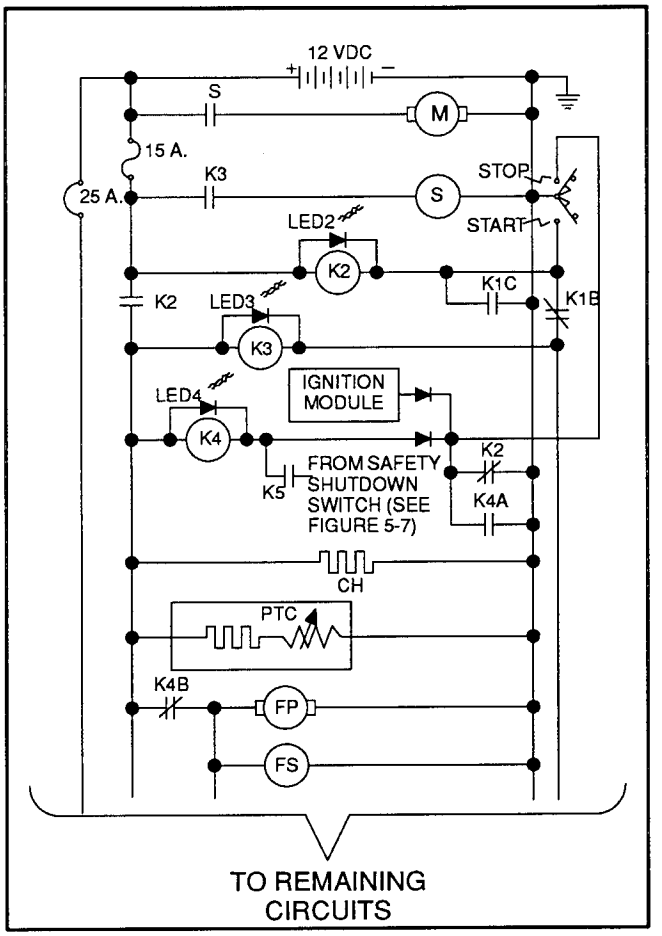


Figure 5-4. PTC Anti-Icing Diagram

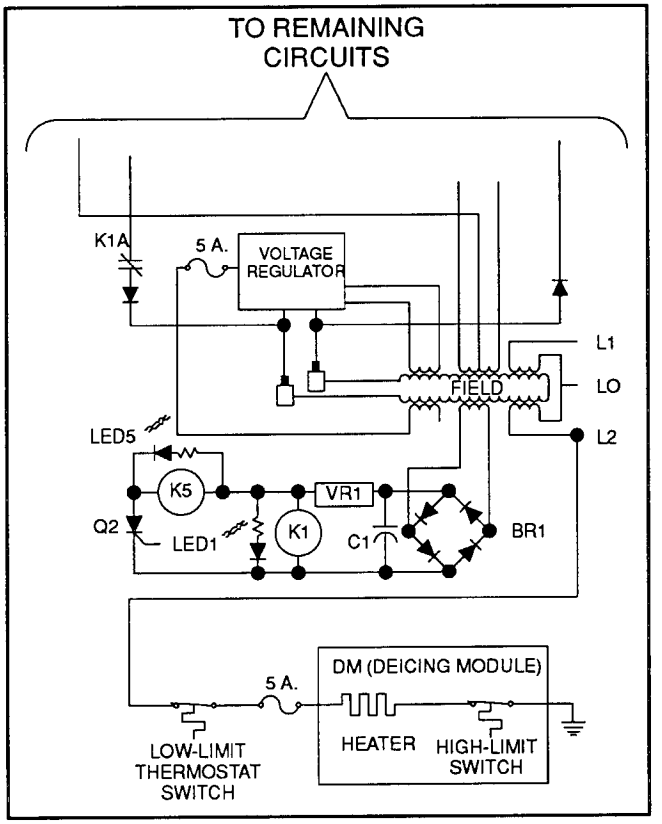


Figure 5-5. Deicing Module Diagram

Stopping

A normal stop is initiated by placing the Start/Stop switch located on the controller front panel in the Stop position and then releasing the switch. See Figure 5-6. In the Stop position, the Start/Stop switch provides one path to ground through a blocking diode to disable the ignition module and another path to ground through a second blocking diode to energize relay K4 (LED4 lights). The normally open K4A contacts then close, latching the K4 relay in an energized condition to keep the ignition module disabled.

When relay K4 energizes, the normally closed K4B contacts open to de-energize the fuel pump (gasoline-fueled engines), the fuel solenoid (LP gas-fueled engines), the electronic governor, and the battery charger. De-energizing the electronic governor in turn de-energizes the AD (antidieseling) solenoid. With the fuel supply turned off by this sequence and the ignition disabled, the engine shuts down.

When the engine shuts down, the generator output decreases and causes both the K1 relay and the K5 relay to de-energize (LED1 and LED5 off). De-energizing the K1 relay opens the normally open K1C contacts, de-energizing the K2 relay (LED2 off). When the K2 relay de-energizes, the normally open K2 contacts open to interrupt power to the remaining controller circuits including relay K4. As a result, the latchup of the K4 relay is broken to return the controller circuits to a normal prestartup condition. K4 relay is de-energized. All controller circuits return to the normal position. The unit is now ready for the next cranking, starting, or running sequence.

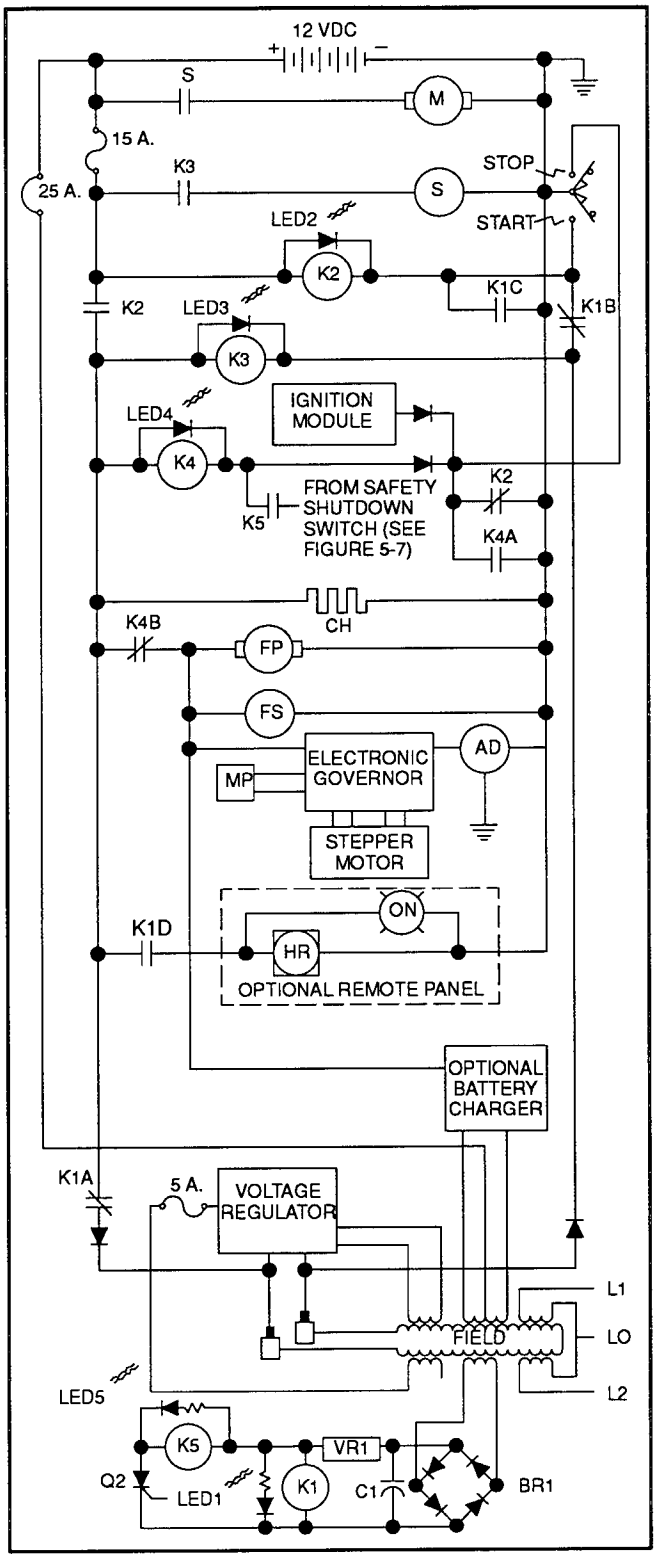


Figure 5-6. Stopping Sequence of Operation

Automatic Safety Shutdowns

The engine is equipped with a low oil pressure switch. The switch closes when oil pressure is insufficient for lubrication and safe operation of the engine.

During running of the generator set, closing the low oil pressure switch results in an automatic safety shutdown of the generator set. See Figure 5-7. During cranking and starting, this shutdown function is disabled by the normally open K5 relay contacts. These contacts remain open until 5 to 10 seconds after normal generator output is sensed.

Once the normally open K5 contacts close, the low oil pressure switch automatic shutdown feature is enabled. If the low oil pressure switch then closes, the K4 relay is energized (LED4 lights). Energizing the K4 relay closes the normally open K4A contacts, latching the K4 relay in an energized condition and routing a ground through a blocking diode to disable the ignition module.

When relay K4 energizes, the normally closed K4B contacts open to de-energize the fuel pump (gasoline-fueled engines), the fuel solenoid (LP gas-fueled engines), the electronic governor, and the battery charger. De-energizing the electronic governor in turn de-energizes the antidieseling (AD) solenoid. With the fuel supply turned off by these actions and the ignition disabled, the engine shuts down.

When the engine shuts down, the generator output decreases and causes both the K1 relay and the K5 relay to de-energize (LED1 and LED5 go out). De-energizing the K1 relay opens the normally open K1C contacts, de-energizing the K2 relay (LED2 goes out). When the K2 relay de-energizes, the normally open K2 contacts open to interrupt power to the remaining controller circuits including relay K4. K4 relay is de-energized. All controller circuits return to the normal position. The unit is now ready for the next cranking, starting, or running sequence.

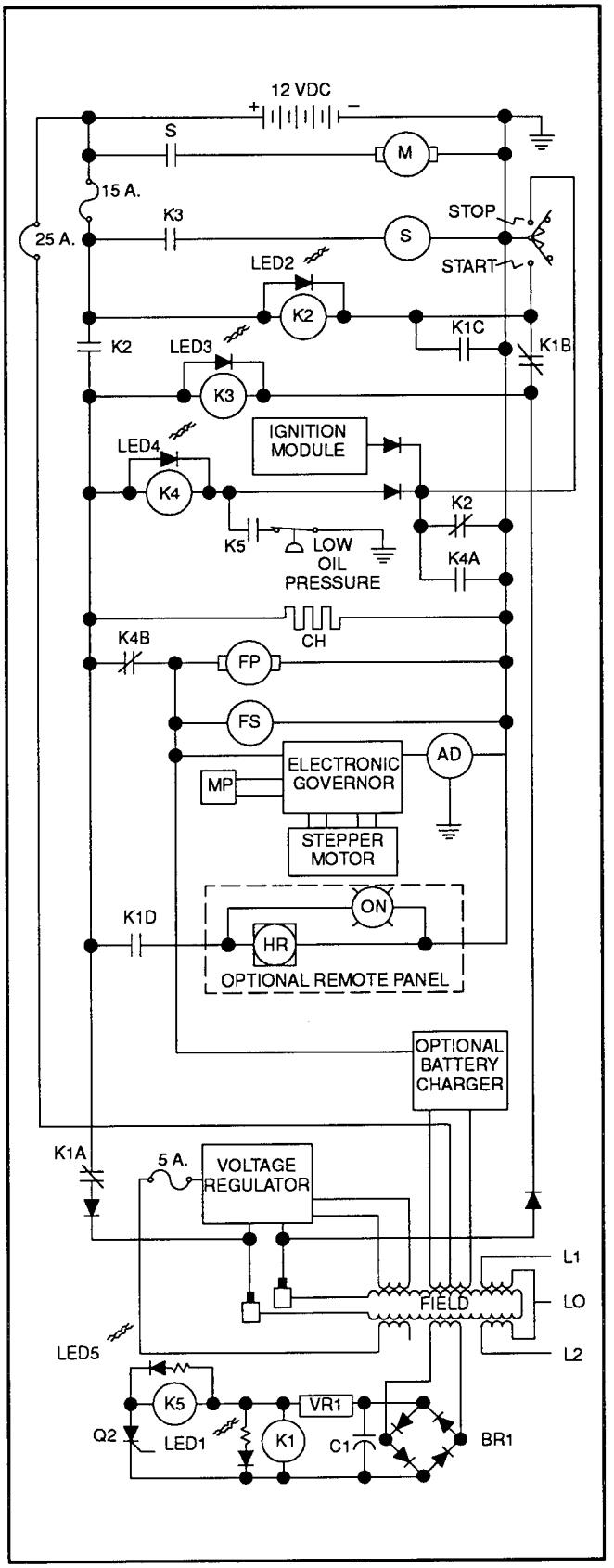


Figure 5-7. Automatic Safety Shutdown Sequence of Operation

Section 6. Generator/Controller Troubleshooting

The section contains flowcharts to troubleshoot the generator set including the controller circuit board. Read all safety precautions at the beginning of this manual before starting the troubleshooting procedures. Additional safety precautions are included with the tests. *Observe these precautions.*

Controller Circuit Board

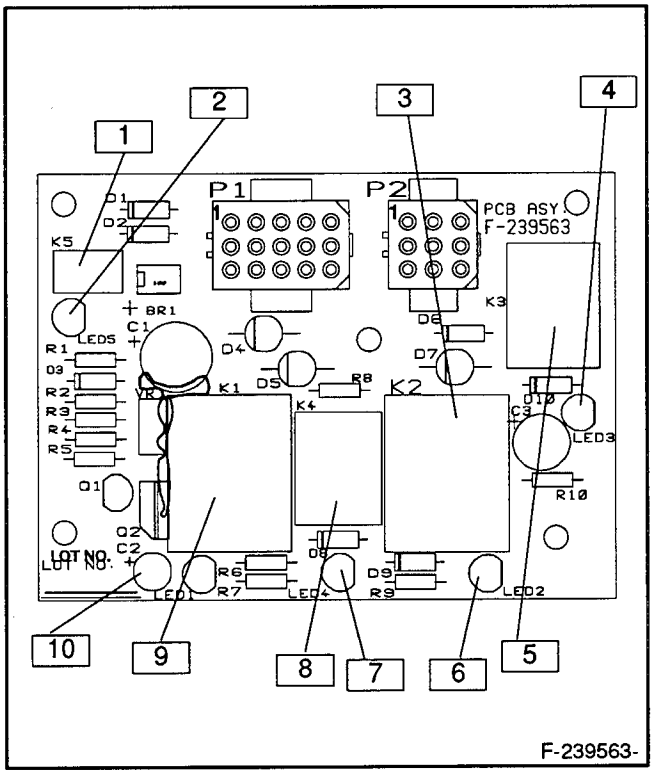
The controller circuit board is equipped with light emitting diodes (LEDs) to indicate the presence of relay coil power and aid in circuit board and generator fault detection. See Figure 6-1.

When K1, K2, K3, K4, or K5 relay is receiving power, the corresponding LED will light. The LED does not indicate whether the relay coil is good or bad. Analyze the fault to determine its functionality.

Use the following flowcharts as an aid in troubleshooting the generator set.

This manual incorporates two flowcharts to troubleshoot the generator and controller. The first flowchart combines the controller and generator troubleshooting procedures. This flowchart uses the LEDs on the circuit board to diagnose generator faults. The second flowchart incorporates generator troubleshooting in the first section and controller troubleshooting in the second section. This flowchart uses generator or engine functions to detect any faults.

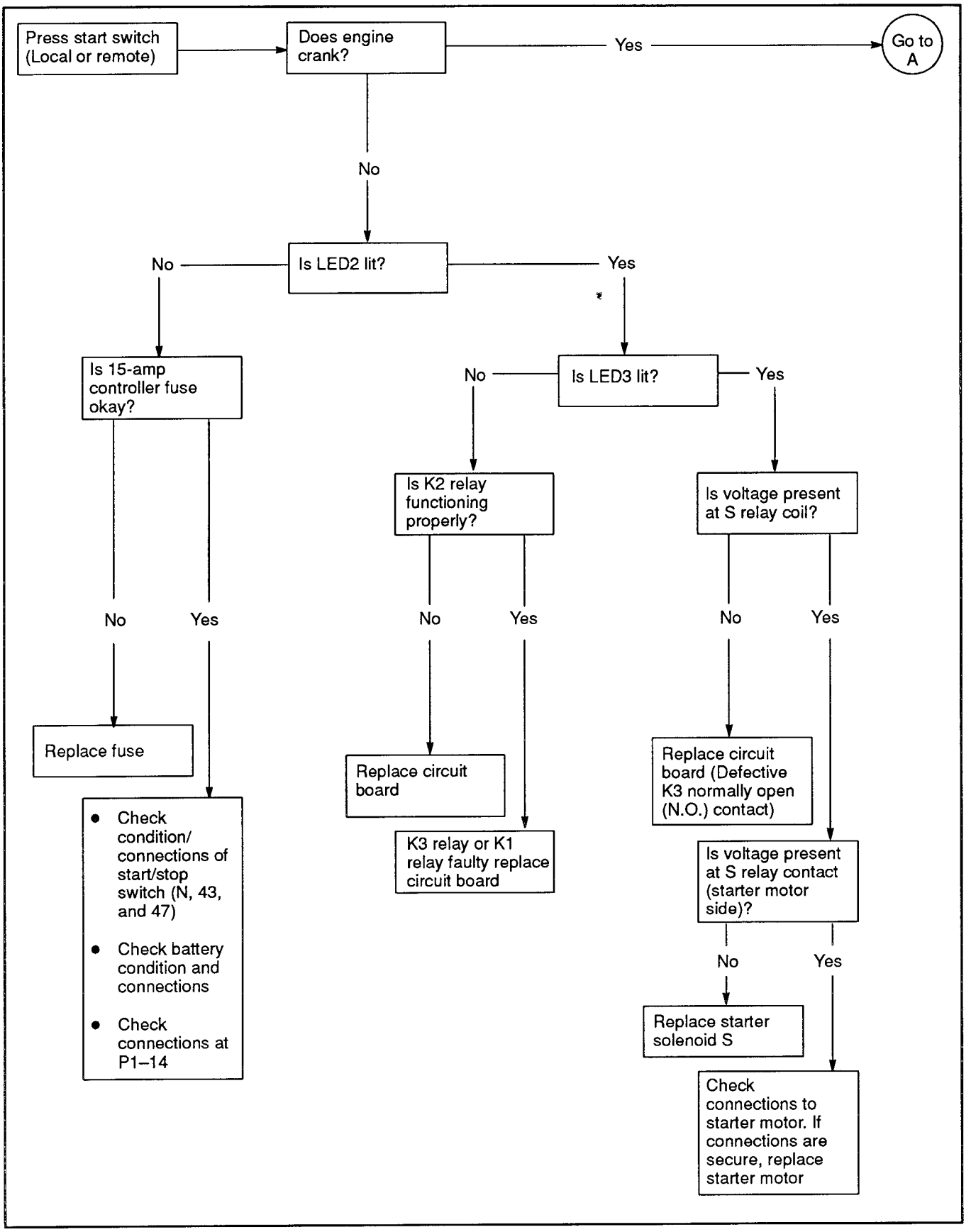
Refer to the detailed procedural instructions for any check or test.



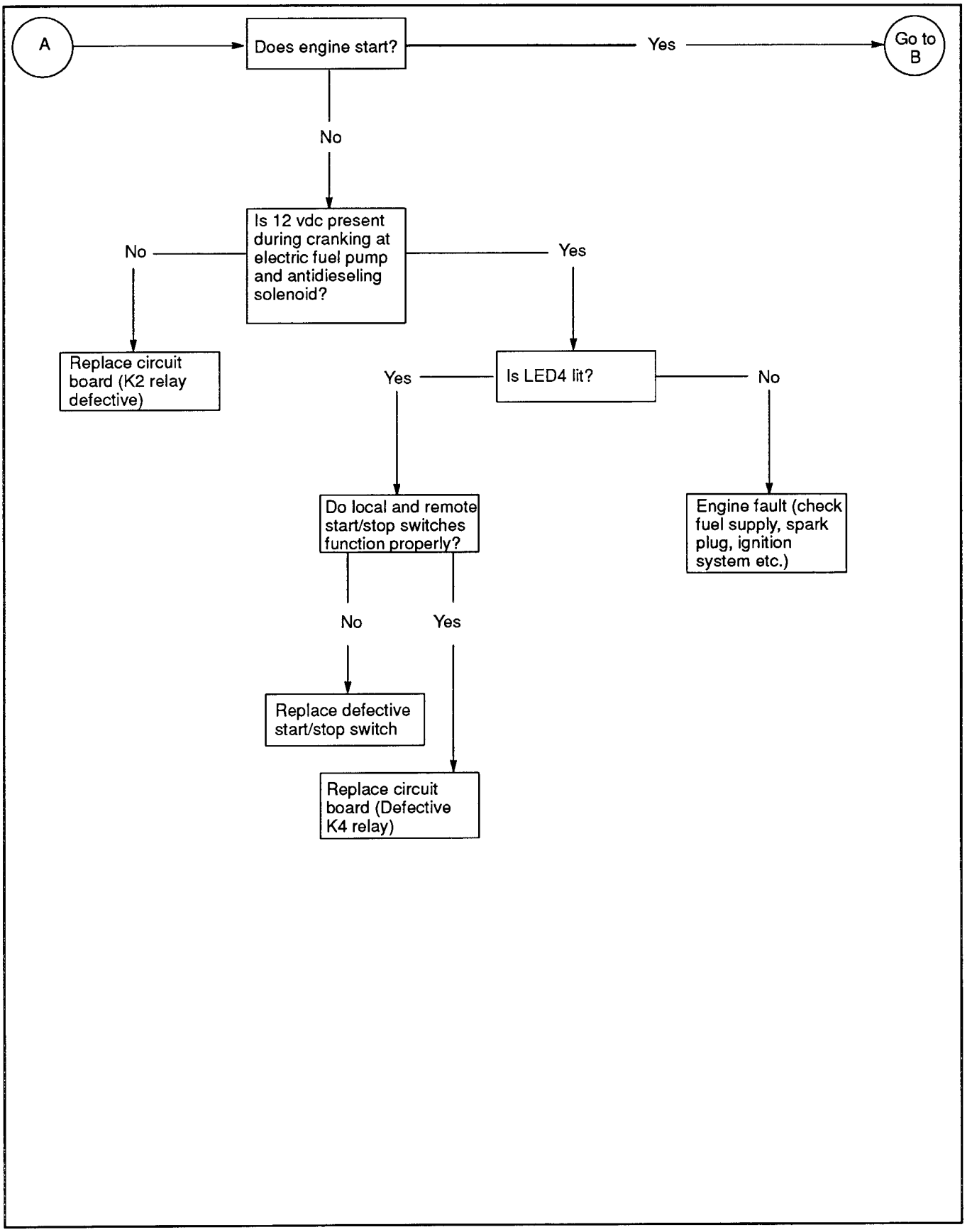
1. K5 Time Delay for Fault Circuit
2. LED 5
3. K2 Start/Run Relay
4. LED 3
5. K3 Run Relay
6. LED 2
7. LED 4
8. K4 Shutdown Relay
9. K1 Interlock—Start and Reg. Disconnect
10. LED 1

Figure 6-1. Controller Circuit Board F-239563

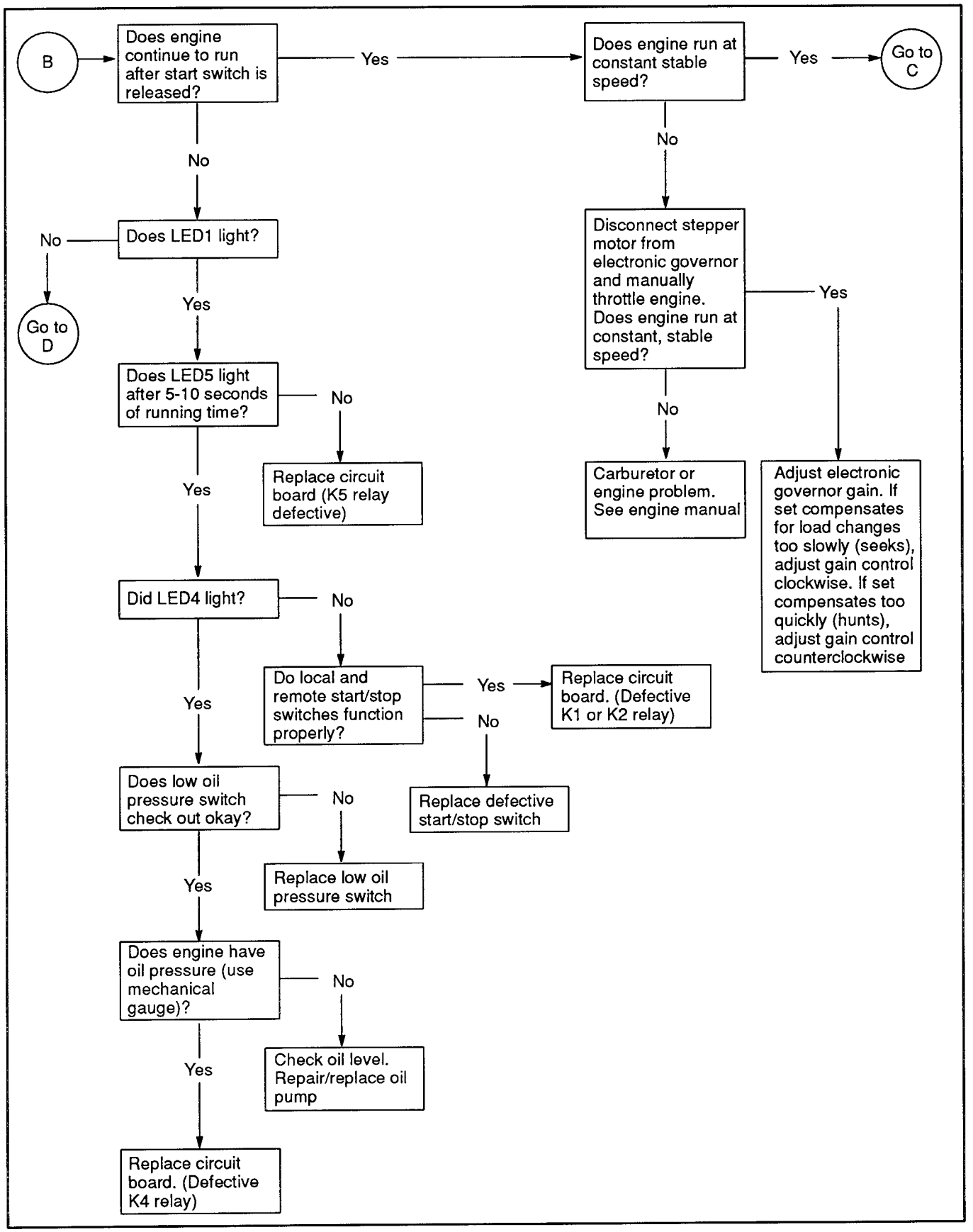
Generator/Controller Troubleshooting (Sheet 1 of 5)



Generator/Controller Troubleshooting (Continued)
(Sheet 2 of 5)



Generator/Controller Troubleshooting (Continued)
(Sheet 3 of 5)



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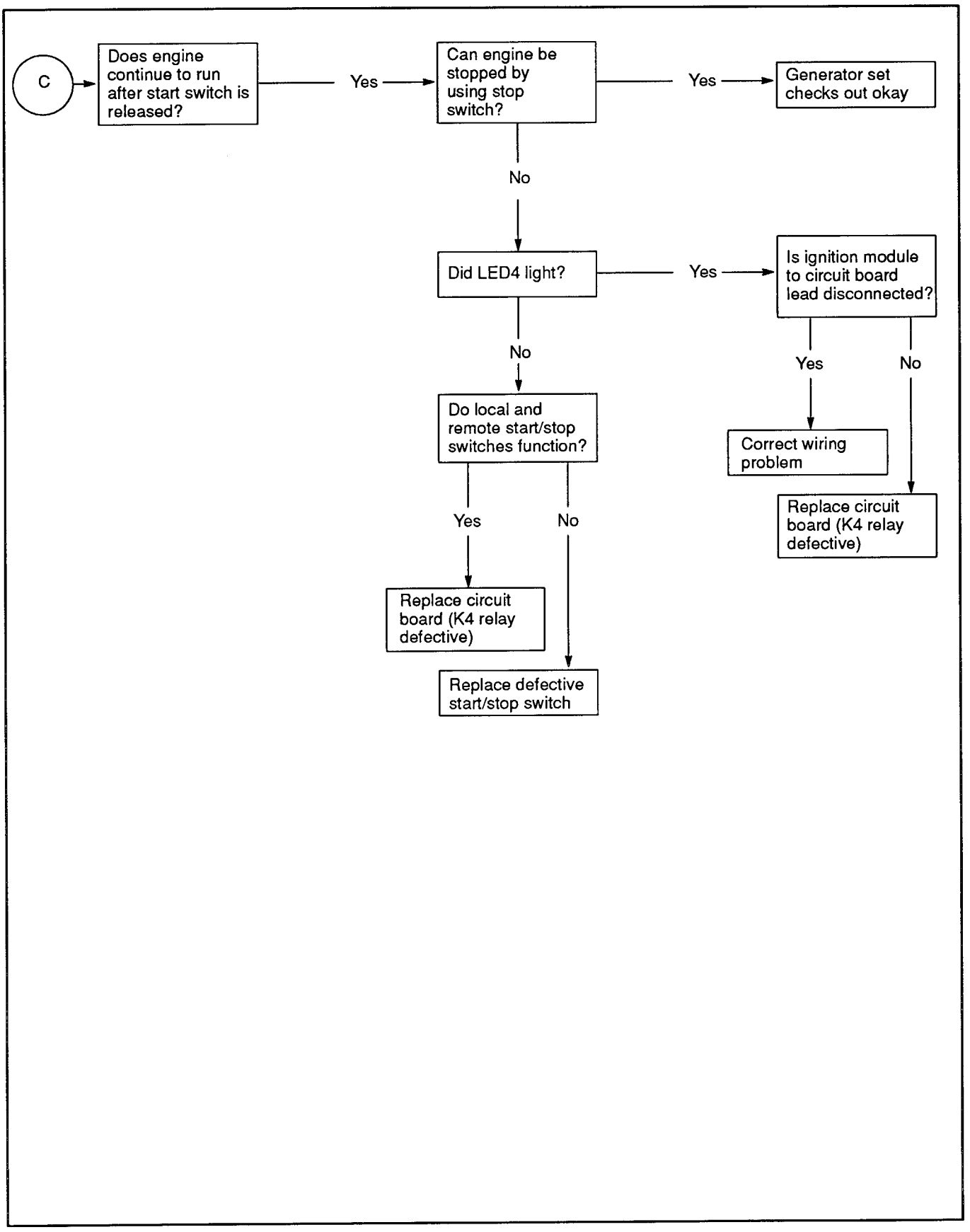

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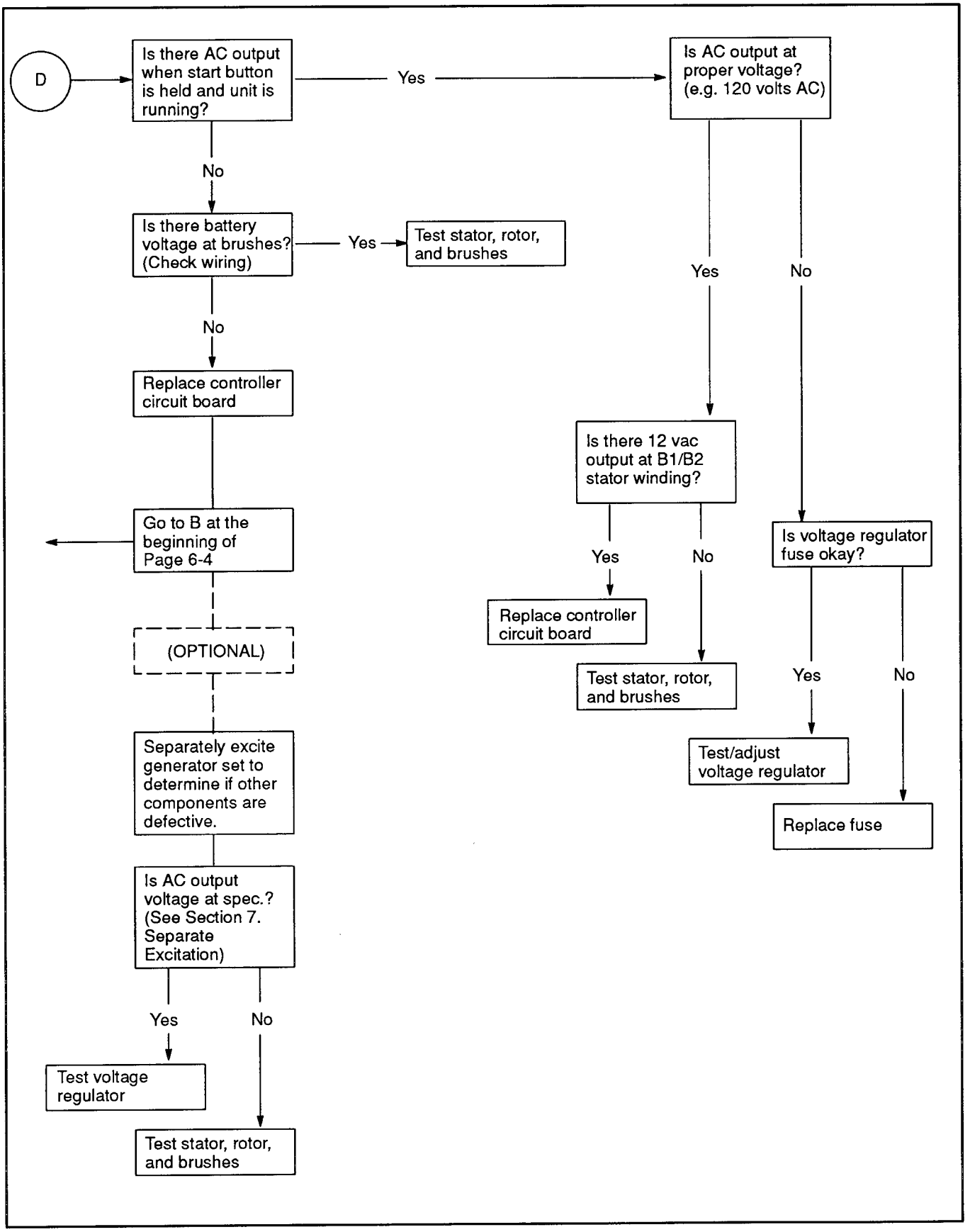
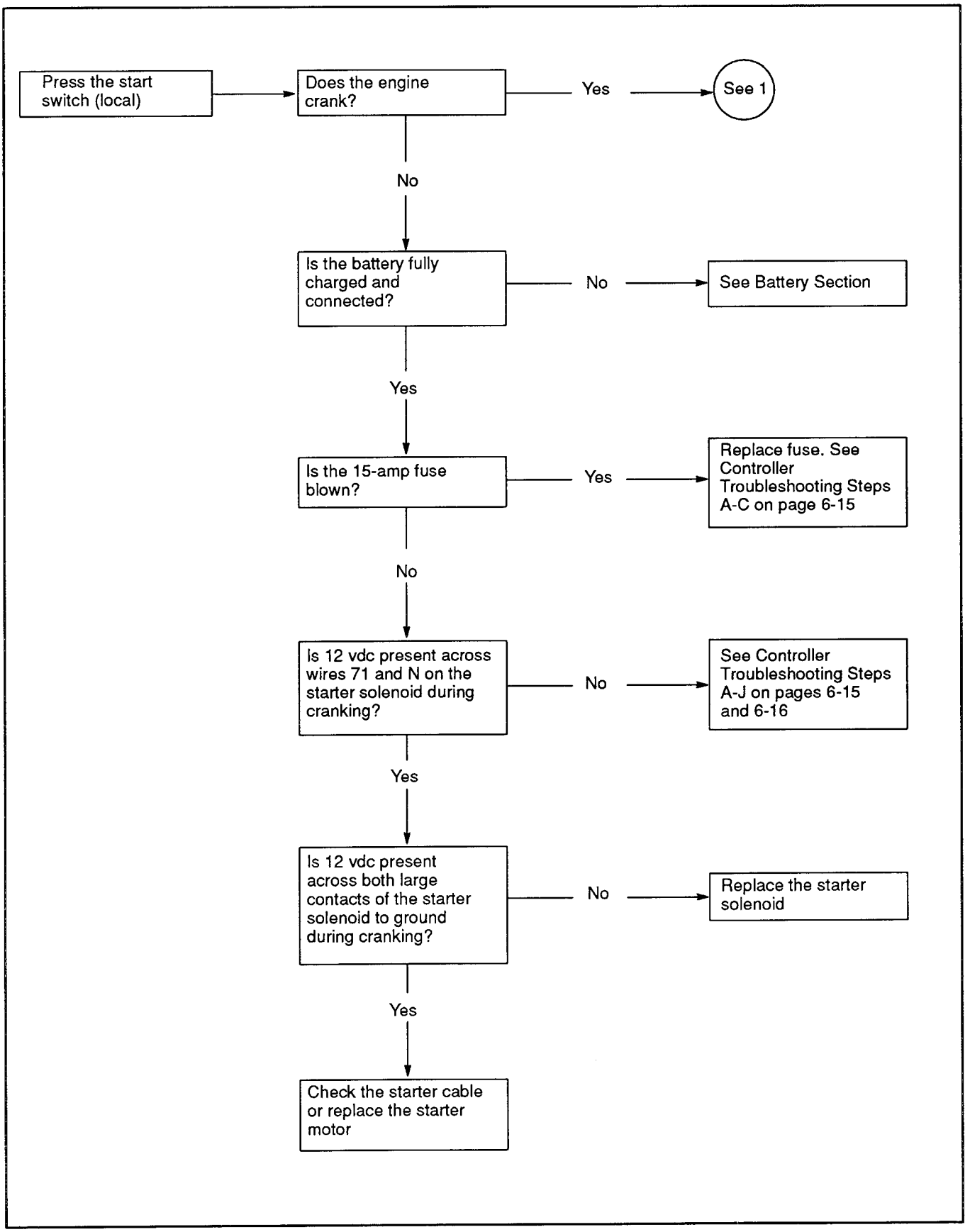
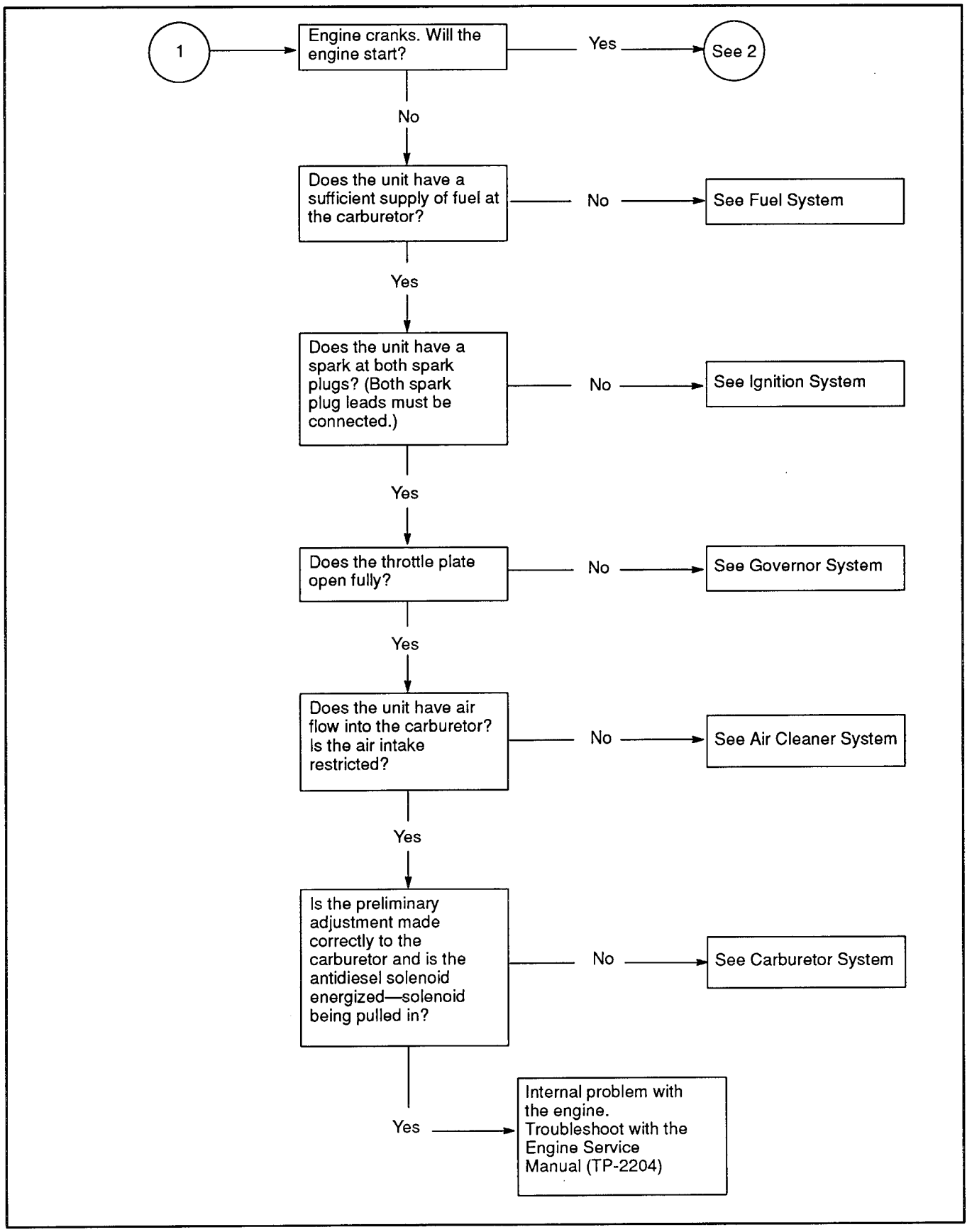


Generator Troubleshooting
(Sheet 1 of 13)



Generator Troubleshooting (Continued)
(Sheet 2 of 13)



Generator Troubleshooting (Continued)
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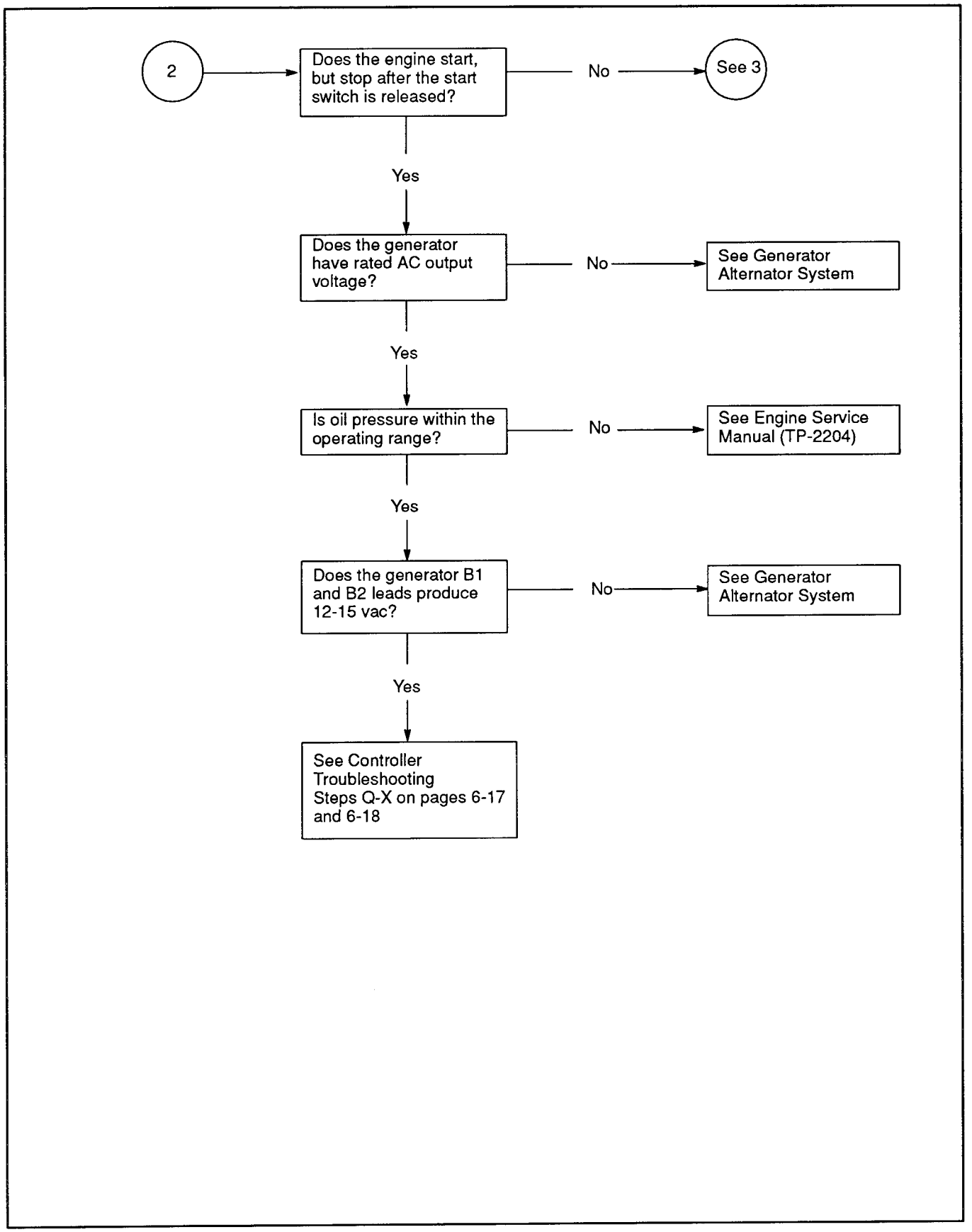

