MARINE GENERATOR SERVICE MANUAL

Models:
7.5A
7.5R

KOHLER®
POWER SYSTEMS

TP-5043 8/87

Table of Contents

Reference Material

It is recommended that the following Regulations and Standards be followed when installing marine generator sets.

Pleasure Craft

U.S. Coast Guard Electrical Systems Regulations
Part 183 of Subchapter S of Chapter 1, Title 33
Code of Federal Regulations, Subparts I and J

U.S. Coast Guard Headquarters
400 Seventh Street, S.W.
Washington, D.C. 20590

NFPA 302, Motor Craft Standard
National Fire Protection Association
470 Atlantic Avenue
Boston, Massachusetts 02210

ABYC Safety Standards for Small Craft
American Boat and Yacht Council, Inc.
190 Ketcham Avenue
Amityville, New York 11701

Commercial Vessels

American Bureau of Shipping
45 Broad Street
New York, New York 10004

Lloyd's Register of Shipping
71 Fenchurch Street
London, EC3M 4BS England

Safety Precautions

A Generator Set, like any other electro-mechanical device can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best safeguards against accident are to be ever mindful of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to operating of a Generator Set are presented below. Keep these in mind.

WARNING

EXPLOSION! Use only generator sets specified for marine use in marine installations.

WARNING

ELECTROCUTION! Failure to install a generator set with an electrical system consistent with governing Regulations and Standards is UNLAWFUL, and may cause ELECTROCUTION of craft occupants, persons in nearby waters, and persons in surrounding craft.

WARNING

LETHAL EXHAUST GAS! An engine discharges deadly carbon monoxide with the exhaust when operating. Carbon monoxide is particularly dangerous in that it is an odorless, tasteless, nonirritating gas that can cause death if inhaled for even a short period of time. Be especially careful if operating the generator when moored or anchored under calm conditions as gases may accumulate. If operating the set dockside, moor your craft so that the exhaust discharges on the lee side (the side sheltered from the wind), and always be mindful of others—make sure your exhaust is directed away from other boats and occupied buildings. If generator set's exhaust discharge hole is near to your craft's water line, DO NOT OVERLOAD CRAFT so as to close or restrict exhaust discharge hole. Maintain exhaust system in accordance with N.F.P.A. and A.B.Y.C. Standards.

WARNING

BACKFIRE! A sudden backfire can cause serious burns. Keep hands and face away from the carburetor when the air cleaner is removed.

WARNING

DANGEROUS FUELS! Use extreme caution when handling, storing, and using fuels — all fuels are highly explosive in a vapor state. 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. Keep fuel lines and connections tight and in good condition — don't replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. Should any fuel leakage, fuel accumulation, or electrical sparks be noted, DO NOT OPERATE GENERATOR SET. Fuel system should include a manual or electrical fuel shut-off valve to be closed when generator set is not operating. Have systems repaired by qualified specialists before resuming generator operation. Additional precautions should be taken when using the following fuel:

Gasoline — Store gasoline only in approved red containers clearly marked GASOLINE. Don't store gasoline in any occupied building.

WARNING

UNIT STARTS WITHOUT NOTICE: To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller master switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

WARNING

FIRE HAZARD! Keep the compartment and generator set clean and free of debris to minimize chances of fire. Keep away from hot engine and generator parts to avoid burning yourself.

WARNING

FLASH FIRE! A sudden flash fire can cause serious burns. To avoid the possibility of a flash fire, 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.

WARNING

HOT COOLANT! Allow engine to cool and release pressure from cooling system before opening heat exchanger pressure cap. To release pressure, cover the heat exchanger cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap.

WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and that wherever electricity is present, there is the potential danger of electrocution. Take the same precautions with electrical appliances in your craft that you would observe in your home. Keep away from electrical circuits and wiring while the set is running and have electrical service performed only by qualified electricians. Make sure unqualified persons, especially children, cannot gain access to your set—keep the compartment door locked or securely latched at all times. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions.

WARNING

HOT PIPING! An engine gets hot while running and exhaust system components get extremely hot. Do not work on generator set until unit is allowed to cool.

WARNING

MOVING PARTS! Belt guard is removed for adjustment of V-belt only. Belt guard must be in place when operating generator set to minimize a safety hazard.

WARNING

ELECTROCUTION! Your generator set MUST NOT be used to "back feed" by connecting it to building/marina electrical circuits. Doing so can cause serious injury or death to utility personnel working to repair a power outage, and may also seriously injure persons on your craft. Unauthorized connection may be unlawful in some states and/or localities. A ship-to-shore transfer switch must be installed to prevent interconnection of generator set power and shore power.

WARNING

DANGEROUS ACID! Avoid contact with battery electroiyte. It contains acid which can eat holes in clothing, burn skin, and cause permanent damage to eyes. 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. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in dangerous spattering of electrolyte.

WARNING

EXPLOSIVE BATTERY GASES! The gases generated by a battery being charged are highly explosive. 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 to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Any compartment containing batteries should be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections.

WARNING

MOVING PARTS! Keep hands, feet, and clothing away from belts and related pulleys when unit is running. Maintain adequate clearance between generator set and walkways. Keep everyone, especially children, away from generator set when unit is running.

WARNING

ELECTRICAL SHOCK! Battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings, and any other jewelry.

WARNING

HIGH VOLTAGE! The heat sink of the voltage regulator contains high voltage. Do not touch when testing voltage regulator or electrical shock will occur.

WARNING

EXCESSIVE NOISE! Never operate without adequate muffler or with faulty exhaust system—exposure to excessive noise is not only tiring but can lead to impairment of nearing.

WARNING

HIGH VOLTAGE! When testing voltage regulator, always unplug power cord from AC power source before connecting or disconnecting wires to prevent danger of electrocution.

WARNING

HIGH VOLTAGE! When the power cord is plugged in during voltage regulator test, the AC pins become "hot" and there is danger of electrocution.

SECTION I
Introduction and Specifications

Introduction

This material covers operation, scheduled maintenance, troubleshooting, and corrective maintenance for Kohler 7500 watt, 120 volt or 120/240 volt, alternating current marine generator sets (Figure 1-1). These units have been manufactured in compliance with United States Coast Guard (U.S.C.G.) regulations 33 CFR and have been certified IGNITION-PROTECTED by the Underwriters Laboratories (U.L.). Solid state circuitry is used on Automatic and Remote models; relay circuitry is used on Remote models only. Differences between automatic and remote, solid state and relay circuitry are noted throughout the manual. All models feature a Kohler designed and built 4-cycle gasoline engine with a rotating field generator. To retain compliance with U.S.C.G. and U.L. standards, replace components indicated in Figure 1-1 only with parts in accordance with U.S.C.G. regulations. See Table 1-1 for specifications and model variations and Table 1-2 for engine specifications. Refer to the wiring diagrams in back of the manual.