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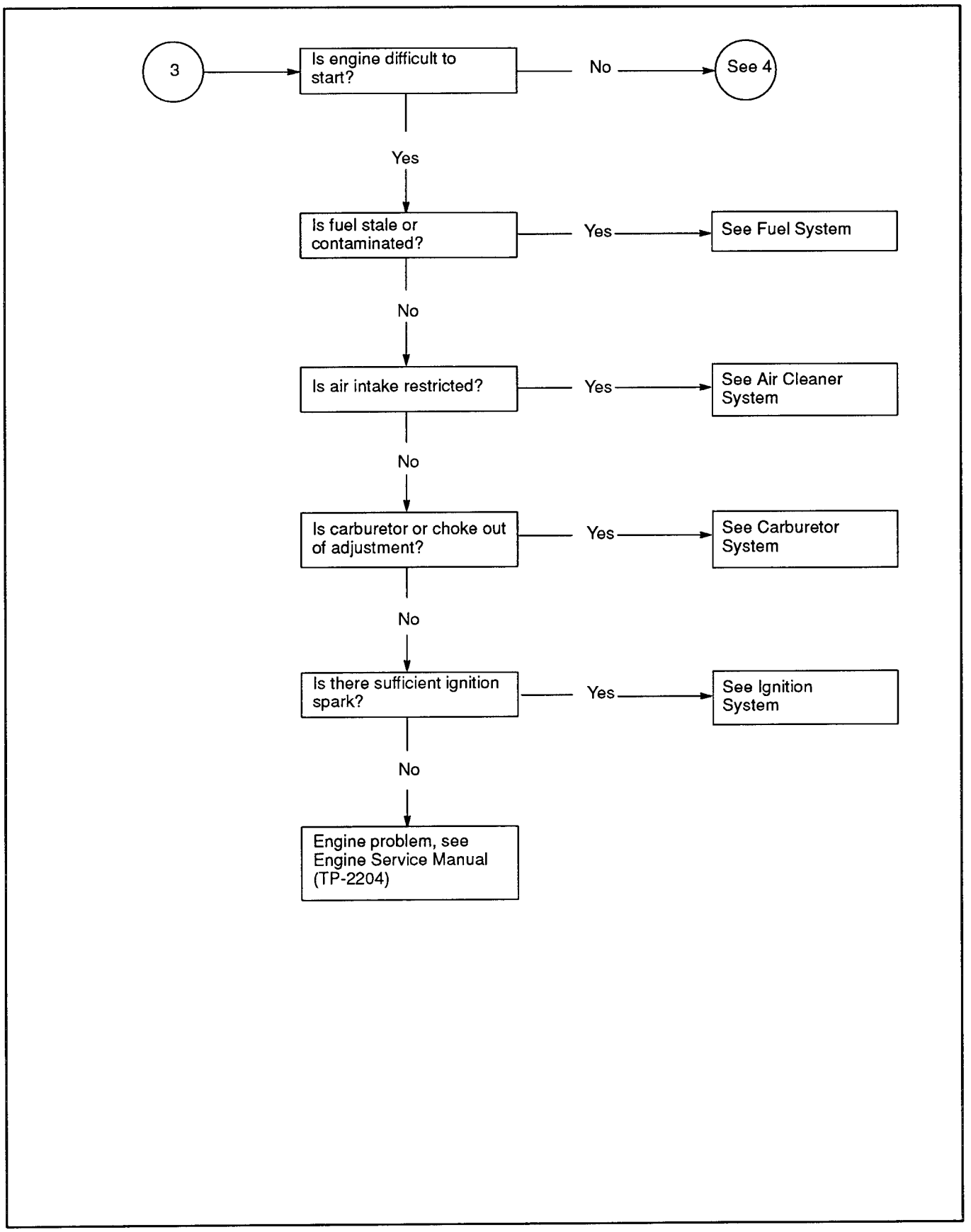
(Sheet 4 of 13)



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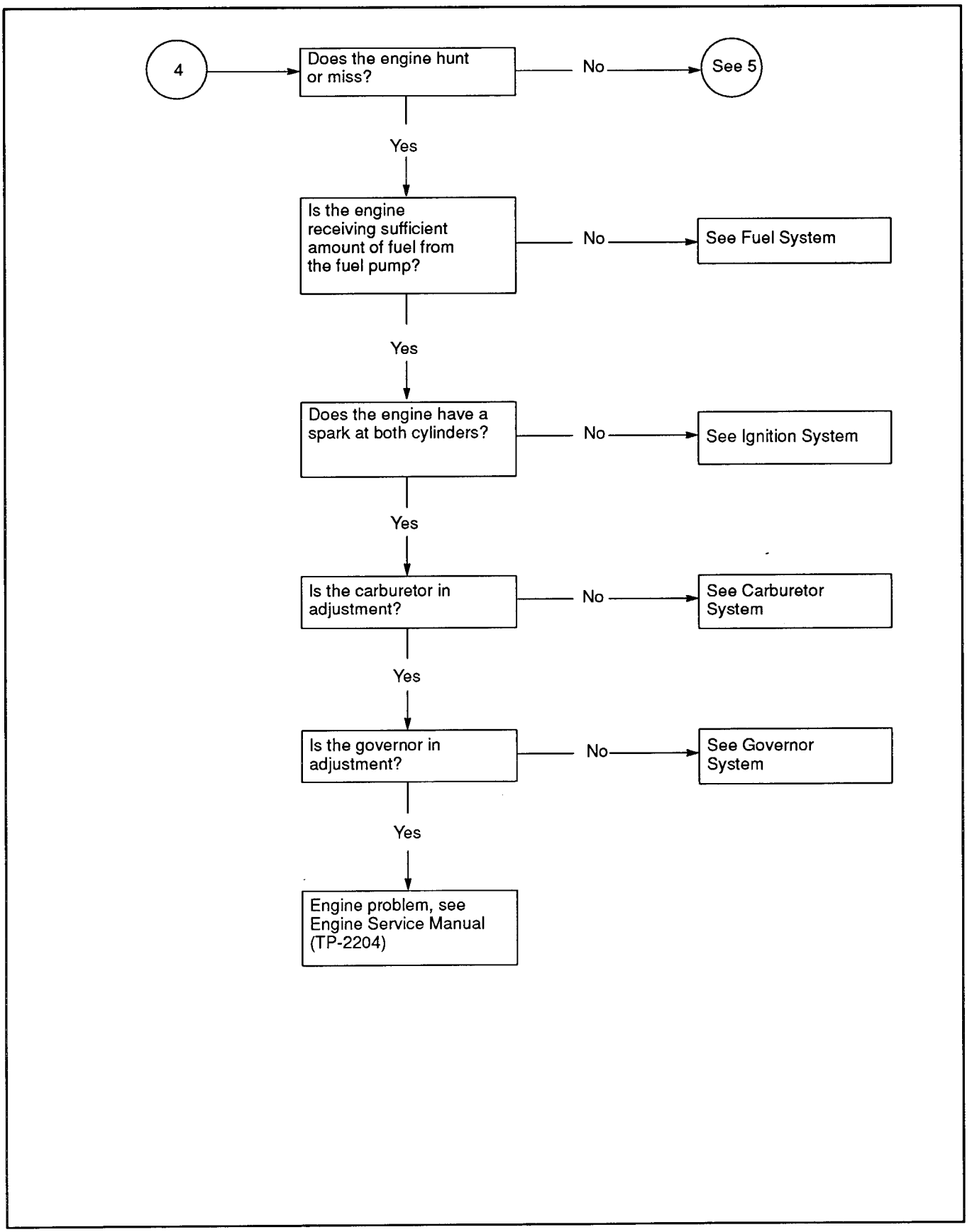
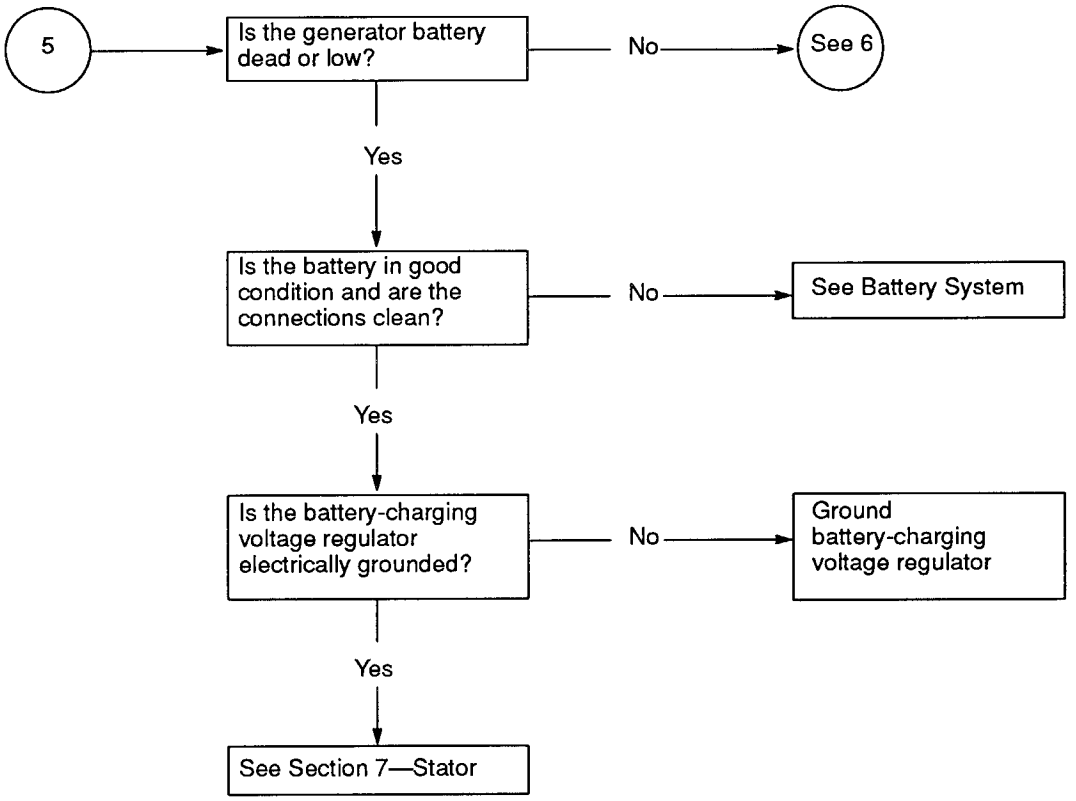
(Sheet 5 of 13)



Generator Troubleshooting (Continued)
(Sheet 6 of 13)



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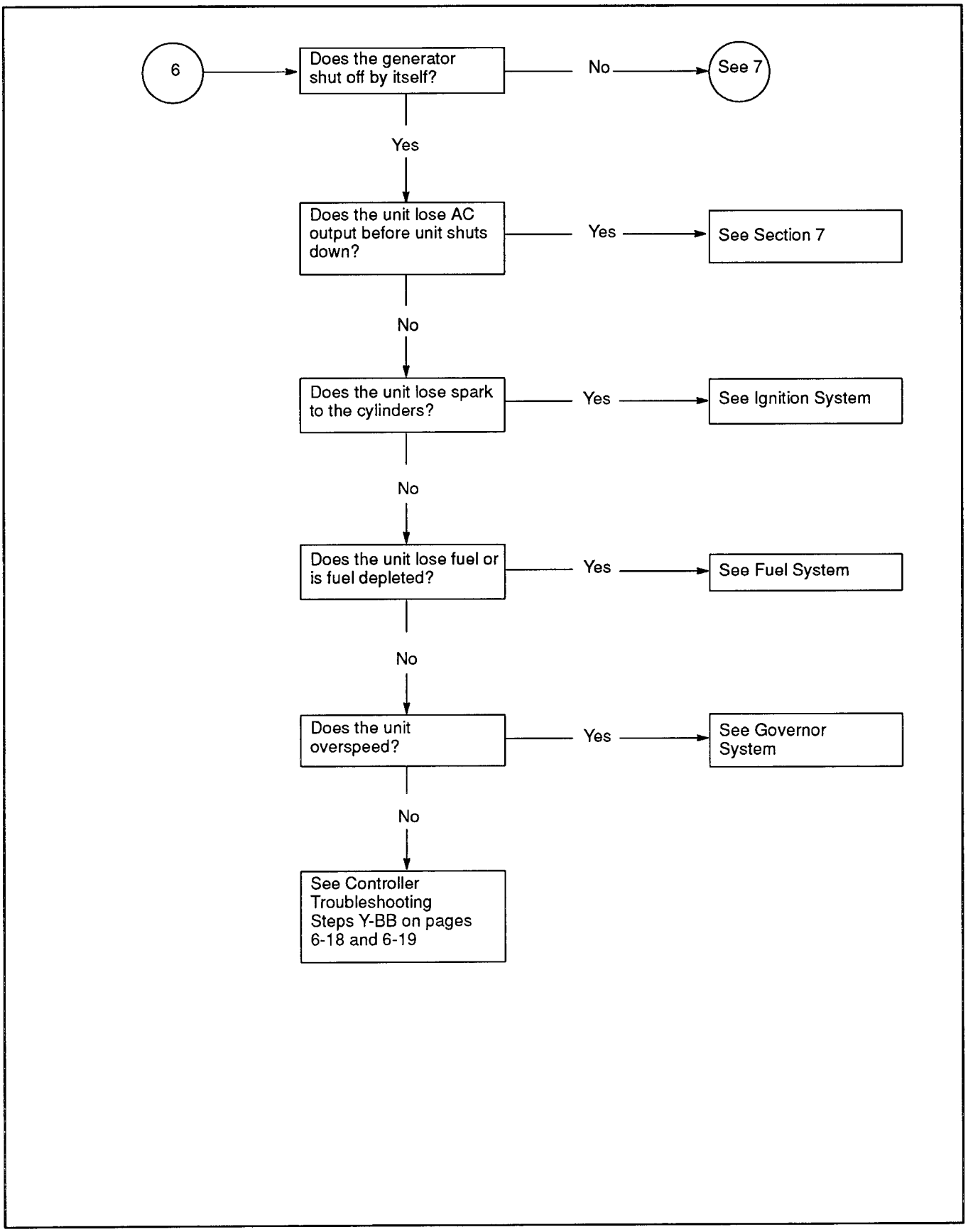
(Sheet 7 of 13)



Generator Troubleshooting (Continued)
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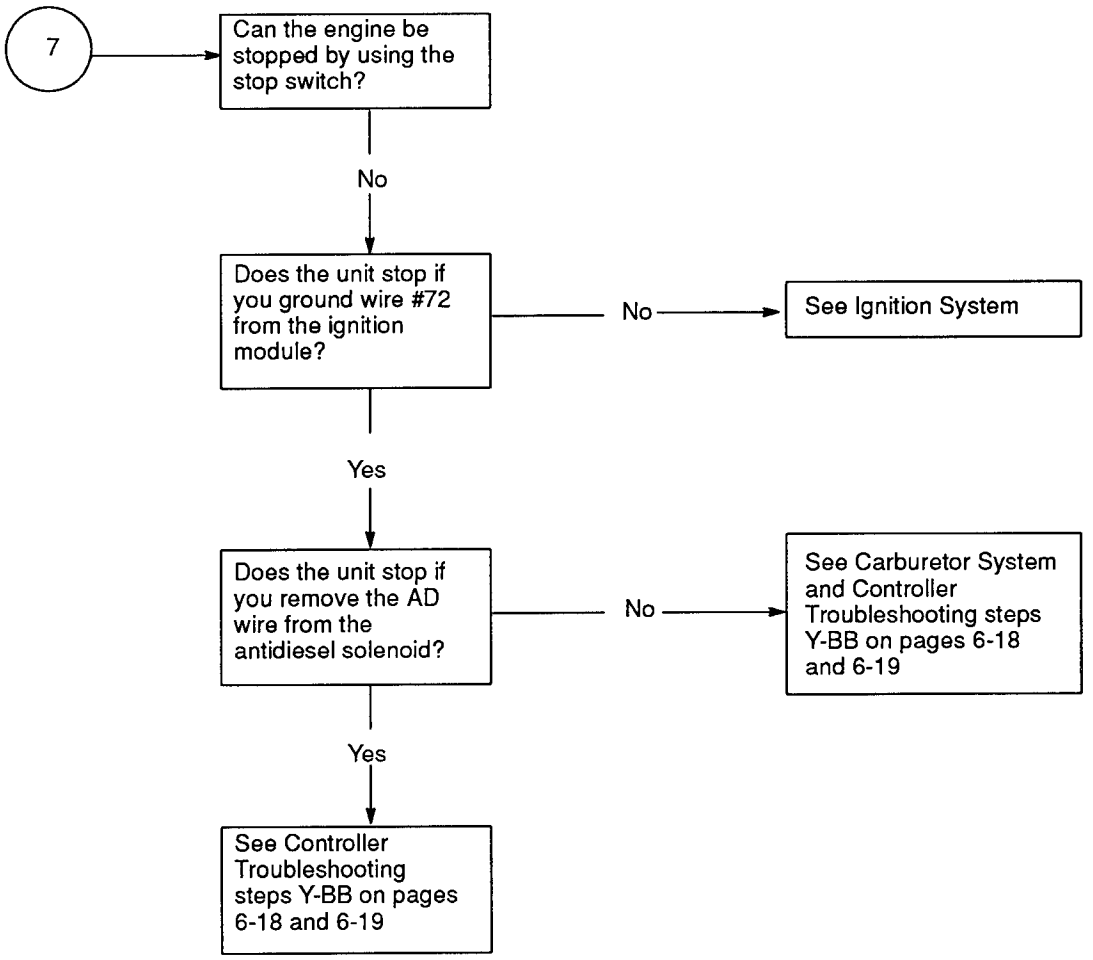
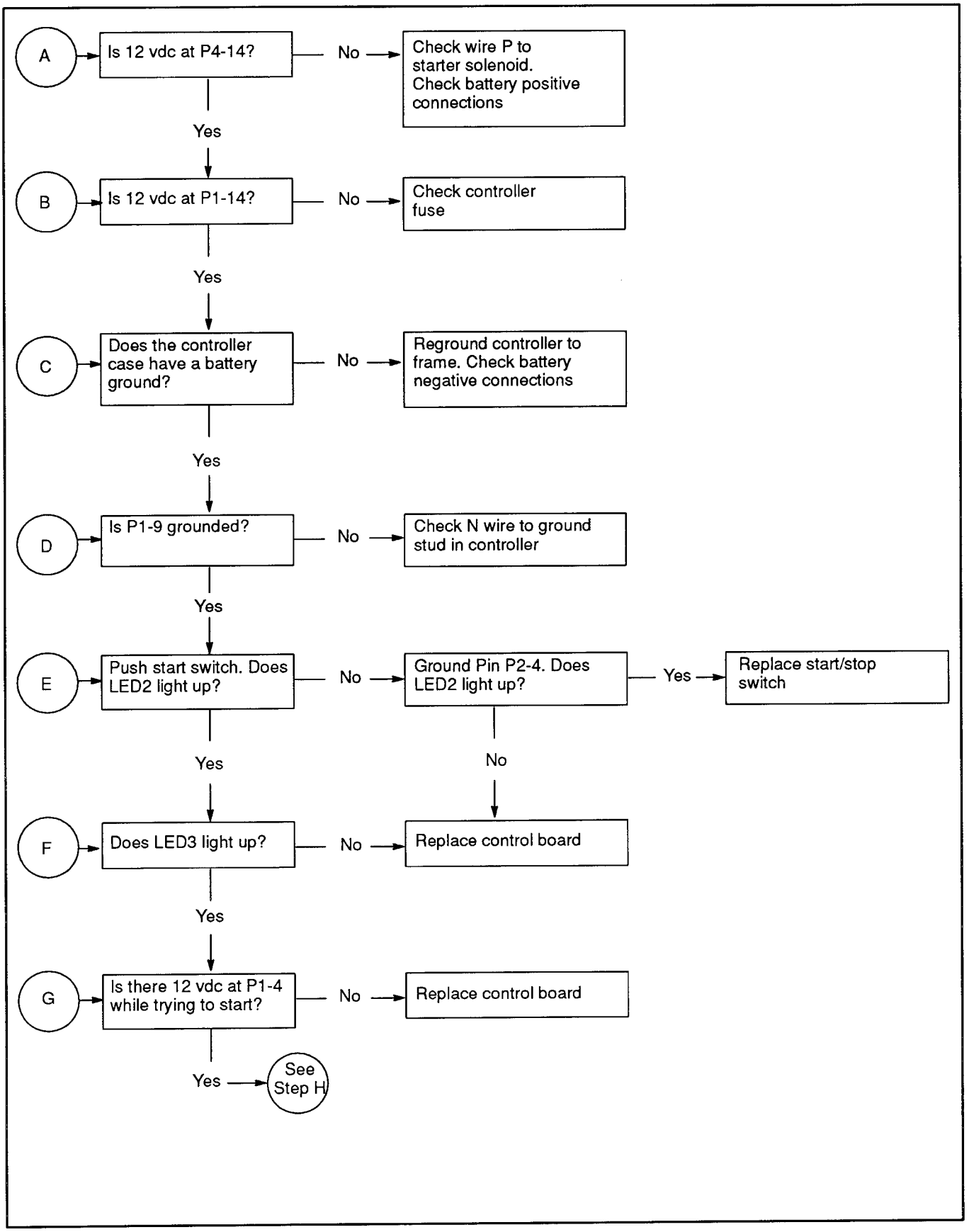


Controller Troubleshooting
(Sheet 9 of 13)



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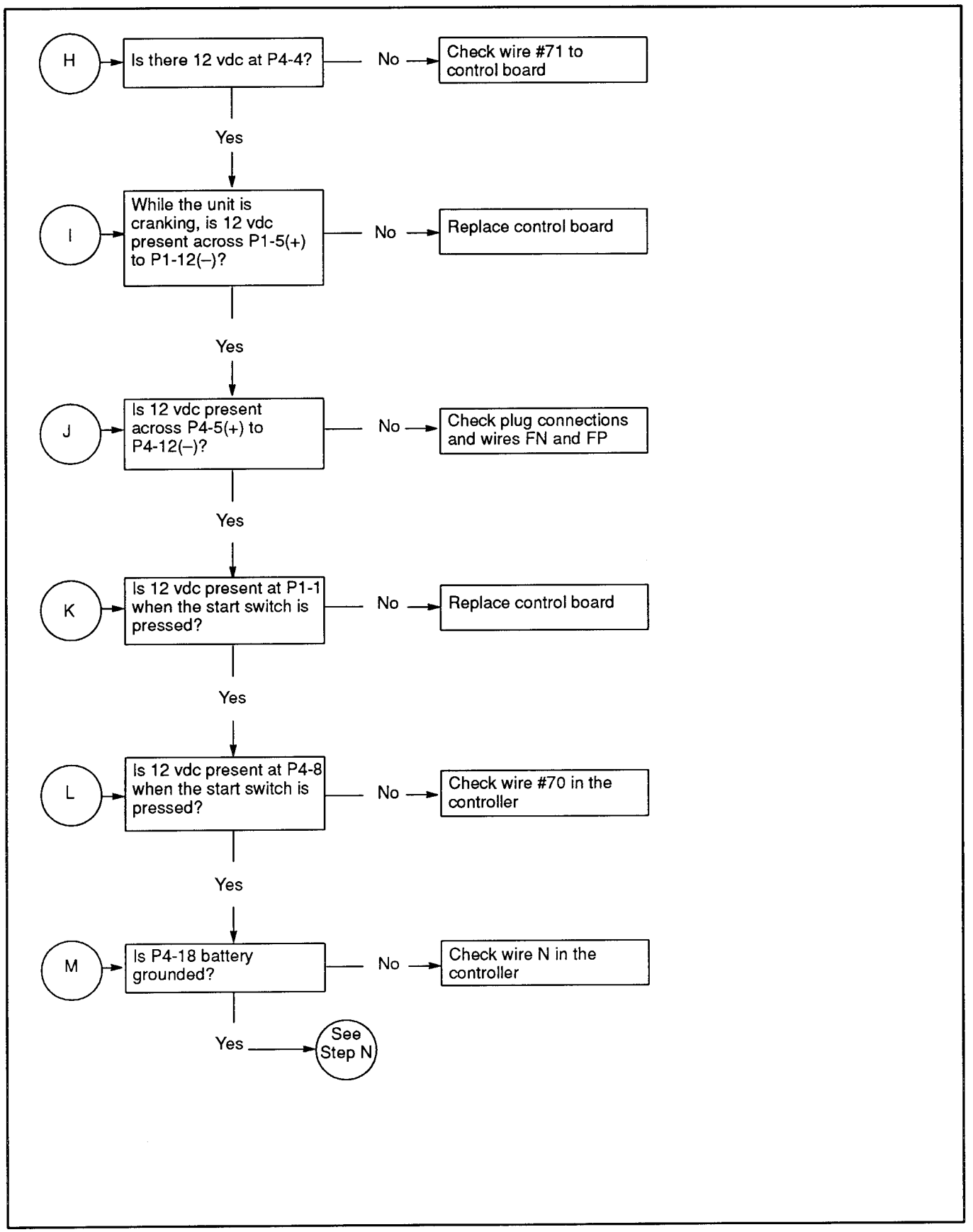
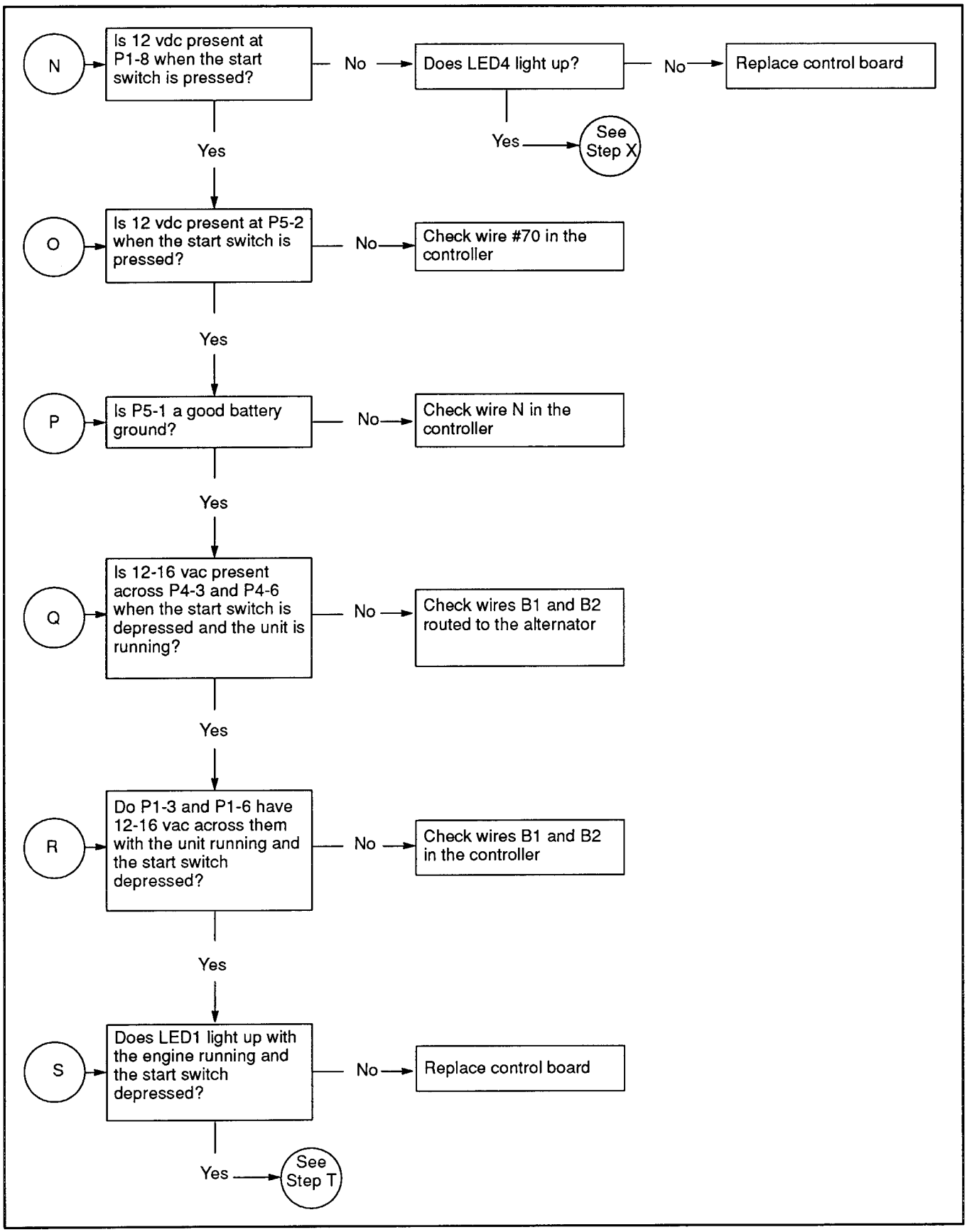
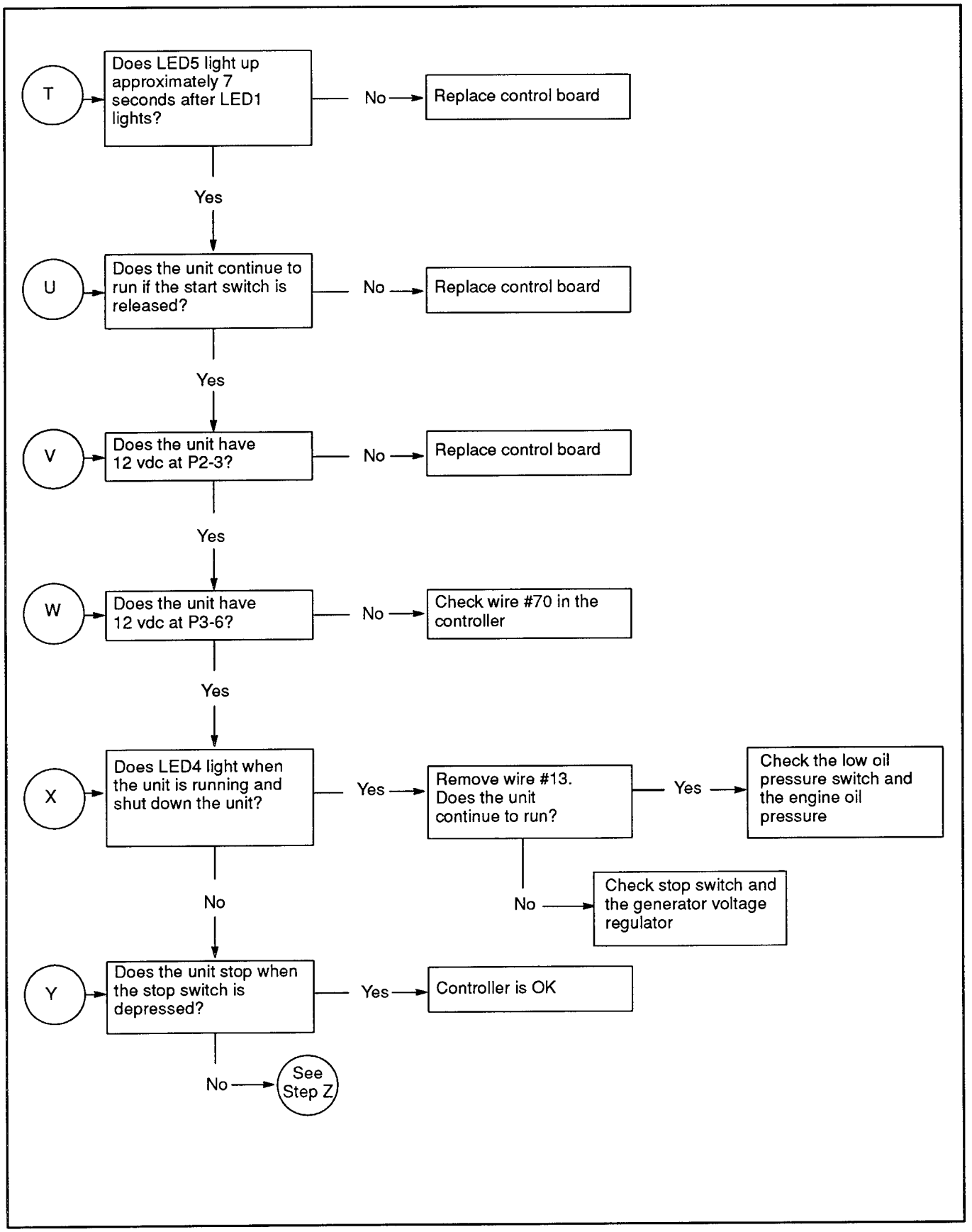
(Sheet 10 of 13)



Controller Troubleshooting (Continued)
(Sheet 11 of 13)



Controller Troubleshooting (Continued)
(Sheet 12 of 13)



Controller Troubleshooting (Continued)
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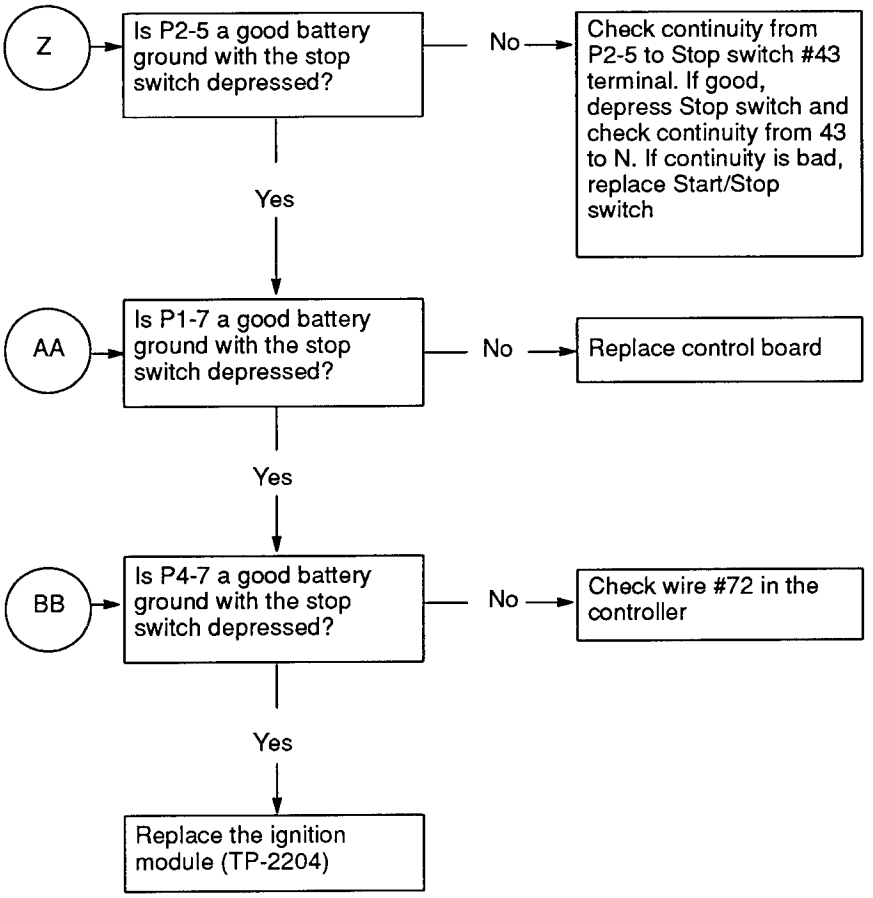
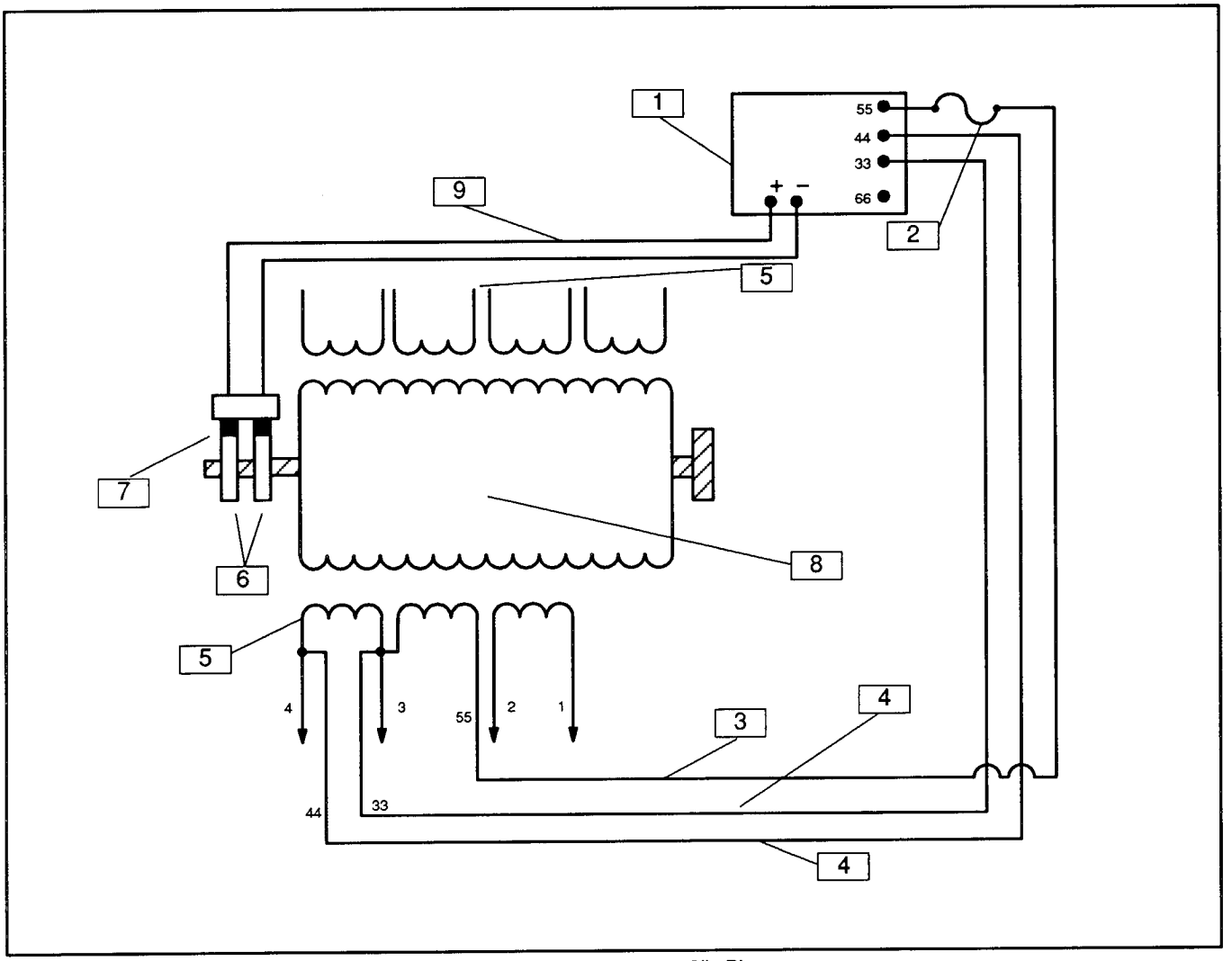


Section 7. Component Testing and Adjustment

Theory of Operation, Single-Phase, 4-Lead Generators with PowerBoost™ IIIE

The 4-lead models utilize a rotating field generator to produce AC current. When the start switch is activated, the rotor (field) is magnetized by DC current from the battery through flashing relay contacts within the controller (see controller operation). When the magnetized rotor is rotated within the stator windings, an electrical current develops within the stator. As engine speed and generator output increase, stator output current (rectified by the voltage regulator) is fed to the rotor through the brushes/slip rings to increase the strength of the rotor field. As the rotor field increases in strength, generator output also increases. The voltage regulator monitors the generator output voltage through leads 33 and 44 and allows the correct amount of DC current to flow to the rotor to meet load requirements. See Figure 7-1.

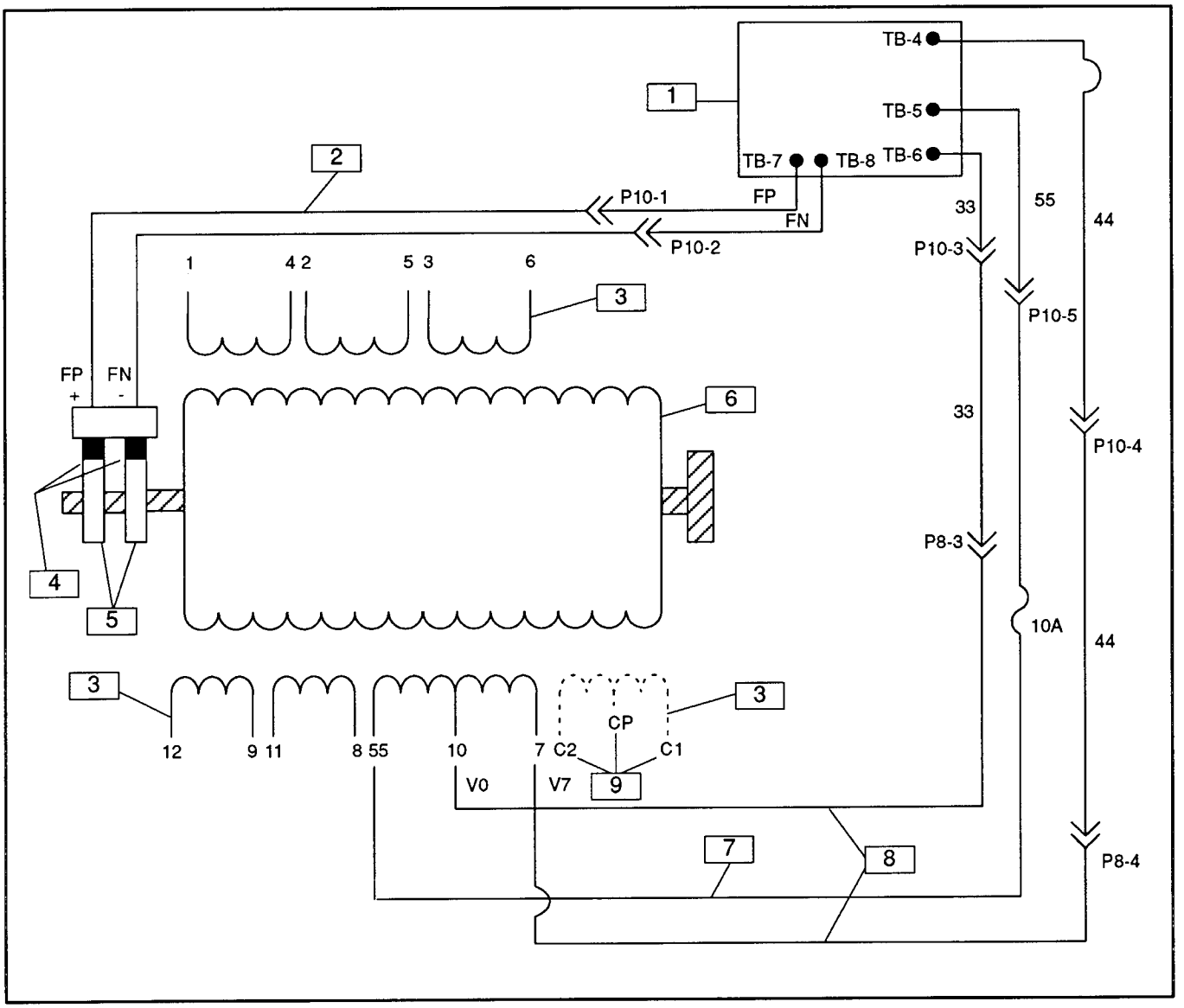


1. Voltage Regulator (PB IIIE)
2. Fuse
3. Power Lead
4. Sensing Lead
5. Stator
6. Slip Rings
7. Brushes
8. Rotor
9. DC Output Excitation

Figure 7-1. 4-Lead Generator Schematic

Theory of Operation, Three-Phase, 12-Lead Reconnectable Generators with PowerBoost™ V

The three-phase models utilize a rotating field generator to produce AC current. When the start switch is activated, the rotor (field) is magnetized by DC current from the battery through flashing relay contacts within the controller (see controller operation). When the magnetized rotor is rotated within the stator windings, an electrical current develops within the stator. As engine speed and generator output increase, stator output current (rectified by the voltage regulator) is fed to the rotor through the brushes/slip rings to increase the strength of the rotor field. As the rotor field increases in strength, generator output also increases. The voltage regulator monitors the generator output voltage through leads 7 and 10 and allows the correct amount of DC current to flow to the rotor to meet load requirements. See Figure 7-2.



1. Voltage Regulator PowerBoost™ V
2. DC Output Excitation
3. Stator
4. Brushes
5. Slip Rings
6. Main Field (Rotor)
7. Power Lead (55)
8. Sensing Leads
9. Battery-Charging Leads (C1, C2, CP)

Figure 7-2. 4/5 kW, 3-Phase Generator Schematic

Generator Troubleshooting

To determine the cause of no- or low-AC output, refer to the troubleshooting flowchart (Figure 7-3) and the separate excitation procedure following. Before beginning the troubleshooting procedures, read all safety precautions at the beginning of this manual. Additional safety precautions are included with the tests; OBSERVE THESE PRECAUTIONS!

Begin the troubleshooting procedure by checking the condition of the voltage regulator 5- or 10-amp fuse. See Section 2 (for fuse location) and Section 7—Component Testing. If the fuse is good, separately excite the generator. The generator field (rotor) may be excited (magnetized) using an outside power source (12-volt automotive battery). In the separate excitation test, you will be duplicating the role of the voltage regulator in providing excitation current to the rotor. By separately exciting the generator to determine the presence of a faulty voltage regulator, it is possible to determine if a running fault exists in the rotor and/or stator. A generator component that appears good while static (stationary) may exhibit a running open or short while dynamic (moving). Centrifugal forces acting on the windings during rotation or insulation break down as temperatures increase and can cause this fault. The flowchart in Figure 7-3 summarizes the troubleshooting procedure.

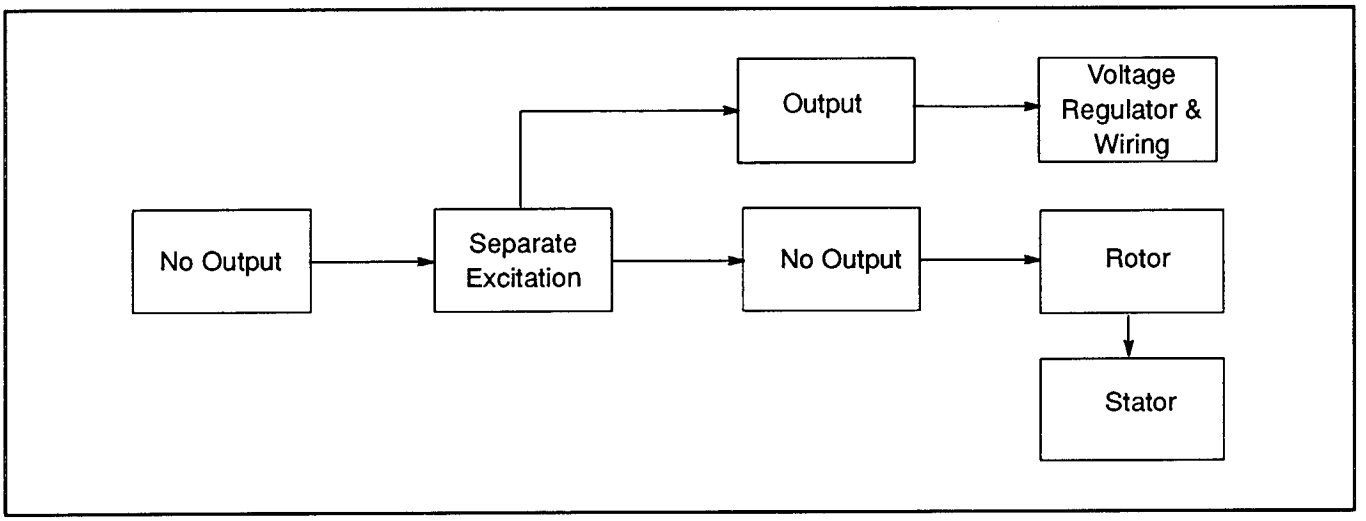


Figure 7-3. Generator Troubleshooting

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

⚠ WARNING

Hazardous voltage.
Backfeed to utility system can cause severe injury, death, or property damage.