Model	Voltage	Phase	Starting	Watts	Amps per Terminal	Freq. (Hz)	RPM	Cooling System
RELAY								
7.5R27	120	1	Remote	7500	62.5	60	1800	Direct
7.5R67	120/240	1	Remote	7500	31.3	60	1800	Direct
7.5R23	120	1	Remote	7500	62.5	60	1800	Heat Exchanger
7.5R63	120/240	1	Remote	7500	31.3	60	1800	Heat Exchanger
SOLID STATE								
7.5A27	120	1	Automatic	7500	62	60	1800	Direct
7.5R27	120	1	Remote	7500	62	60	1800	Direct
7.5R67	120/240	1	Remote	7500	31	60	1800	Direct
7.5A23	120	1	Automatic	7500	62	60	1800	Heat Exchanger
7.5R23	120	1	Remote	7500	62	60	1800	Heat Exchanger
7.5R63	120/240	1	Remote	7500	31	60	1800	Heat Exchanger

Table 1-1. Generator Specifications

Lube Oil Capacity		5 quarts (3.8 lts)
Fuel Inlet Connection Size		1/8" N.P.T.
Battery Voltage		12 V
Battery Amp Hr.		90
Battery Ground		Negative
Battery Cranking Current		120 amps
Battery Charging Current, Solid State		8 Max (Tapering)
Battery Charging Current, Relay		1 Amp, Trickle Charge
Engine Model		L654
Breaker Point Gap		.015 in. (0.39 mm)
RPM		1800
Fuel System Choke		Automatic Thermal/Electric
Spark Plug Gap		.025 in. (0.64 mm)
Total Air Requirements		375 cfm (10.5 m^3/min.)
Fuel Consumption	25% Load	.70 gal/hr (2.6 lts/hr)
	50% Load	.80 gal/hr (3.0 lts/hr)
	75% Load	1.1 gal/hr (4.2 lts/hr)
	100% Load	1.4 gal/hr (5.3 lts/hr)

Table 1-2. Engine Specifications

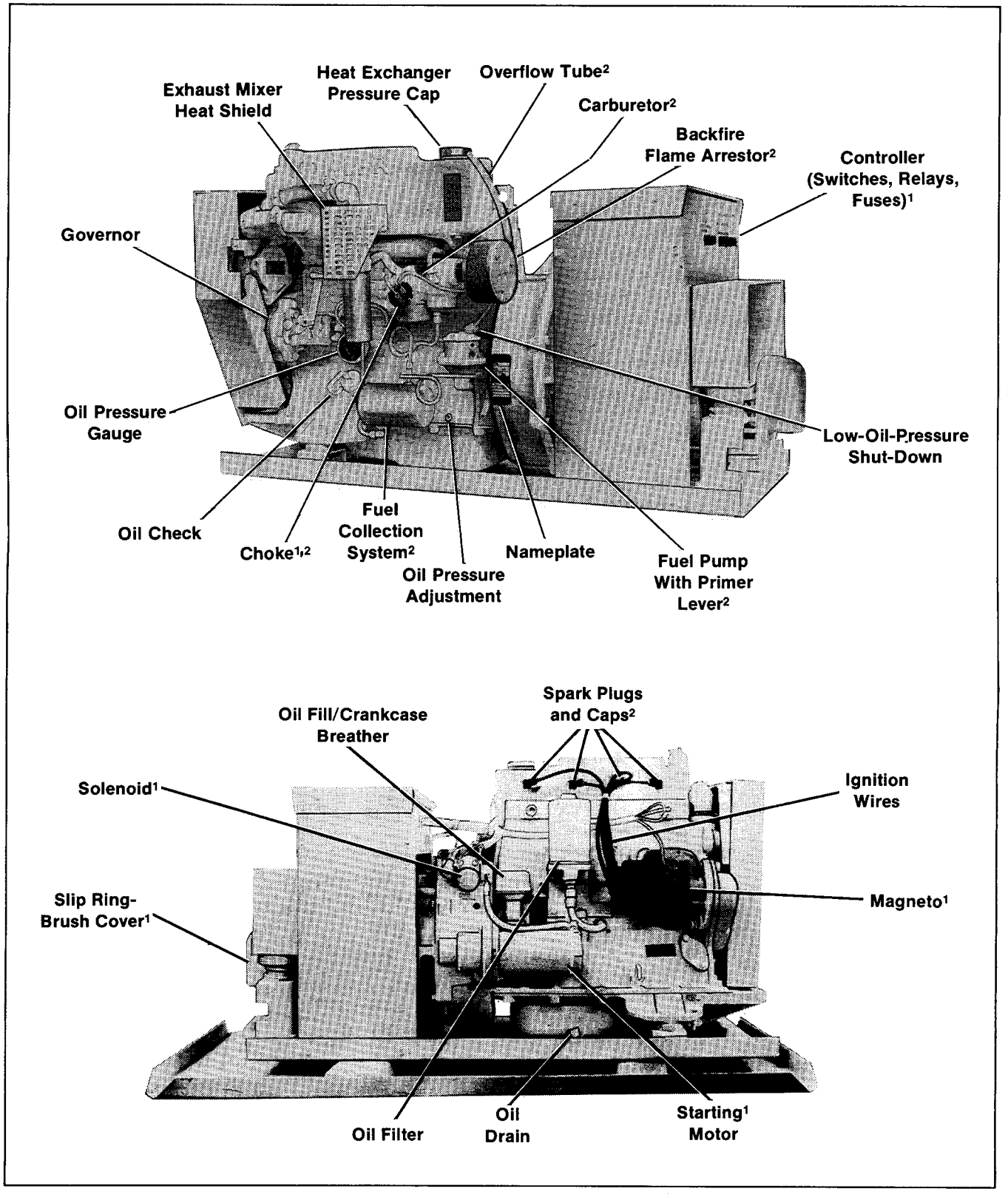


Figure 1-1. Service and Adjustment Points

[1]Indicated components have been Ignition-Protection tested in accordance with U.S.C.G. Regulations. Replace only with U.S.C.G. approved parts.

[2]Indicated components have been tested in accordance with U.S.C.G. Regulations other than Ignition Protection. Replace only with U.S.C.G. approved parts.

Oil Specifications

OIL CHANGE:

On a new set, overhauled engine or those rebuilt with new short blocks, use a single viscosity non-detergent oil during the first 5 hours of operation to promote seating of the piston rings. After the 5 hour break-in period, change the oil at 100 hour intervals or every 6 months—whichever occurs first. Change oil more frequently if set is operated under extremely dusty or dirty conditions. Whenever possible, drain oil while it is hot as it will flow more freely and carry away a greater amount of contaminants. Oil capacity is 5 quarts.

CAUTION

Failure to change break-in oil after first five hours of operation may result in premature ring and cylinder wear.

NOTE

Although an oil drain plug is located on the oil pan, the oil can be pumped from the engine via the filter neck to avoid oil spillage while draining oil.

OIL FILTER:

During every other oil change or every 200 hours the oil filter cartridge should be replaced. Wrap rags around the base and use a pan to catch any oil in the cartridge. Twist the cartridge off in a counterclockwise direction. Replace with a new cartridge. Oil the cartridge gasket before attaching and twist the cartridge hand tight (approximately 3/4 turn after the gasket makes contact). After oil is replenished, run the engine and check the area around the filter for signs of leakage, retighten the cartridge as necessary. See Figure 1-2.

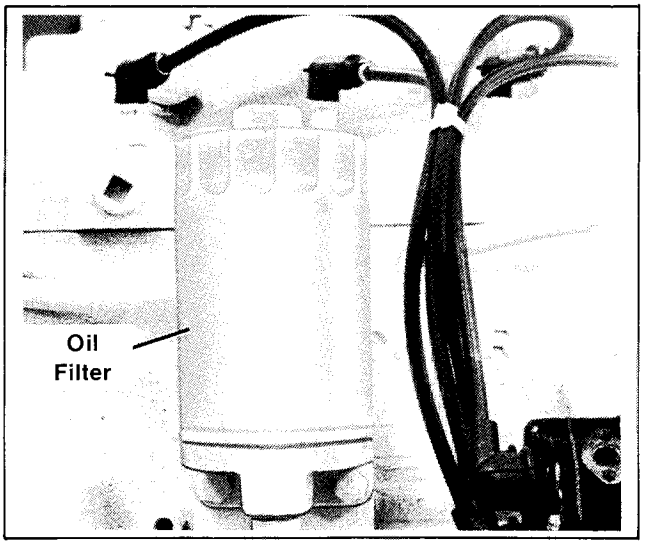


Figure 1-2. Oil Filter Service

OIL PRESSURE:

After the engine has been thoroughly warmed up and is operating with proper weight of oil in crankcase, the oil pressure should be about 20 psi (138kPa). An external oil pressure adjusting screw is provided on the crankcase just below and to the rear of the carburetor. (See Figure 1-1.) If normal operating pressure is lower than 20 psi (138kPa), remove acorn nut, loosen locknut then turn screw until pressure is correct. Secure locknut at new setting and reinstall protective acorn nut. See Figure 1-3. When engine is cold, pressure may be as high as 50-60 psi (345-414kPa) but should gradually return to about 20 psi (138kPa) as the engine warms up.

The engine is equipped with a low oil pressure shut-down. This feature protects the engine against internal damage in the event the oil pressure drops too low due to oil pump failure or other malfunction.

CAUTION

The low oil pressure shut-down does NOT protect against damage due to operating with the oil level below the safe range — it is not a low oil level shut-down. The only protection against running out of oil is to check the level regularly, and to add oil as needed.

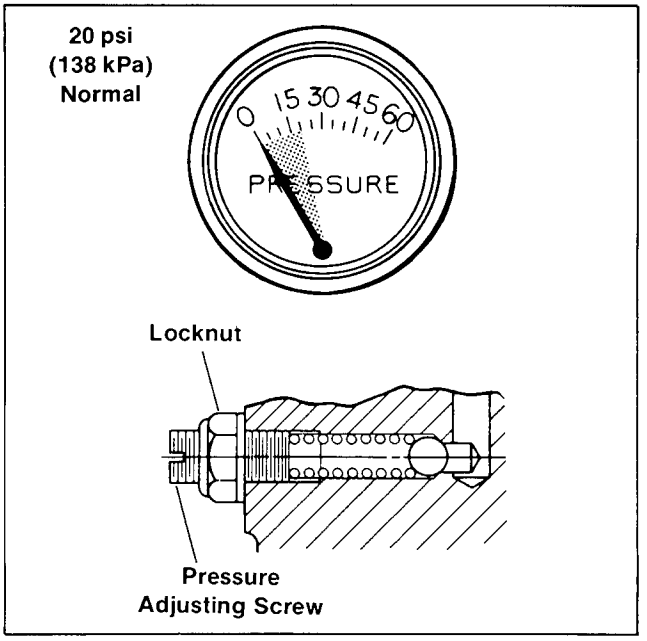


Figure 1-3. Oil Pressure and Adjustment

Fuel Specifications

Use a good quality grade of low lead or nonleaded gasoline with a pump sticker rating of at least 85 octane (90 octane-research method). Low lead or nonleaded fuel helps keep combustion chamber deposits at a minimum. Regular fuel may be used when low lead or nonleaded gasoline is not available. Oil must NOT be mixed with the fuel. Use only fresh gasoline; stale fuel will cause gum deposits to form in the carburetor. Add fuel stabilizers if the gasoline will remain in the tank for several months. Such additives are only a help; gasoline should never be stored for more than six months.

SECTION 2
Operation

General

There are two basic models of Kohler 7500 watt marine generator sets; remote models ("R" designation) and automatic models ("A" designation). Remote models feature connections for mounting another switch at a remote location in the cabin or pilot house. Automatic models crank automatically after a load demand of approximately 60 watts or more (such as a refrigerator turning on), and automatically stop approximately 60 seconds after the load is turned off. Both models provide protection against complete discharge of the battery from overcranking. If the engine is cranked for more than 60 seconds without starting, cranking will stop automatically. Before again attempting to start the generator set, refer to "Reset Procedure" following.

Prestart Checklist

To prevent the possibility of explosion and to insure continued satisfactory operation, the following items should be checked before each start-up.

OIL LEVEL:

Should be at or near full mark. Add oil as needed to bring level up to this range.

COOLING:

Remove the pressure cap on closed type heat exchanger system to check coolant level. Add clean fresh water (or antifreeze solution) until level is just below overflow tube opening. See Section 10.

COMPARTMENT:

Keep the engine room or compartment clean and dry. Check for fuel or oil leaks. Check the condition of fuel system, exhaust piping, hoses and muffler; repair any faulty components before getting under way. Open hatch to air out compartment and use ignition protected bilge blowers to clear fumes from area before each start-up. If fuel leaks, fumes, exhaust gases, or electrical sparks are noted, make necessary repairs before operating generator set.

BATTERY:

Remove caps and check the electrolyte level of each cell; add distilled water if necessary. Check to make sure it is connected correctly. Battery installation and connections must meet Coast Guard Standards. Battery should be serviced by authorized personnel only.

BACKFIRE FLAME ARRESTOR:

The silencer not only muffles the sound of the air intake but also functions as a flame arrestor in the event of engine backfire. Be sure the silencer is in place and assembled properly so it can function as intended. See Section 9.