Do not connect to any building electrical system without connecting through an approved device and after building main switch is open.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Separate Excitation

1. Disconnect all leads from voltage regulator.
2. Connect a DC ammeter, 10-amp fuse, and a 12-volt automotive battery to the positive (+) and negative (–) brush leads as shown in Figure 7-4. Note and record the ammeter reading.
3. Divide battery voltage by specified rotor resistance to determine approximate ammeter reading.

Example:

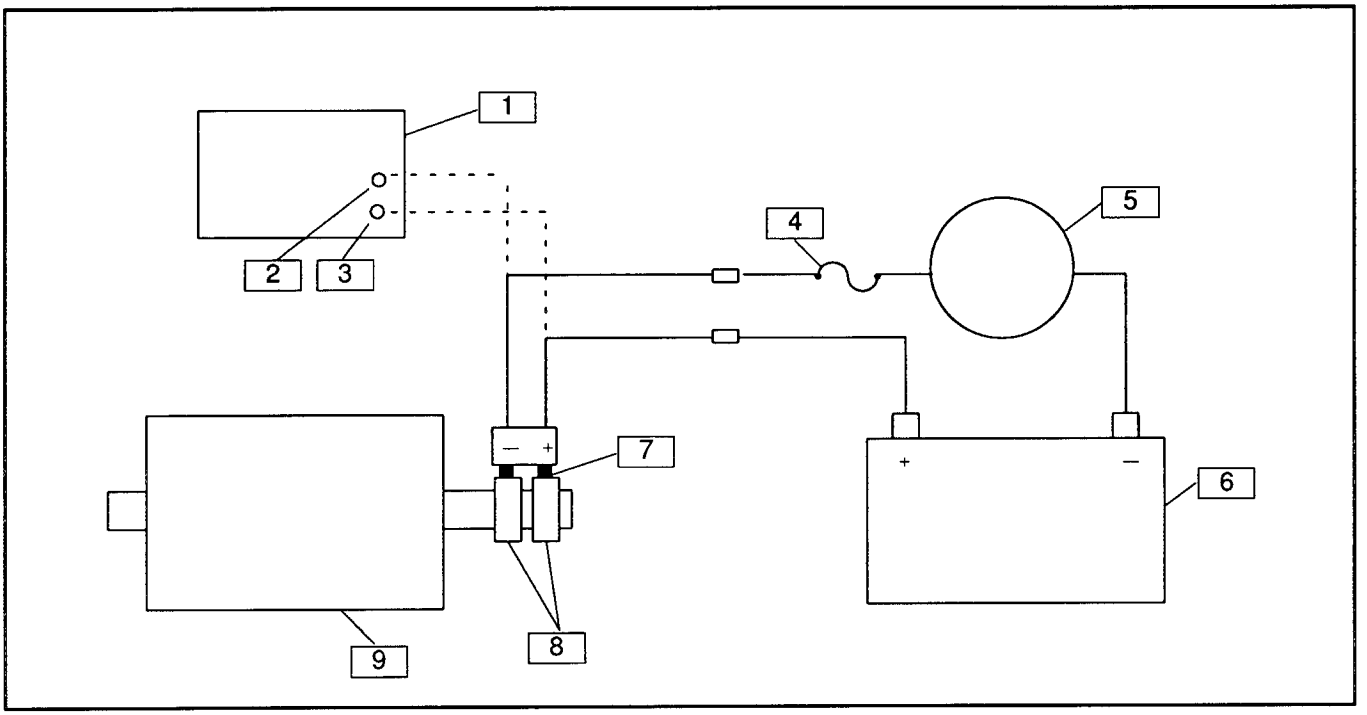
$$\frac{\text{12 Volts (Battery Voltage)}}{\text{4.7 Ohms (Rotor Resistance)}} = \text{2.6 Amps (Rotor Current)}$$

Specified rotor resistance values are found in Section 1—Specifications.

4. Start engine and check ammeter reading. If ammeter reading is stable proceed to Step 5. An increasing ammeter reading indicates a shorted rotor. A decreasing, zero, or unstable reading suggests an open circuit. Refer to Rotor later in this section to test rotor. If ammeter is stable, refer to Step 5 to check stator.
5. Check for AC output across stator leads (see Stator later in this section) and compare to readings in Section 1—Specifications. If readings vary, a faulty stator is likely. Refer to Stator later in this section for further information.
6. If rotor and stator test good in prior steps, the voltage regulator is probably defective. See Voltage Regulator later in this section.

NOTE

Stator output voltages found in Section 1 are based on a battery voltage of 12 volts. Should actual battery voltage vary (11-14 volts), resulting values will also vary.



1. Voltage Regulator
2. (–) Terminal—1-Phase; (8) Terminal—3-Phase
3. (+) Terminal—1-Phase; (7) Terminal—3-Phase
4. 10-Amp Fuse
5. DC Ammeter
6. 12 Volt Battery (DC Power Supply)
7. Brushes
8. Slip Rings
9. Main Field (Rotor)

Figure 7-4. Separate Excitation Connections

PowerBoost™ IIIE—Voltage Regulator

The PowerBoost™ IIIE voltage regulator monitors output voltage magnitude and frequency to supply current to the generator exciter field. To determine if the under-frequency unloading (volts-per-hertz) portion of the voltage regulator is functioning, reduce engine speed (Hz) and check for a corresponding drop in AC voltage. AC voltage should remain constant until engine speed drops below (approximately) 56 Hz on 60 Hz models or 46 Hz on 50 Hz models. When frequency drops below 56 Hz on 60 Hz models or 46 Hz on 50 Hz models, AC voltage should decline. Perform the test below using the following components to check regulator output.

- Variable transformer, 0-140 volts (0.5-amp minimum)
- 120-volt AC plug (50 or 60 Hz)
- 120-volt, 100-watt lamp
- AC voltmeter
- #14 AWG copper wire (minimum)

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

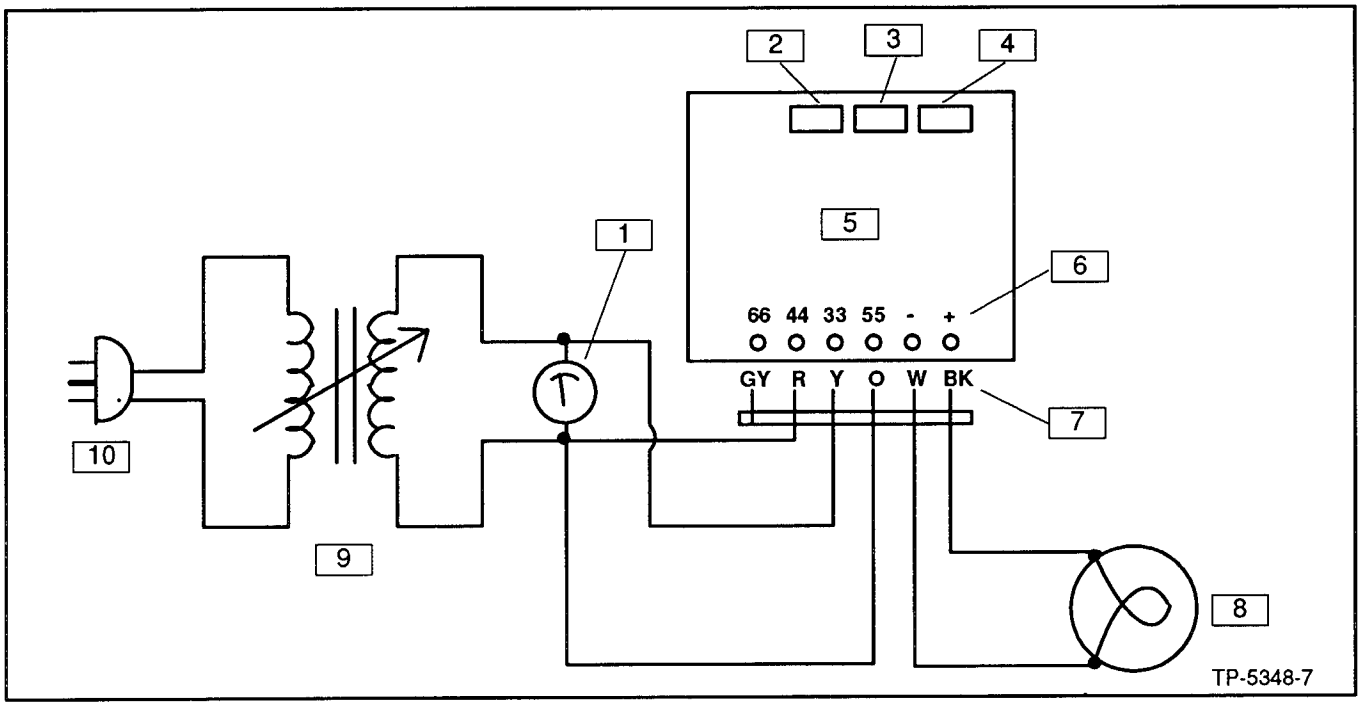
Hazardous voltage can cause severe injury or death. High voltage is present at the heat sink of the voltage regulator. Do not touch voltage regulator heat sink when testing or electrical shock will occur. *(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only.)*

PowerBoost™ IIIE Voltage Regulator Test Procedure

1. Disconnect P10 connector of wiring harness from connector on voltage regulator.
2. See Figure 7-5 to connect components.
3. Turn variable transformer setting to zero. Plug in variable transformer.
4. Turn variable transformer on. Slowly increase variable transformer voltage to 100 volts. If the lamp does not illuminate, turn the voltage adjustment pot clockwise. If the lamp still does not illuminate, there is low- or no-voltage output. The regulator is defective and should be replaced.
5. Slowly increase voltage to 120 volts. The lamp should go out and remain out as voltage is further increased. If the lamp does not go out, turn the voltage adjustment pot counterclockwise. If the lamp still does not go out, there is high voltage. The regulator is defective and should be replaced.
6. Turn variable transformer to zero and unplug AC cord.

NOTE

Connect a remote rheostat to terminal 66 on PowerBoost™ IIIE voltage regulator to fine-adjust voltage. Do not connect stator lead 66 to terminal 66 on PowerBoost™ IIIE models.



1. AC Voltmeter
2. Voltage Adjustment Pot
3. Stabilizer Pot
4. Volts/Hz Pot
5. PowerBoost™ IIIE Voltage Regulator
6. Stator/Rotor Connections (for reference only)
7. Lead Color
8. 120-Volt, 100-Watt Lamp
9. Variable Transformer
10. 120-Volts AC

Figure 7-5. PowerBoost IIIE Voltage Regulator Test

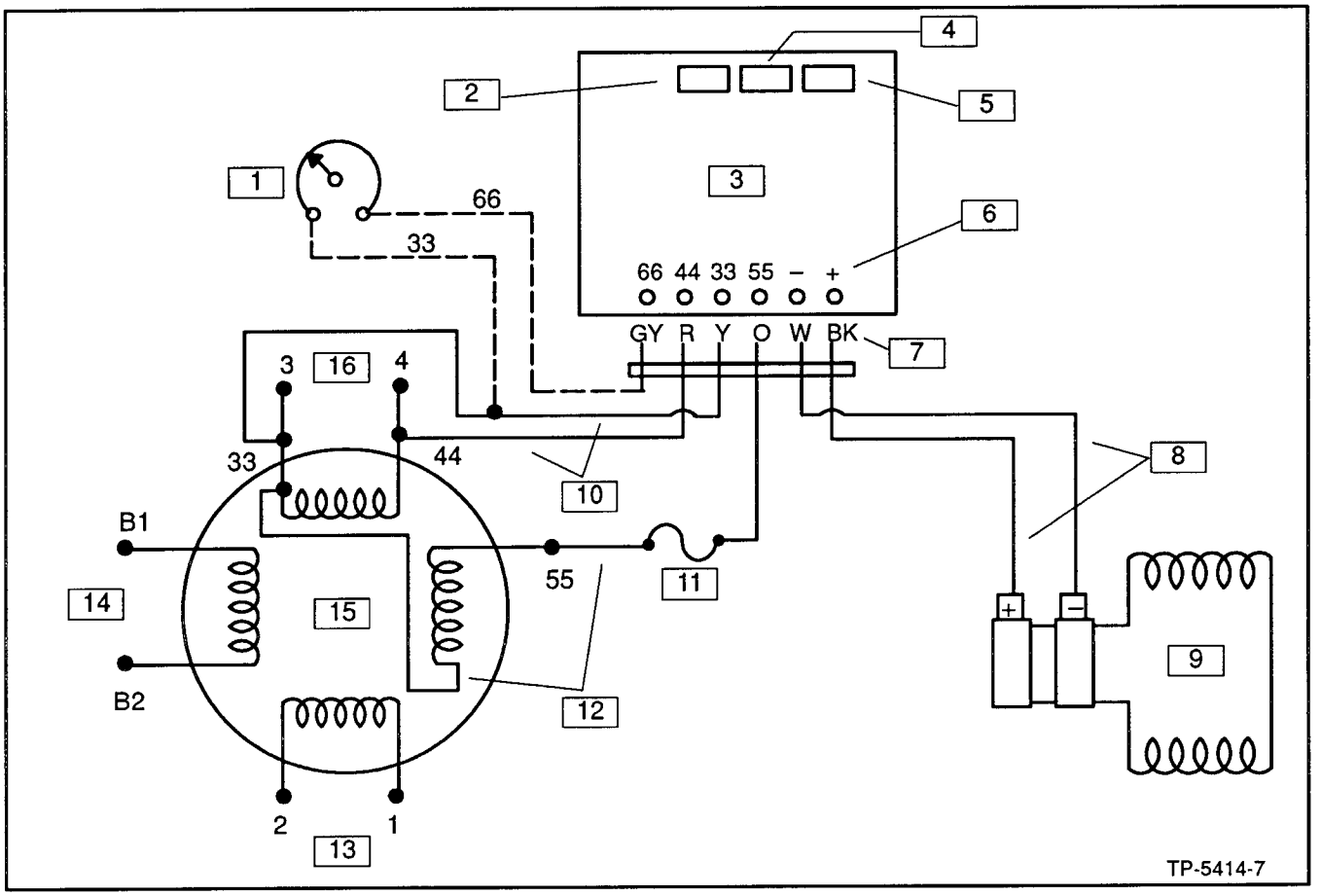
PowerBoost™ IIIE Voltage Regulator Adjustment

The PowerBoost™ IIIE voltage regulator monitors generator output to control current flow to the generator field. However, this voltage regulator has a special feature to maintain generator output voltage under load until the generator output frequency drops to a preset level (factory setting is 56.3 Hz on 60 Hz models or 46.3 Hz on 50 Hz models). Below this point, the voltage regulator allows output voltage to drop. The drop allows the engine to speed up and pick up the load. When generator speed returns to normal, the output voltage returns to normal.

The voltage regulator is factory set for generator operation under a variety of load conditions. Under normal circumstances, no further adjustment is necessary. However, if the regulator is replaced or has been tampered with, readjust according to the following procedure. Voltage regulator components are identified in Figure 7-6 and described in the following paragraphs.

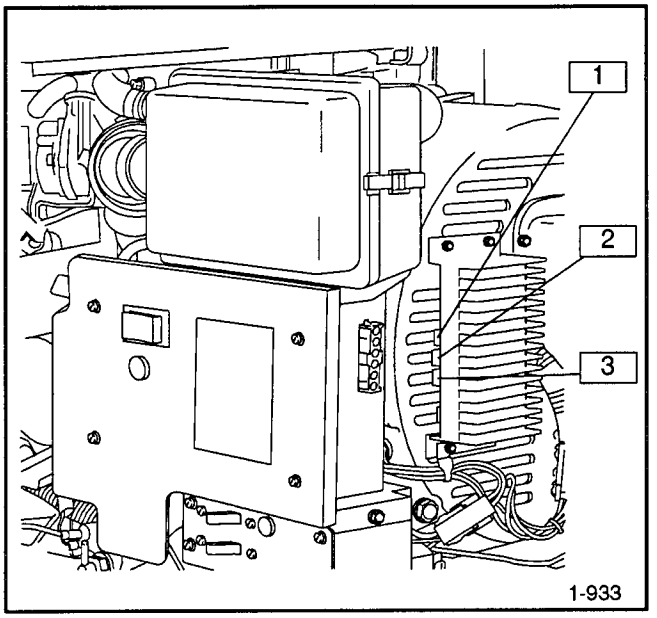
NOTE

The voltage regulator is located on the generator end bracket and is serviceable by removing four screws. Adjustments are possible without removing the regulator from the controller bracket. See Figure 7-7.



1. Optional Remote Rheostat
2. Voltage Adjustment Pot
3. PowerBoost™ IIIE Voltage Regulator
4. Stabilizer Pot
5. Volts/Hz Pot
6. Stator/Rotor Connections (for reference only)
7. Lead Color
8. DC Output
9. Rotor
10. Sensing
11. 5-Amp Fuse
12. AC Power Input (Aux.)
13. Main
14. Control
15. Stator
16. Main

Figure 7-6. PowerBoost™ IIIE Voltage Regulator Wiring Diagram



1. Voltage Adjustment Pot
2. Stabilizer Pot
3. Volts/Hz Pot

Figure 7-7. PowerBoost™ IIIE Voltage Regulator, Installed

NOTE

To adjust generator output voltage from a remote location, connect a customer-provided rheostat across regulator leads/terminals 33 and 66. The rheostat (10k ohms, 1/2-watt minimum) will provide a 5-volt adjustment range.

1. **Voltage Adjustment Pot** Adjusts generator output within range of approx. 100-130 Volts.
2. **Stabilizer Pot** Fine-tunes regulator circuitry to reduce light flicker.
3. **Volts/Hz Pot** Determines engine speed (Hz) at which generator output voltage will begin to drop.

NOTE

For optimum results apply full load when adjusting stability pot.

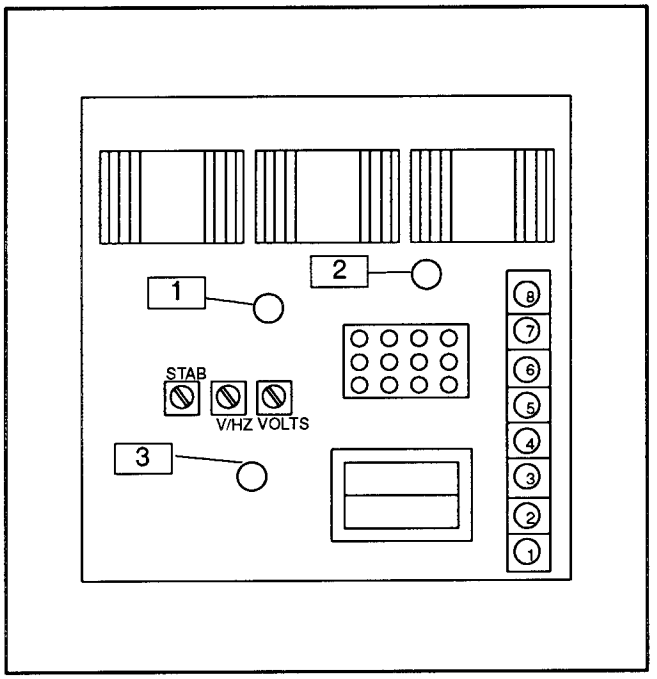
1. With generator set off turn remote rheostat (if equipped) to midpoint. Turn voltage, volts/Hz and stability pots fully counterclockwise. Connect voltmeter and frequency meter to AC circuit or an electrical outlet.
2. Start generator set. Rotate voltage adjustment pot clockwise to increase voltage (counterclockwise to decrease voltage) until desired output voltage is achieved.
3. Rotate stability pot clockwise until light flicker is minimized.
4. Readjust voltage adjustment pot (if necessary).
5. Adjust engine speed so generator output as measured on a frequency meter is at desired cut-in frequency (factory setting is 56.3 Hz for 60 Hz models or 46.3 Hz for 50 Hz models).
6. Adjust volts/Hz pot clockwise until voltmeter reading just begins to drop. At this setting, the generator attempts to maintain normal output voltage until engine speed drops below setting made in Step 5.
7. Readjust engine speed to normal (1800 rpm for 60 Hz or 1500 rpm for 50 Hz).
8. Readjust voltage adjustment pot if necessary.
9. Readjust stability pot if necessary.
10. Use optional remote rheostat if equipped to make final voltage adjustments. Stop generator set.

PowerBoost™ V—Voltage Regulator

The PowerBoost™ V voltage regulator monitors output voltage magnitude and frequency to supply current to the generator exciter field. AC voltage should remain constant until engine speed drops below 56 Hz on 60-Hz models or 46 Hz on 50-Hz models. When frequency drops below 56/46 Hz, AC voltage should decline. To determine if the under-frequency unloading (volts-per-hertz) portion of the voltage regulator is functioning, reduce engine speed (Hz) and check for a corresponding drop in AC voltage. Perform the test below using the following components to check regulator output.

- 1:2 step-up transformer
- 120-volt AC plug
- 250-volt, 100-watt lamp
- AC voltmeter
- #14 AWG insulated copper wire (minimum)

LEDs offer a visual indication of sensing, input power, and field output availability. See Figure 7-8 for locations.



1. LED1, Green (Input)
2. LED2, Red (Output)
3. LED3, Yellow (Sensing)

Figure 7-8. PowerBoost™ V Voltage Regulator

⚠ WARNING

Hazardous voltage.

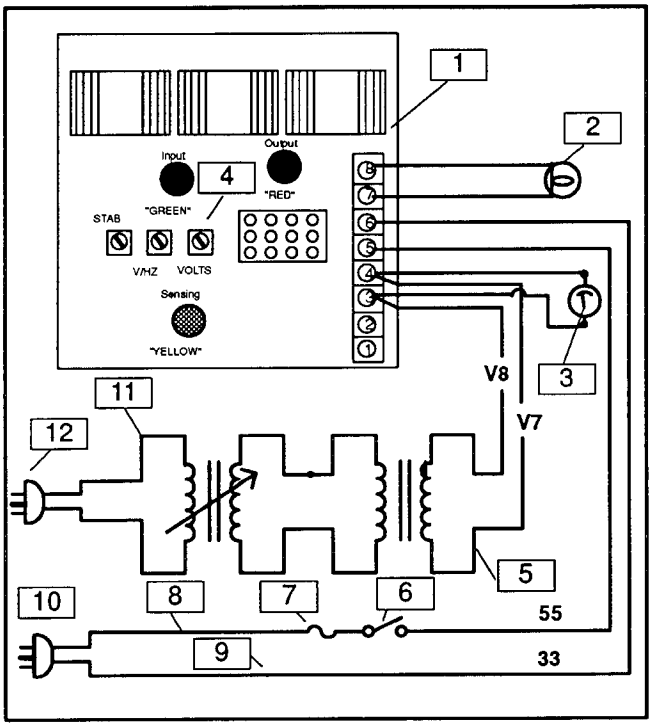
Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.



1. Voltage Regulator PowerBoost™ V
2. 250 Volt, 75-100-Watt Lamp
3. AC Voltmeter, 250 Volt (Minimum)
4. Volts Potentiometer
5. 1:2 Step-Up Transformer
6. Single-Pole Single-Throw Switch
7. 1-Amp Fuse
8. Black Wire
9. White Wire
10. 250 vac
11. Variable Transformer (Variac)
12. 120 vac

Figure 7-9. Voltage Regulator A-Board

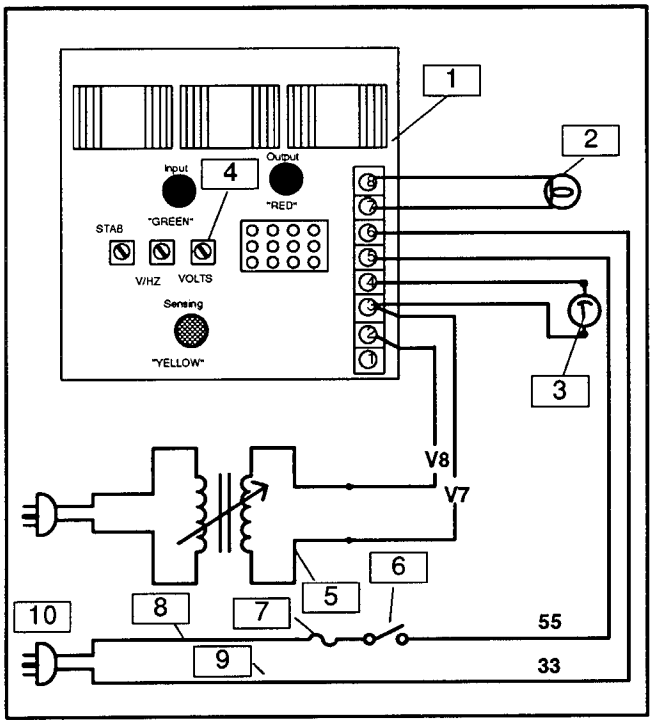
Test Procedure

240 Volt A- or B- Board

NOTE

Test regulator field for a maximum of one minute followed by a five-minute cooldown.

1. Connect components as shown in Figure 7-9. If a 200-240-volt power source is available, the step-up transformer is not required.
2. If plug (item 10) is 250 volts, use 250-volt lamp (item 2). If plug is 120 volts, use 120-volt lamp.
3. Turn Volts potentiometer (pot) fully clockwise.
4. Set variac to zero or minimum voltage.
5. Plug power cord into outlet.
6. Turn power variac on. AC voltmeter should indicate power supply voltage of zero volts. Lamp should be off.
7. Slowly increase variac. Light should begin to illuminate at approximately 90 volts.
8. Adjust variac to 240 volts. Do not exceed 300 volts. The lamp should illuminate brightly. If the lamp does not illuminate, the voltage regulator is defective and should be replaced.
9. Turn Volts pot fully counterclockwise. The lamp should go off. If it does not go off, the voltage regulator is defective.
10. Turn Volts pot clockwise. Lamp should be illuminated.
11. Turn power supply off and disconnect power cord.
12. See Voltage Regulator Adjustment procedure.



1. Voltage Regulator PowerBoost™ V
2. 120 Volt, 75-100-Watt Lamp
3. AC Voltmeter, 250 Volt (Minimum)
4. Volts Potentiometer
5. Variable Transformer (Variac)
6. Single-Pole Single-Throw Switch
7. 1-Amp Fuse
8. Black Wire
9. White Wire
10. 100-120 vac

Figure 7-10. Voltage Regulator B-Board

120 Volt B- Board Only

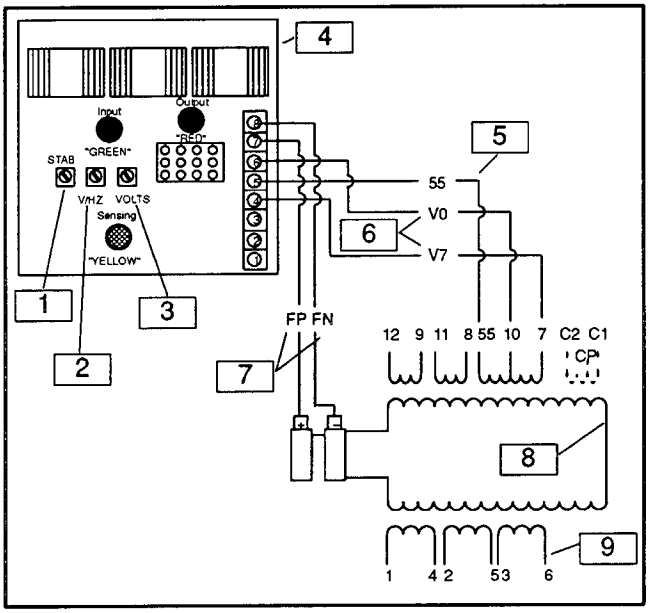
NOTE

Test regulator field for a maximum of one minute followed by a five-minute cooldown.

1. Connect components as shown in Figure 7-10.
2. Turn Volts potentiometer (pot) fully clockwise.
3. Set variac to zero or minimum voltage.
4. Plug power cord into outlet.
5. Turn power variac on. AC voltmeter should indicate power supply voltage of zero volts. Lamp should be off.
6. Slowly increase variac. Lamp should begin to illuminate at approximately 60 volts.
7. Adjust variac to 120 volts. Do not exceed 150 volts. The lamp illuminates brightly. If the lamp does not go on, the voltage regulator is defective and should be replaced.
8. Turn Volts pot fully counterclockwise. The lamp should go off. If it does not go off, the voltage regulator is defective.
9. Turn Volts pot clockwise. Lamp should be illuminated.
10. Turn power supply off and disconnect power cord.
11. See Voltage Regulator Adjustment procedure.

PowerBoost™ V Voltage Regulator Adjustment

The PowerBoost™ V voltage regulator monitors generator output to control current flow to the generator field. However, unlike early PowerBoost™ regulators, PowerBoost™ V maintains generator output under load until the generator engine speed drops to a preset factory setting 56.3 Hz on 60-Hz models and 46.3 Hz on 50-Hz models. At this point (under factory settings) the regulator allows generator voltage and current to drop to a level sufficient to handle load. When the generator speed returns to normal (60 Hz or 50 Hz) as load is accepted, generator output also returns to normal. The voltage regulator is factory set for generator operation under a variety of load conditions. Under normal circumstances, no further adjustment is necessary. However, if the regulator is replaced or has been tampered with, readjust according to the following procedure. Voltage regulator components are identified in Figure 7-11 and Figure 7-12 and described in the following paragraphs.



1. Stability (STAB) Potentiometer
2. Volts/Hz (V/HZ) Potentiometer
3. Voltage Adjustment (VOLTS) Potentiometer
4. Voltage Regulator PowerBoost™ V
5. Power Supply Lead (55)
6. Sensing Leads
7. DC Output
8. Main Field (Rotor)
9. Armature (Stator)

Figure 7-11. PowerBoost™ V Voltage Regulator Wiring Diagram

Voltage Adjustment Pot adjusts generator output within range of approx. 100-130 volts.

Stability Pot fine-tunes regulator circuitry to reduce light flicker.

Volts/Hz Pot adjustment determines engine speed (Hz) at which generator output voltage will begin to drop.

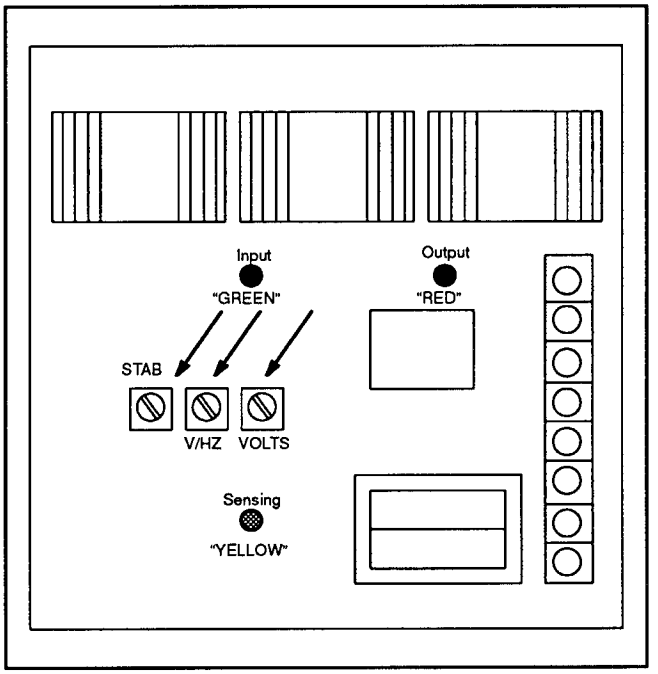


Figure 7-12. PowerBoost™ V Adjustment Pots

PowerBoost™ V Voltage Regulator Adjustment Procedure

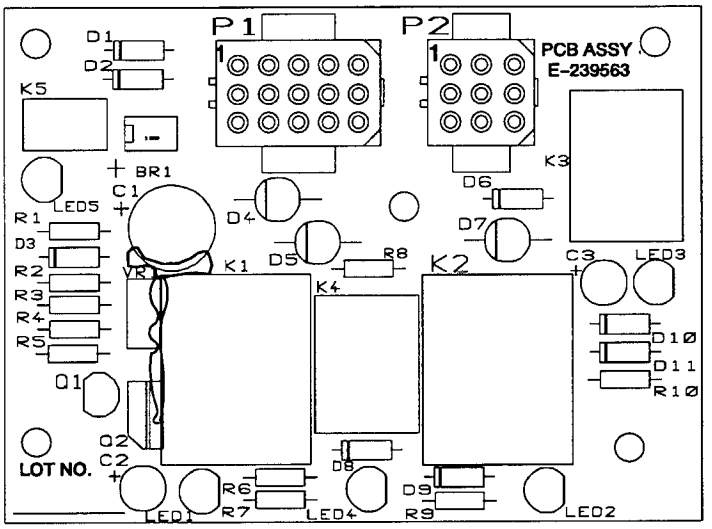
1. Turn voltage and volts/Hz pots fully counterclockwise. Connect voltmeter to AC circuit or an electrical outlet.
2. Start generator set. Rotate voltage adjustment pot clockwise to increase voltage or counterclockwise to decrease voltage until desired output voltage is achieved.
3. Rotate stability pot clockwise until light flicker is minimized.
4. Readjust voltage adjustment pot if necessary.
5. Adjust engine speed so generator output as measured on a frequency meter is at desired cut-in frequency (factory setting is 56.3 Hz for 60-Hz models or 46.3 Hz for 50-Hz models).
6. Rotate volts/Hz adjustment pot clockwise until voltage level measured on voltmeter begins to drop. When set to these specifications, the generator will attempt to maintain normal output as load is applied until engine speed drops below the frequency set in Step 5.
7. Readjust engine speed to normal (1800 rpm for 60-Hz models or 1500 rpm for 50-Hz models).
8. Readjust stability pot if necessary.
9. Readjust voltage adjustment pot if necessary.
10. Use remote rheostat if equipped to make final voltage adjustments.
11. Stop generator set.

Controller Circuit Board

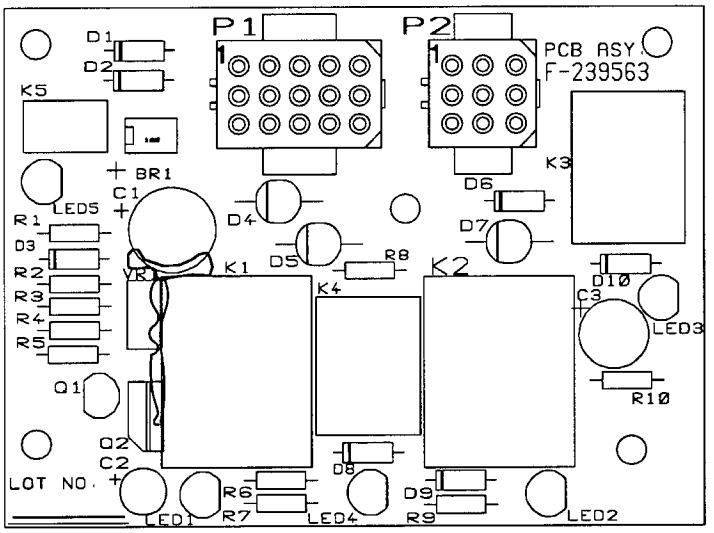
It is possible to check some controller circuit board components (relays) without removing the component from the board. Make these checks before installing a new board and attempting startup. Most of the tests are referred to in Section 4—General Troubleshooting. Use a high-quality multimeter and follow the manufacturer's instructions. To obtain accurate readings when testing, remove all circuit board connectors and conformal coating (transparent insulation) from component terminals. Use Figure 7-13 and refer to the controller circuit board layout and schematic in Figure 7-14.

Component	Ohmmeter Connections	Remarks	Results
K1 Relay Coil	K1 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	Good—approx. 160 ohms. Low resistance (continuity)—shorted coil. High resistance—open coil.
K2 Relay Coil	K2 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	Good—approx. 160 ohms. Low resistance (continuity)—shorted coil. High resistance—open coil.
K3 Relay Coil	K3 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	Good—approx. 400 ohms. Low resistance (continuity)—shorted coil. High resistance—open coil.
K4 Relay Coil	K4 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	Good—approx. 125 ohms. Low resistance (continuity)—shorted coil. High resistance—open coil.
K5 Relay Coil	K5 coil terminals (See relay schematic)	Ohmmeter on R x 10 scale	Good—approx. 510 ohms. Low resistance (continuity)—shorted coil. High resistance—open coil.

Figure 7-13. Controller Circuit Board Tests for E-239563 or F-239563 Circuit Boards



E-239563



F-239563

Figure 7-14. Controller Circuit Board (Sheet 1 of 2)

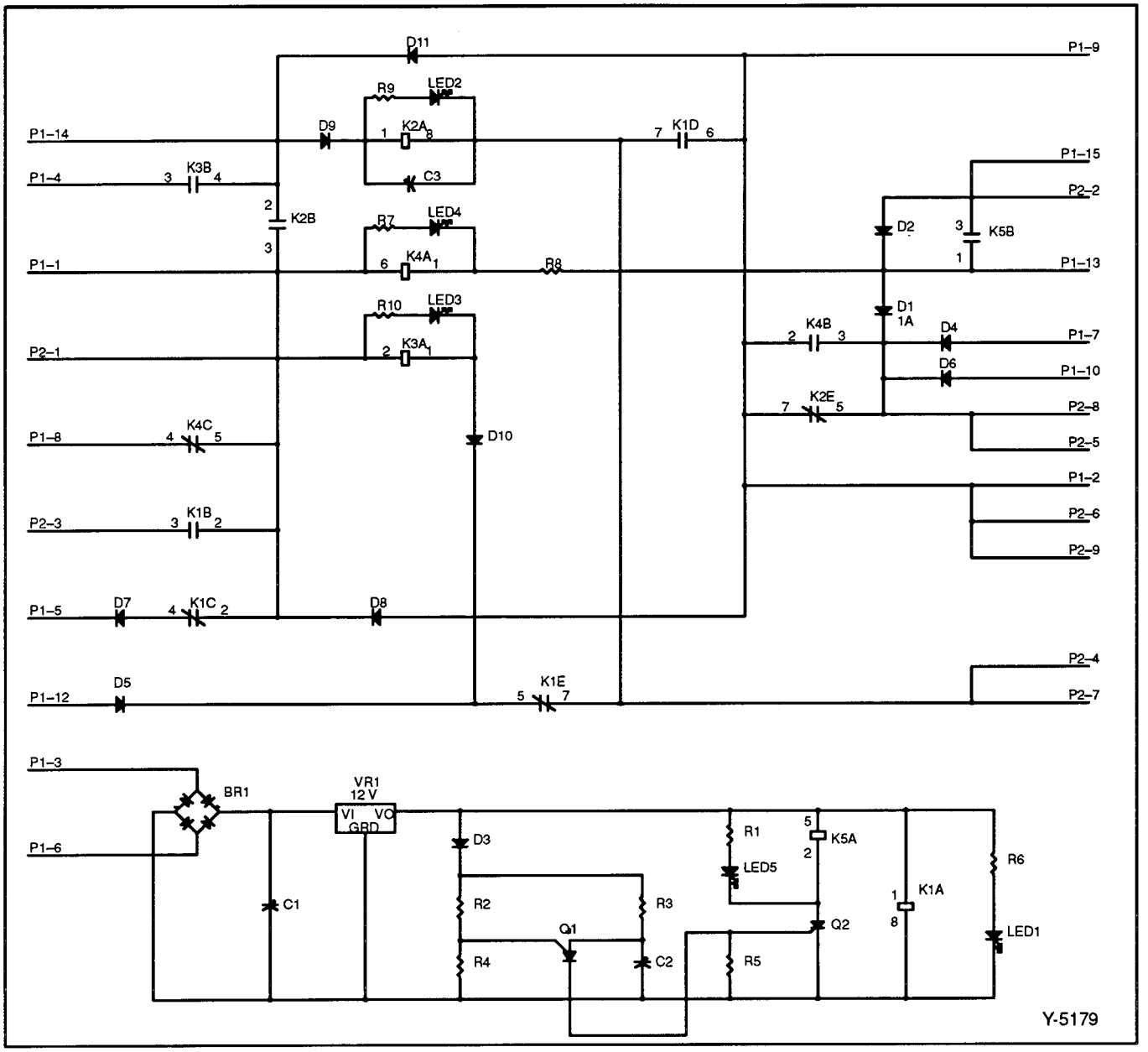


Figure 7-14. Controller Circuit Board Wiring Diagram (Sheet 2 of 2)

Engine/Generator Components

With the generator set battery connected, check the wiring harness and some engine/generator components. Place the controller or remote start/stop switch in the prescribed position and check for 12 volts DC at each component using a DC voltmeter. This will verify that the switches function and 12 volts DC are present at each component.

Test Component	Voltmeter Connections	Remarks	Results/ Additional Tests
B1 and B2 stator auxiliary winding	Disconnect B1/B2 leads. Connect AC voltmeter to leads. **NOTE:** Voltage can be measured only momentarily since unit will not continue to run after start switch is released. STOP generator.	With voltmeter range set to 20 volts AC or greater, rock and hold controller or remote Start/Stop switch to start until engine starts and reaches specified speed.	Reading of 12-15 volts indicates B1/B2 winding is good.
Carburetor electric choke, antidiesel solenoid, fuel pump (or gas valve), S relay, anti-icing plate, and governor system wiring harness	Red test clip to each component positive (+) terminal. Black test clip to engine block (ground)	With voltmeter range set to 12 volts DC or greater, place controller or remote switch in start position.	12 volts DC reading indicates wiring harness is okay. To check electric choke, antidieseling solenoid, S relay, and deicing plate, see ohmmeter tests following. To determine if fuel pump (or gas valve) is good, proceed to next step. To check/adjust governor, see separate paragraph with same title in this section.
Fuel pump (or gas valve)	None	Disconnect fuel pump (or gas valve) leads at in-line connector. Apply 12 volts DC to fuel pump (or gas valve) leads. Maintain polarity (red lead to (+) and black lead to (–). **WARNING:** See Safety Precautions before proceeding.	If good—fuel pump (or gas valve) will operate.

Figure 7-15. Engine/Generator Component Testing with Voltmeter

⚠ WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Use protective goggles and clothes. Battery acid can cause permanent damage to eyes, burn skin, and eat holes in clothing.

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc., to prevent burns and sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being changed. Always turn battery charger off before disconnecting battery connections. Remove negative lead first and reconnect it last when disconnecting battery.

To further check generator set components, disconnect the battery and remove wiring harness plugs from the controller circuit board. Use an ohmmeter to check continuity and to isolate defective components as described in Figure 7-16. Also refer to Figure 7-17 and the proper wiring diagram in Section 9.

NOTE

Before performing ohmmeter checks, disconnect generator set battery to prevent damage to the ohmmeter.

Test Component	Ohmmeter Connections	Remarks	Results
Controller switch	P2-6 and P2-4	Ohmmeter on R x 1 scale. Place rocker switch in start position.	If good—zero ohms (continuity). Any resistance other than zero or very low ohms—replace switch.
	P2-6 and P2-5	Ohmmeter on R x 1 scale. Place rocker switch in stop position.	If good—zero ohms (continuity). Any resistance other than zero or very low ohms—replace switch.
Carburetor choke (See Figure 7-18)	Disconnect leads at choke and connect to choke terminals.	Ohmmeter on R x 1 scale.	If good—approx. 18 ohms at 75° F (24° C).
Antidieseling solenoid (see Figure 7-19)	Disconnect lead at solenoid. Solenoid terminal and engine block (ground).	Ohmmeter on R x 1 scale.	If good—approx. 22 ohms at 75° F (24° C).
Starter solenoid (S relay) (see Figure 7-20)	P1-4 and P1-9	Ohmmeter on R x 1 scale.	If good—approx. 3.5–4 ohms at 80° F (27° C).
Anti-icing plate (thermistor) (see Figure 7-21)	Disconnect lead at thermistor. Connect to thermistor terminal and engine block (ground).	Ohmmeter on R x 1 scale.	If good—approx. 10 ohms.
Controller 15-amp circuit breaker (or fuse) and wiring	Battery positive (+) cable and P1-14	Ohmmeter on R x 1 scale.	If good—zero or very low ohms. No reading (infinity)—open circuit or circuit breaker tripped.
Low oil pressure (LOP) safety shutdown switch	P1-15 and engine block (ground)	Ohmmeter on R x 1 scale.	If good—zero ohms (continuity). Then, disconnect LOP switch lead and isolate terminal. Meter reading shows an open circuit.
Remote switch (optional)	J3-1 and J3-3 (plug side)	Ohmmeter on R x 1 scale. Place rocker switch in start position.	If good—zero ohms (continuity). Any resistance other than zero or very low ohms—replace switch.
	J3-1 and J3-2 (plug side)	Ohmmeter on R x 1 scale. Place rocker switch in stop position.	If good—zero ohms (continuity). Any resistance other than zero or very low ohms—replace switch.
Remote panel hourmeter (optional)	J3-1 and J3-6 Disconnect ON light leads.	Ohmmeter on R x 1 scale.	If good—zero ohms. (continuity).
Remote panel Generator ON Light (optional)	J3-1 and J3-6 Disconnect hourmeter leads.	Ohmmeter on R x 1 scale.	If good—zero ohms. (continuity).