Starting-Stopping (Remote)

REMOTE — MODELS 7.5R: Solid State and Relay Circuitry

1. Open manual fuel shut-off valve (if equipped). Place generator set master switch to REMOTE position. See Figure 2-1 for relay model or Figure 2-2 for solid state model.

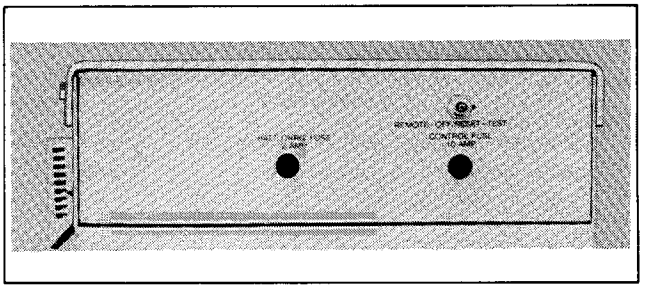


Figure 2-1. Remote Controller, Relay Circuitry

2. Operate set from remote start-stop switch. If engine fails to start after the first attempt, close the seacock (Kingston cock) before attempting start-up. This will help prevent seawater from entering the engine cylinders through the exhaust valves.

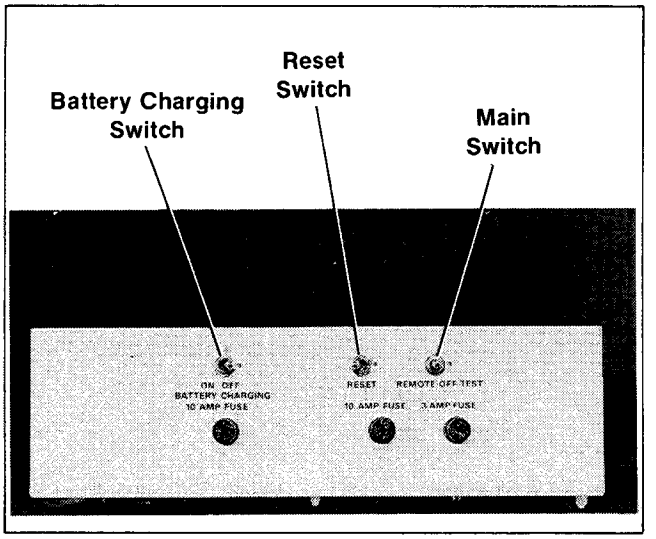


Figure 2-2. Remote Controller, Solid State Circuitry

CAUTION

Do not crank engine continuously for more than 10 seconds at a time. A 60 second cool-down period must be allowed between cranking attempts if the engine does not start. If the unit fails to start after three attempts, contact an Authorized Kohler Service Dealer for repair. Failure to follow these guidelines may result in burn-out of the starter motor from overheating.

NOTE

Should engine fail to start within (30 seconds — relay model, or 60 seconds — solid state model), cranking will automatically cease. If oil pressure drops too low or operating temperatures climb too high, generator will automatically shut down. Correct problem and move toggle switch to (OFF/RESET — relay model, or OFF and then actuate RESET switch — solid state model) position before again attempting start-up.

Once the generator set is started, the seacock (Kingston cock) must be opened to allow passage of cooling water.

CAUTION

Failure to open seacock (Kingston cock) after generator set is running will result in serious engine damage due to overheating.

NOTE

Check that the marine ship-to-shore transfer switch is in the proper position, if used.

3. To stop generator set, shut off all lights and appliances and run for 1-2 minutes at no load to allow for engine cool-down. Place controller master switch to (OFF/RESET — relay model, or OFF — solid state model) position. Close manual shut-off valve (if equipped).

AUTOMATIC — MODELS 7.5A

1. Place controller master switch in AUTO position. See Figure 2-3.

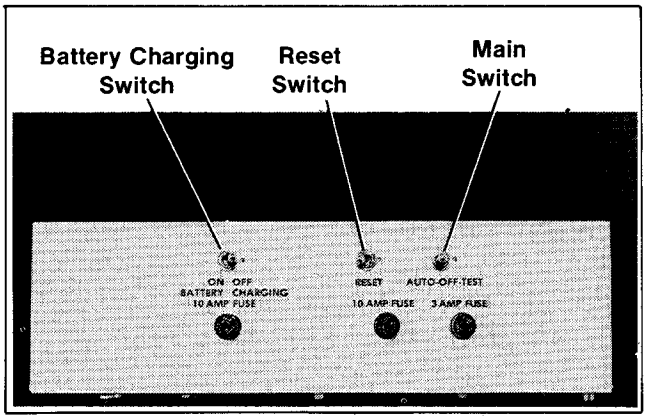


Figure 2-3. Automatic Controller, Solid State Circuitry

2. Generator set will start when light or appliances of at least 60 to 100 watts are turned on.

NOTE

Should engine fail to start within 60 seconds, cranking will automatically cease. If oil pressure drops too low or operating temperatures climb too high, generator will automatically shut down. Correct problem and move toggle switch to OFF position and actuate RESET switch before again attempting start-up.

3. Set will stop approximately one minute (cool-down period) after lights and appliances are shut off and load demand drops below approximately 60 watts.

CAUTION

Units will not reliably start with loads of less than 100 watts. Loads of less than 100 watts may cause units to cycle on and off resulting in battery drain.

Test Operation

⚠ WARNING

UNIT STARTS WITHOUT NOTICE! To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller master switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

1. Open manual fuel shut-off valve (if equipped). Place generator set master switch to TEST position. See Figure 2-1 for relay model, Figure 2-2 for remote solid state model, or Figure 2-3 for automatic solid state model.
2. If engine fails to start after the first attempt, close the seacock (Kingston cock) before attempting start-up. This will help prevent seawater from entering the engine cylinders through the exhaust valves.

NOTE

If carburetor bowl has been drained for storage, or if set has been run out of fuel, carburetor must be primed using primer level at fuel pump.

CAUTION

Do not crank engine continuously for more than 10 seconds at a time. A 60 second cool-down period must be allowed between cranking attempts if the engine does not start. If the unit fails to start after three attempts, contact an Authorized Kohler Service Dealer for repair. Failure to follow these guidelines may result in burn-out of the starter motor from overheating.

NOTE

Should engine fail to start within (30 seconds — relay model, or 60 seconds — solid state model), cranking will automatically cease. If oil pressure drops too low or operating temperatures climb too high, generator will automatically shut down. Correct problem and move toggle switch to (OFF/RESET — relay model, or OFF and then actuate RESET switch — solid state models) position before again attempting start-up.

Once the generator set is started, the seacock (Kingston cock) must be opened to allow passage of cooling water.