Figure 7-16. Engine/Generator Set Component Testing with Ohmmeter

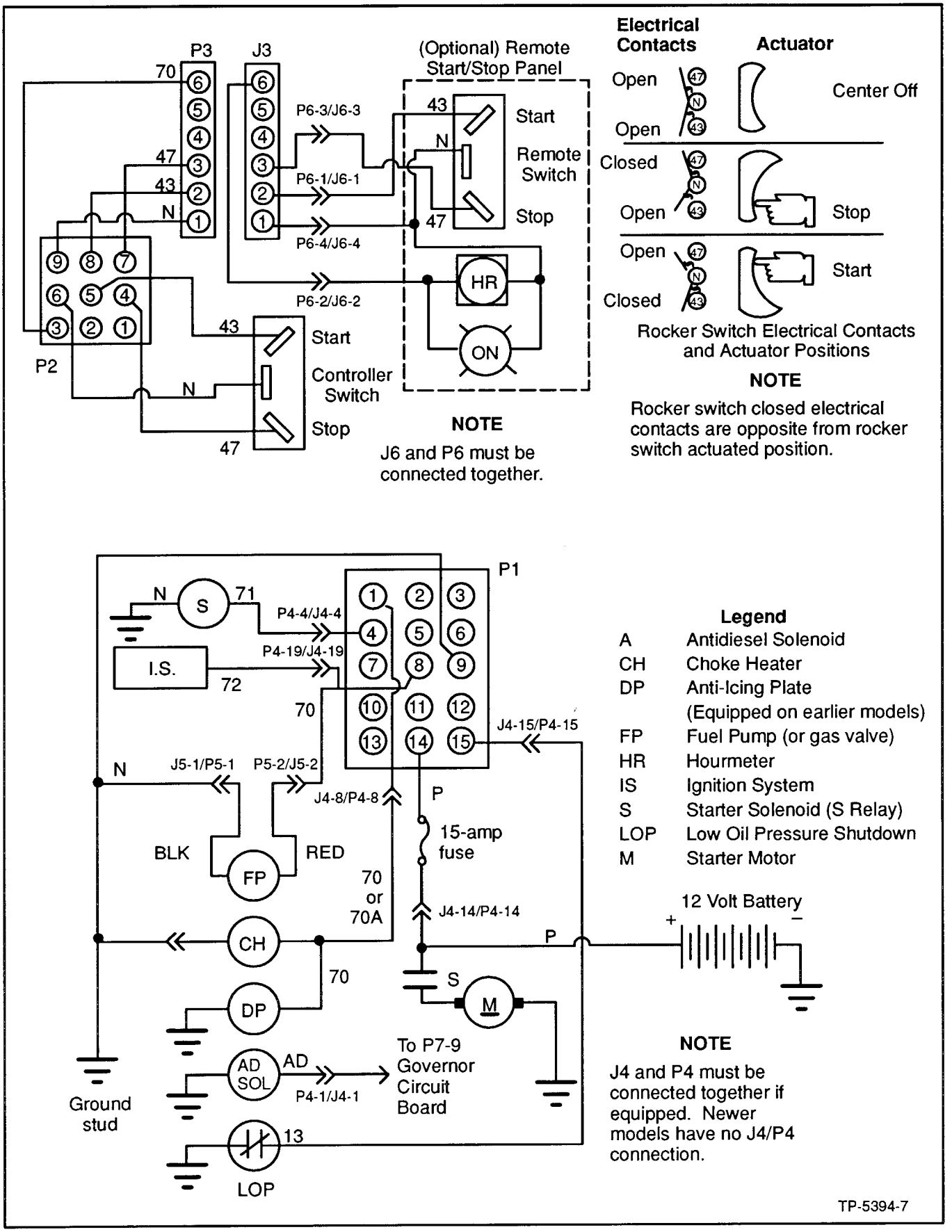
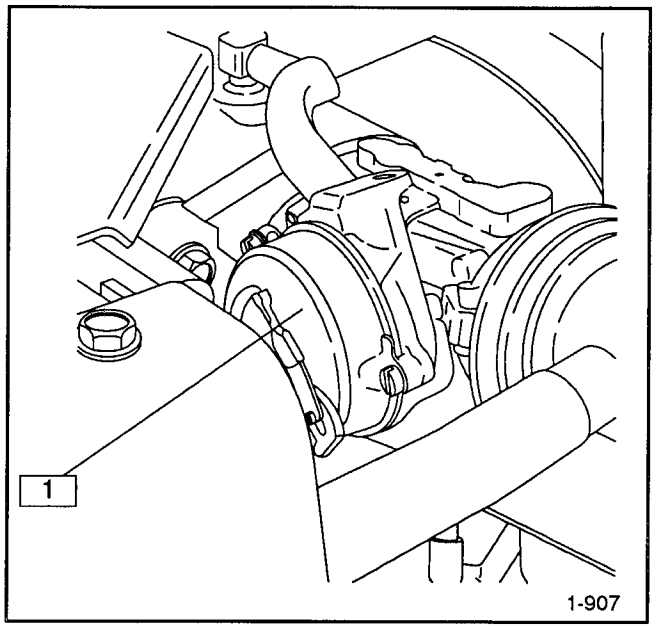
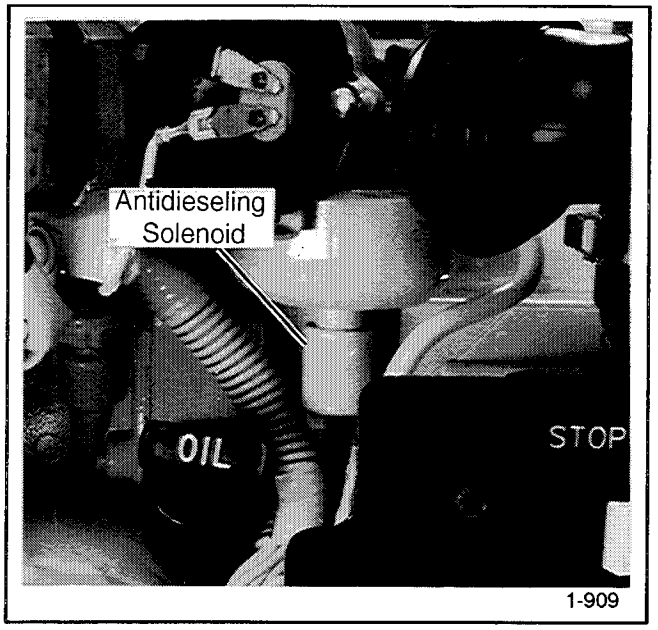


Figure 7-17. Wiring Harness Connections



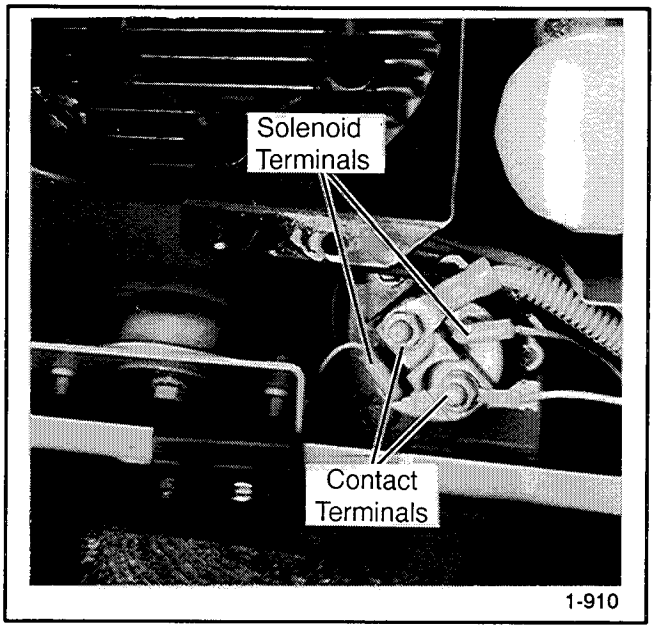
1. Electric Choke

Figure 7-18. Carburetor Electric Choke



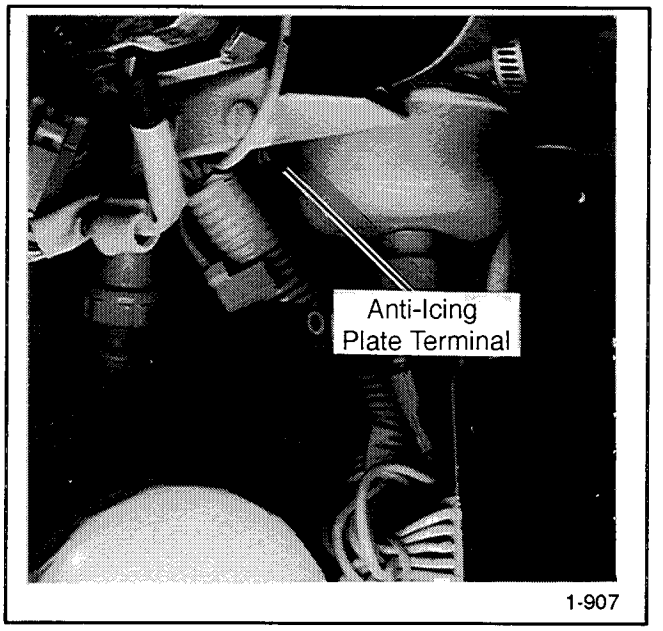
1. Antidieseling Solenoid

Figure 7-19. Antidieseling Solenoid



1. Solenoid Terminals
2. Contact Terminals

Figure 7-20. Starter Solenoid (S Relay)



1. Anti-Icing Plate Terminal

Figure 7-21. Anti-Icing Plate Terminal (Older Models)

Rotor

The four-pole rotor creates the magnetic field needed to sustain alternating current in the stator windings. Prior to testing, inspect the rotor for visible damage to pole shoes, insulation, exposed coil windings, and slip ring surfaces. Check rotor bearing for noisy operation, excessive wear, and heat discoloration. Replace or repair these components if any of the above conditions exists.

Slip rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly machined appearance. Wipe with a dry, lint-free cloth. Use very fine sandpaper (#00) to remove roughness. Use light pressure on the sandpaper. Do not use emery or carborundum paper or cloth. Remove all carbon dust from the generator. If the rings are black or pitted, remove the rotor and remove some of the surface material using a lathe.

Check the rotor for continuity and resistance. Measure the rotor resistance (ohms) between the two slip rings (Figure 7-22). See Specifications—Generator in Section 1 for typical readings.

NOTE

Since ohmmeters do vary in their accuracy, use values in Section 1 as a reference for approximate rotor resistance readings. Take readings at room temperature or about 70° F (21° C). Rotor resistance will vary directly with increase in temperature.

To check for rotor shorted to ground, adjust ohmmeter to zero ohms. Touch one ohmmeter lead to either slip ring and other lead to rotor poles or shaft. Meter should register no continuity.

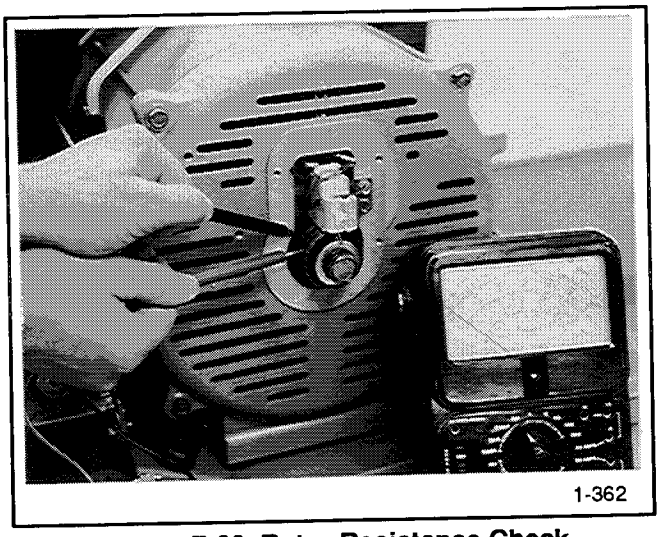


Figure 7-22. Rotor Resistance Check

NOTE

When checking rotor resistance with rotor installed, brushes must not be in contact with rotor slip rings. Use brush retainer on brushes for accurate resistance readings.

Repair or replace the rotor if any faults are detected in the previous tests.

Stator, 1 Phase

The stator consists of a series of coils of wire placed in a laminated steel frame. The stator leads supply voltage to the AC load and voltage regulator.

Inspect the stator for heat discoloration before testing. Also inspect stator for visible damage to housing lead wires, exposed coil windings, and exposed and varnished areas of frame laminations. Be sure the stator is riveted securely in the stator housing.

Checking Stator Continuity and Resistance

1. To check stator continuity, set ohmmeter on R x 1 scale. Contact the red and black meter leads. Adjust ohmmeter to zero ohms. Check stator continuity by connecting meter leads to stator leads. See Figure 7-23.

NOTE

Disconnect all stator leads prior to performing stator continuity tests.

NOTE

See Section 1 for stator resistance readings. Most ohmmeters will not provide accurate readings when measuring less than 1 ohm. Consider the stator good if a low resistance reading (continuity) is obtained and there is no evidence of shorted windings (heat discoloration).

Leads 1, 2, 3, and 4 are the generator output leads. Leads 33 and 44 are the voltage regulator sensing leads. Leads 33 and 55 are the voltage regulator power supply. Leads B1 and B2 are the generator output interlock circuit for the controller. Refer to the schematic in Figure 7-24 when performing the following tests:

- Continuity between leads 1 and 2
- Continuity between leads 3 and 4
- Continuity between leads 33 and 44
- Continuity between leads 33 and 55
- Continuity between leads B1 and B2
- No continuity between lead 1 and leads 3, 4, 33, 44, and 55
- No continuity between lead 1 and leads B1 and B2
- No continuity between lead 4 and leads B1 and B2
- No continuity between any stator lead and ground on stator housing or frame laminations

Repair or replace the stator if the stator fails any checks.

2. Contact ohmmeter leads and readjust ohmmeter to zero ohms. Check cold resistance of stator windings by connecting meter leads to stator leads 1 and 2, 3 and 4, 33 and 44, 33 and 55, and B1 and B2. Typical stator winding resistance readings are listed in Section 1.

NOTE

Take ohmmeter readings at room temperature or about 70°F (21°C). Stator resistance will vary directly with increase temperature.

NOTE

When taking an ohmmeter reading using lead 55, make connection prior to in-line fuse.

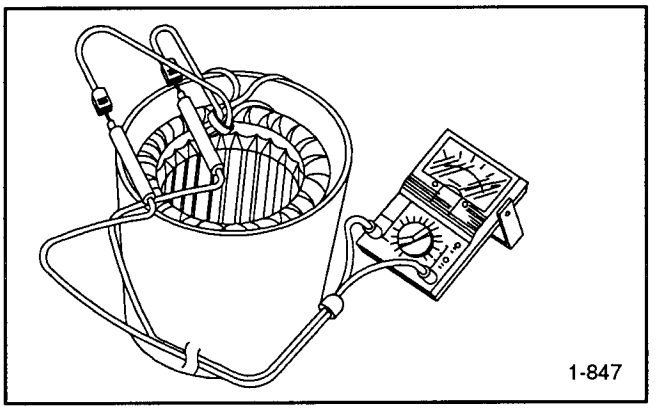


Figure 7-23. Stator Resistance Check

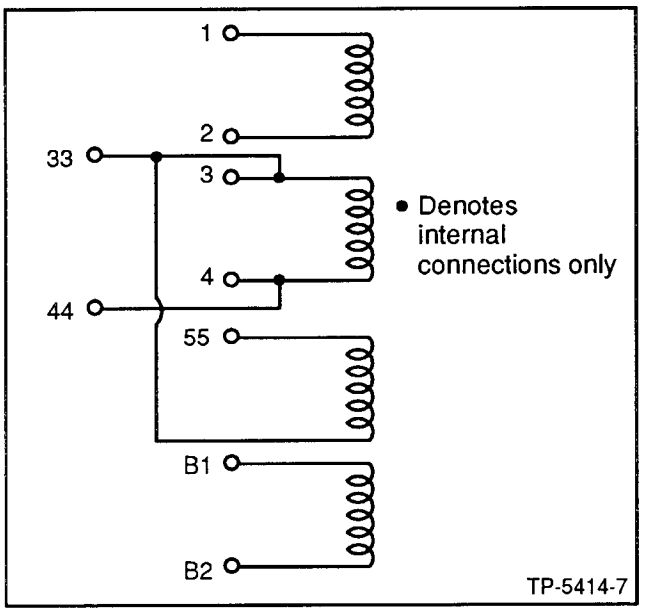


Figure 7-24. Generator Stator Leads

Stator, 3 Phase (12 Lead)

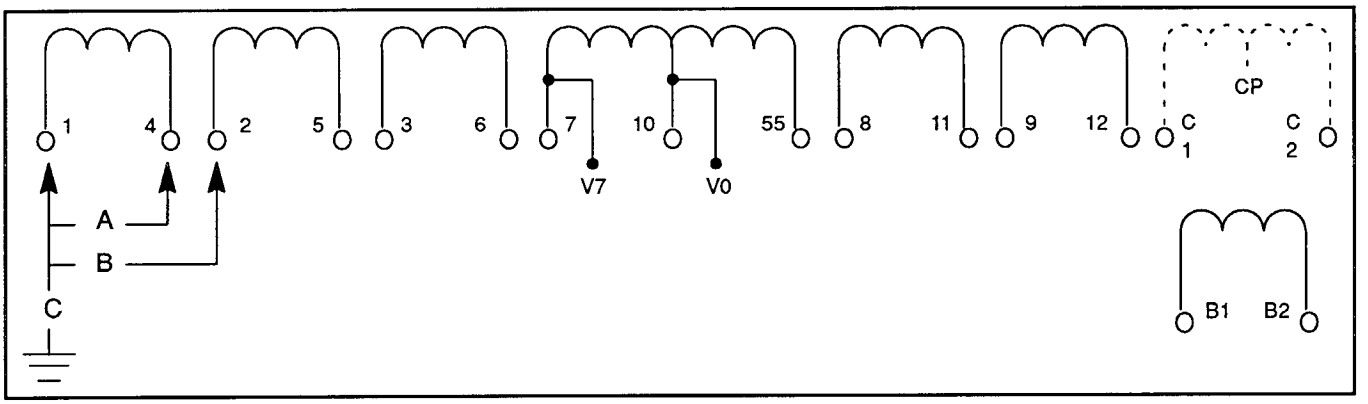
The stator produces electrical output (AC) as the magnetized main field rotates within the stator windings. Test the condition of the stator according to the following procedure.

1. Disconnect generator starting battery (negative lead first) and power to battery charger (if equipped).
2. Check the generator output leads for connection (see Section 9—Wiring Diagrams).
3. Check condition of V0 and V7 leads at stator and at voltage regulator (33 and 44).
4. Use an ohmmeter to check continuity of V7, V0, and 55 leads between stator and voltage regulator. No continuity (low resistance) indicates an open lead. Repair any open leads.
5. Inspect stator for evidence of shorted windings (heat discoloration). If the stator shows signs of heat discoloration, test stator windings as described in the following steps before replacing stator.
6. Disconnect all stator leads to isolate windings. To check stator continuity, set ohmmeter on R x 1 scale. Contact the red and black ohmmeter leads; adjust ohmmeter to zero ohms. Check stator continuity by connecting meter leads to stator leads as shown in Figure 7-25.

NOTE

Perform stator tests on all stator windings.

- There should be continuity between leads 1 and 4, 2 and 5, 3 and 6, etc.
- There must be no continuity between winding 1-4 and any other winding. This statement also applies to windings 2-5, 3-6, 7-10-55, etc.
- There must be no continuity between any stator lead and ground on stator housing or frame laminations.



A. Continuity/Resistance Between Points
B. No Continuity Between Points
C. No Continuity Between Points

Figure 7-25. Generator Stator Leads

7. Contact ohmmeter leads together and readjust ohmmeter to zero ohms. Check cold resistance of stator windings by connecting meter leads to stator leads 1-4, 2-5, 3-6, etc. Typical stator winding resistances are found in Section 1—Specifications. If the stator resistance test is inconclusive, perform a megohmmeter test on stator as described in the next step.

NOTE

Most ohmmeters will not provide accurate readings when measuring less than one ohm. The stator can be considered good if a low resistance reading (continuity) is obtained and there is no evidence of shorted windings (heat discoloration).

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

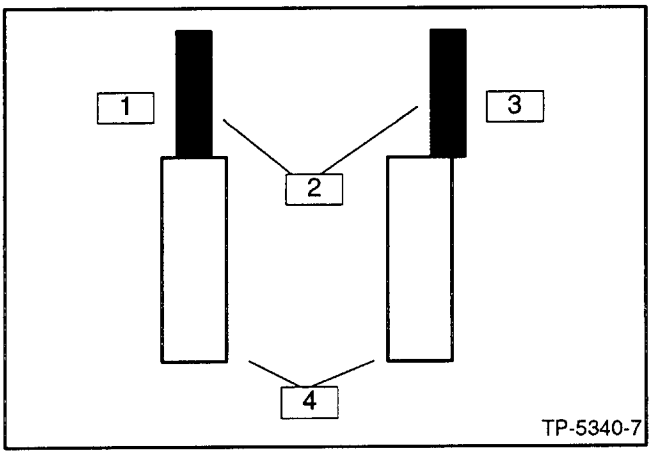
8. Check stator for ground. Using a megohmmeter, apply 500 volts DC to any stator lead from each winding and stator frame. (Follow the instructions of the megohmmeter manufacturer when performing this test.) Repeat test on other leads until all stator windings have been tested. A reading of approximately 500K ohms (1/2 megohm) and higher indicates the stator is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replace the stator.

Brushes

The brushes conduct current from the voltage regulator to the slip rings. Since the brushes carry a low current, they should last the life of the generator. Abrasive dust on the slip rings could, however, shorten the life of the brushes. Excessive arcing at the brushes could damage the voltage regulator. Weak springs, damaged slip rings, sticking brushes, loose holder, or poor brush contact can cause arcing at the brushes.

The brushes must be free to move within the holder and be held in contact by the springs. When properly positioned, spring pressure on the brush surface will cause the brush to wear evenly. Brushes must ride 100% on the rings or arcing will occur and cause burned rings or failure of the voltage regulator. Figure 7-26 shows the correct positioning of the brushes. Add or remove shims as necessary to center brushes on slip rings.

Replace brushes if they show excessive or uneven wear.



1. Correct Positioning
2. Brushes
3. Improper Positioning
4. Generator Slip Rings

Figure 7-26. Brush Positioning

Electronic Governor

The governor system consists of an electronic isochronous governor, an electro-mechanical stepper motor, and a magnetic pickup. Electrical pulses are supplied by the magnetic pickup to the isochronous governor (control unit) each time one of the ring gear teeth passes the pickup. The control unit compares the frequency of these pulses to a preset reference and provides a signal to the stepper motor which controls the carburetor throttle position and the engine speed. This is a closed-loop system and typically provides steady-state speed regulation of ± 0.25%.

The electronic governor is set at the factory and usually will not require adjustment. If the unit operates erratically, check the following items BEFORE readjustment.

- Check electrical connections—check the stepper motor, controller box, and governor connector (inside the controller) for clean and tight connections.
- Check magnetic pickup connections. Poor connections may cause the signal to be erratic. As long as this erratic signal is being sent, the unit will not shut down due to loss of pickup.
- Check electrical ground connections—a good DC ground must be provided to the controller assembly and governor circuit.
- Check for dirt buildup on magnetic pickup—metal filings or caked-on dirt/grease may decrease the output signal of magnetic pickup.
- Check for stepper motor/throttle shaft coupling wear—if the roll pin wore the slot of the stepper motor coupling, loosen coupling screw and move coupling so that roll pin is positioned at a point in stepper motor coupling without wear. Tighten coupling screw.

If the governor is removed or tampered with, use the following adjustment procedure.

1. Check alignment of governor actuator shaft to carburetor throttle shaft. In order for engagement, shafts must be concentric. Throttle plate position can be either open or closed during check. Carburetor throttle shaft pin must be in the slot of the stepper motor coupling with the pin in the middle of the depth of the slot. No other adjustment is necessary or possible with this arrangement.

   a. The governor stepper motor should function with steady and smooth movement during operation. If movement of stepper motor is erratic or large changes in movement occur, check shaft alignment, check for excessive coupling slot wear, and check for broken or loose wiring including plug connections.

   b. To test for operation of the stepper motor, disconnect magnetic pickup leads. Manually move the throttle shaft/governor stepper motor fully counterclockwise (closed throttle). Start generator set. Stepper motor should initially move clockwise (wide open throttle) and then go completely counterclockwise. The stepper motor should remain in this position. STOP generator set. If stepper motor fails this test, replace stepper motor.

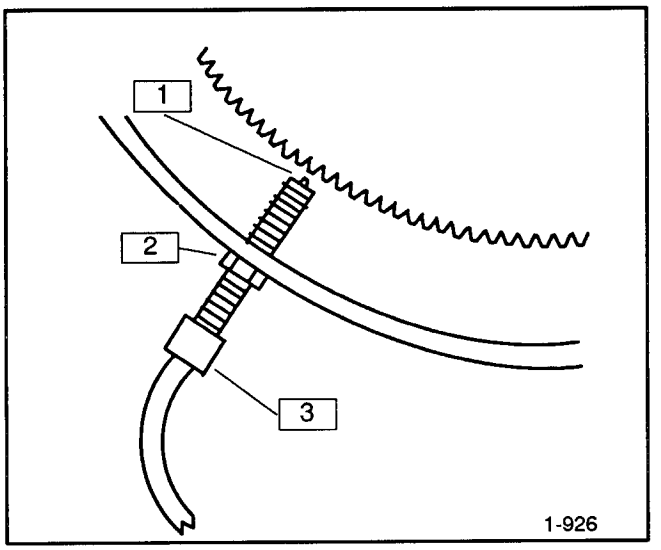
   c. Connect magnetic pickup leads.

   NOTE

   Before replacing the stepper motor, make sure that the controller circuit board is functioning by verifying that 12 volts are entering the governor circuit board at pin 6.

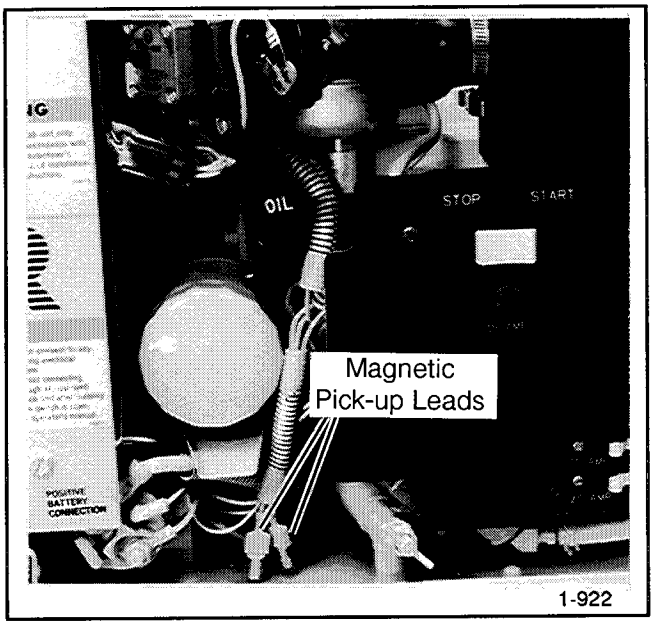
2. The magnetic pickup air gap is 0.040 in. (1.02 mm) ± 0.005 in. (0.127 mm). See Figure 7-27.

   a. To verify operation of the magnetic pickup, connect voltmeter to magnetic pickup leads. See Figure 7-28. During engine cranking, voltage should be 1.75 volts AC minimum. If the air gap has been checked and is correct, replace magnetic pickup if proper voltage is not measured.



1. Air Gap
2. Locknut
3. Magnetic Pickup

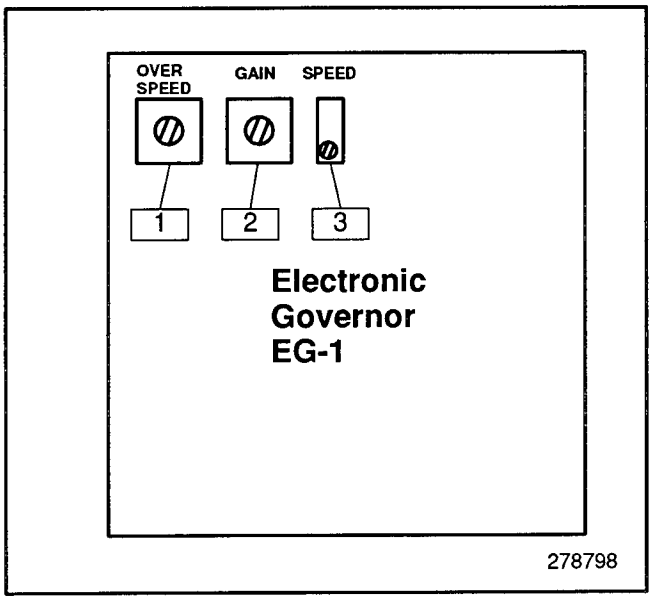
Figure 7-27. Magnetic Pickup Air Gap



1. Magnetic Pickup Leads

Figure 7-28. Magnetic Pickup Leads

3. Adjust carburetor fuel mixture as stated in gasoline carburetor or LP carburetor found in Section 3.



1. Overspeed Potentiometer
2. Gain Potentiometer
3. Speed Potentiometer

Figure 7-29. Governor Pots

NOTE

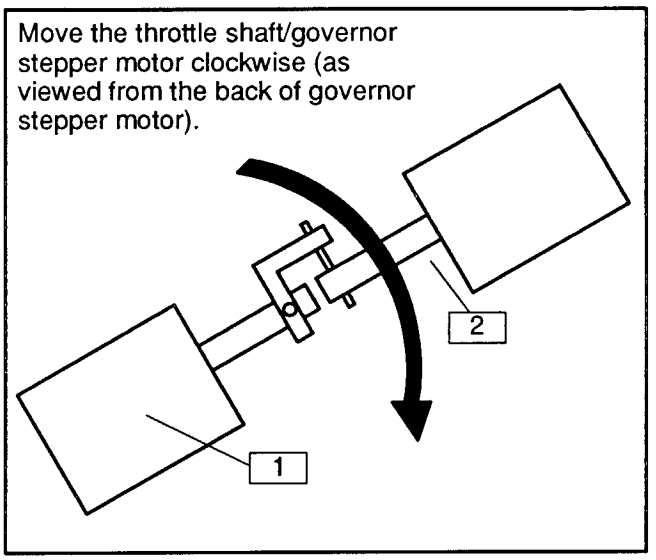
Often hunting/surging problems thought to be caused by the governor are actually linked to carburetor adjustment. Be sure carburetor is adjusted before continuing to next step.

4. Attach a frequency meter to AC output leads. Start and run the generator until normal operating temperature is obtained (about 5-10 minutes).
5. Adjust the electronic governor speed pot to obtain a full load engine speed of 60 Hz (1800 rpm) on 60 Hz models and 50 Hz (1500 rpm) on 50 Hz models. See Figure 7-29. Turn clockwise to increase frequency and counterclockwise to decrease frequency.
6. With generator set running and with no load applied, check stability. If generator set speed is unstable or hunting/surging is observed, turn gain pot approximately 1/8 turn counterclockwise or until the generator set becomes stable where there is no hunting/surging. Observe frequency reading. Repeat Step 5, as necessary.
7. Apply rated load to generator set and observe frequency reading. No-load and full-load frequencies should be within ±0.5% of desired frequency. If not within specification, check that the carburetor throttle plate is opening fully and that it is not sticking; and check that carburetor is adjusted.
   a. Check for hunting/surging at full load. Turn gain pot in 1/8 turn increments (as required) counterclockwise until stability is observed.
8. Remove load and observe frequency. Frequency should return to value stated in speed adjustment (Step 5). Gain adjustment *may* affect generator set speed/frequency. If speed has been changed, repeat Step 5.

NOTE

If speed adjustments were repeated, it is not necessary to repeat gain adjustments (Steps 6 and 7) as speed adjustments have no affect on gain adjustments.

9. With unit running, check overspeed cutout point. Manually move the throttle shaft/governor stepper motor coupling clockwise (as viewed from the back of the governor stepper motor). See Figure 7-30. Do not use speed adjustment pot to check the overspeed cutout point. Observe frequency meter and note frequency at which generator set shuts down. Factory setting is 72 Hz for 60 Hz models and 60 Hz for 50 Hz models (or 120% of rated speed/frequency).



1. Stepper Motor
2. Carburetor Throttle Shaft

Figure 7-30. Manually Moving Stepper Motor

NOTE

Reset overspeed after making any speed adjustments.

10. Turn overspeed pot counterclockwise to increase overspeed cutout point and clockwise to decrease overspeed cutout point. Readjust overspeed pot and repeat procedure as necessary to obtain the desired overspeed cutout point.
11. Stop generator set.

If after performing governor adjustments the generator set is not within the stated specifications, repeat Steps 5 through 11. If this fails to bring generator set to electronic governor specifications, replace governor controller circuit board.

NOTE

See diagrams in Section 9 for electronic governor wiring.

Section 8. Disassembly/Reassembly

ıbolt the generator set from the vehicle before ɜassembly. Disconnect all external ınnections—battery cables at battery (negative lead st), AC output leads at coach junction box, remote art panel at controller P3 connector, fuel line at filter let, and exhaust system. Observe all safety ecautions listed at the beginning of this manual ıring the disassembly/reassembly procedure.

NOTE

ARDWARE DAMAGE! Engine and generator make ɜe of both SAE and metric hardware. Use the correct ze tools to prevent rounding of bolt heads and nuts.

Disassembly

1. Remove four screws using a 1/4-in. nutdriver or socket wrench from start/stop control panel. See Figure 8-1.

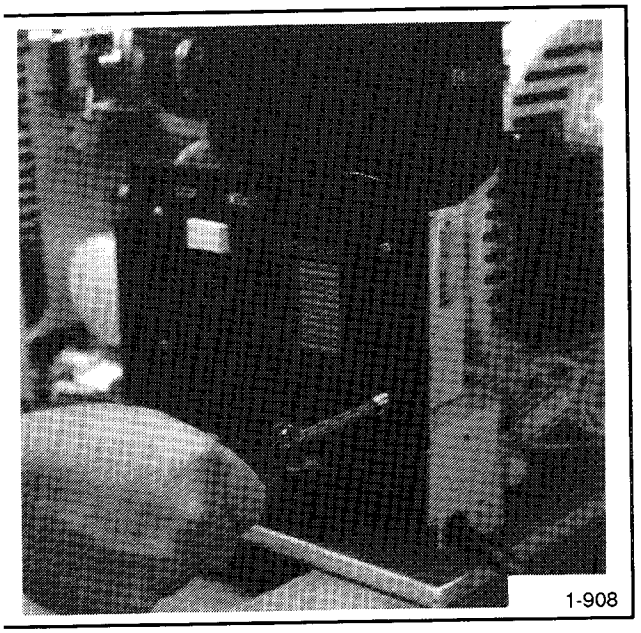


Figure 8-1. Controller Cover Removal

2. If main circuit board or electronic governor circuit board require replacement, follow Steps 2a-2d. If circuit board replacement is not required, go to Step 3.

NOTE

If adjustment to electronic governor circuit board is required, pot adjustment can be made without removing circuit boards.

a. Remove P1 (15-pin) and P2 (9-pin) connectors from main circuit board.

b. Remove four nuts using 1/4-in. nutdriver from long studs. Remove three white insulator washers and one black (long) spacer from studs. Remove main circuit board. See Figure 8-2.

NOTE

For reassembly black spacer goes on stud in center of circuit board (near D4 diode).

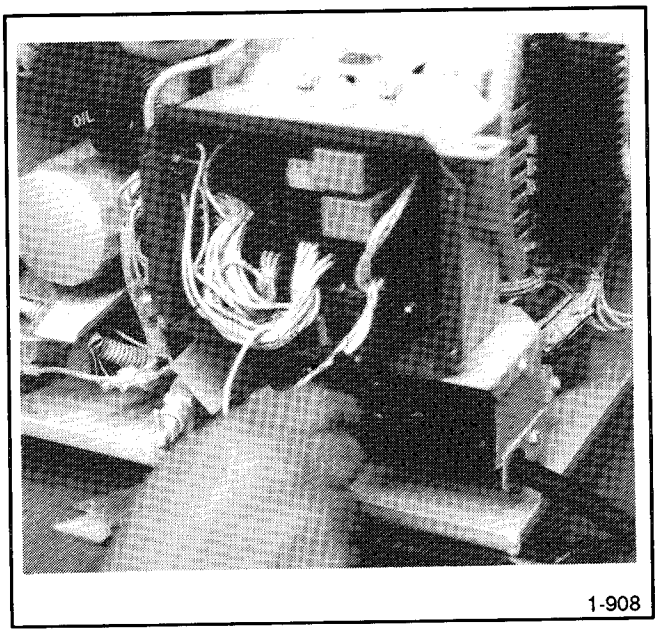


Figure 8-2. Main Circuit Board Removal

c. Remove four nuts and lock washers using 5/16-in. nutdriver and remove main circuit board bracket. See Figure 8-3.

d. Remove P7 (12-pin) connector from electronic governor circuit board and then remove electronic governor circuit board.

NOTE

For reassembly, reverse Steps 2a-2d. Electronic governor circuit board is installed with pots to the left side.

NOTE

If electronic governor circuit board was replaced or pots altered, see Section 7—Component Testing and Adjustment, Electronic Governor.

3. Loosen hose clamp between air cleaner assembly and carburetor at carburetor side.

4. Remove breather hose at air cleaner assembly by removing adapter from air cleaner assembly. Hose clamp does not need loosening.

5. Remove two air cleaner bracket screws from stator assembly using 5/16-in. socket wrench. See Figure 8-4.

6. Release three latches and remove air cleaner cover. See Figure 8-5. Carefully remove air cleaner element from base. Protect element from dirt/dust contamination until installation.

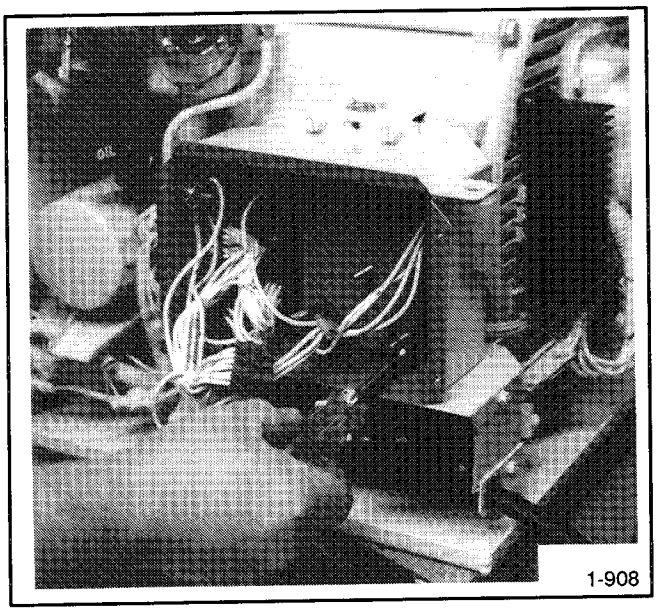


Figure 8-3. Circuit Board Bracket Removal

Figure 8-4. Air Cleaner Bracket Removal

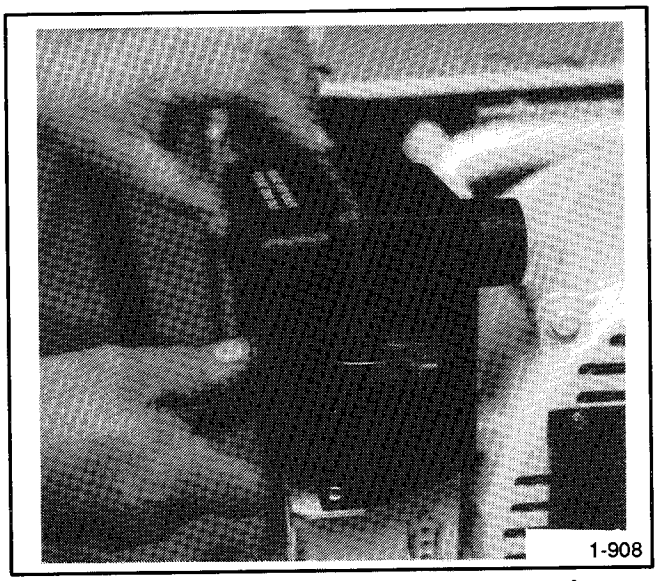


Figure 8-5. Air Cleaner Cover Removal

7. Remove two screws from air cleaner base using 3/8-in. socket wrench (or screwdriver). Remove air cleaner base. See Figure 8-6.

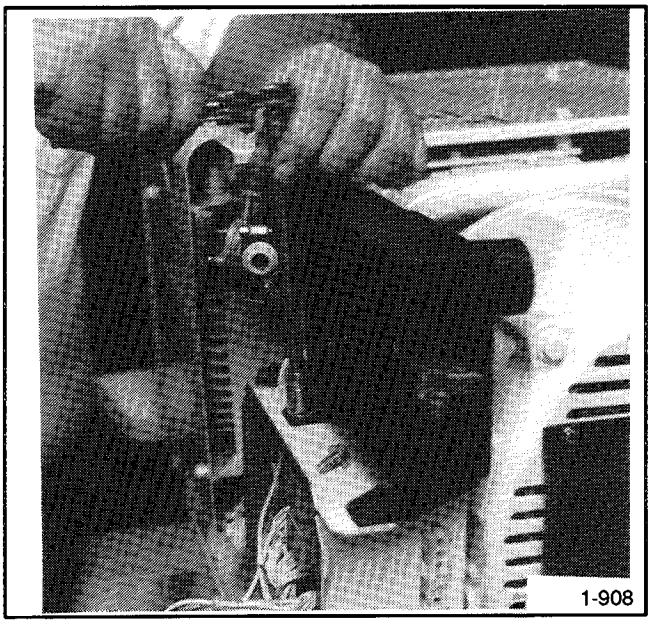


Figure 8-6. Air Cleaner Base Removal

8. Disconnect fuel pump (2-pin) connector and (20-pin) connector, if equipped, from controller box.

9. Remove four screws from AC circuit breaker panel using 1/4-in. nutdriver or socket wrench. See Figure 8-7.

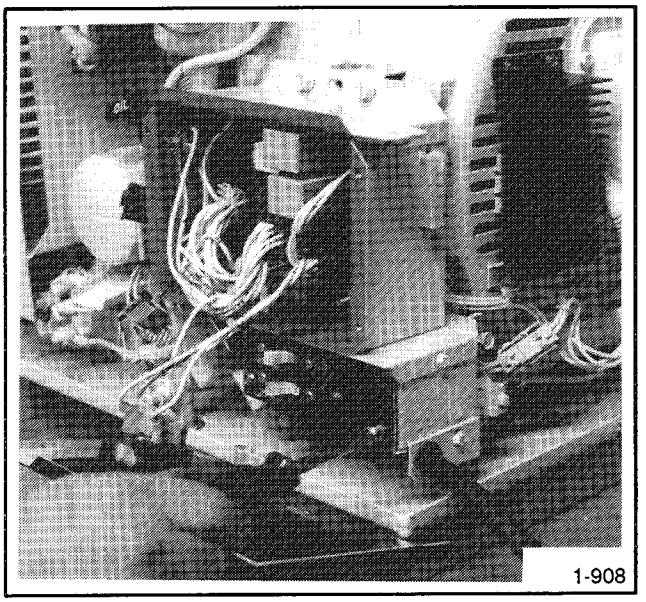


Figure 8-7. AC Circuit Breaker Panel Removal

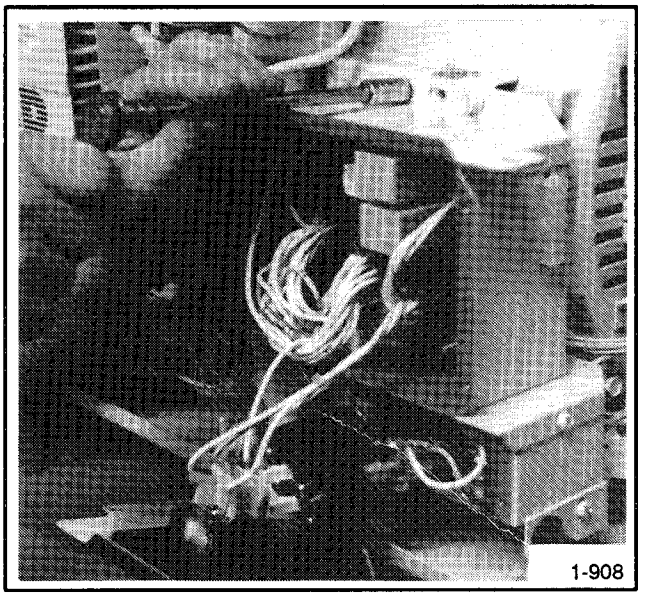


Figure 8-8. Controller Box (Top Screw) Removal

10 Remove two screws from top of controller box using 3/8-in. socket wrench. See Figure 8-8.

11. Remove one screw on side of controller box using 1/4-in. nutdriver and lift off controller box. See Figure 8-9.

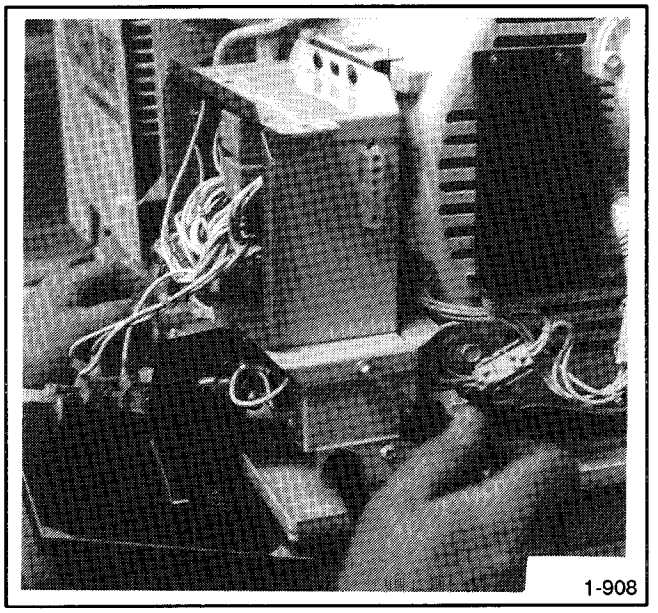


Figure 8-9. Controller Box (Side Screw) Removal

12. Disconnect 6-pin voltage regulator connector and 4-pin connector. Disconnect push-on connectors of leads FN, FP, B1, and B2 (near fuel pump).

13. Remove four screws and remove voltage regulator using 1/4-in. nutdriver or socket wrench. See Figure 8-10.

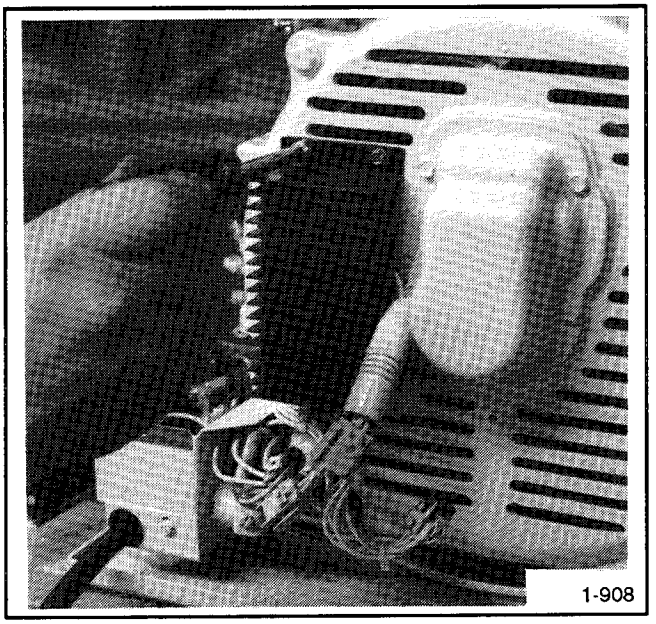


Figure 8-10. Voltage Regulator Removal (Single-Phase Models Only)

14. Remove four screws and brush cover using 5/16-in. socket wrench. See Figure 8-11.

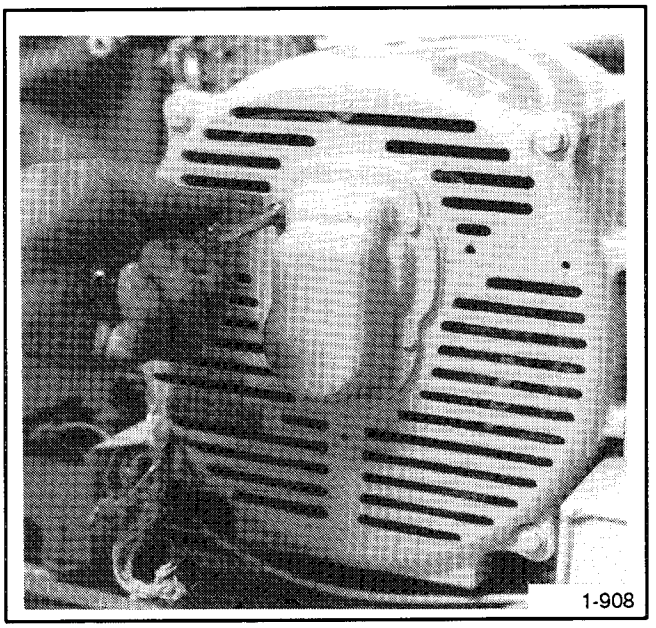


Figure 8-11. Brush Cover Removal

15. Pull leads outward to raise brushes in holder and install brush retainer (length of stiff wire or paper clip will also work). See Figure 8-12.

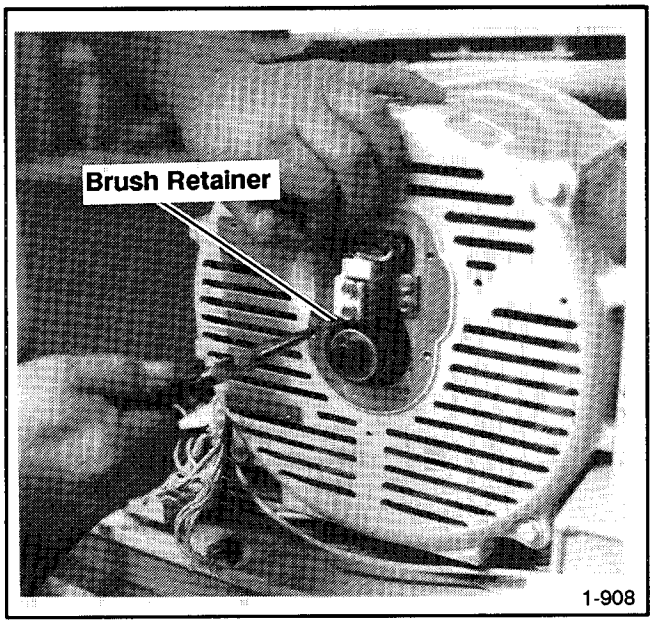


Figure 8-12. Brush Retainer Installation

16. Raise unit (use hoist if necessary) and support with wood block(s). Height must be sufficient to use ratchet wrench on vibromounts. See Figure 8-13.

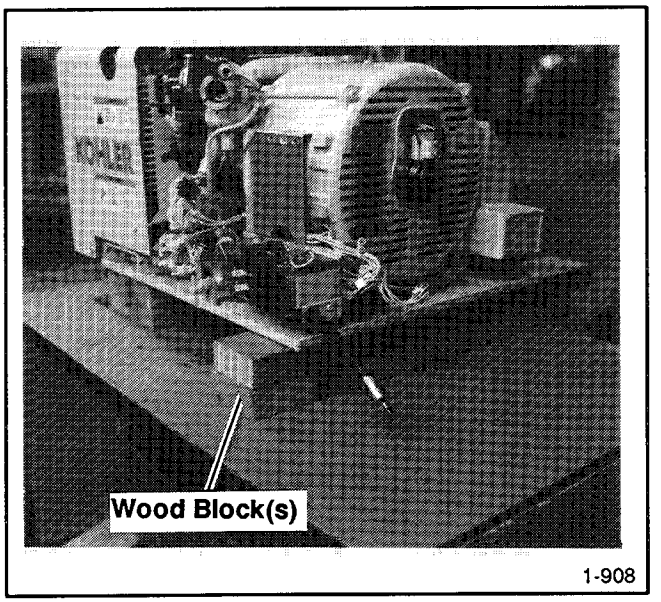


Figure 8-13. Under-Unit Wood Block(s) Supports

17. Remove two bolts on vibromounts at stator assembly using 9/16-in. socket wrench. See Figure 8-14.

Figure 8-14. Vibromount Bolt Removal

18. On sets with gasoline fuel system, use a 7/16-in. wrench (a flare nut wrench if available) to loosen fuel line fitting at fuel pump. See Figure 8-15. Lift and bend fuel line slightly to clear fuel pump adapter.

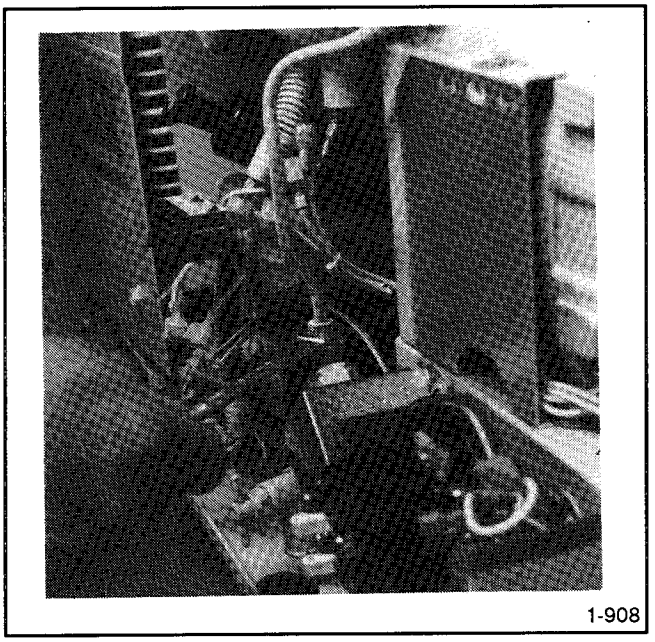
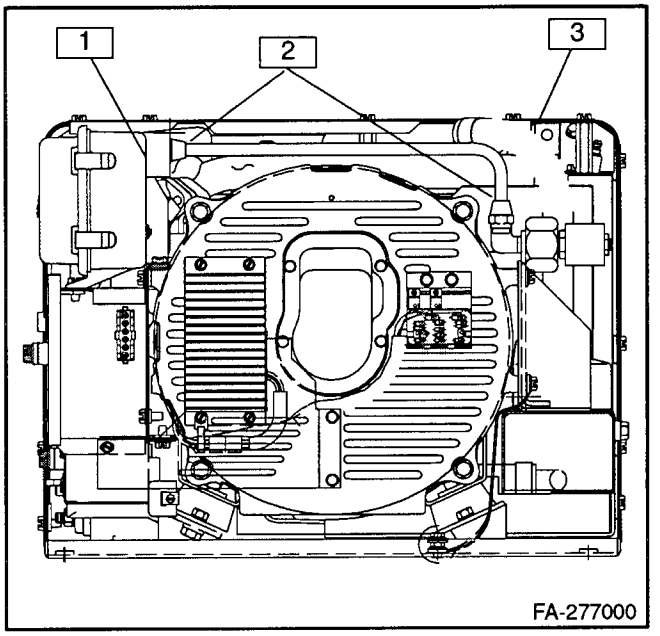


Figure 8-15. Gasoline Fuel Line Disconnection

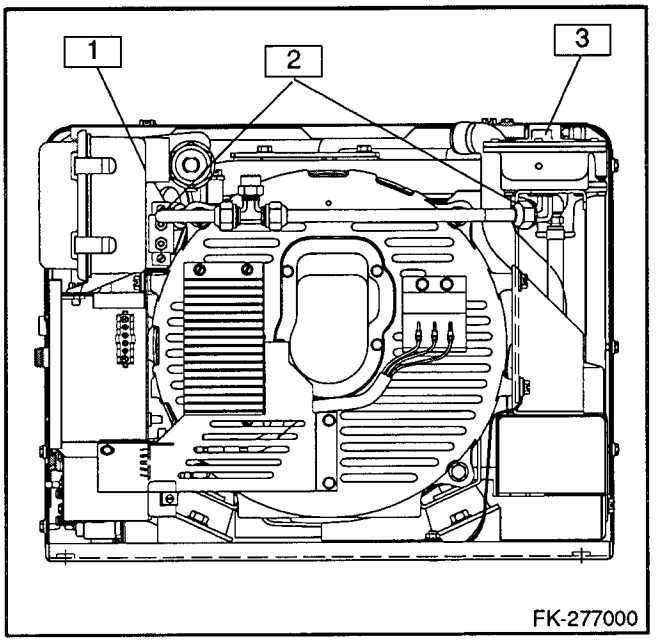
19. On sets with vapor withdrawal (LP gas fuel system), remove fuel line between secondary regulator and carburetor. See Figure 8-16.



1. Carburetor
2. Disconnect Here
3. Secondary Regulator

Figure 8-16. Vapor LP Gas Fuel Line Removal

20. On sets with liquid withdrawal (LP gas fuel system), remove fuel line between secondary regulator and carburetor. See Figure 8-17.



1. Carburetor
2. Disconnect Here
3. Secondary Regulator

Figure 8-17. Liquid LP Gas Fuel Line Removal

21. Remove two screws that attach mounting bracket (or oil reservoir) to stator using a 3/8-in. wrench. See Figure 8-18.

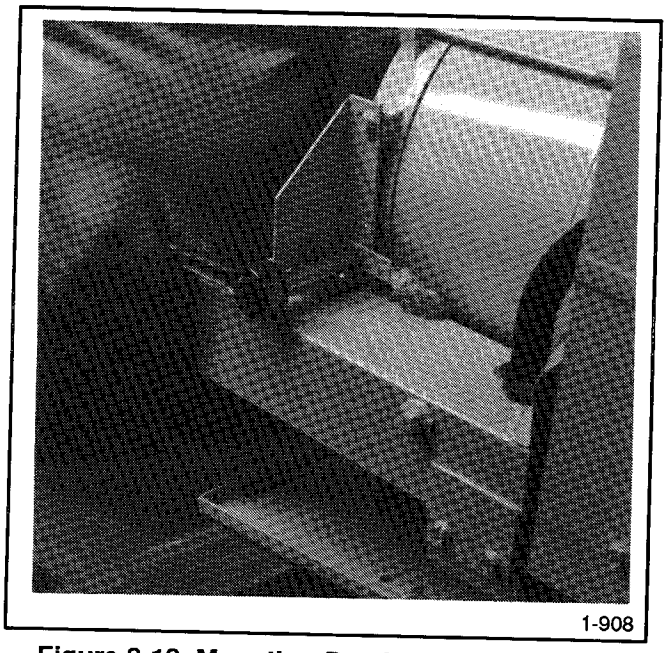
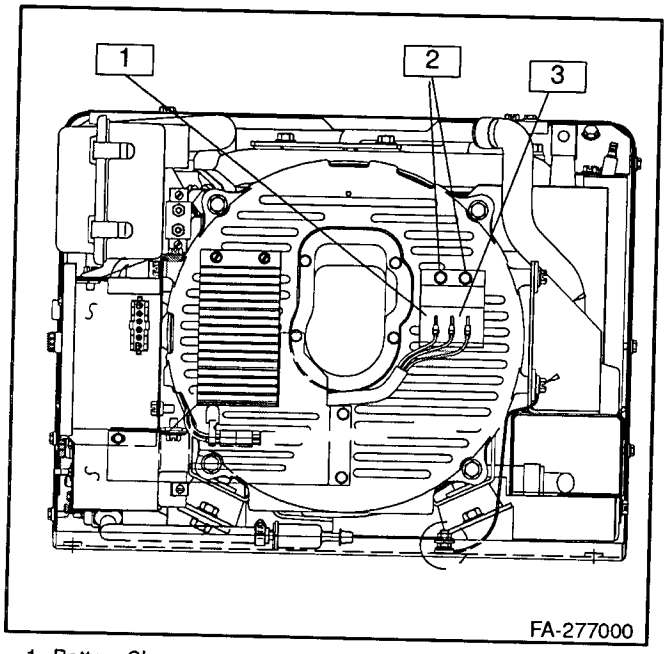


Figure 8-18. Mounting Bracket Bolts Removal

22. If optional battery charger is installed, disconnect the three leads to the battery charger and remove the two screws that secure the battery charger to the end plate. See Figure 8-19.

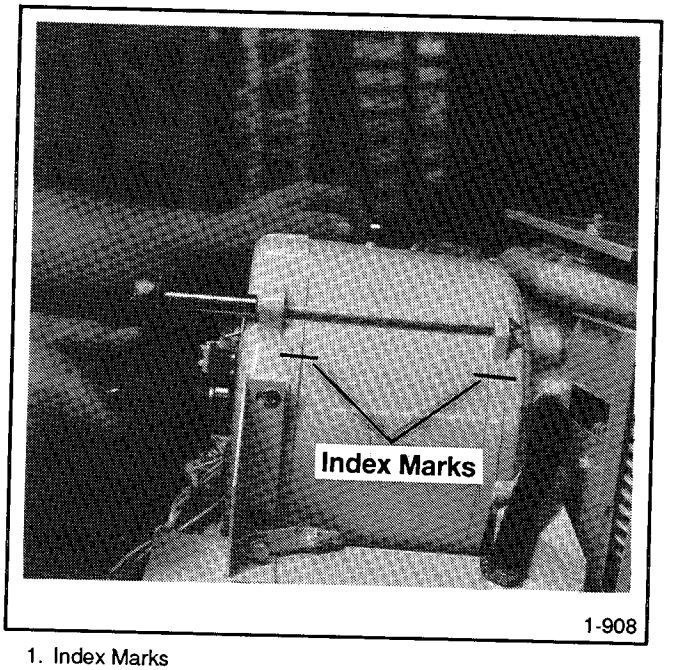


1. Battery Charger
2. Screws
3. Leads

Figure 8-19. Battery Charger Removal

23. Paint index marks (for use during reassembly) across stator housing/generator adapter joint and across stator housing/end plate joint. See Figure 8-20.

24. Remove four overbolts from end bracket using 7/16-in. socket wrench. See Figure 8-20.



1. Index Marks

Figure 8-20. Overbolt Removal

25. Use a rubber (soft faced) hammer to carefully remove end bracket from stator assembly. See Figure 8-21.

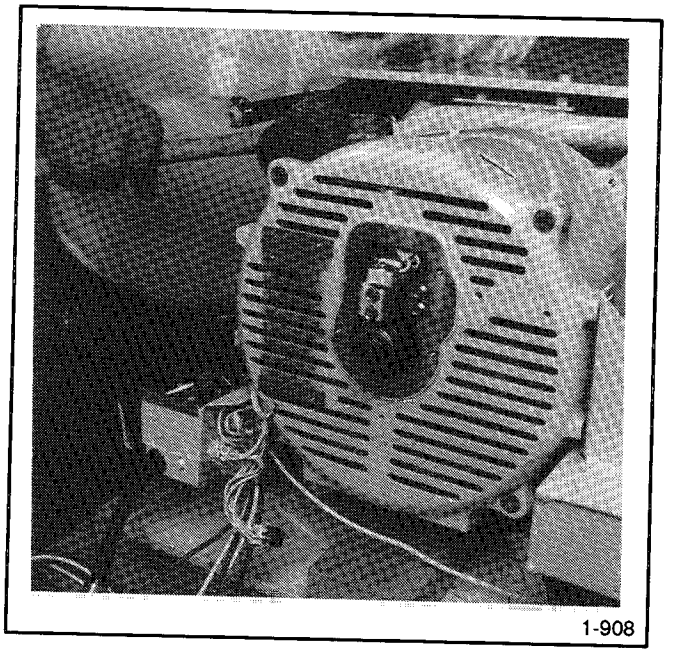


Figure 8-21. End Bracket Removal

26. Disconnect push-on connectors of lead 55 and remove end bracket.

27. Remove bolt at vibromount to release ground strap and equipment ground (green) lead using 3/8-in. socket wrench. See Figure 8-22.

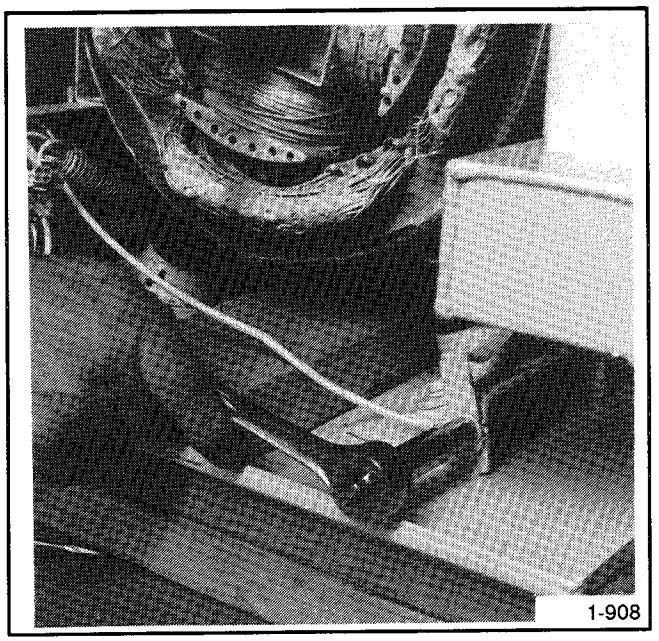


Figure 8-22. Ground Bolt Removal

28. Remove stator assembly by sliding off adapter lip. Use a screwdriver between stator assembly shell edge and generator adapter to loosen stator, if necessary. Be careful not to damage mating surfaces. See Figure 8-23.

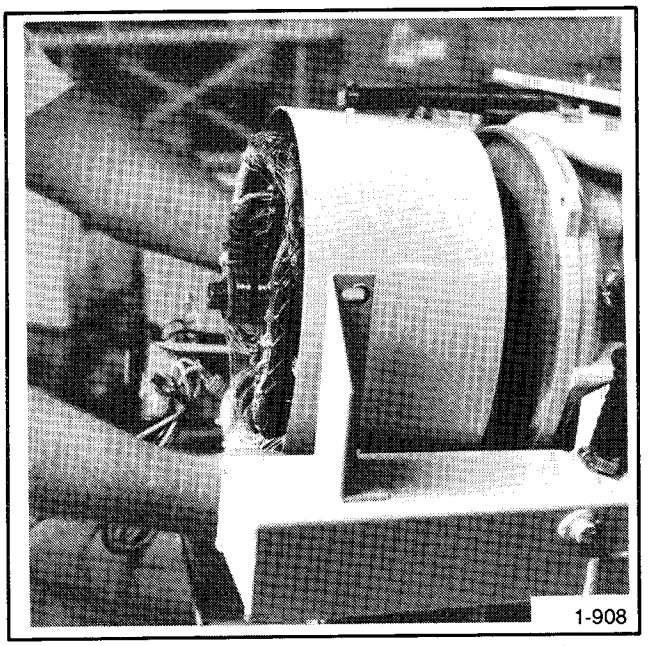


Figure 8-23. Stator Assembly Removal

29. Remove two screws and AC circuit breaker box from stator assembly using 3/8-in. socket wrench. See Figure 8-24.

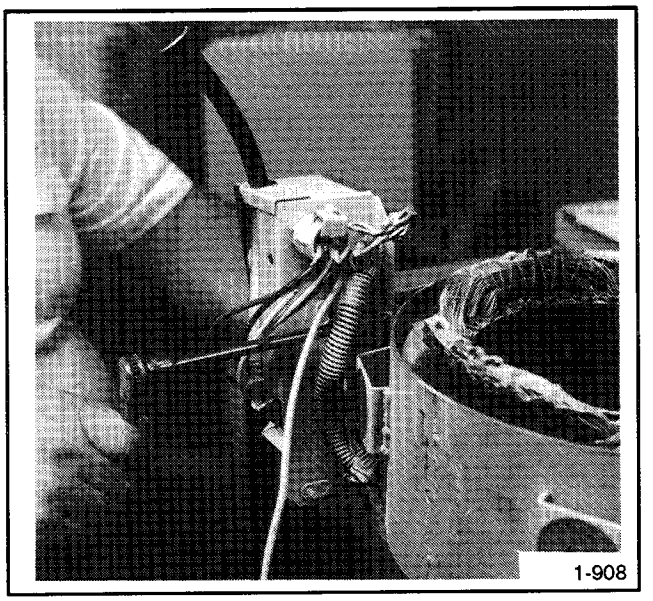
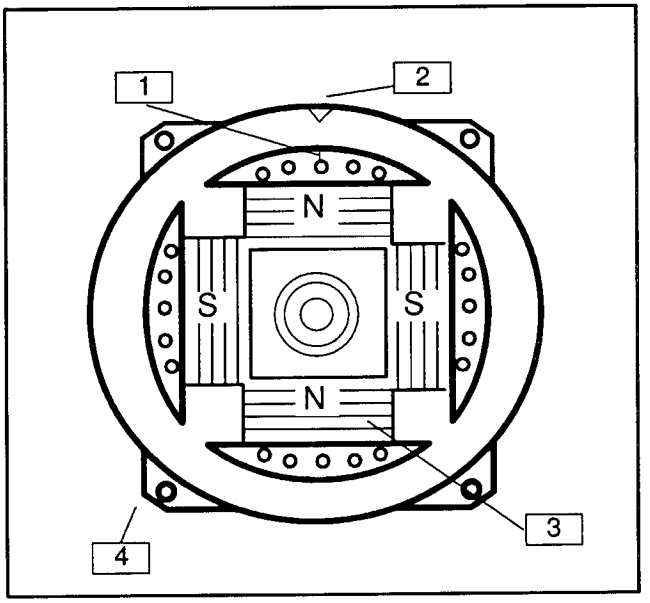


Figure 8-24. AC Circuit Breaker Box Removal

30. Disconnect leads 1, 2, 3, 4, and 55 from AC circuit breaker box to separate stator assembly from AC circuit breaker box.

31. Before removing rotor, rotate rotor using a ratchet on thrubolt so that rotor paint mark is to the top (12 o'clock position). See Figure 8-25.



1. Paint Mark on Rotor Pole
2. "V" Notch on Generator Adapter
3. Rotor
4. Generator Adapter

Figure 8-25. Rotor to Generator Adapter Alignment

32. Loosen thrubolt 2-3 turns leaving an 1/8 in. (3 mm) gap between bolt and rotor using a 3/4 in. socket wrench. Use a strap wrench on rotor windings and socket wrench on thrubolt *(or* place wrench on thrubolt and strike wrench with lead hammer using a medium force blow) to loosen thrubolt. See Figure 8-26.

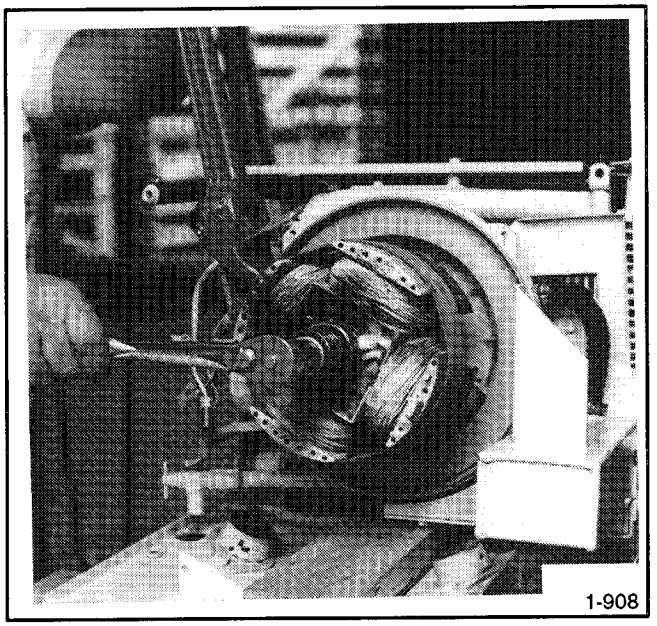


Figure 8-26. Loosening Rotor Thrubolt

33. Strike thrubolt head with lead hammer using a medium force blow to loosen rotor. If necessary, use prybar or large screwdriver to pry rotor at laminations. See Figure 8-27. Do NOT allow pry tool to contact windings.

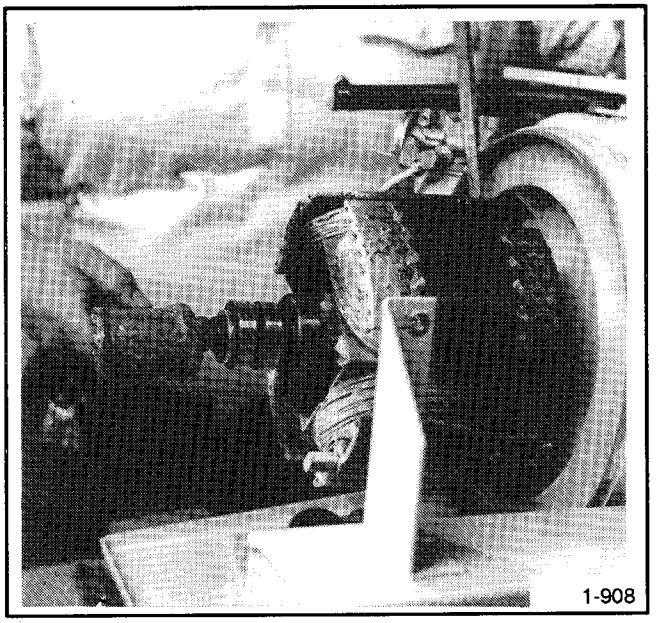


Figure 8-27. Rotor Removal

NOTE

Do not attempt to loosen rotor thrubolt by blocking rotor cooling fan and turning rotor with any kind of wrench. Damage to fan blades and rotor may result.

34. When rotor has been loosened, remove thrubolt and then slide rotor from tapered crankshaft.

Reassembly

NOTE

To prevent O-ring damage, clean bearing of rust or corrosion.

1. Coat crankshaft tapered shaft with antiseize compound. See Figure 8-28.

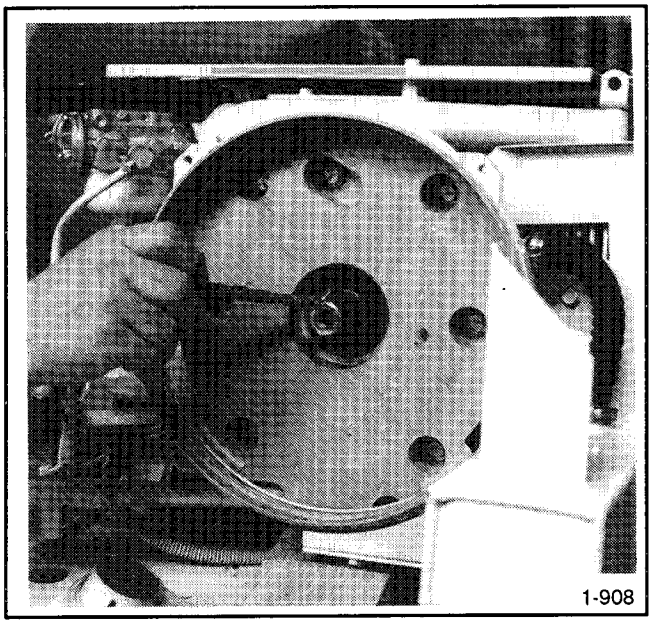


Figure 8-28. Antiseize Compound Application

NOTE

Check rotor alignment if rotor was removed without first aligning paint stripe to the top or if engine crankshaft was rotated with rotor removed. This alignment is essential to prevent light flicker while unit is running. If alignment is suspected to be incorrect, access spark plug ignition coil under blower housing. Rotate flywheel to align bottom of upper magnet on flywheel with top of ignition coil core. See Figure 8-29.

2. Place rotor onto tapered shaft of crankshaft with rotor paint stripe (indicating north pole) to the top (12 o'clock position). Align center of (north pole) with V notch on generator adapter and handtighten thrubolt. Attach a strap wrench to rotor and torque thrubolt to 40-55 ft. lbs. (54-75 Nm). See Figure 8-30. Do not allow flywheel to rotate when assembling rotor to crankshaft.

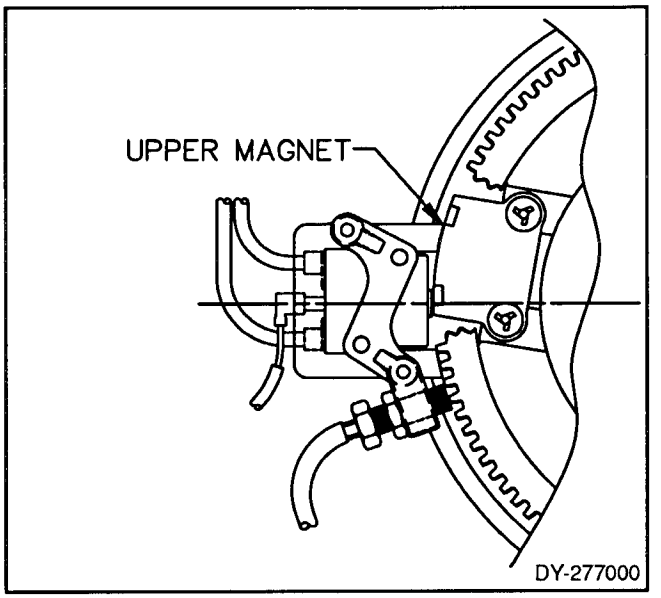
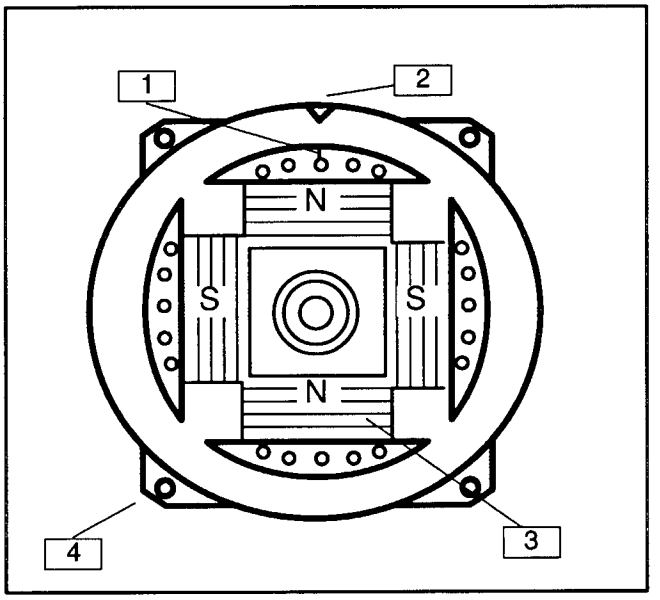


Figure 8-29. Ignition Coil to Flywheel Magnet Alignment



1. Paint Mark on Rotor Pole
2. V Notch on Generator Adapter
3. Rotor
4. Generator Adapter

Figure 8-30. Rotor to Generator Adapter Alignment

3. Attach stator leads 1, 2, 3, 4, and 55 to AC circuit breaker box. See Section 9—Wiring Diagrams for proper connection.

4. Attach AC circuit breaker box to stator assembly using two screws.

5. Install stator assembly over rotor and onto lip of generator adapter. Insure that notches in stator shell are up and that index lines painted on stator and generator adapter are aligned.

6. Fit end bracket onto stator assembly, aligning painted index lines on stator and end bracket.

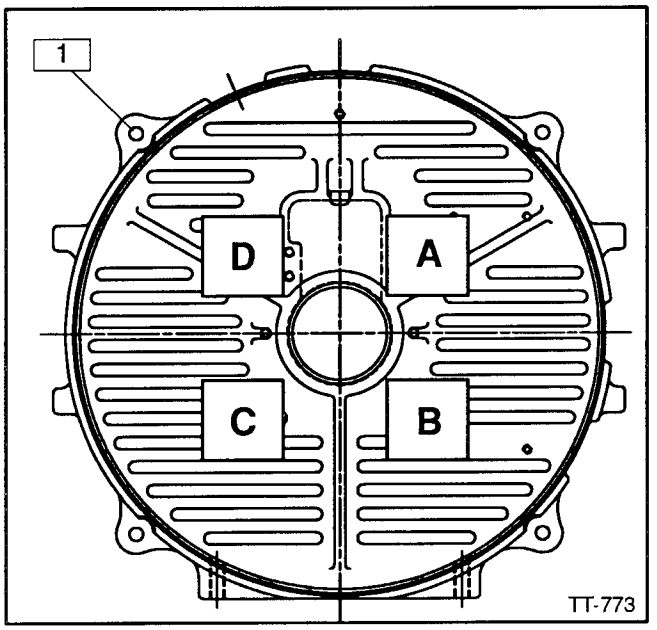
NOTE

Do NOT attempt to install end bracket to rotor by tightening overbolts. Damage to end bracket and/or generator adapter may result.

NOTE

Do not use lubricant during assembly.

7. Using a hard rubber or dead-blow hammer alternately strike end bracket using medium force blows. Use the rotating sequence shown in Figure 8-31 to install end bracket.



1. Overbolts

Figure 8-31. End Bracket Installation

8. When end bracket is completely installed in stator assembly, install and torque overbolts to 60 in. lbs. (7 Nm).

9. If used, install battery charger on end plate and secure with two self-tapping screws and flat washers. Then reconnect leads C1, C2, and 70 to terminals of battery charger.

10. Install bolt attaching ground strap and equipment ground (green) lead to vibromount. Place flat washer, equipment ground (green) lead, ground strap, and internal-external tooth lock washer on bolt. Place internal-external tooth lock washer between vibromount bracket and ground strap.

11. Connect leads 55 together at push-on terminals.

12. Install two bolts to secure mounting bracket or oil reservoir to stator. After inserting bolt through bottom hole of bracket, place a flat washer, ground strap, and internal-external tooth lock washer on bolt in that order before threading bolt into stator housing.

13. Reconnect fuel line to:
    - fuel pump on sets with gasoline fuel system,
    - carburetor and secondary regulator on sets with LP gas fuel system.

14. Attach stator assembly to vibromounts using two bolts.

15. Lift (use hoist, if necessary) and remove wood block(s) supporting generator set.

16. Remove brush retainer from brush holder. Install end bracket cover with four screws.

17. Install voltage regulator using four screws. Mount with adjustment pots toward the start/stop panel.

    If the voltage regulator is replaced or has been tampered with, use readjustment procedure found in Section 7—Component Testing and Adjustment, Voltage Regulator Adjustment.

18. Connect leads FN, FP, B1, and B2 together at push-on terminals. Install 6-pin voltage regulator connector and 4-pin connector.

19. Install two screws at top of controller box.

Section 9. Wiring Diagrams

⚠ WARNING

Hazardous voltage.

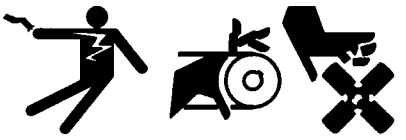
Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Whenever electricity is present, there is the hazard of electrocution. Open main circuit breaker on all power sources before servicing equipment. Electrically ground the generator set and electrical circuits when in use. Never come into contact with electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution is increased under such conditions.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Disconnect battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by the remote start/stop switch unless this precaution is followed.

The following information is provided to illustrate the proper connection of generator sets. In all cases, follow the National Electrical Code (NEC).

The reconnection procedure may require voltage/frequency reconnection. If frequency changes are required, the governor and voltage regulator will need to be adjusted. See Section 7—Component Testing and Adjustment for governor and voltage regulator adjustments.

NOTE

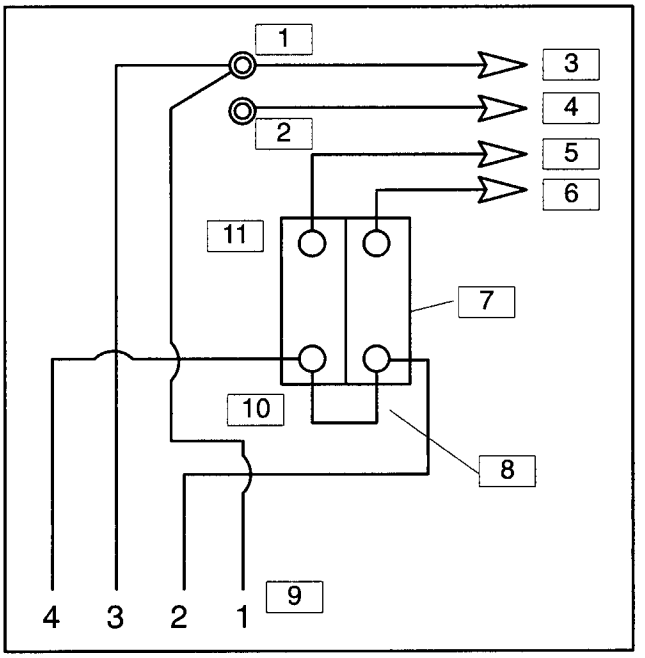
When connecting a generator set to a voltage different than nameplate voltage, place a notice on the unit indicating this change. A decal (part no. 246242) is available to indicate reconnected voltage from authorized Kohler dealers/distributors.

Four-Lead Reconnectable (Single-Phase) Generator Sets Where Generator Output Can Be Reconnected For 120 Volt or 120/240 Volt, 60 Hz; or 110 Volt or 110/220 Volt, 50 Hz

The following information is provided to illustrate the proper reconnection of 4-lead generator sets. In all cases, follow the National Electrical Code (NEC).

120-Volt (or 110-Volt) Configurations—Figure 9-1 and Figure 9-2 (Views A and B)

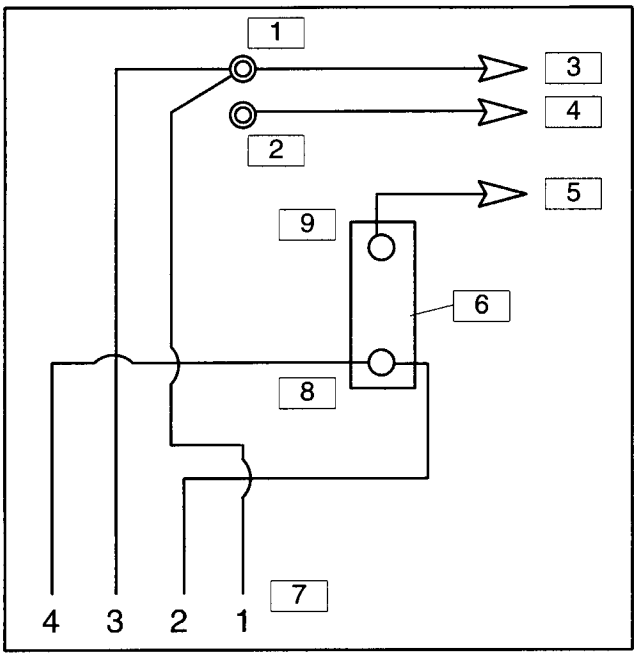
Do not connect together the load-side terminals of the circuit breaker when a factory two-pole circuit breaker is used. See Figure 9-1. If the installation requires a 120-volt, 2-wire system, use a single-pole circuit breaker. See Figure 9-2. Size the output lead (L1) accordingly when connecting stator phase leads together. Use a jumper lead on the *line* side of the circuit breaker. This allows for balancing of the load of the generator set.



	60 Hz	50 Hz
L0-L1	120 Volt	110 Volt
L0-L2	120 Volt	110 Volt

1. L0 (Neutral)
2. Ground
3. L0
4. Ground
5. L1
6. L2
7. Factory Two-Pole or (2) 1-Pole Circuit Breakers
8. Jumper Lead
9. Stator Leads
10. Line Side
11. Load Side

Figure 9-1. View A—120 Volt, 3 Wire



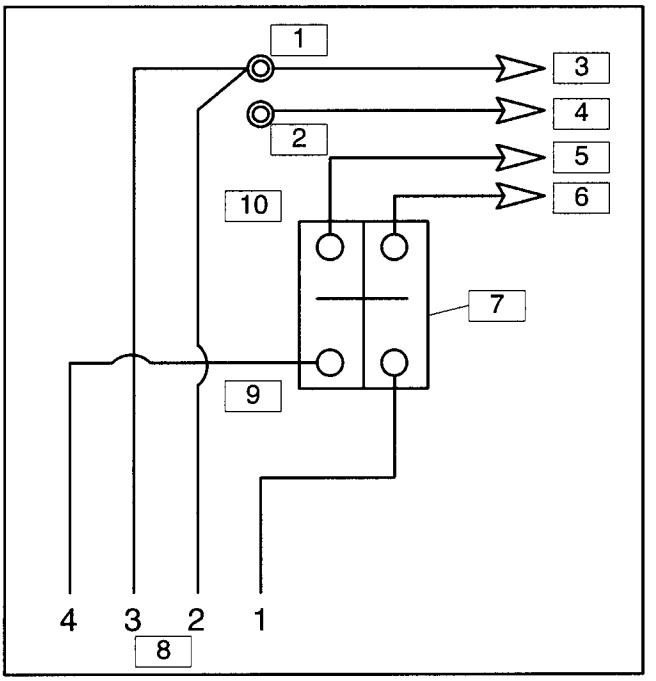
	60 Hz	50 Hz
L0-L1	120 Volt	110 Volt
L0-L2	120 Volt	110 Volt

1. L0 (Neutral)
2. Ground
3. L0
4. Ground
5. L1
6. 1-Pole Circuit Breaker
7. Stator Leads
8. Line Side
9. Load Side

Figure 9-2. View B—120 Volt, 2 Wire

120/240-Volt (or 110/220-Volt) Configurations—Figure 9-3 (View C)

Jumper lead not used. If unit was wired originally for straight 120 volt (or 110 volt), 3 wire, remove jumper lead. See Figure 9-1 for location. Circuit breaker MUST be a circuit breaker manufacturer two-pole circuit breaker. Two single-pole circuit breakers do not conform to the National Electric Code (NEC) requirements when supplying a 240-volt (or 220-volt) load. This is true even if they are attached mechanically together. Leads L1 and L2 are different phases and must never be connected together.



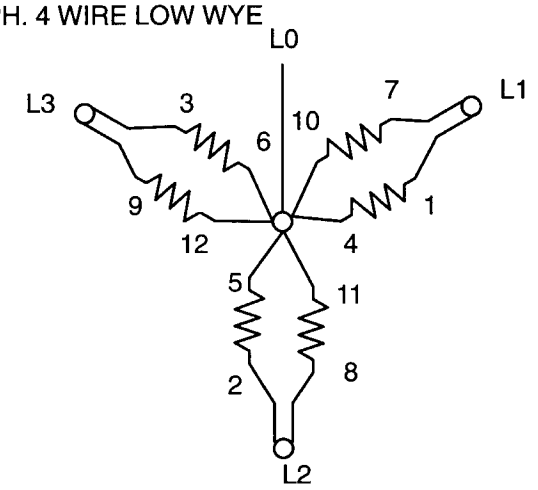
	60 Hz	50 Hz
L0-L1	120 Volt	110 Volt
L0-L2	120 Volt	110 Volt
L1-L2	240 Volt	220 Volt

1. L0 (Neutral)
2. Ground
3. L0
4. Ground
5. L2
6. L1
7. Factory Two-Pole Circuit Breaker
8. Stator Leads
9. Line Side
10. Load Side

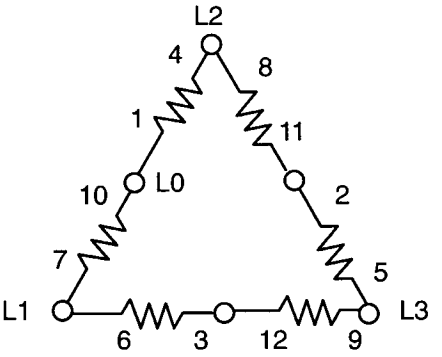
Figure 9-3. View C—120/240 Volt, 3 Wire

Twelve-Lead Reconnectable (Three-Phase) Generator Sets

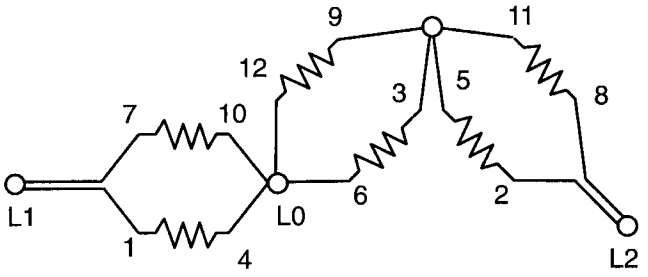
12-LEAD STATOR
60 Hz–120/208 volt or 139/240 volt
3 PH. 4 WIRE LOW WYE
50 Hz–120/208 volt or 110/190 volt
3 PH. 4 WIRE LOW WYE



12-LEAD STATOR
60 Hz–120/240 volt, 3 PH. 4 WIRE DELTA
50 Hz–110/220 volt, 3 PH. 4 WIRE DELTA



60 Hz–120/240 volt, 1 PH. 3 WIRE
50 Hz–110/220 volt, 1 PH. 3 WIRE



12-LEAD STATOR
60 Hz–277/480 volt, 3 PH. 4 WIRE HIGH WYE
50 Hz–220/380 volt, 3 PH. 4 WIRE HIGH WYE

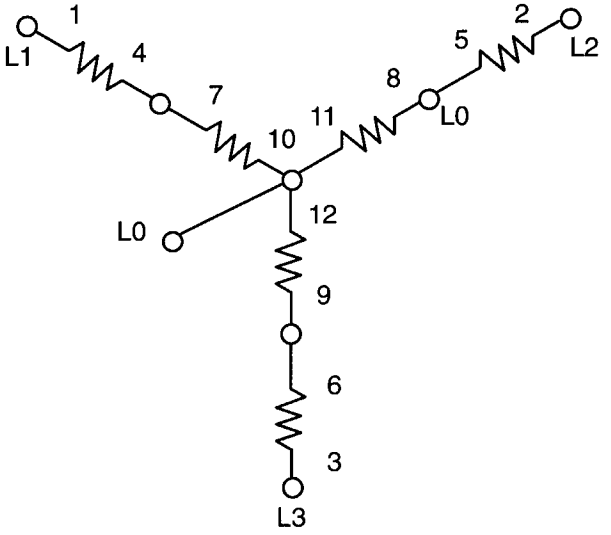


Figure 9-4. Three-Phase Voltage Reconnections

Generator Set Wiring Diagrams

The models represented in this manual include 15 wiring diagrams. To find the wiring diagram that applies to a particular generator set, record the specification number from the nameplate on the generator set. Refer to the listings in Figure 9-5 and use the specification number to obtain the correct figure numbers for the schematic- and point-to-point wiring diagram.