CAUTION

Failure to open seacock (Kingston cock) after generator set is running will result in serious engine damage due to overheating.

NOTE

Check that the marine ship-to-shore transfer switch is in the proper position, if used.

3. To stop generator set, shut off all lights and appliances and run for 1-2 minutes at no load to allow for engine cool-down. Place controller master switch of (OFF/RESET — relay model, or OFF — solid state models) position. Close manual shut-off valve (if equipped).

Reset Procedures

1. Move controller master switch to (OFF/RESET — remote relay model, or OFF — remote solid state and automatic solid state models).
2. Correct cause of fault shut-down.

⚠ WARNING

UNIT STARTS WITHOUT NOTICE! To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller main switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

3. If unit is a solid state remote or automatic model, activate RESET switch.
4. Move controller master switch to (REMOTE or TEST — remote relay and solid state models, or AUTO or TEST — automatic solid state model) for start-up.

CAUTION

If unit is an automatic or remote solid state model, cranking can be initiated after fault shutdown by maintaining master switch in REMOTE, AUTO, or TEST position and actuating separate RESET switch.

SECTION 3
Scheduled Maintenance

General

Scheduled maintenance is "preventive" maintenance. Major repair can be avoided by correcting problems when they are small. When performing maintenance, always look for signs of potential trouble, such as loose connections or dirty components. When running the set, listen for any unusual noises.

⚠ WARNING

UNIT STARTS WITHOUT NOTICE: To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller master switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

Maintenance Schedule

Refer to Table 3-1 for scheduled maintenance requirements. Perform each function at the indicated time interval. Intervals stated are for normal operating conditions. Service more frequently under severe conditions. For each function, refer to the applicable section for instructions.

NOTE

On a new, overhauled, or rebuilt engine change the oil after the first five hours of operation. Thereafter change oil every 100 hours or 6 months whichever occurs first.

NOTE

Operate the generator set under load conditions at least once a month. Allow generator set to run about one hour to reach operating temperature. This prevents the formation of corrosion on internal engine components when exhaust gases chemically react with salt water or other high-mineral content waters. If unit is to be out of service for several months, see "Storage Procedure" as outlined in Operator's Manual.

NOTE

For maintenance work on engine components, refer to the Kohler L654 Engine Service Manual, ES-652.

NOTE

There is only one bearing in the generator portion of the unit and it is of a sealed type. Therefore, the generator portion of the unit does not require lubrication.

Perform Service at Intervals Indicated (X)	Before Each Startup	Every 50 Hours or 3 Months	Every 100 Hours or 6 Months	Every 200 Hours or Yearly	Every 500 Hours
Check Oil Level	X				
Check Coolant Level (closed system only)	X				
Check Compartment Condition	X				
Check Battery	X				
Check Backfire Flame Arrestor	X				
Check Water Pump Belt Tension		X			
Change Oil			X		
Check Spark Plugs			X		
Check Electrical Connections			X		
Check Valve Clearance				X	
Check Breaker Points				X	
Check Ignition Timing				X	
Check Carburetor Adjustment				X	
Clean Crankcase Breather				X	
Brushes and Slip Rings Check and Service				X	
Change Oil Filter Cartridge (if equipped)				X	
Transformer-Rectifier (check condition and battery charge)					X
Check and Service Cylinder Heads					X

Table 3-1. Scheduled Maintenance

SECTION 4
Troubleshooting

General

When troubleshooting a generator set, always consider the simplest causes first. Narrow the problem down to a functional system, such as fuel or ignition. To operate efficiently, an engine must have sufficient fuel, a good ignition spark and good compression. All adjustments must be correct. For a generator to produce the required electricity, all parts must be clean, all connections tight, and all components in working order. To make engine repairs refer to the Kohler L654 Engine Service Manual, ES-652. Always consider every possible cause of malfunction. Knowledge of four cycle engines and battery ignition systems can be applied.

Remote — Models 7.5R

SOLID STATE

Table 4-1 lists some common causes of engine/generator troubles — use this table and Figure 4-1 to locate causing factors.

Table 4-1. Troubleshooting Remote — Solid State Circuitry — Models 7.5R

CONDITION	POSSIBLE CAUSE
A. Unit Will Not Crank with Switch in Test Position	1. Weak or dead battery. 2. Blown fuse (Section 5). 3. Reversed or poor battery connections — must be negative ground (Section 2). 4. Faulty "C" cranking solenoid (Section 5). 5. Faulty starter motor. 6. Open harness connections (Section 5). 7. Faulty "CR" relay (Section 5). 8. Open jumper, terminal strip P to B+ (Section 5). 9. Open jumper, terminal strip 50 to 51 (Section 5). 10. Open foil, loose or broken pin on main or regulator circuit board (Section 5). 11. Open foil, loose or broken pin on mother board (Section 5). 12. Defective main or regulator circuit board (Section 5).
B. Unit Cranks but Will Not Start	1. No fuel. 2. No spark (Section 11). 3. Open foil, loose or broken pin on circuit board (Section 5). 4. Open or ground in harness assembly (Section 5). 5. Faulty circuit board (Section 5). 6. Faulty "1CR" relay (Section 5). 7. Poor compression (Engine Manual, ES-652). 8. Valve problems (Engine Manual, ES-652).
C. Unit is Hard Starting	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Improper cooling (Section 10). 4. Poor compression (Engine Manual, ES-652). 5. Valve problems (Engine Manual, ES-652). 6. Choke out of adjustment (Section 9).
D. Unit Starts but Shuts Down Within 60 Seconds	1. Misadjusted or faulty speed sensor (Section 7). 2. Low engine oil pressure (Section 1). 3. Faulty engine temperature sensor (Section 10). 4. No fuel. 5. Open or poor pin connection, or 6 circuit connector (Section 5). 6. Open or poor pin connection on main control circuit board (Section 5). 7. Faulty regulator or main control circuit board (Section 5).