The information supplied below and on the following page is for factory-shipped units and may differ for field-converted units. A wiring harness diagram is available. See Figure 9-36.

Specification Number	Wiring Diagram Number	Schematic Wiring Diagram Figure Number	Point-to-Point Wiring Diagram Figure Number
PA-101203	278677	9-6	9-7
PA-101205	278677	9-6	9-7
PA-101207	278677	9-6	9-7
PA-101209 (gasoline)	278960	9-8	9-9
PA-101209 (LP)	278435	9-10	9-11
PA-101210 (gasoline)	278960	9-8	9-9
PA-101210 (LP)	278435	9-10	9-11
PA-101211 (gasoline)	278960	9-8	9-9
PA-101211 (LP)	278435	9-10	9-11
PA-101212 (gasoline)	278960	9-8	9-9
PA-101212 (LP)	278435	9-10	9-11
PA-101213 (gasoline)	278960	9-8	9-9
PA-101213 (LP)	278435	9-10	9-11
PA-101214 (gasoline)	278960	9-8	9-9
PA-101214 (LP)	278435	9-10	9-11
PA-101215	227453	9-12	9-13
PA-101216	227453	9-12	9-13
PA-101217	227757 *	9-14	9-15
PA-101218	227757 *	9-14	9-15
PA-101219	227759 *	9-16	9-17
PA-101220	227757 *	9-14	9-15
PA-101221	227759 *	9-16	9-17
PA-101222	227740	9-18	9-19
PA-101223	227740	9-18	9-19
PA-101224	227740	9-18	9-19
PA-101225	227740	9-18	9-19
PA-101226	227740	9-18	9-19
PA-101227	227740	9-18	9-19
PA-101228	227843	9-20	9-21
PA-101229	227740	9-18	9-19
PA-101230	227740	9-18	9-19
PA-101231	227843	9-20	9-21
PA-101232	227843	9-20	9-21
PA-101233	227740	9-18	9-19
PA-101234	227740	9-18	9-19
PA-101235	227740	9-18	9-19
PA-101236	227740	9-18	9-19
PA-101237	227845	9-22	9-23
PA-101238	227845	9-22	9-23
PA-101302	278825	9-24	9-25
PA-101304	278701	9-26	9-27
PA-101305	278701	9-26	9-27

* Indicates new deicing module wiring diagrams.

Figure 9-5. Wiring Diagram Index (Sheet 1 of 2)

Specification Number	Wiring Diagram Number	Schematic Wiring Diagram Figure Number	Point-to-Point Wiring Diagram Figure Number
PA-101308	278701	9-26	9-27
PA-101310	278825	9-24	9-25
PA-101312	278435	9-10	9-11
PA-101313 (gasoline)	278960	9-8	9-9
PA-101313 (LP)	278435	9-10	9-11
PA-101314 (gasoline)	278960	9-8	9-9
PA-101314 (LP)	278435	9-10	9-11
PA-101315 (gasoline)	278960	9-8	9-9
PA-101315 (LP)	278435	9-10	9-11
PA-101316 (gasoline)	278960	9-8	9-9
PA-101316 (LP)	278435	9-10	9-11
PA-101317	278435	9-10	9-11
PA-101318	227453	9-12	9-13
PA-101319	227453	9-12	9-13
PA-101320	278825	9-24	9-25
PA-101321	278825	9-24	9-25
PA-101322	227758 *	9-28	9-29
PA-101323	227758 *	9-28	9-29
PA-101324	227759 *	9-16	9-17
PA-101325	227758 *	9-28	9-29
PA-101326	227759 *	9-16	9-17
PA-101327	227760 *	9-30	9-31
PA-101328	227760 *	9-30	9-31
PA-101329	227760 *	9-30	9-31
PA-101330	227760 *	9-30	9-31
PA-101331	227740	9-18	9-19
PA-101332	227740	9-18	9-19
PA-101333	227740	9-18	9-19
PA-101334	227740	9-18	9-19
PA-101335	227740	9-18	9-19
PA-101336	227740	9-18	9-19
PA-101337	227846	9-32	9-33
PA-101338	227844	9-34	9-35
PA-101339	227740	9-18	9-19
PA-101340	227740	9-18	9-19
PA-101341	227844	9-34	9-35
PA-101342	227844	9-34	9-35
PA-101343	227846	9-32	9-33
PA-101344	227740	9-18	9-19
PA-101345	227740	9-18	9-19
PA-101346	227740	9-18	9-19
PA-101347	227740	9-18	9-19
PA-101348	227845	9-22	9-23
PA-101349	227845	9-22	9-23
PA-101350	227846	9-32	9-33
PA-101351	227846	9-32	9-33
PA-101352	227740	9-18	9-19
PA-101353	227740	9-18	9-19

* Indicates new deicing module wiring diagrams.

Figure 9-5. Wiring Diagram Index (Sheet 2 of 2)

NOTES

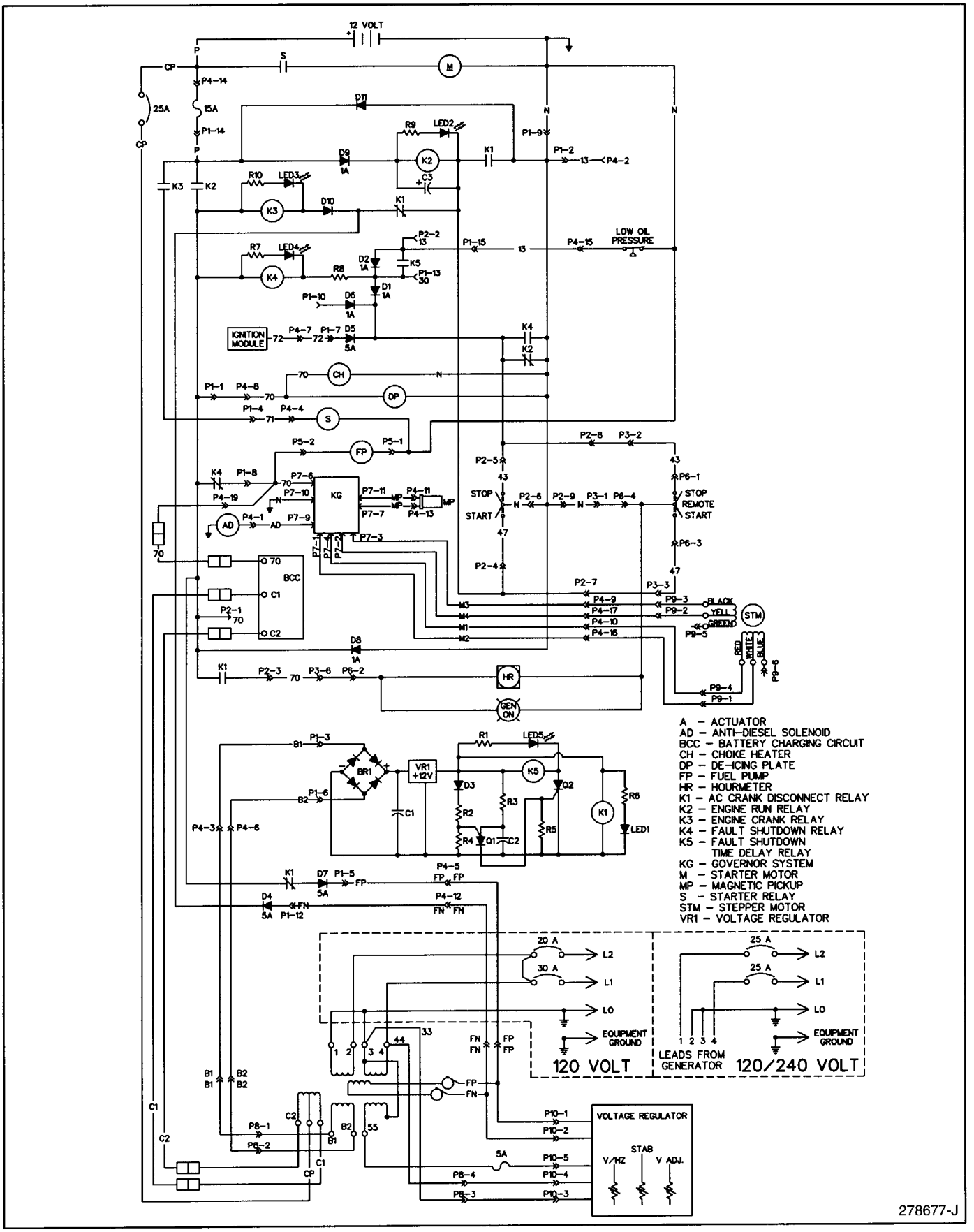


Figure 9-6. Schematic Portion of Wiring Diagram 278677

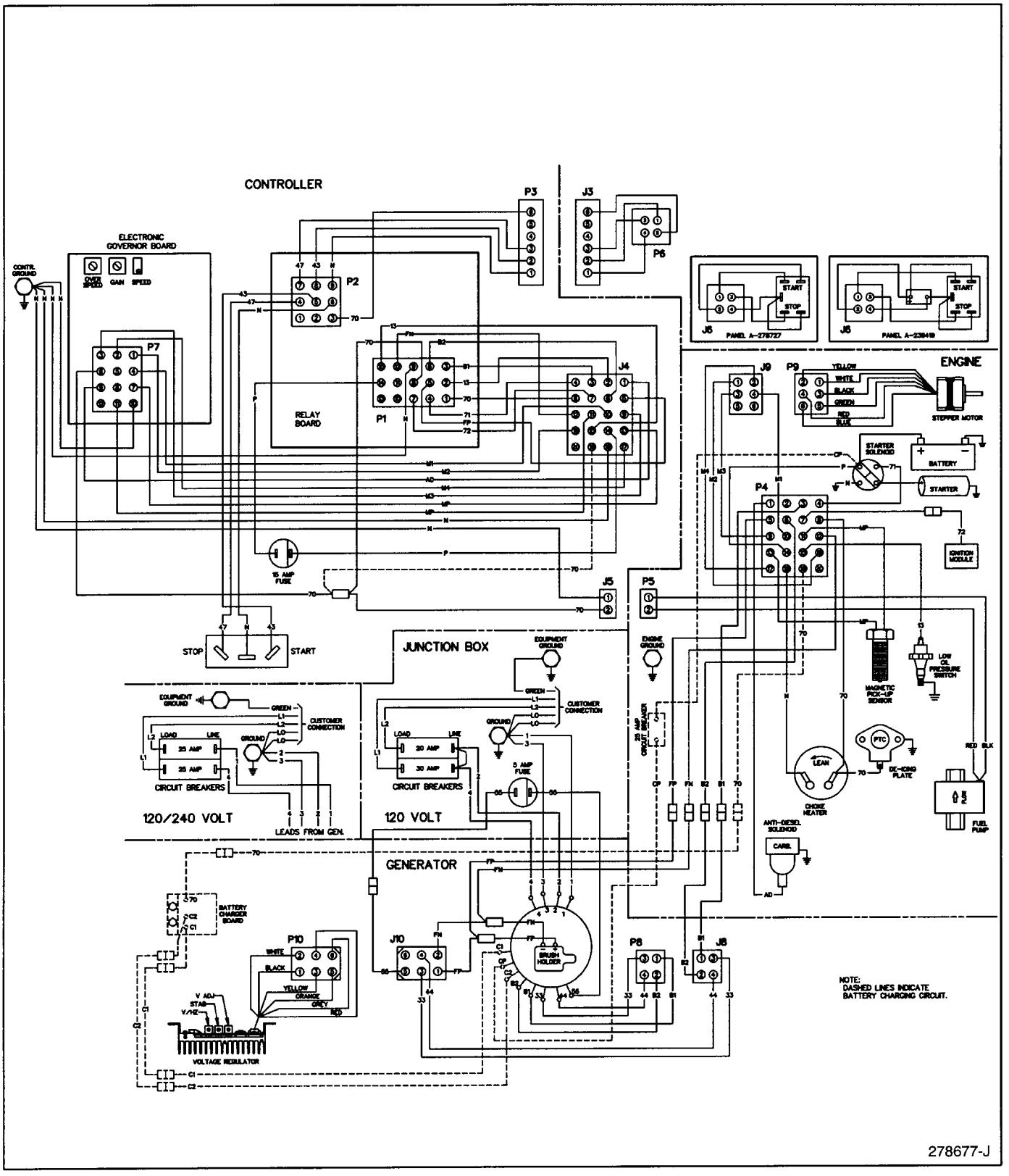


Figure 9-7. Point-to-Point Portion of Wiring Diagram 278677

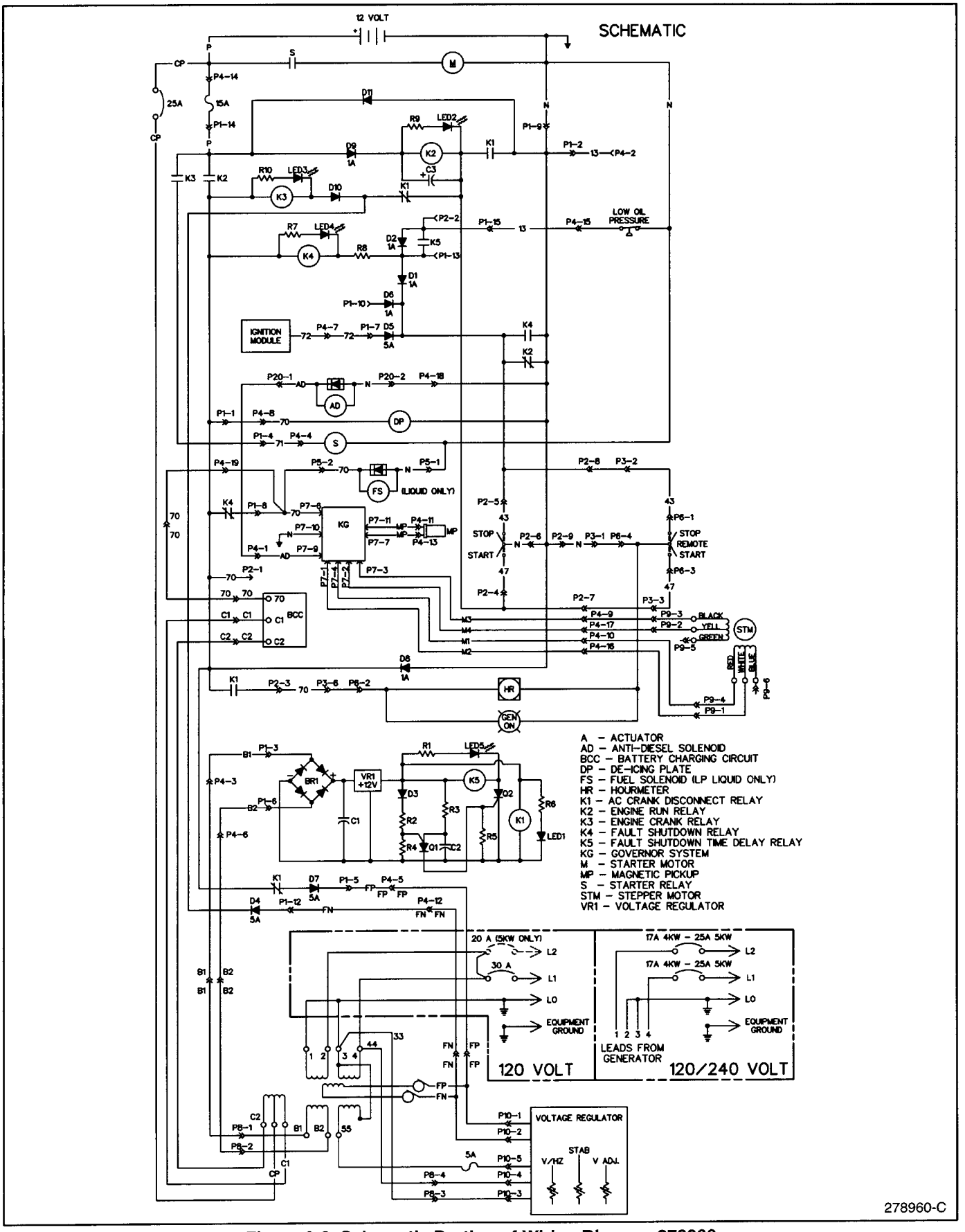


Figure 9-8. Schematic Portion of Wiring Diagram 278960

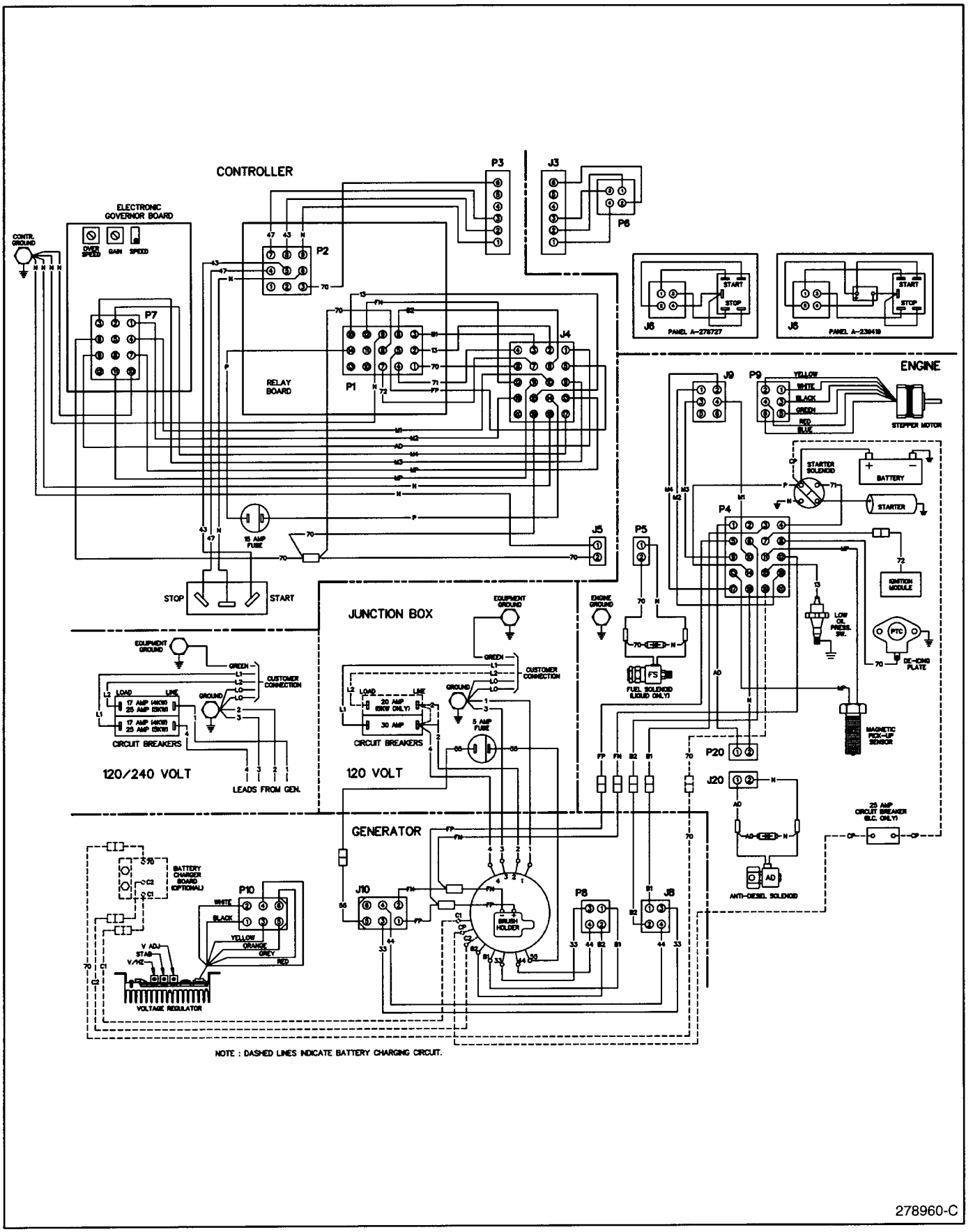


Figure 9-9. Point-to-Point Portion of Wiring Diagram 278960

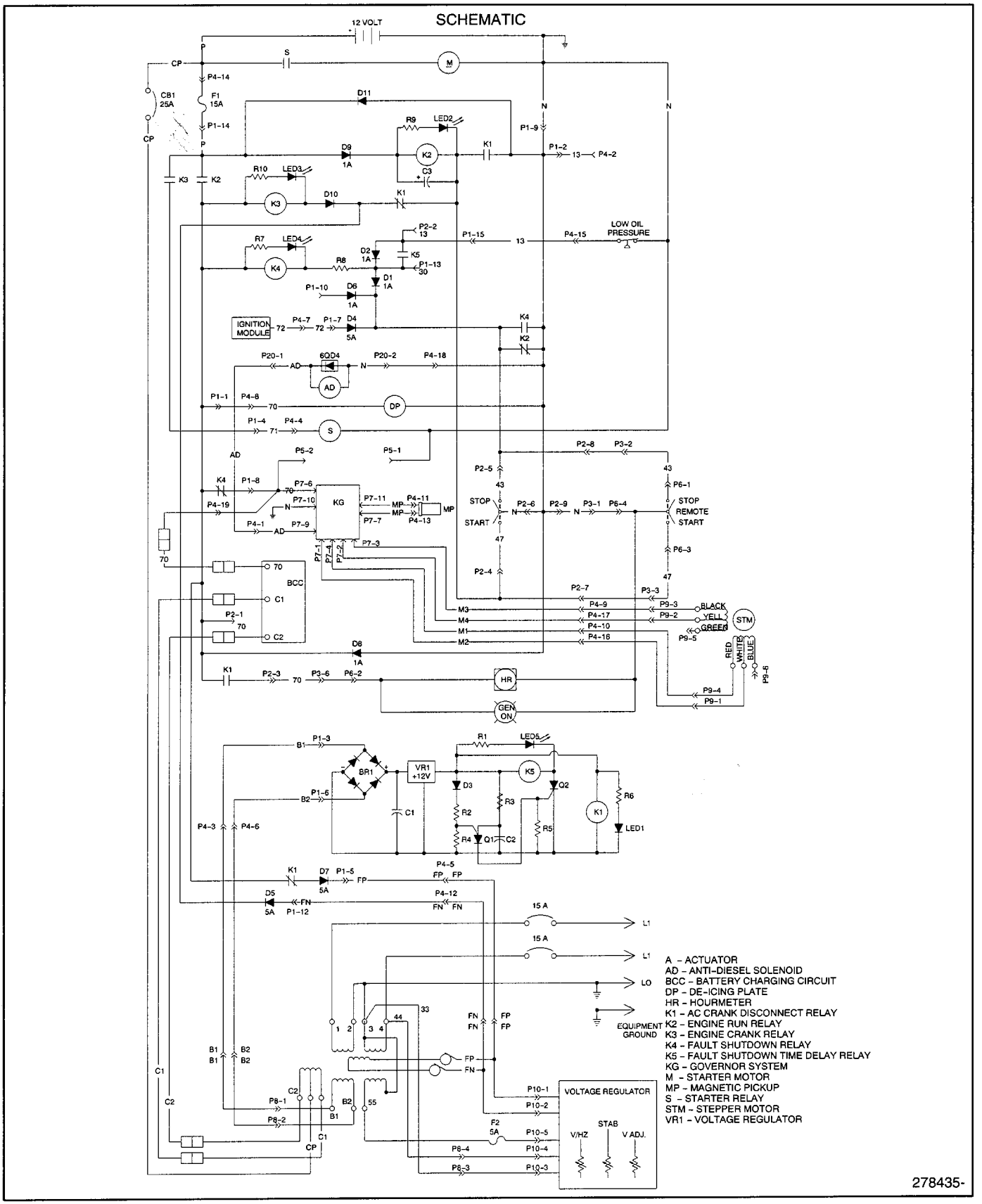


Figure 9-10. Schematic Portion of Wiring Diagram 278435

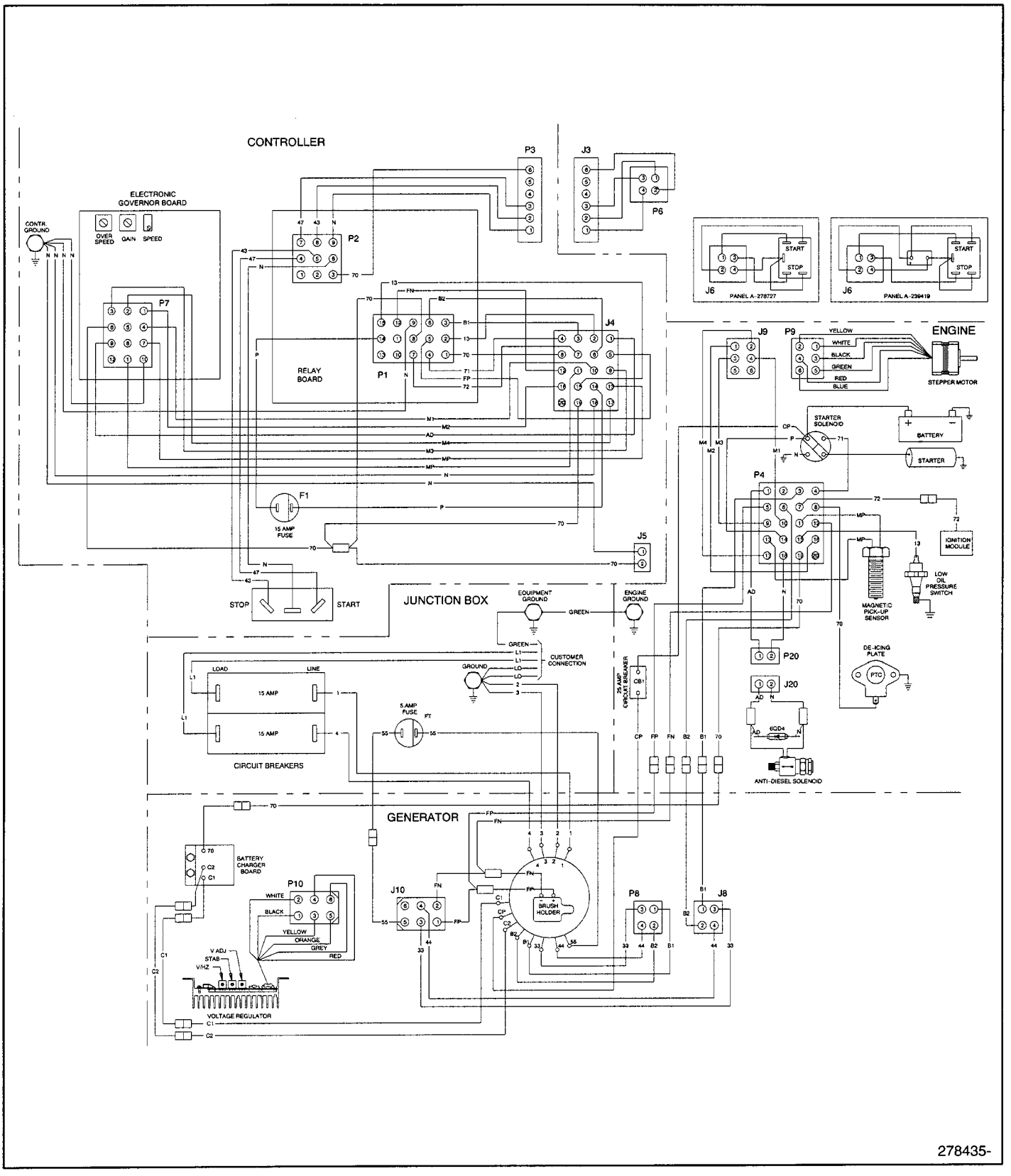


Figure 9-11. Point-to-Point Portion of Wiring Diagram 278435

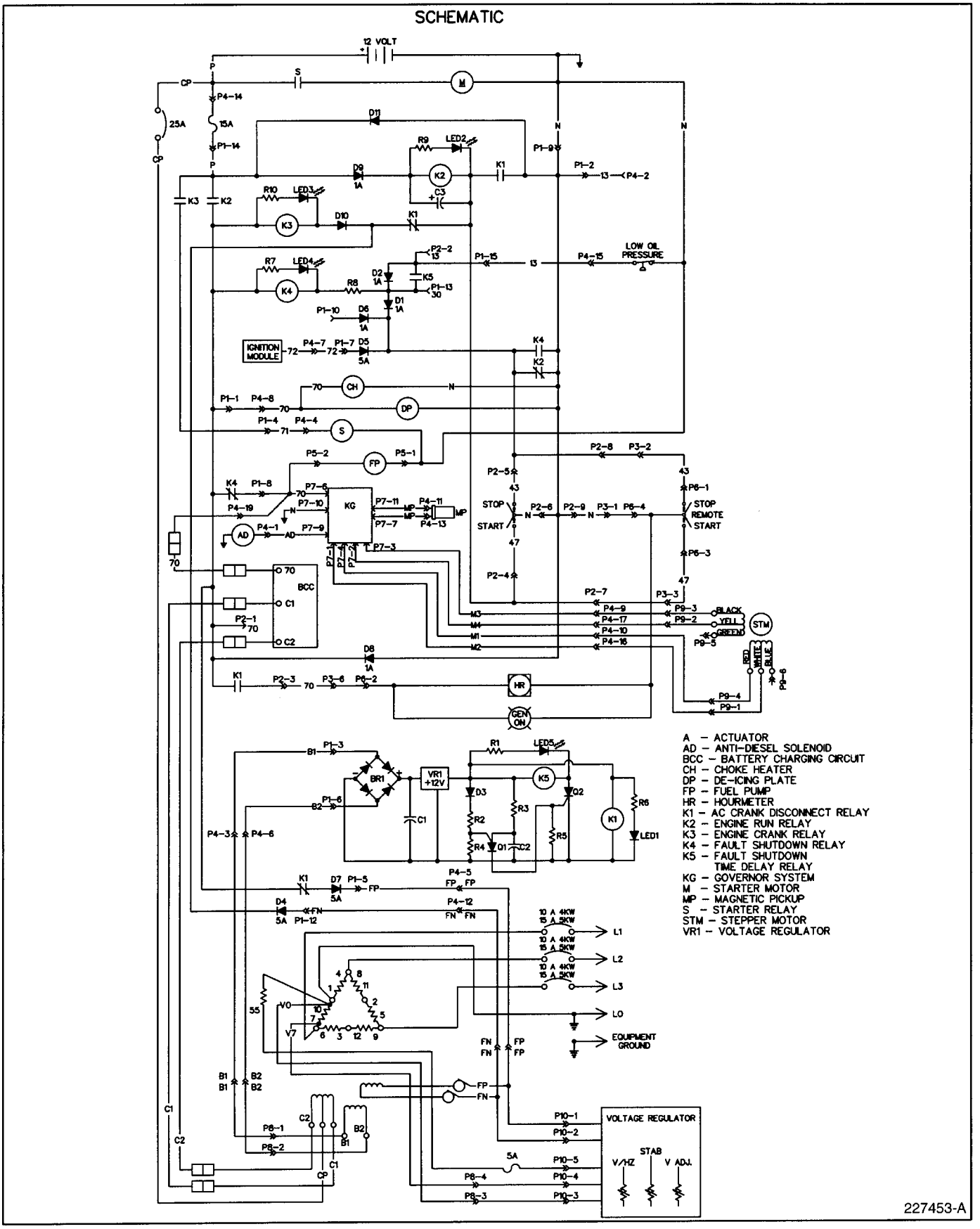


Figure 9-12. Schematic Portion of Wiring Diagram 227453

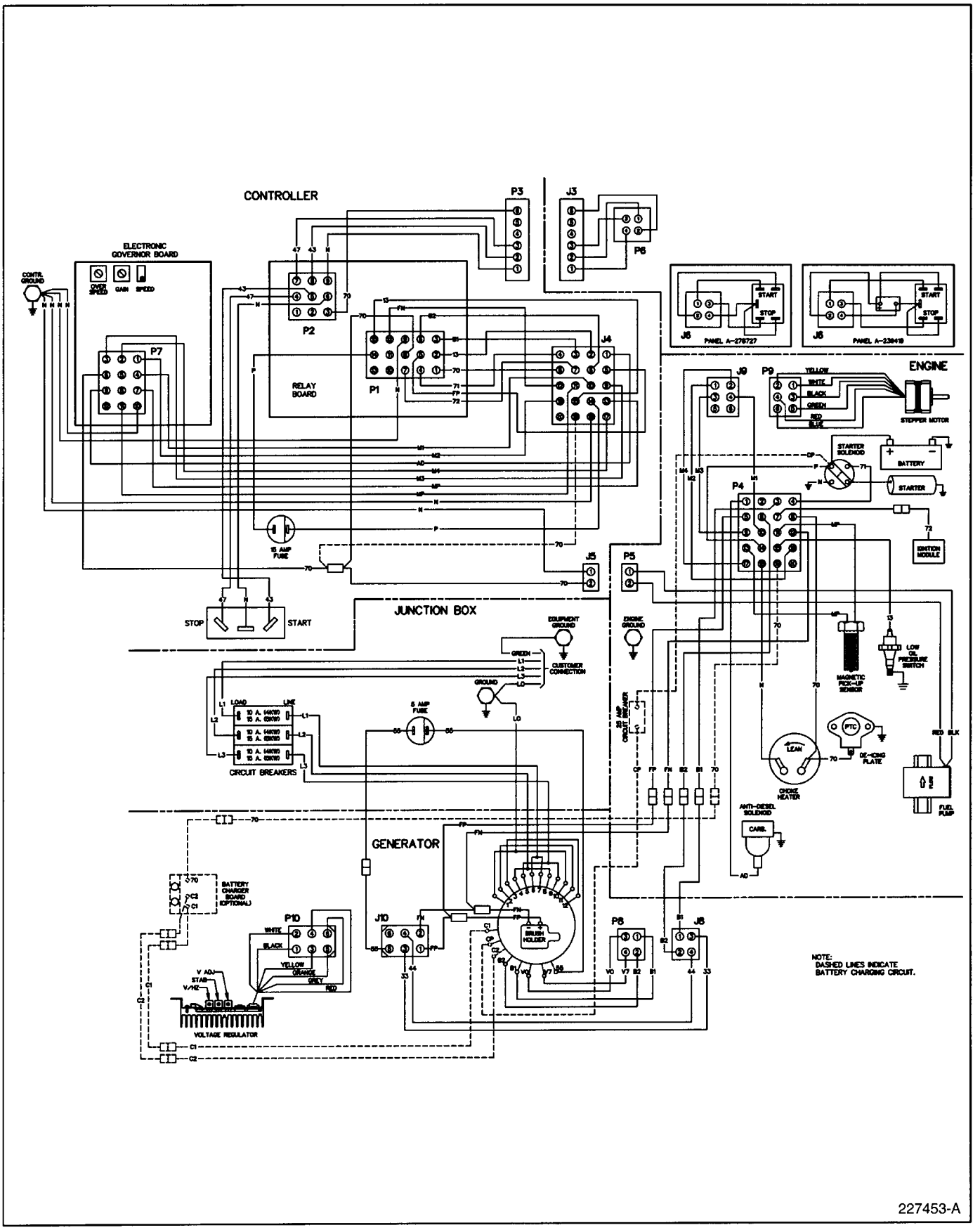


Figure 9-13. Point-to-Point Portion of Wiring Diagram 227453

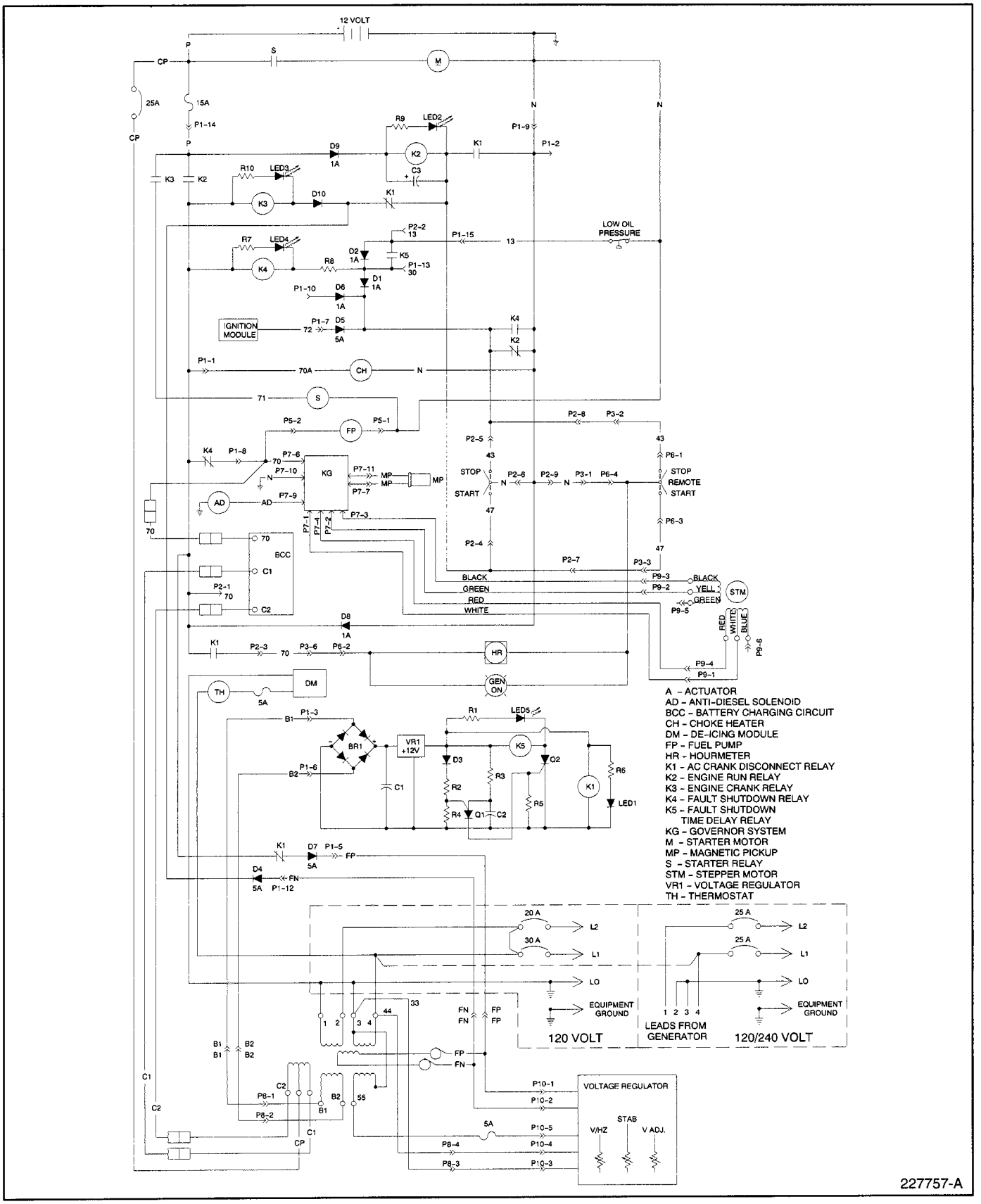


Figure 9-14. Schematic Portion of Wiring Diagram 227757

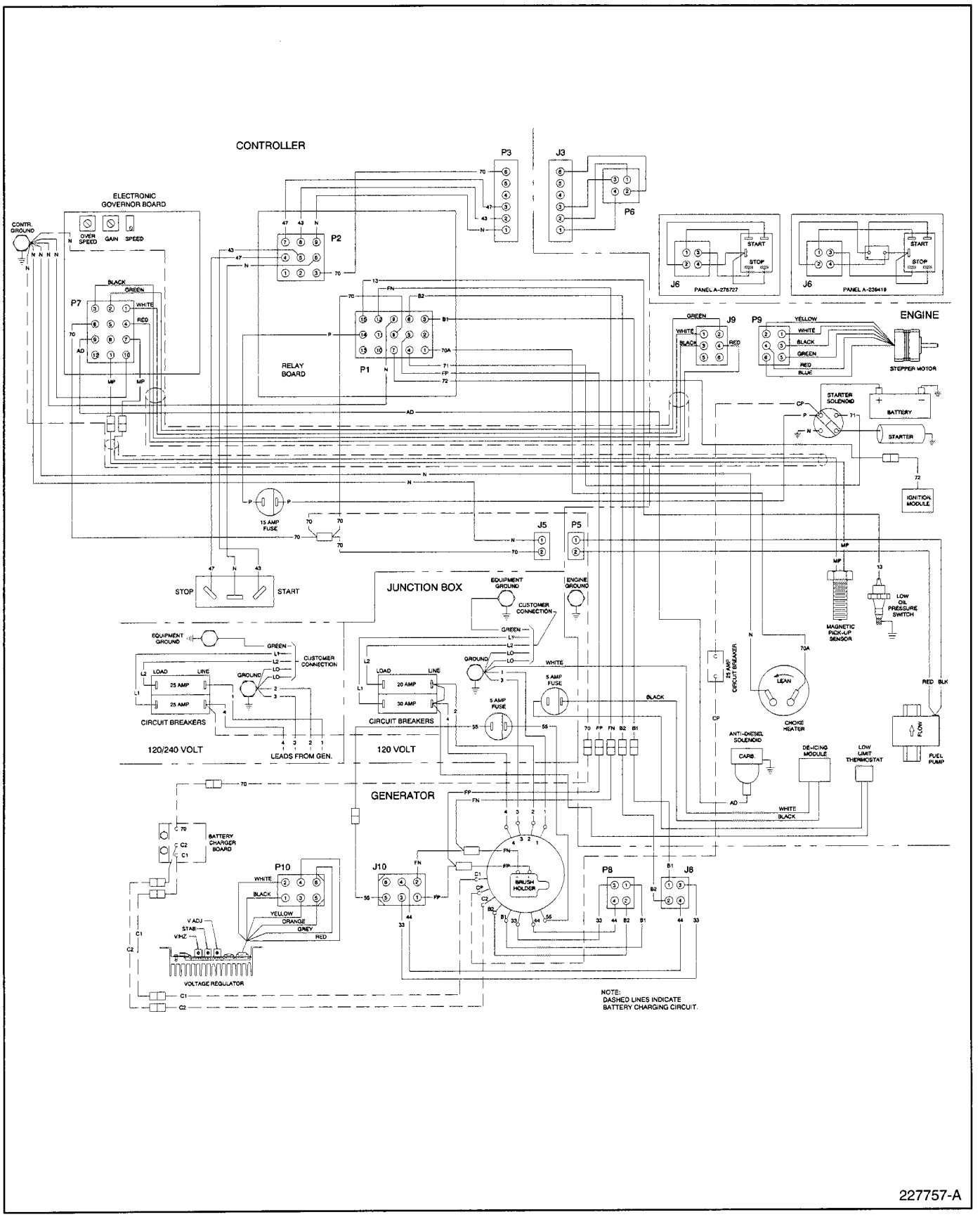


Figure 9-15. Point-to-Point Portion of Wiring Diagram 227757

SCHEMATIC

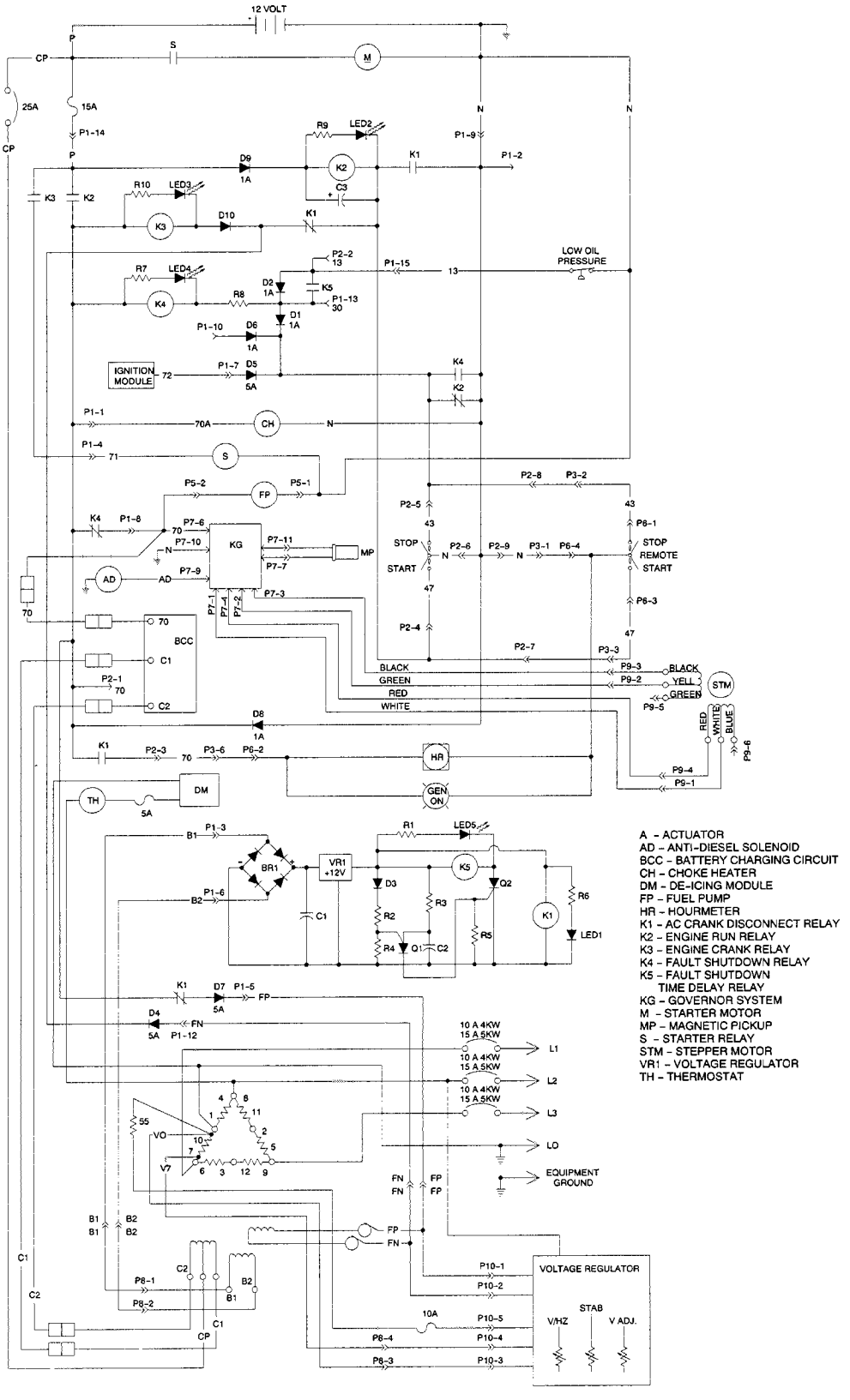


Figure 9-16. Schematic Portion of Wiring Diagram 227759

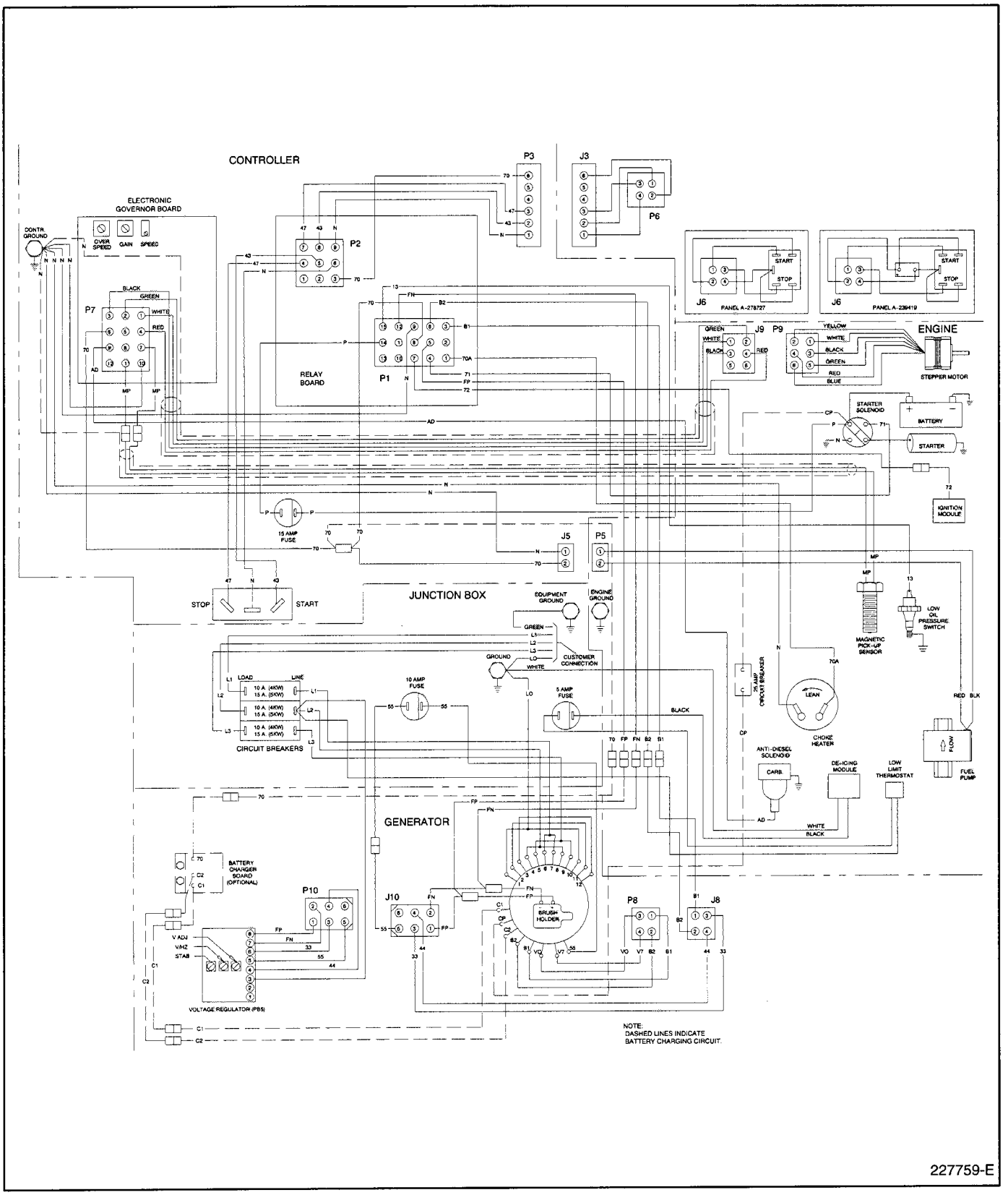


Figure 9-17. Point-to-Point Portion of Wiring Diagram 227759

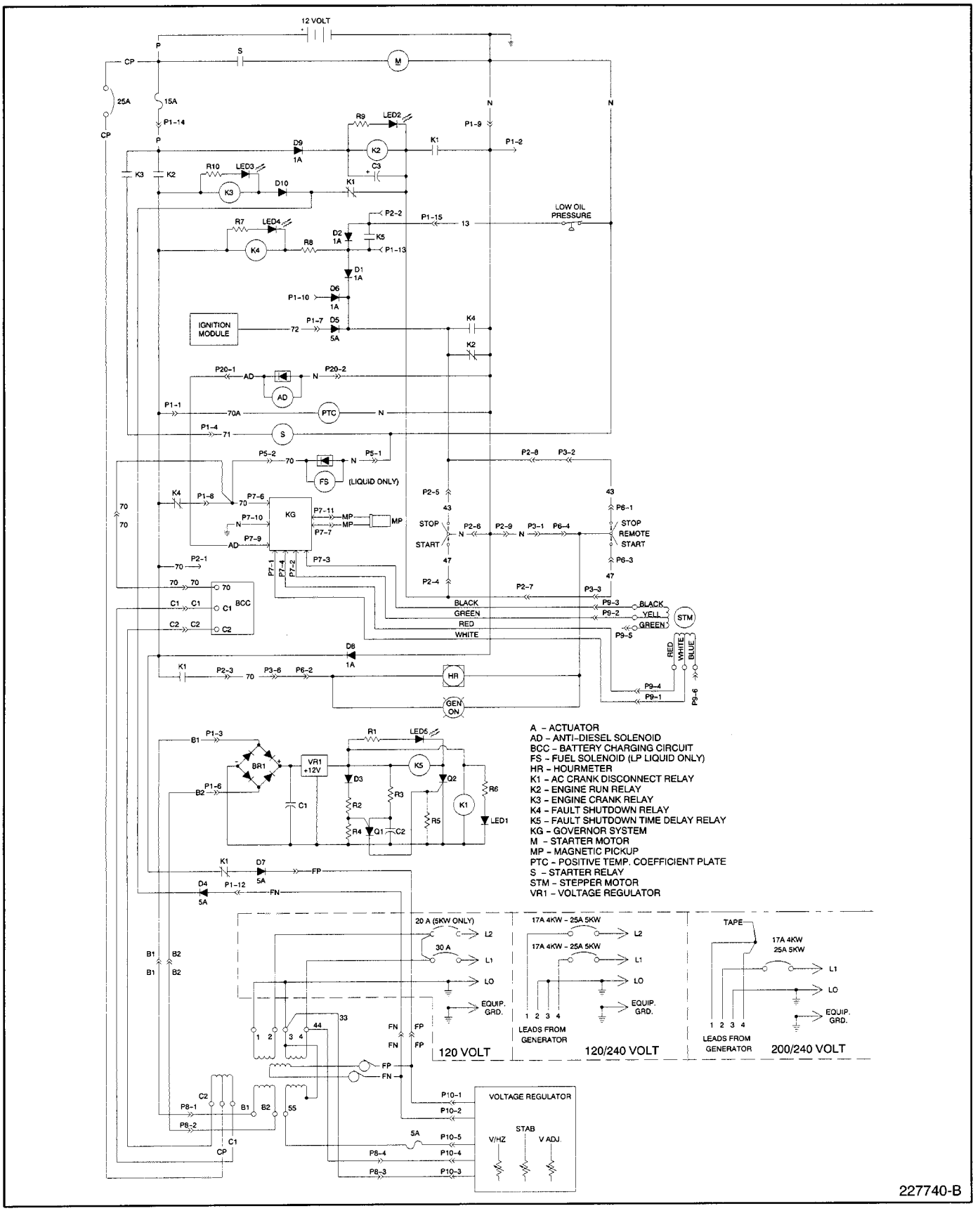


Figure 9-18. Schematic Portion of Wiring Diagram 227740

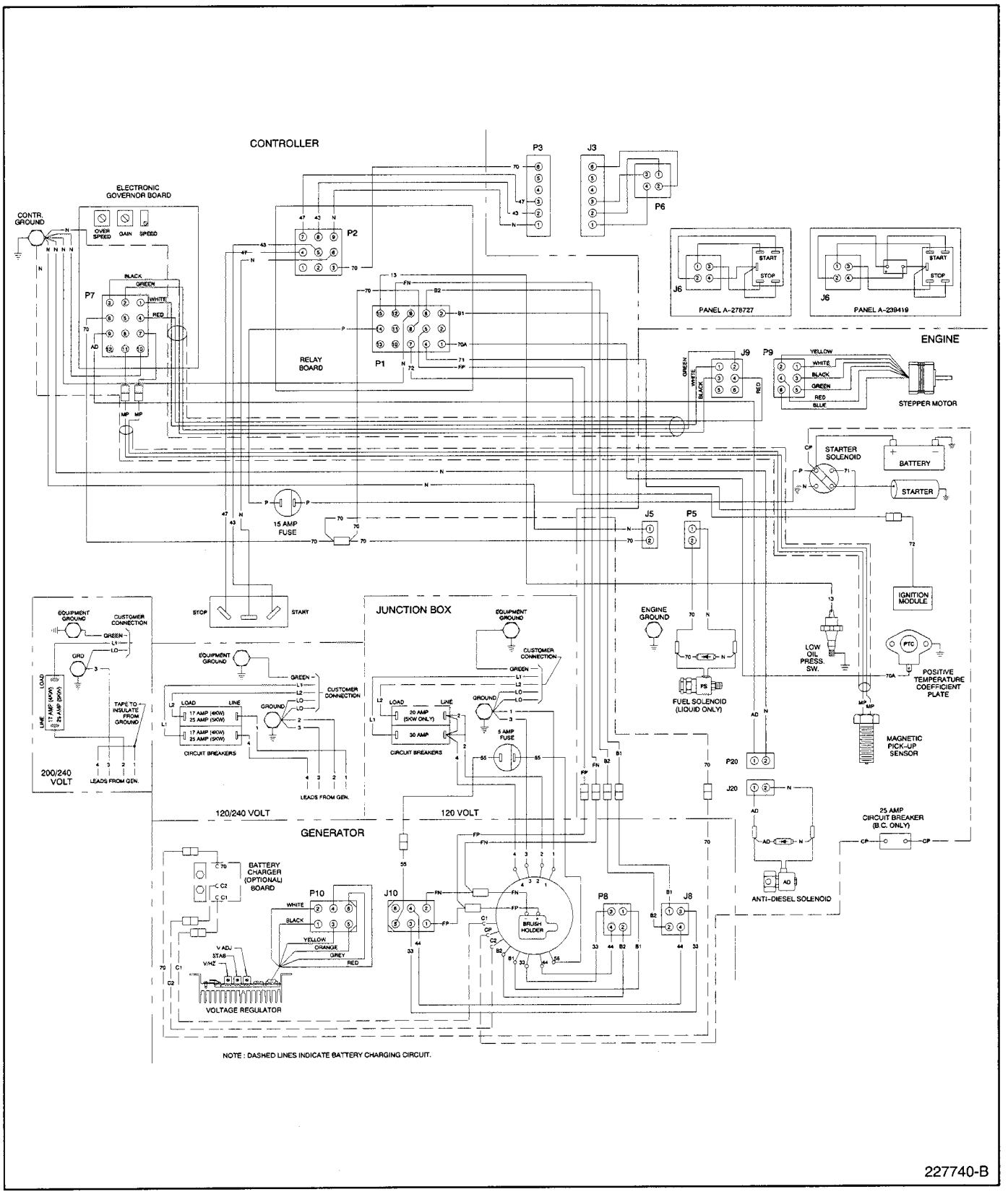


Figure 9-19. Point-to-Point Portion of Wiring Diagram 227740

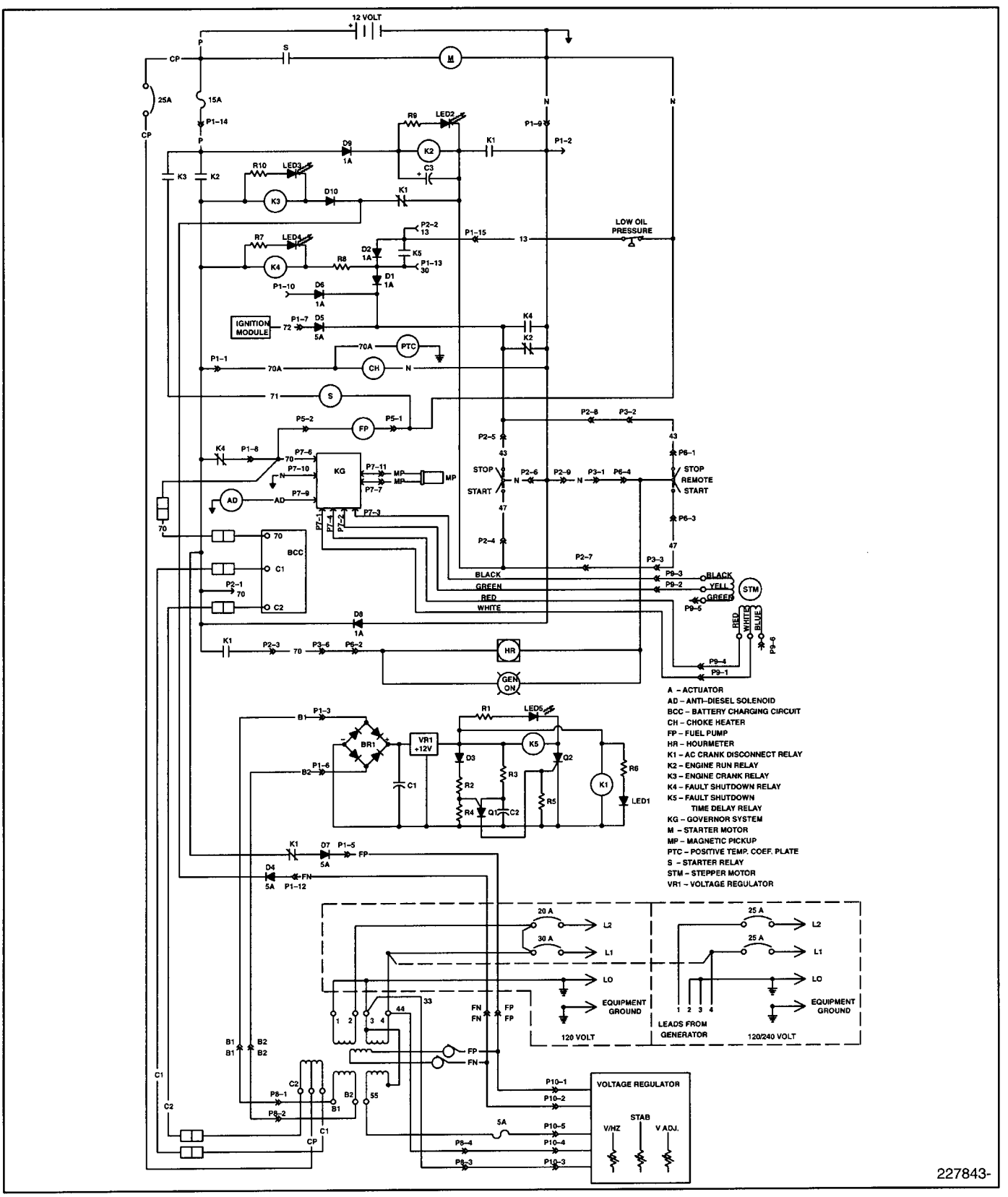


Figure 9-20. Schematic Portion of Wiring Diagram 227843

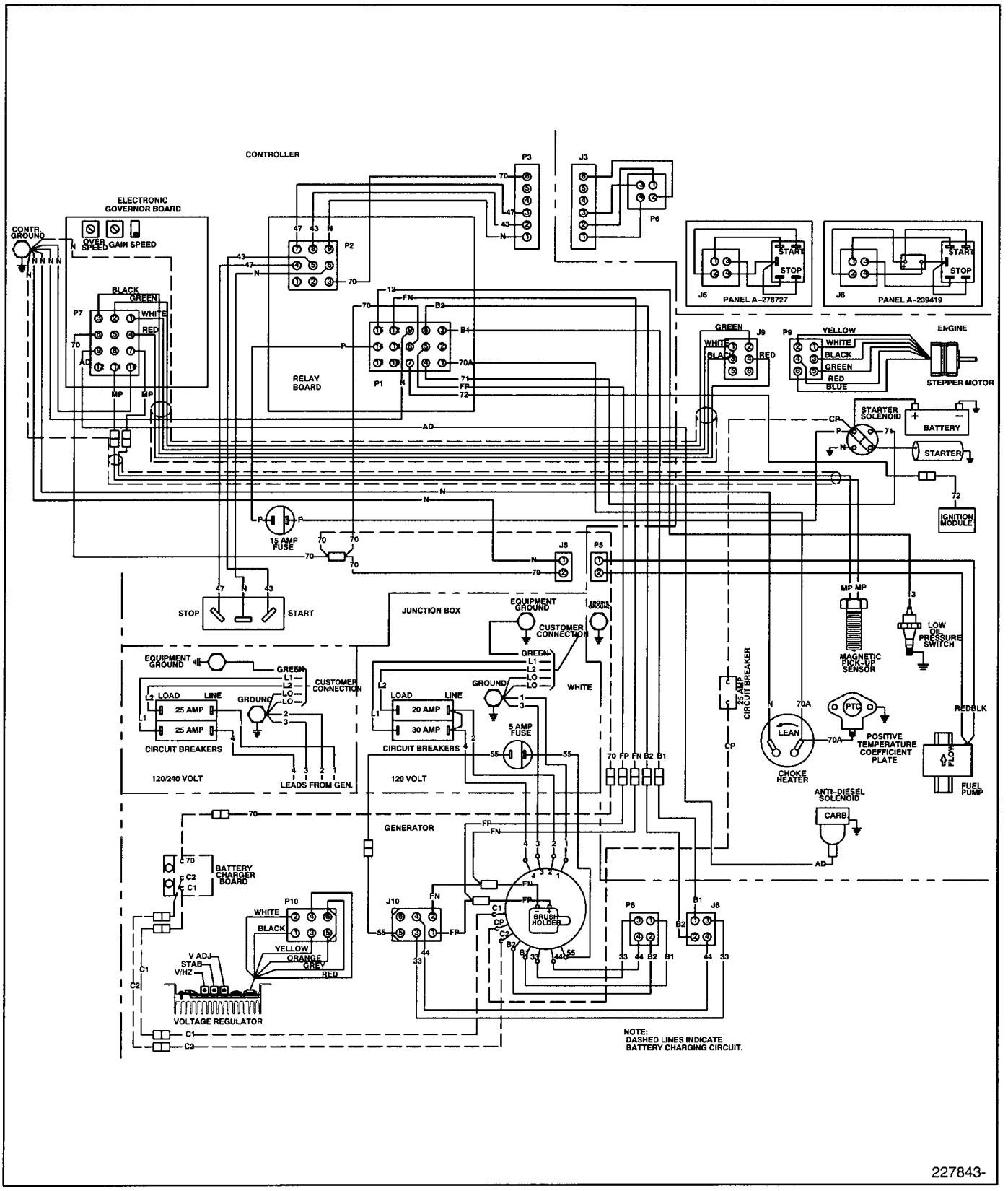


Figure 9-21. Point-to-Point Portion of Wiring Diagram 227843

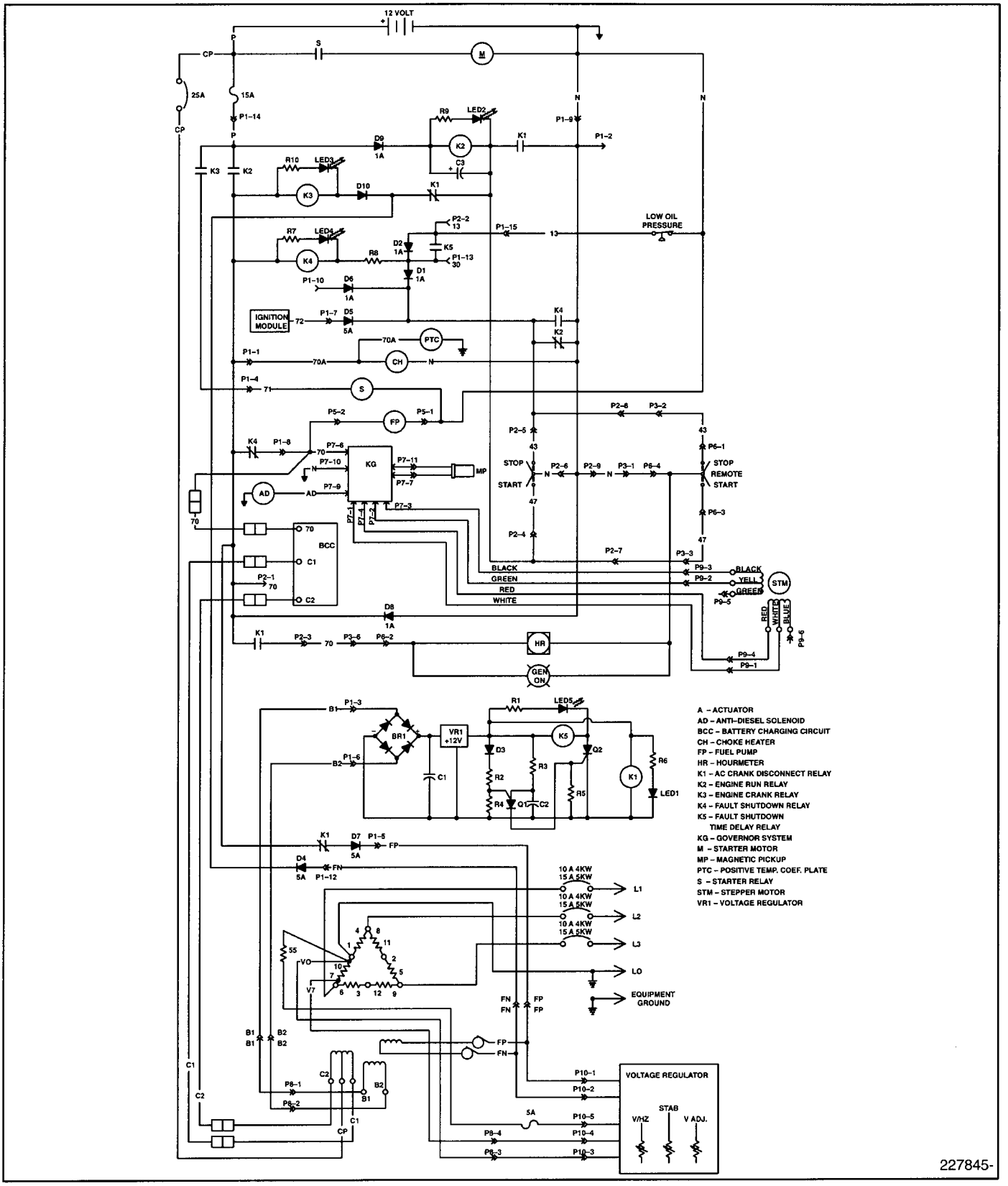


Figure 9-22. Schematic Portion of Wiring Diagram 227845

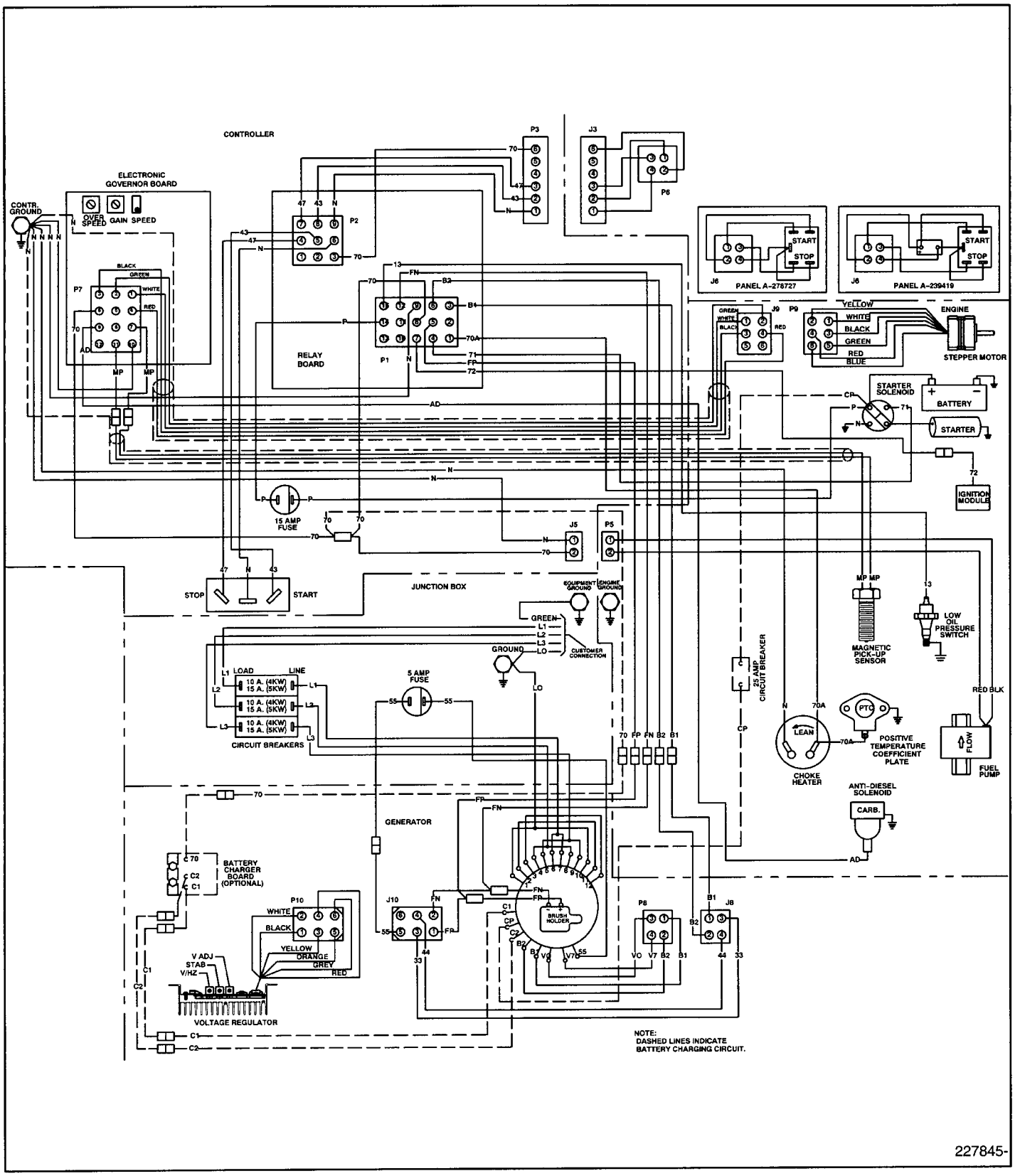


Figure 9-23. Point-to-Point Portion of Wiring Diagram 227845

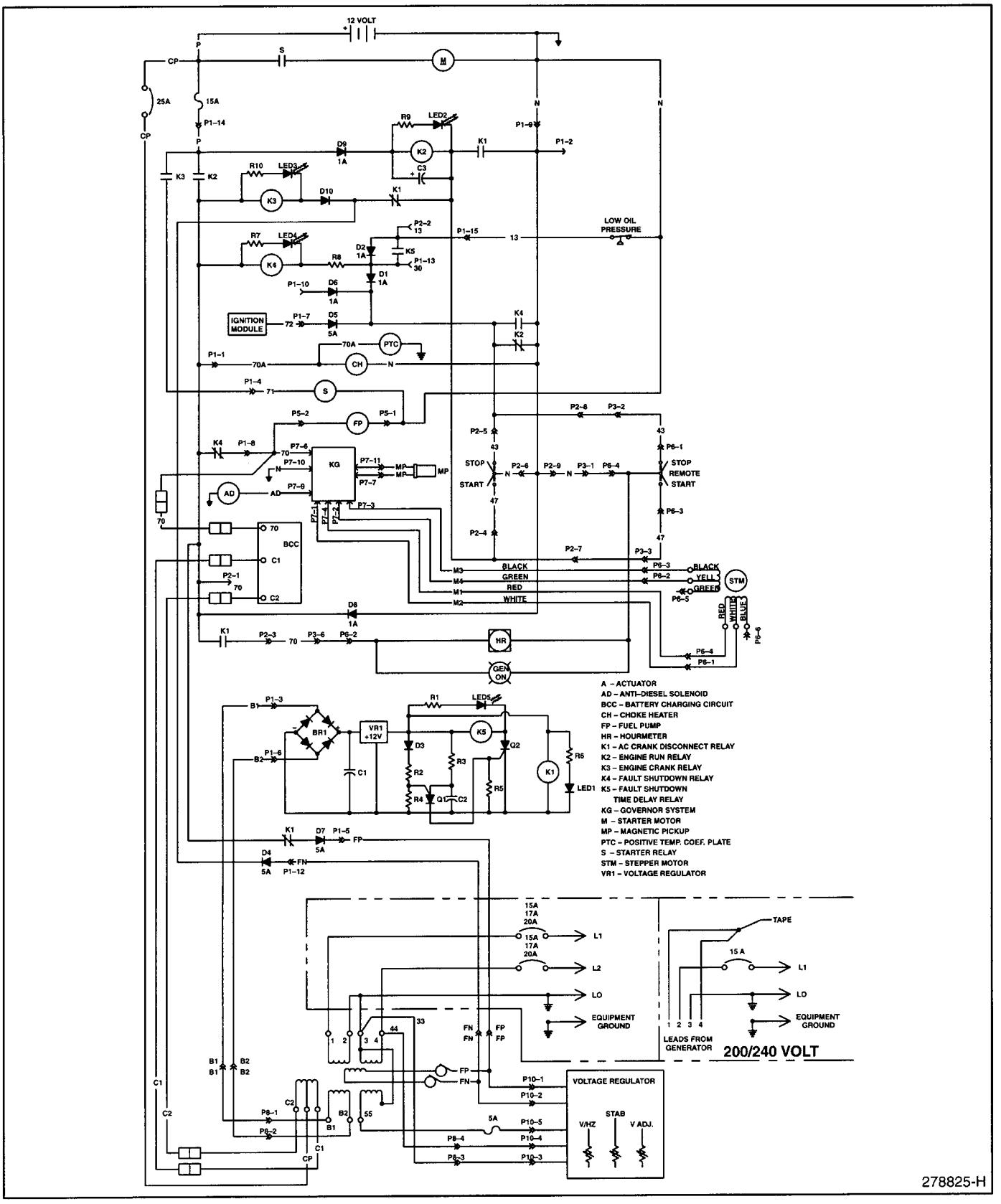


Figure 9-24. Schematic Portion of Wiring Diagram 278825

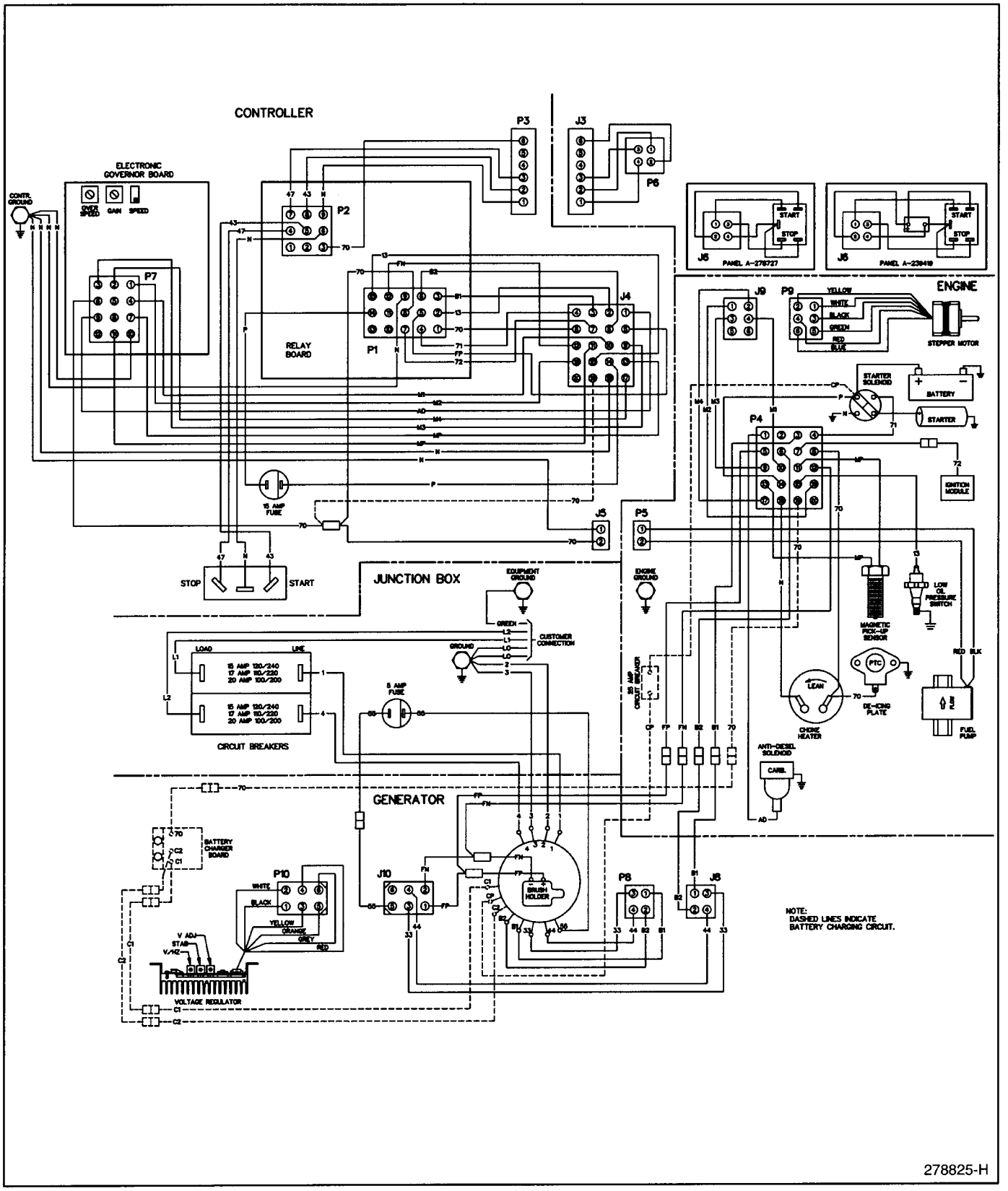


Figure 9-25. Point-to-Point Portion of Wiring Diagram 278825

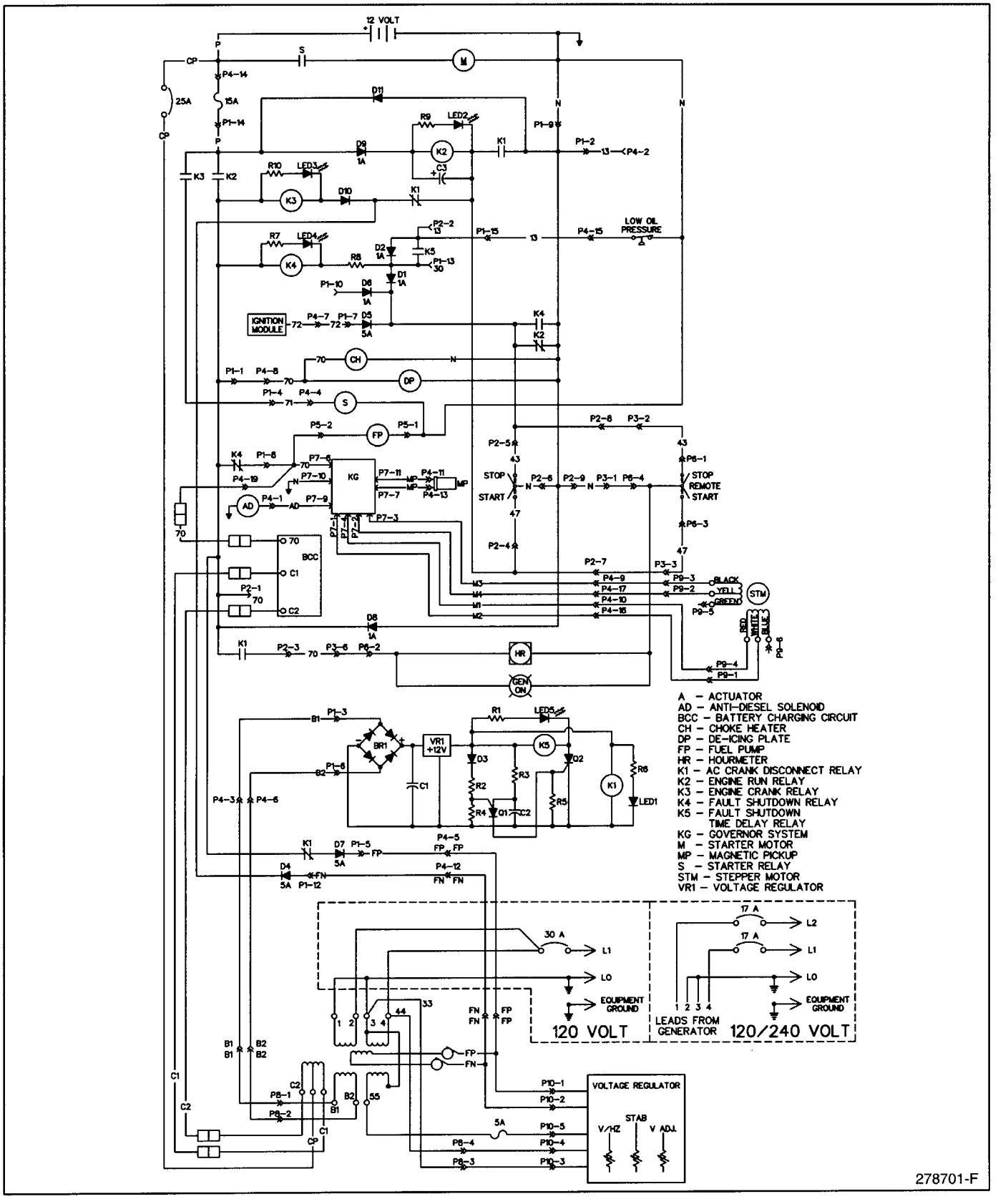


Figure 9-26. Schematic Portion of Wiring Diagram 278701

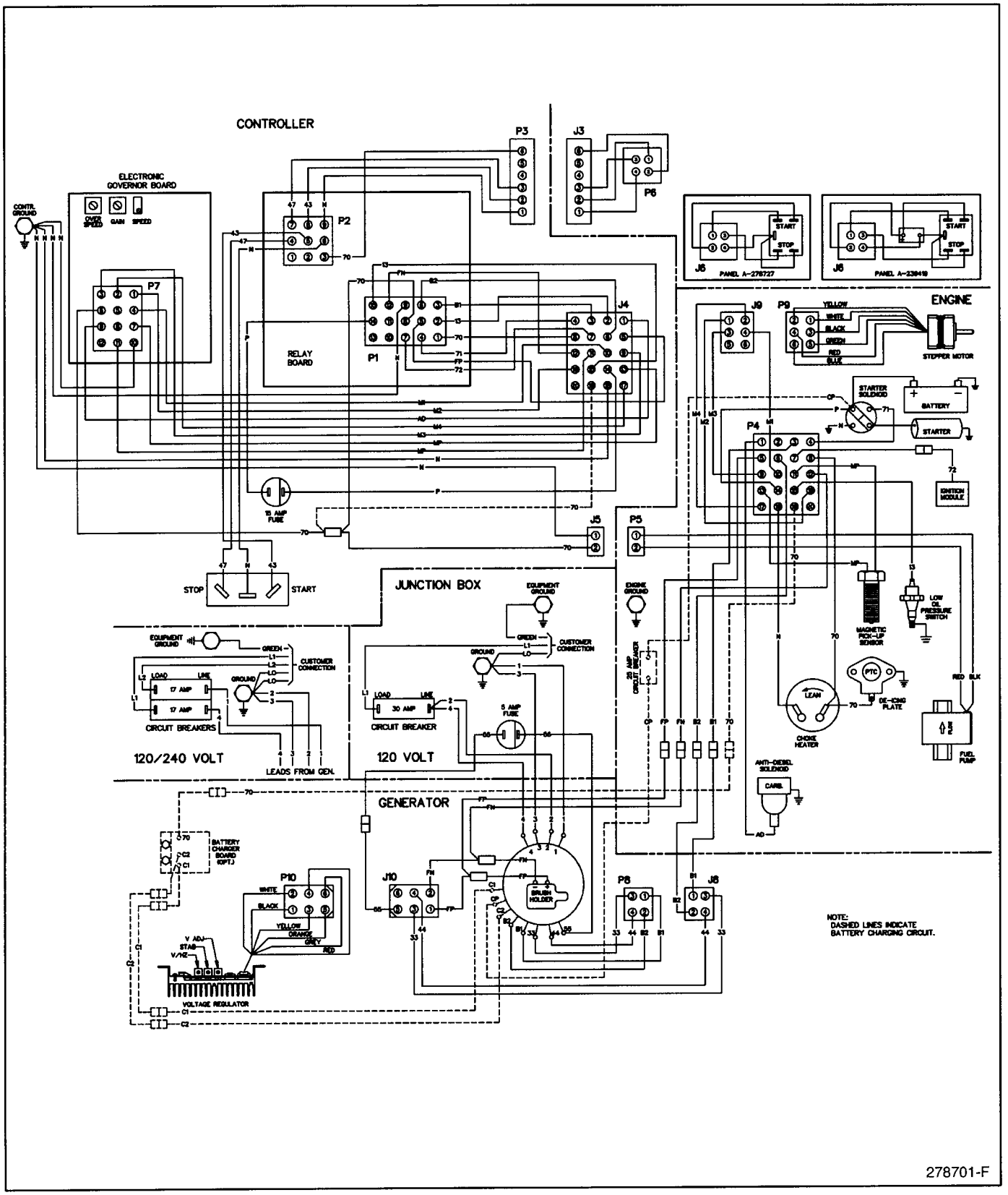


Figure 9-27. Point-to-Point Portion of Wiring Diagram 278701

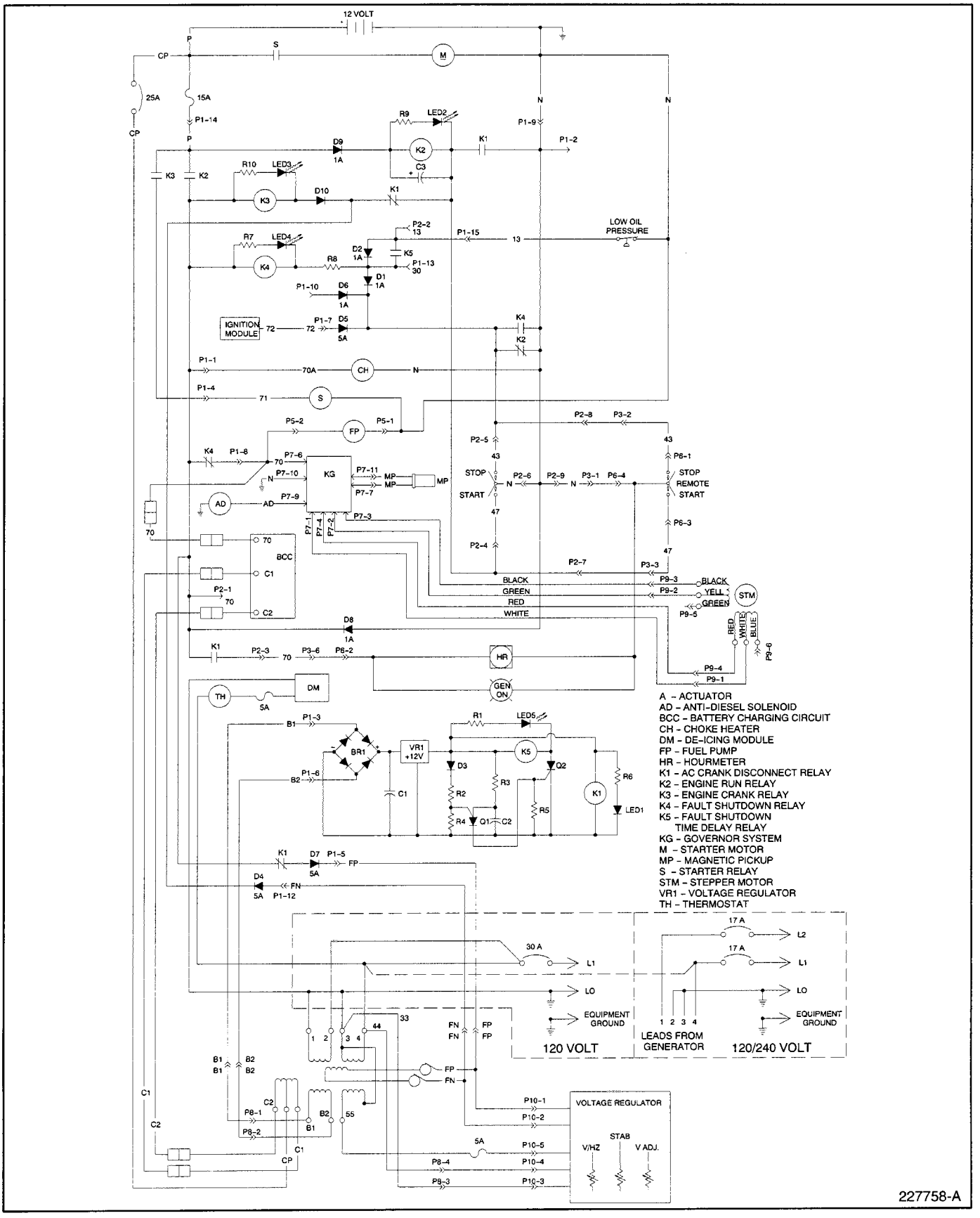


Figure 9-28. Schematic Portion of Wiring Diagram 227758

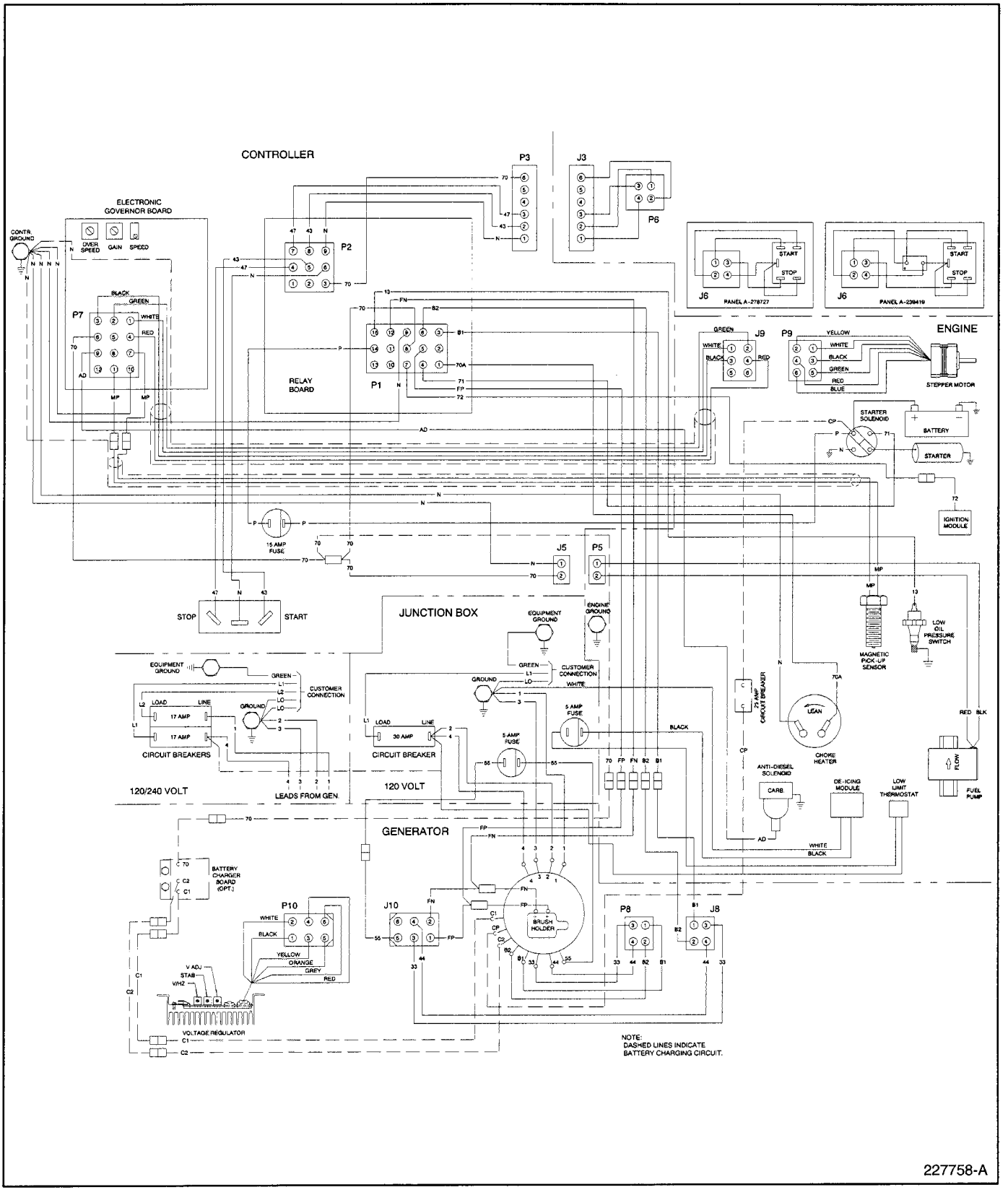


Figure 9-29. Point-to-Point Portion of Wiring Diagram 227758

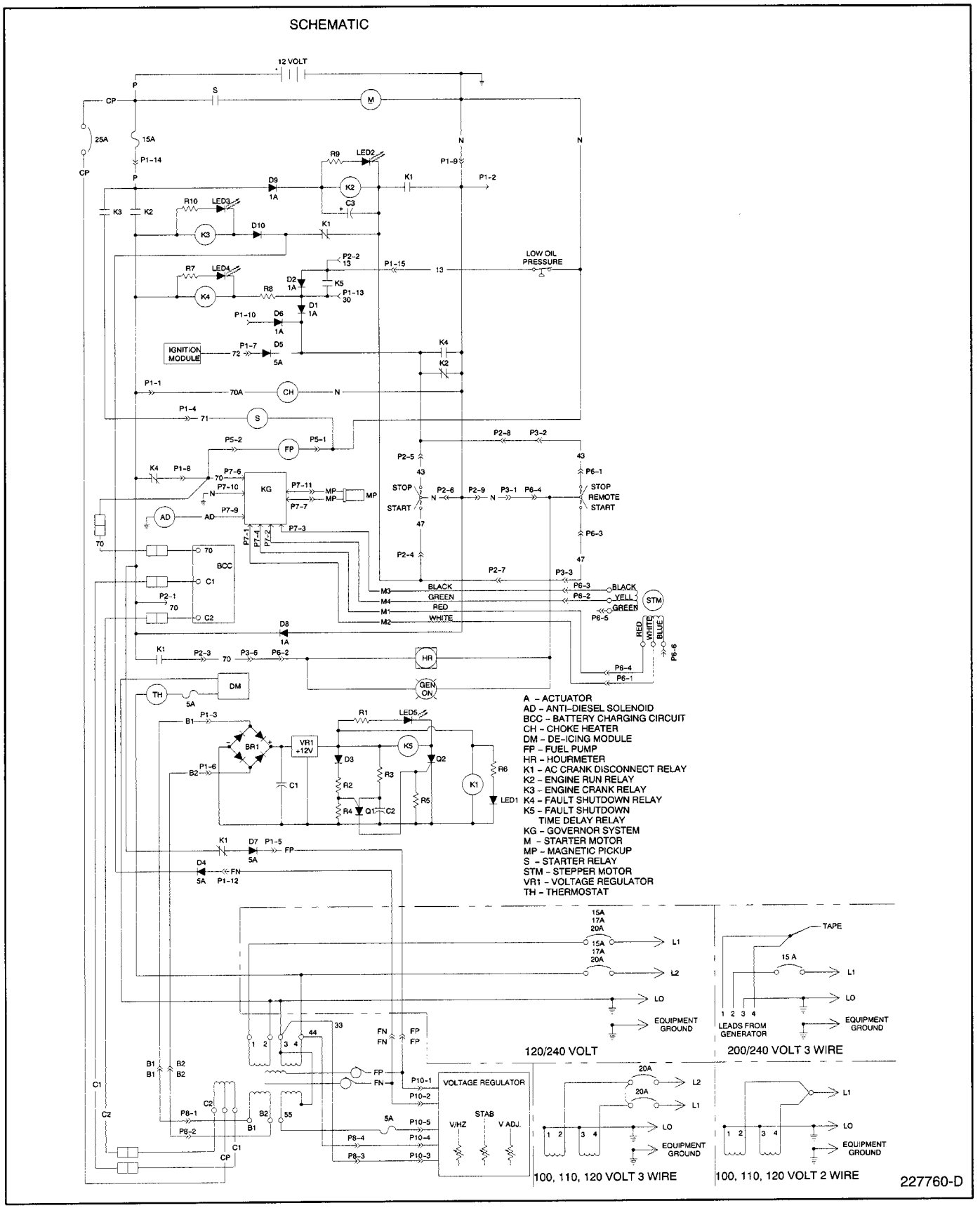


Figure 9-30. Schematic Portion of Wiring Diagram 227760

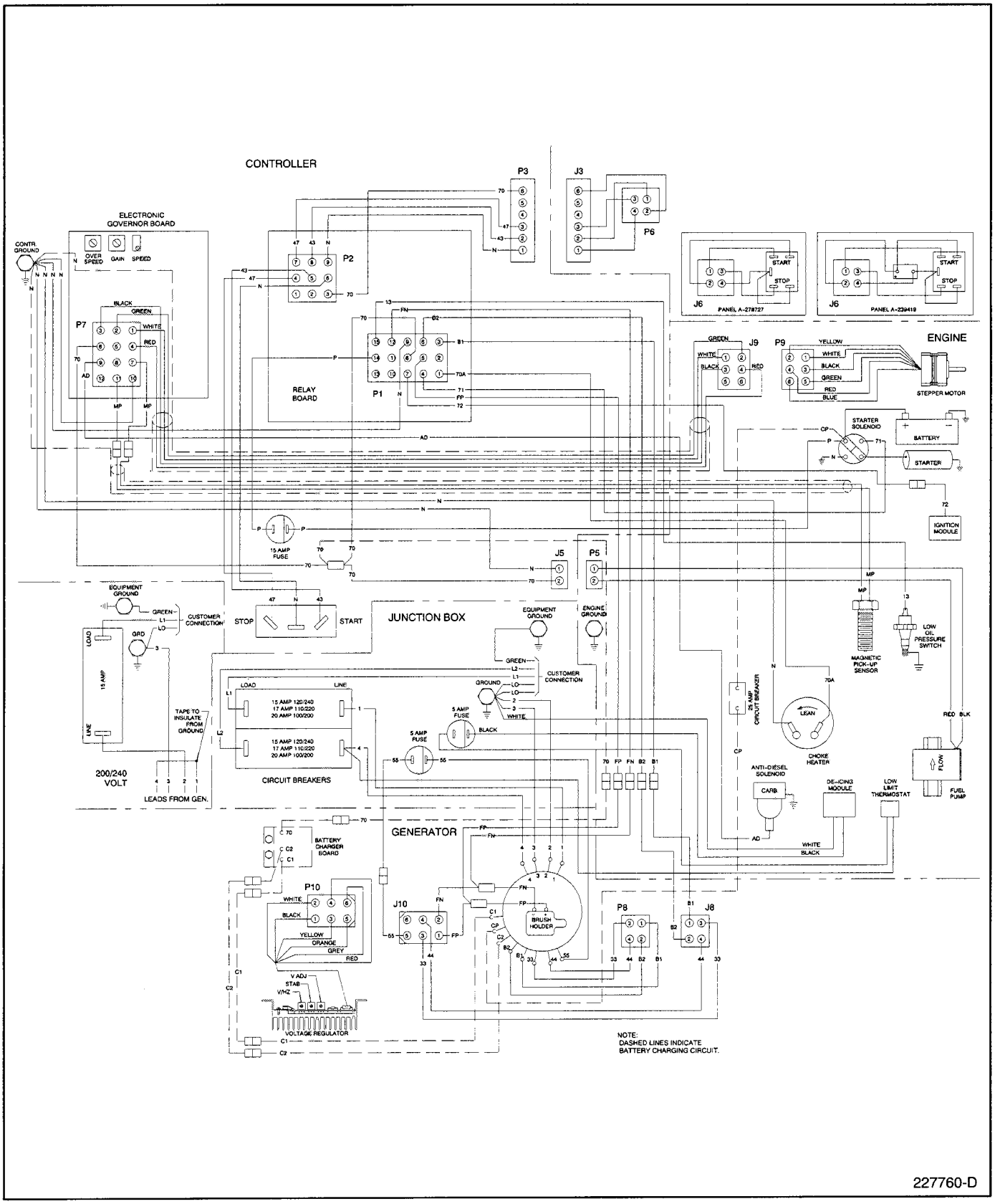


Figure 9-31. Point-to-Point Portion of Wiring Diagram 227760

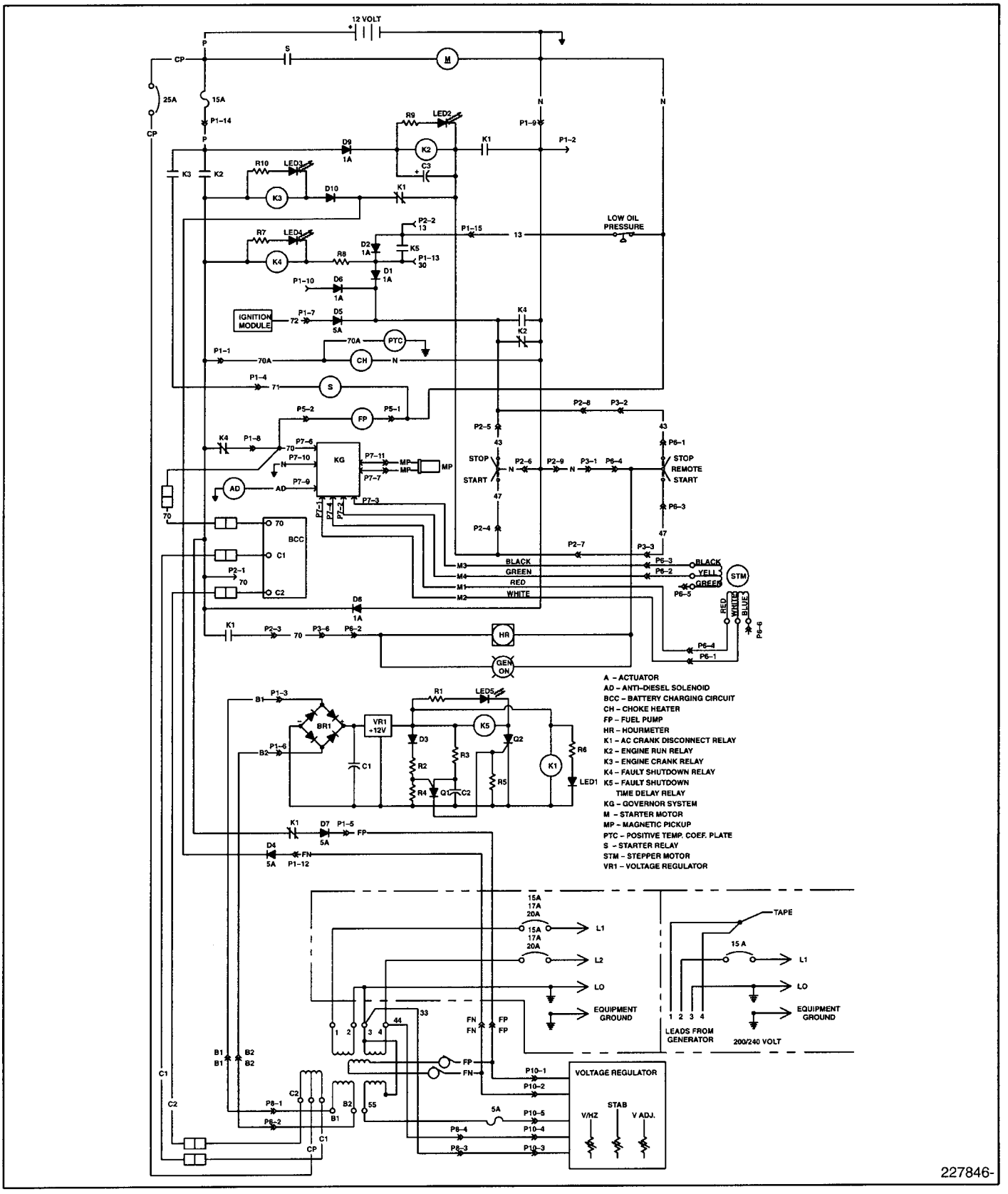


Figure 9-32. Schematic Portion of Wiring Diagram 227846

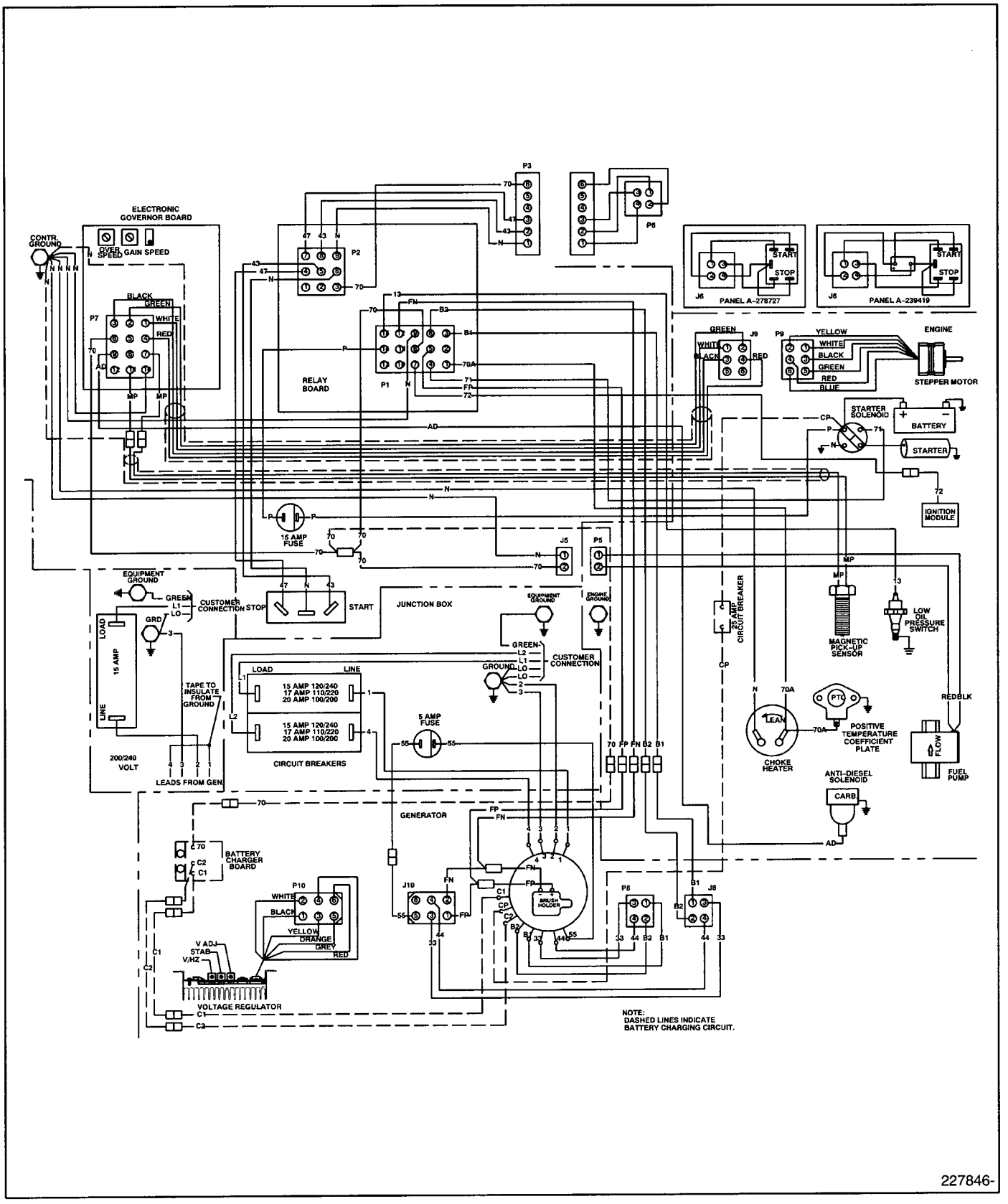


Figure 9-33. Point-to-Point Portion of Wiring Diagram 227846

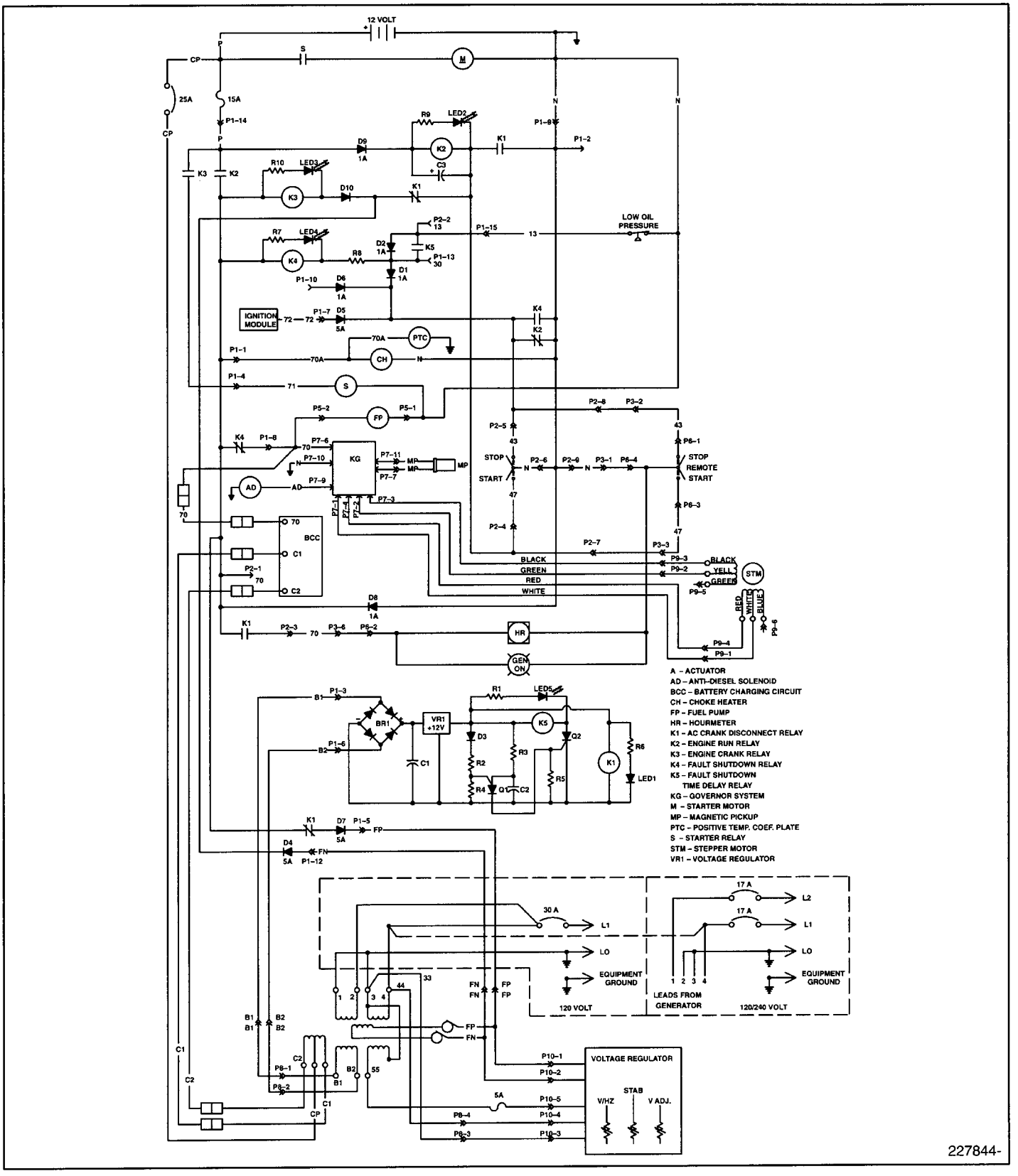


Figure 9-34. Schematic Portion of Wiring Diagram 227844

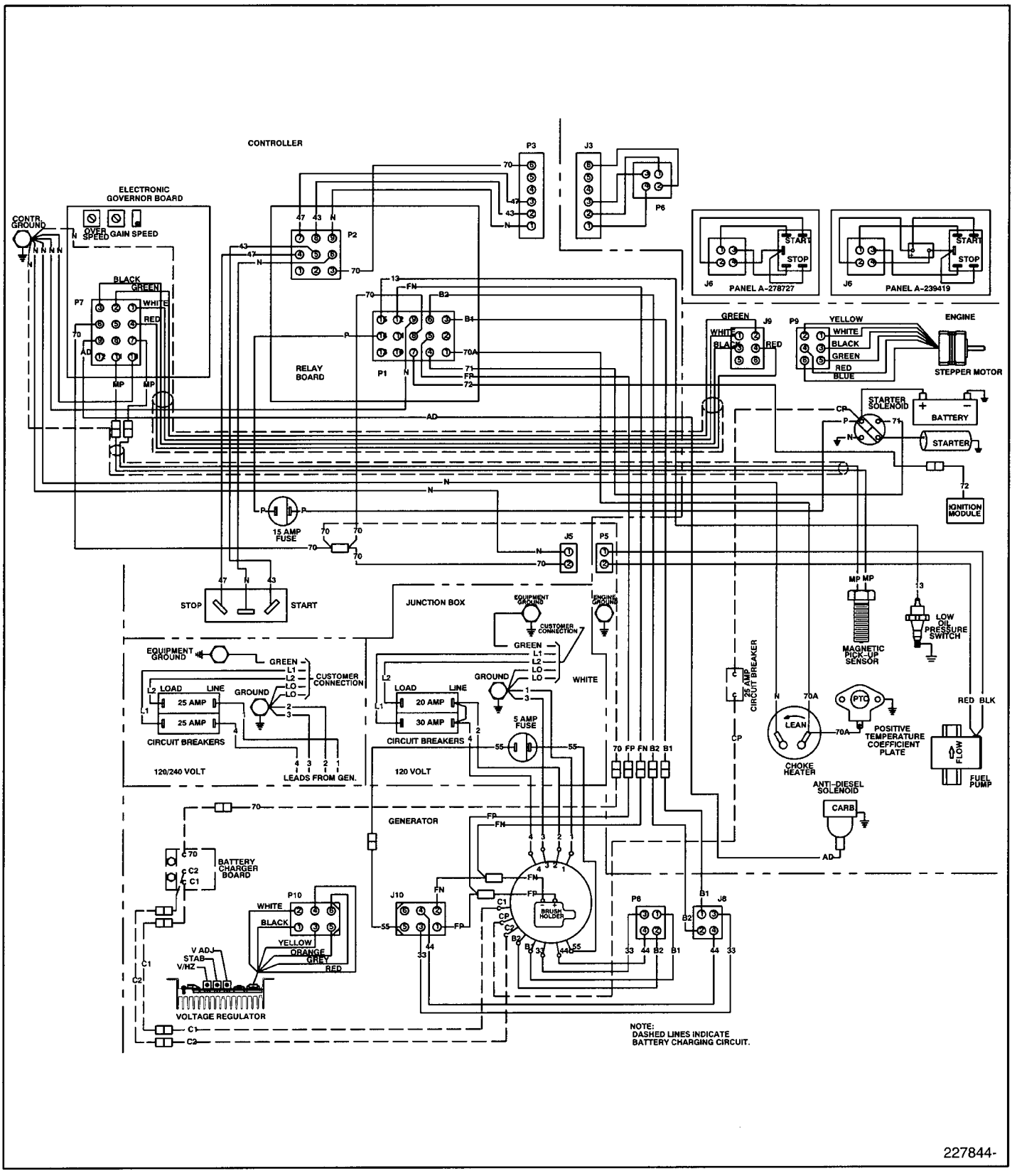


Figure 9-35. Point-to-Point Portion of Wiring Diagram 227844

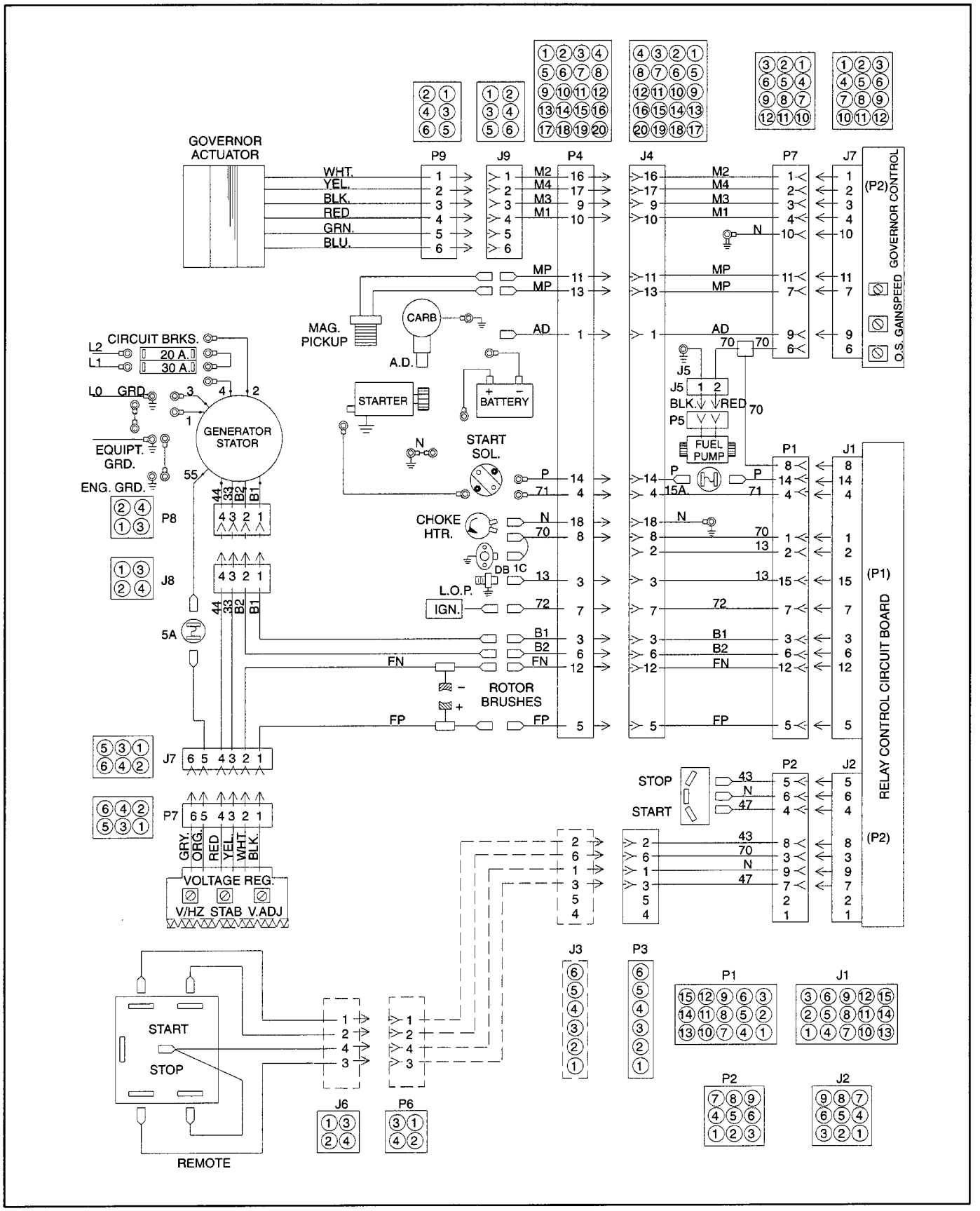


Figure 9-36. Harness Wiring Diagram (Typical)

Appendix A. Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally they will appear in the text in complete form with the abbreviation following in parentheses the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below. Some items may not apply to this application.

Abbreviation	Description
ABDC	after bottom dead center
AC	alternating current
AISI	American Iron and Steel Institute
AHWT	anticipatory high water temp.
ALOP	anticipatory low oil pressure
AM	amplitude modulation
amp	ampere
amps	amperes
ANSI	American National Standard Institute
API	American Petroleum Institute
approx.	approximate, approximately
A/R	as required, as requested
A/S	as supplied, as stated, as suggested
ASA	American Standards Association (former name of ANSI)
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after dead top center
aux.	auxiliary
A/V	audio–visual
AWG	American Wire Gage
AWM	appliance wiring material
BBDC	before bottom dead center
BDC	before dead center
BHP	brake horsepower
bmep	brake mean effective power
BTDC	before top dead center
Btu	British thermal unit
°C	Celsius degree
cc	cubic centimeter
CCA	cold cranking amps
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CID	cubic inch displacement
cm	centimeter, centimeters
cmm	cubic meters per minute
co.	company
cont'd.	continued
CPVC	chloropoly vinyl chloride
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
cu. in.	cubic inch (es)

Abbreviation	Description
CWC	city-water cooled
cyl.	cylinder
dB	decibel
dBA	decibels (A weighted)
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
e.g.	example given
EIA	Electronic Industries Association
EMI	electromagnetic interference
EPA	Environmental Protection Agency
etc.	etcetera, (and so forth)
ext.	external
°F	Fahrenheit degree
fl. oz.	fluid ounce(s)
FM	frequency modulation
ft.	foot, feet
ft. lbs.	foot pound(s)
fs	full scale
ga.	gauge (meters wire size)
gal./gals.	gallon, gallons
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust temperature
Hg.	mercury (element)
H_2O	water
HP	horsepower
hr, hrs	hour, hours
HWT	high water temperature
Hz	hertz (cycles per second)
ID	inside diameter
IEEE	Institute of Electrical and Electronic Engineers
in.	inch, inches
inc.	incorporated
in. lbs.	inch pounds
int.	internal
int.-ext.	internal–external

Abbreviation	Description
ISO	International Standards Organization
J	joule, joules
JIS	Japanese Industry Standard
kg	kilogram, kilograms
kg/cm^2	kilograms per square centimeter
kgm	kilogram meter(s)
kJ	kilojoules (btu cal)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
LxWxH	length x width x height
LED(s)	light emitting diode(s)
lb., lbs.	pound, pounds
L/hr.	liter per hour, liters per hour
L/min.	liter(s) per minute
LOP	low oil pressure
LP	liquified petroleum
LWT	low water temperature
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
meggar	megohmmeter
MHz	megahertz
mi.	mile, miles
mil	one one–thousandth of an inch
min.	minimum
misc.	miscellaneous
mJ	milli joule(s)
MJ	mega joule(s)
mm	millimeter
m^3/min	cubic meters per minute
MPa	megaPascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
mW	milliwatt(s)
MW	megawatt(s)
N/A	not available
NBS	National Bureau of Standards
N.C.	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	Newton meter(s)
N.O.	normally open
no., nos.	number, numbers

Abbreviation	Description
NPT	National Standard taper pipe thread per general use
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed
O/S	oversize
OSHA	Occupational Safety and Health Act
OV	overvoltage
oz.	ounce, ounces
PF	power factor
PMG	permanent magnet generator
pot	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
PVC	polyvinyl chloride
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
r.h.m.	round–head machine (screw)
rms	root means square
RPM	revolutions per minute
RTV	room temperature vulcanization
RV	recreational vehicle
SAE	Society of Automotive Engineers
SCR	silicon controlled rectifier
sec.	second, seconds
spec, specs	specification
sq.	square
sq. cm.	square centimeters
sq. in.	square inch(es)
tach	tachometer
TDC	top dead center
tech. pub.	technical publications
temp.	temperature
TIF	telephone influence factor
TP, TPs	technical publications
turbo	turbocharger
UHF	ultrahigh frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
U/S	undersize