(Troubleshooting Remote — continued on next page)

Table 4-1. Troubleshooting Remote — Solid State Circuitry — Models 7.5R (Continued)

CONDITION	POSSIBLE CAUSE
E. Unit Stops Suddenly	1. No fuel. 2. No spark (Section 11). 3. Improper cooling (high temperature cutout) (Section 10). 4. Improper lubrication (low oil pressure cutout) (Section 1). 5. Valve problems (Engine Manual, ES-652). 6. Set overloaded (Section 1).
F. Unit Operates Erratically	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Faulty governor (Section 9). 5. Full fuel collection tank (Section 9).
G. Unit Lacks Power	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Poor compression (Engine Manual, ES-652). 6. Valve problems (Engine Manual, ES-652). 7. Carbon build-up (Engine Manual, ES-652). 8. Set overloaded (Section 1).
H. Unit Knocks or Pings	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Carbon build-up (Engine Manual, ES-652). 6. Set overloaded (Section 1).
I. Unit "Skips" or Misfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11). 3. Valve problems (Engine Manual, ES-652).
J. Unit Backfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11). 3. Valve problems (Engine Manual, ES-652).
K. Unit Runs — No AC Ouput	1. Open in voltage build-up circuit (Section 7). 2. Faulty voltage regulator (Section 7). 3. Sticky generator brushes (Section 7). 4. Faulty generator rotor (Section 7). 5. Faulty or misconnected generator stator (Section 7). 6. Faulty interlock circuit board.
L. Unit Overheats	1. Improper cooling (Section 10). 2. Set overloaded (Section 1). 3. Improper lubrication (Section 1). 4. Fuel mixture wrong (Section 9). 5. Valve problems (Engine Manual, ES-652). 6. Poor ignition (Section 11).
M. Unit Will Not Shut Down with Switch in Off Position	1. No ground connection to engine magneto (Section 5). 2. Open in circuit board foil pattern (Section 5). 3. Open in 12 circuit connector plug on harness (Section 5). 4. Faulty "1CR" relay contacts (Section 5).

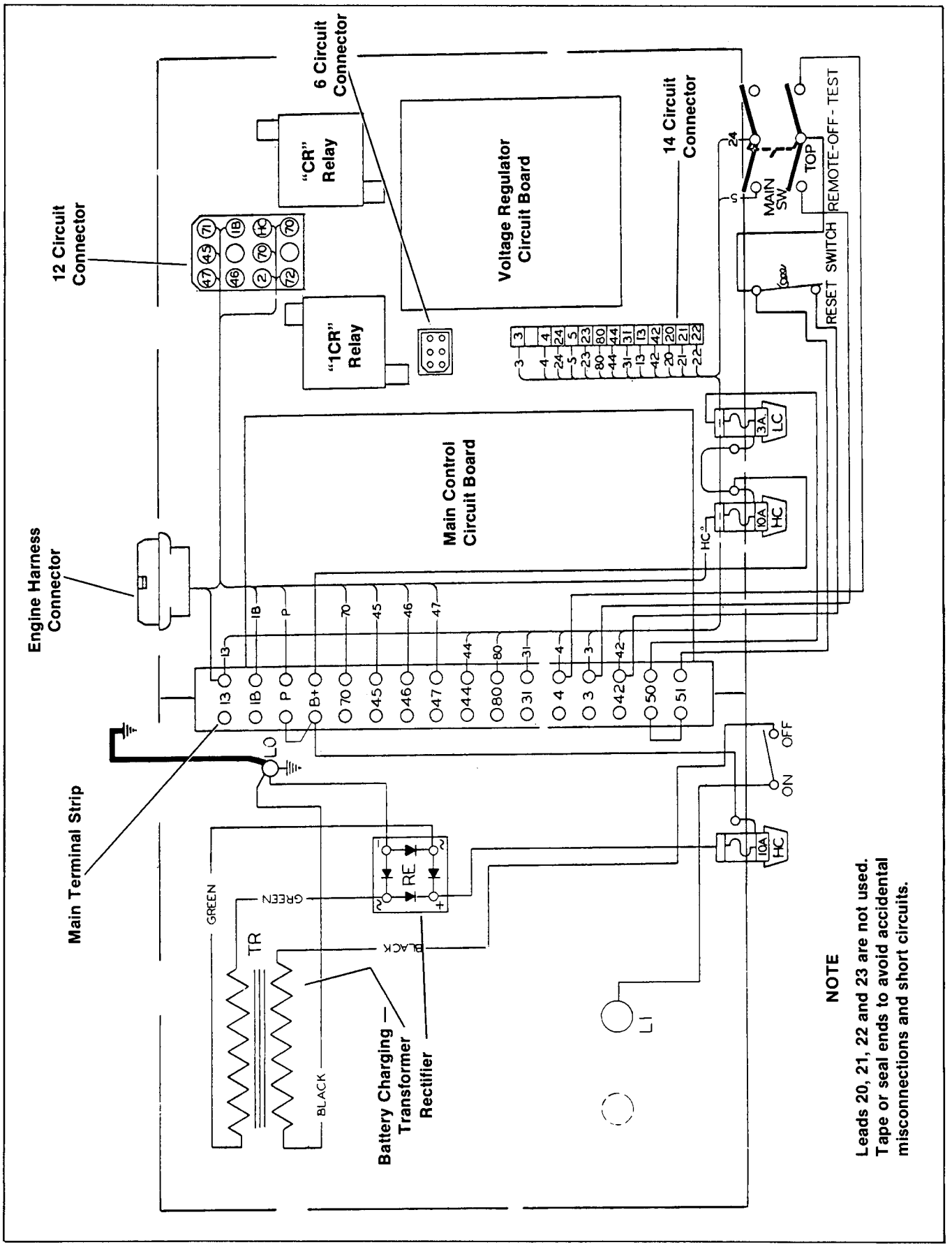


Figure 4-1. Remote Controller — Solid State Circuitry — Models 7.5R

Automatic — Models 7.5A

Table 4-2 lists some common causes of engine/generator troubles — use this table and Figure 4-2 to locate causing factors.

Table 4-2. Troubleshooting Automatic — Solid State Circuitry — Models 7.5A

CONDITION	POSSIBLE CAUSE
A. Unit Will Not Crank in Test Position	1. Weak or dead battery. 2. Blown fuse (Section 5). 3. Reverse or poor battery connection — must be negative ground (Section 2). 4. Faulty "C" cranking solenoid (Section 5). 5. Open connector pin or harness connection (Section 5). 6. Faulty "CR" relay (Section 5). 7. Open foil, loose or broken interconnecting pin on mother, regulator, or main control circuit board (Section 5). 8. Open jumper-terminal strip "P" to "B+" (Section 5). 9. Open jumper-terminal strip "50" to "51" (Section 5). 10. Defective regulator board (Section 5). 11. Defective circuit board (Section 5). 12. Defective main control board (Section 5). 13. Faulty starter motor.
B. Unit Will Not Crank on Load Demand	1. Miswired load connection to generator (Section 12). 2. Open "L" load relay contacts (Section 5).
C. Unit Cranks but Will Not Start	1. No fuel. 2. No spark (Section 11). 3. Open foil, loose or broken pin on circuit board (Section 5). 4. Open or ground in harness assembly (Section 5). 5. Faulty circuit board (Section 5). 6. Faulty "1CR" relay (Section 5). 7. Poor compression (Engine Manual, ES-652). 8. Valve problems (Engine Manual, ES-652).
D. Unit is Hard Starting	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Improper cooling (Section 10). 4. Poor compression (Engine Manual, ES-652). 5. Valve problems (Engine Manual, ES-652). 6. Choke out of adjustment (Section 9).
E. Unit Starts but Shuts Down Within 60 Seconds	1. Misadjusted or faulty speed sensor (Section 7). 2. Low engine oil pressure (Section 1). 3. Faulty engine temperature sensor (Section 10). 4. No fuel. 5. Open or poor pin connector, or 6 circuit connector (Section 5). 6. Open or poor pin connection on main control circuit board (Section 5). 7. Faulty main control circuit board (Section 5).
F. Unit Continues to Start and Stop (with Normal Time Delays)	1. Insufficient load applied to generator (Section 2). 2. Defective or miswired toroid coil (Section 12). 3. Open connection, or faulty main control circuit board (Section 5).
G. Unit Starts by Itself (No Load Applied)	1. Open toroid coil (Section 5). 2. Open wiring, terminal 20 or 21 (Section 5). 3. Loose 14 pin connector (Section 5). 4. Undetected load applied (Section 2).