U.S.A.	United States of America
V	volt, volts
vac	volts alternating current
vdc	volts direct current
VHF	very high frequency
W	watt, watts

Appendix B. Common Hardware Application Guidelines

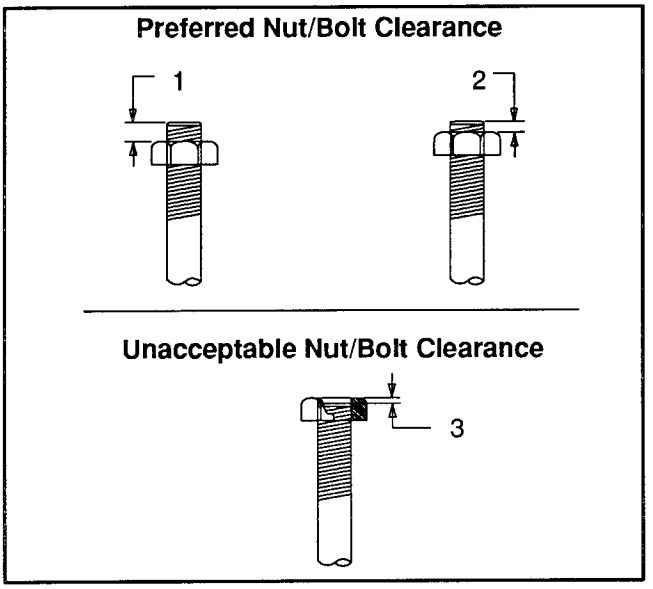
Many parts catalogs and service manuals will contain common hardware entries and hardware references instead of part numbers for common hardware.

This information gives common hardware application guidelines. Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure B-1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred size.

Split Lock Washers: Split lock washers are no longer used as locking devices. For hardware up to 1/2 in. diameter a whiz nut (serrated flange) is used. The locking method used for hardware above 1/2 in. diameter will be SAE flat washers with preloading (torque) of the bolt/screw. See General Torque Specifications and other torque specifications in the service literature.

Common Hardware Entries: When hardware size (diameter and threads per inch) is given but no indication of type of additional hardware is shown, use the illustration in Figure B-2 as a guide.

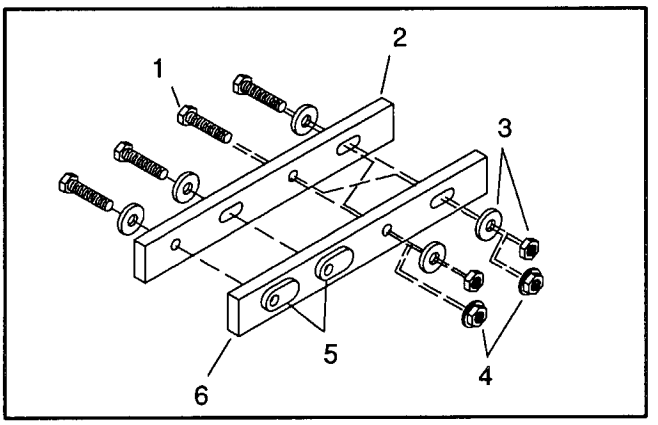


1. 1/2 in. bolt diameter
2. Min. 1 full thread beyond top of nut
3. Below top of nut

Figure B-1. Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted. For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter uses a properly torqued whiz nut. See Figure B-2.
3. Follow these SAE washer rules after determining exit hole type:
   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see Step 2 above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to the diagram below, which depicts the preceding hardware configuration possibilities.



1. Cap screw
2. Entry hole types
3. Standard nut and SAE washer: greater than 1/2 in. dia. hardware
4. Whiz nut: up to and including 1/2 in. dia. hardware
5. Weld nuts
6. Exit hole types

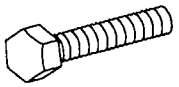
Figure B-2. Acceptable Hardware Combinations

Appendix C. Common Hardware Identification

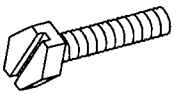
Common hardware has many different head, drive, and grade (hardness) styles. Some of the more common types are shown in Figure C-1 and Figure C-2. This is a guide for identification purposes. Not all generator hardware used is shown.

Screws/Bolts/Studs

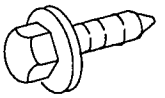
HEAD STYLES



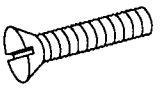
Hex. Head or Machine Head



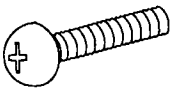
Hex. Head or Machine Head



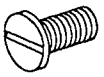
Hex. Head or Machine Head with Washer



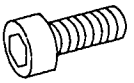
Flat Head



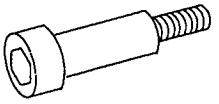
Round Head



Pan Head

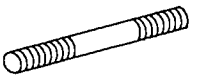


Socket Head Cap or Allen™ Head Cap



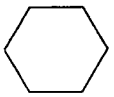
Socket Head or Allen™ Head Shoulder Bolt

Sheet Metal Screw

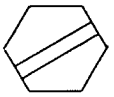


Stud

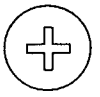
DRIVE STYLES



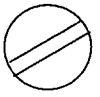
Hex.



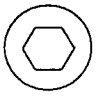
Hex. and Slotted



Phillips®



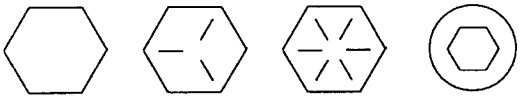
Slotted



Hex. Socket

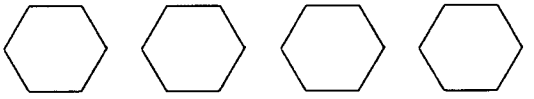
GRADE (HARDNESS)

American Standard



Grade 2 Grade 5 Grade 8 Grade 8/9

Metric



5.8 8.8 10.9 12.9

SAMPLE DIMENSIONS

American Standard

Major Thread Diameter In Fractional Inches Or Screw Number Size — 1/4-20 x 1 — Length In Inches

Threads Per Inch

Metric

Major Thread Diameter In Millimeters — M8-1.25 x 20 — Length In Millimeters

Distance Between Threads In Millimeters

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Phillips® is a registered trademark of the Phillips Screw Company.

Figure C-1. Screws/Bolts/Studs

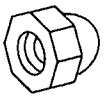
Nuts

STYLES

Hex. Head

Lock Nut or
Nylock Nut

Square Nut

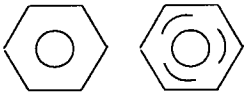


Cap Nut or
Acorn Nut

Wing Nut

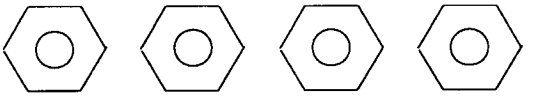
GRADE (HARDNESS)

American Standard



Grade 2 Grade 5

Metric



5.8 8.8 10.9 12.9

SAMPLE DIMENSIONS

American Standard

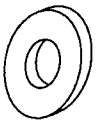
Major Thread Diameter In Fractional Inches Or Screw Number Size — 1/4-20 — Threads Per Inch

Metric

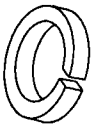
Major Thread Diameter In Millimeters — M8-1.25 — Distance Between Threads In Millimeters

Washers

STYLES



Plain
Washer

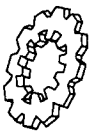


Split Lock
Washer or
Spring Washer

Spring Washer
or Wave Washer

External
Tooth Lock
Washer

Internal
Tooth Lock
Washer



Internal-External
Tooth Lock Washer

GRADE (HARDNESS)

There is no marking to identify hardness. Usually hardened washers have a black oxide or black phosphate finish rather than a zinc (silver-colored) finish.

SAMPLE DIMENSIONS

Plain Washers

Internal Dimension — 9/32 x 5/8 x 1/16 — Thickness

External Dimension

Lock Washers

5/8

Internal Dimension

Figure C-2. Nuts/Washers

Appendix D. General Torque Specifications

Use the following specifications for American Standard fasteners when no torque values are given elsewhere in this manual for a specified bolt. The values are based on new plated threads. Increase values by 20% if non-plated threads are used. Screws threaded into aluminum must have two diameters of threads engaged and may require 30% or more reduction in the torque.

American Standard

Size	Measurement	Assembled in Cast Iron or Steel			Assembled in Aluminum
		Grade 2	Grade 5	Grade 8	Grade 2 or 5
8-32	in. lbs. (Nm)	16 (2)	20 (2.3)	–	16 (1.8)
10-24	in. lbs. (Nm)	26 (3)	32 (3.6)	–	26 (2.9)
10-32	in. lbs. (Nm)	26 (3)	32 (3.6)	–	26 (2.9)
1/4-20	in. lbs. (Nm)	60 (7)	96 (10.8)	132 (14.9)	60 (6.8)
1/4-28	in. lbs. (Nm)	72 (8)	108 (12.2)	144 (16.3)	72 (8.1)
5/16-18	in. lbs. (Nm)	120 (14)	192 (21.7)	264 (29.8)	120 (13.6)
5/16-24	in. lbs. (Nm)	132 (15)	204 (23.1)	288 (32.5)	132 (14.9)
3/8-16	ft. lbs. (Nm)	18 (24)	28 (38)	39 (53)	18 (24)
3/8-24	ft. lbs. (Nm)	20 (27)	31 (42)	44 (60)	20 (27)
7/16-14	ft. lbs. (Nm)	29 (39)	44 (60)	63 (85)	
7/16-20	ft. lbs. (Nm)	32 (43)	50 (68)	70 (95)	
1/2-13	ft. lbs. (Nm)	44 (60)	68 (92)	96 (130)	
1/2-20	ft. lbs. (Nm)	49 (66)	76 (103)	108 (146)	
9/16-12	ft. lbs. (Nm)	60 (81)	98 (133)	138 (187)	
9/16-18	ft. lbs. (Nm)	67 (91)	108 (148)	154 (209)	
5/8-11	ft. lbs. (Nm)	83 (113)	135 (183)	191 (259)	
5/8-18	ft. lbs. (Nm)	94 (128)	153 (208)	216 (293)	
3/4-10	ft. lbs. (Nm)	147 (199)	240 (325)	338 (458)	
3/4-16	ft. lbs. (Nm)	164 (222)	268 (363)	378 (513)	
1-8	ft. lbs. (Nm)	191 (259)	532 (721)	818 (1109)	
1-12	ft. lbs. (Nm)	209 (283)	582 (789)	895 (1214)	

Metric

Size (mm)	Measurement	Assembled in Cast Iron or Steel			Assembled in Aluminum
		5.8	8.8	10.9	
6 x 1.00	ft. lbs. (Nm)	5 (7)	6 (9)	9 (12)	5 (7)
8 x 1.25	ft. lbs. (Nm)	14 (19)	14 (20)	20 (37)	14 (19)
8 x 1.00	ft. lbs. (Nm)	16 (21)	17 (24)	23 (31)	16 (21)
10 x 1.50	ft. lbs. (Nm)	25 (35)	27 (37)	38 (51)	25 (35)
10 x 1.25	ft. lbs. (Nm)	29 (39)	34 (46)	45 (61)	29 (39)
12 x 1.75	ft. lbs. (Nm)	42 (57)	45 (61)	65 (89)	
12 x 1.50	ft. lbs. (Nm)	48 (65)	55 (75)	78 (106)	
14 x 2.00	ft. lbs. (Nm)	64 (86)	69 (94)	101 (137)	
14 x 1.50	ft. lbs. (Nm)	74 (100)	81 (110)	116 (157)	
16 x 2.00	ft. lbs. (Nm)	98 (133)	104 (141)	150 (204)	
16 x 1.50	ft. lbs. (Nm)	104 (141)	116 (157)	168 (228)	
18 x 2.50	ft. lbs. (Nm)	133 (181)	145 (196)	208 (283)	
18 x 1.50	ft. lbs. (Nm)	145 (196)	156 (212)	226 (306)	

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