Table 4-2. Troubleshooting Automatic — Solid State Circuitry — Models 7.5A (Continued)

CONDITION	POSSIBLE CAUSE
H. Unit Stops Suddenly	1. No fuel. 2. No spark (Section 11). 3. Improper cooling (high temperature cutout) (Section 10). 4. Improper lubrication (low oil pressure cutout) (Section 1). 5. Valve problems (Engine Manual, ES-652). 6. Set overloaded (Section 1). 7. Loss of load (above 60 watts) (Section 2).
I. Unit Operates Erratically	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Faulty governor (Section 9). 5. Full fuel collection tank (Section 9).
J. Unit Lacks Power	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Poor compression (Engine Manual, ES-652). 6. Valve problems (Engine Manual, ES-652). 7. Carbon build-up (Engine Manual, ES-652). 8. Set overloaded (Section 1).
K. Unit Knocks or Pings	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Carbon build-up (Engine Manual, ES-652). 6. Set overloaded (Section 1). 7. Faulty AC interlock board.
L. Unit "Skips" or Misfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11).
M. Unit Backfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11). 3. Valve problems (Engine Manual, ES-652).
N. Unit Runs — No AC Output	1. Open in voltage build-up circuit (Section 7). 2. Faulty voltage regulator (Section 7). 3. "L" load relay not functioning or faulty (Section 5). 4. Sticky generator brushes (Section 7). 5. Faulty generator rotor (Section 7). 6. Faulty or misconnected generator stator (Section 7).
O. Unit Overheats	1. Improper cooling (Section 10). 2. Set overloaded (Section 1). 3. Improper lubrication (Section 1). 4. Fuel mixture wrong (Section 9). 5. Valve problems (Engine Manual, ES-652). 6. Poor ignition (Section 11).
P. Unit Will Not Shut Down when Load Demand is Removed (After Normal 60 Second Delay)	1. Undetected load remaining on generator output terminals (Section 2). 2. Open in circuit board foil pattern (Section 5). 3. Open in 12 circuit connector plug or harness (Section 5). 4. No ground connection to magneto (Section 5). 5. Faulty "1CR" relay contacts (Section 5).

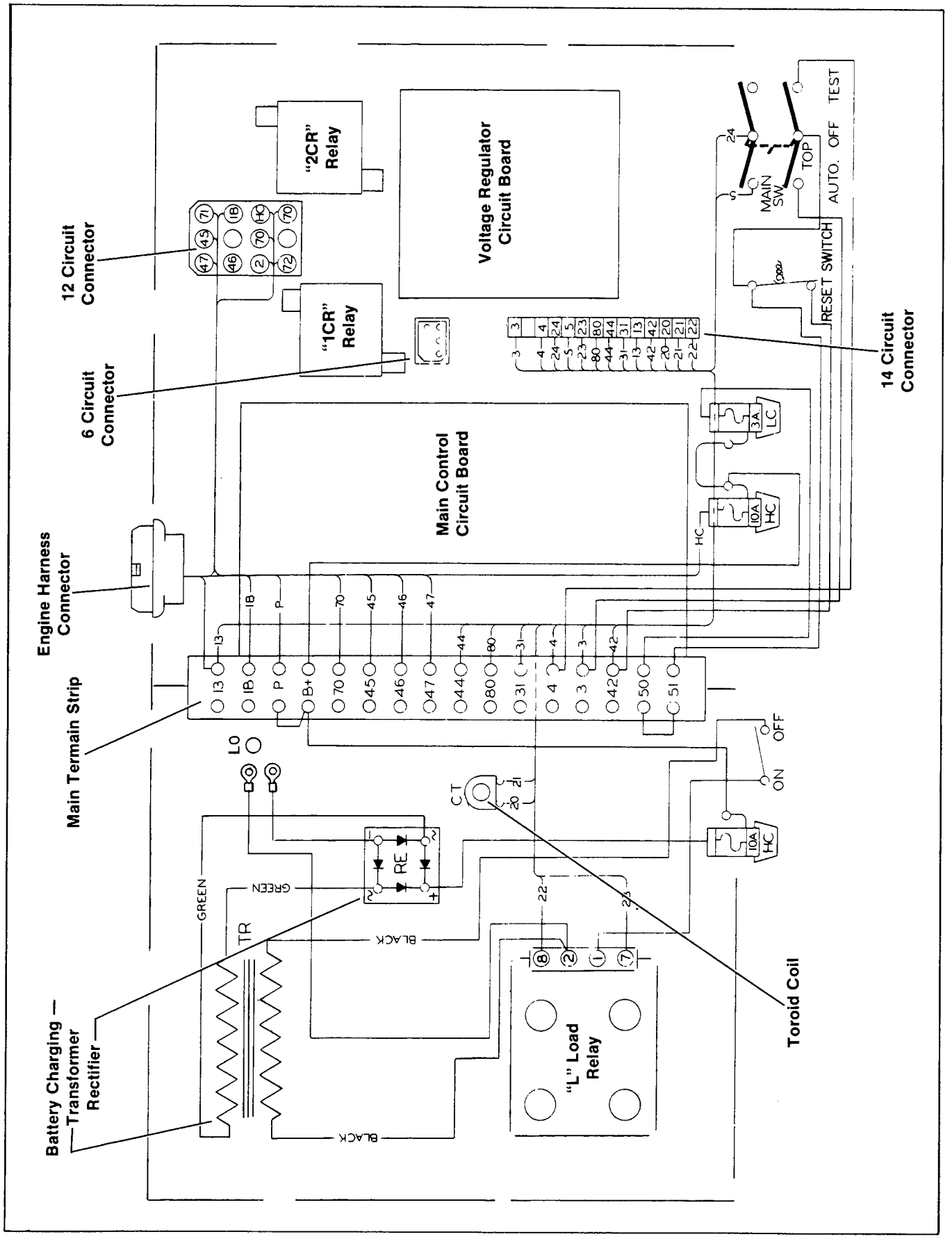


Figure 4-2. Automatic Controller — Solid State Circuitry — Models 7.5A

Remote — Models 7.5R

RELAY CIRCUITRY

Table 4-3 lists some common causes of engine/generator troubles — use this table and Figure 4-3 to locate causing factors.

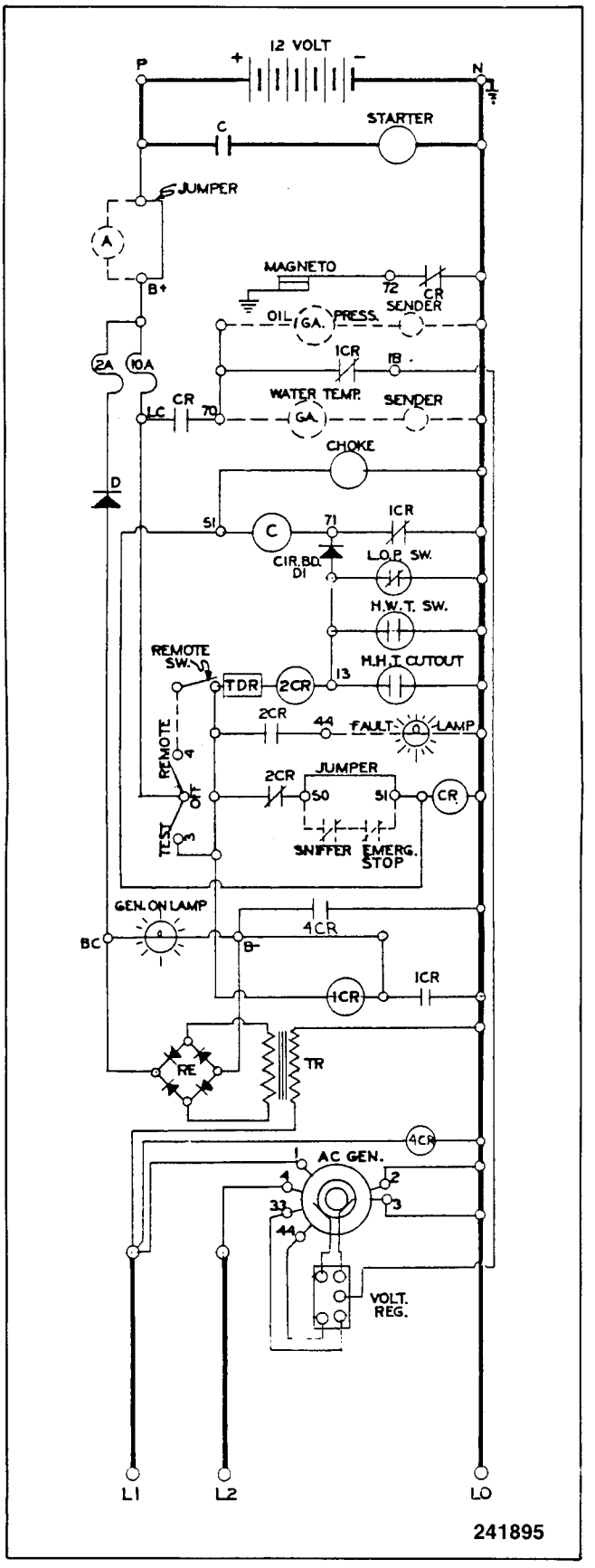


Figure 4-3. Remote Controller — Relay Circuitry — Models 7.5R

Table 4-3. Troubleshooting Remote — Relay Circuitry — Models 7.5R

CONDITION	POSSIBLE CAUSE
A. Unit Will Not Crank with Switch in Test Position	1. Weak or dead battery. 2. Reversed or poor battery connections — must be negative ground (Section 2). 3 Faulty "C" cranking solenoid (Section 5). 4 Faulty starter motor. 5. Open harness connections (Section 5). 6. Blown fuse (Section 5). 7. Open jumper, terminal strip P to B+ (Section 5). 8. Open jumper, terminal strip 50 to 51 (Section 5). 9. Faulty "2CR" relay contacts. 10. Faulty switch.
B. Unit Cranks but Will Not Start	1. No fuel. 2. No spark (Section 11). 3. Open or ground in harness assembly (Section 5). 4. Faulty "CR" relay. 5. Poor compression (Engine Manual, ES-652). 6. Valve problems (Engine Manual, ES-652). 7. Defective choke (Engine Manual, ES-652).
C. Unit is Hard Starting	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Improper cooling (Section 10). 4. Poor compression (Engine Manual, ES-652). 5. Valve problems (Engine Manual, ES-652). 6. Choke out of adjustment (Section 9). 7. Faulty ignition system (magneto, spark plugs, breaker points) (Engine Manual, ES-652).
D. Unit Starts but Shuts Down Within 30 Seconds	1. Low engine oil pressure (Section 1). 2. Faulty engine temperature sensor (Section 10). 3. High temperature cutouts (Section 10). 4. Two amp fuse blown (Section 5). 5. No AC output voltage (Section 7). 6. Defective "1CR" or "4CR" relay (Section 5).
E. Unit Stops Suddenly	1. No fuel. 2. No spark (Section 11). 3. Improper cooling (high temperature cutout) (Section 10). 4. Improper lubrication (low oil pressure cutout) (Section 1). 5. Valve problems (Engine Manual, ES-652). 6. Set overloaded (Section 1). 7. Emergency stop circuit energized.
F. Unit Operates Erratically	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Faulty governor (Section 9). 5. Full fuel collection tank (Section 9).
G. Unit Lacks Power	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Poor compression (Engine Manual, ES-652). 6. Valve problems (Engine Manual, ES-652). 7. Carbon build-up (Engine Manual, ES-652). 8. Set overloaded (Section 1).

Table 4-3. Troubleshooting Remote — Relay Circuitry — Models 7.5R (Continued)

CONDITION	POSSIBLE CAUSE
H. Unit Knocks or Pings	1. Improper fuel (Section 1). 2. Fuel mixture wrong (Section 9). 3. Poor ignition (Section 11). 4. Improper cooling (Section 10). 5. Carbon build-up (Engine Manual, ES-652). 6. Set overloaded (Section 1).
I. Unit "Skips" or Misfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11). 3. Valve problems (Engine Service Manual, ES-652).
J. Unit Backfires	1. Fuel mixture wrong (Section 9). 2. Poor ignition (Section 11). 3. Valve problems (Engine Manual, ES-652).
K. Unit Runs-No AC Output (Shut-down after 30 Seconds)	1. Open in voltage build-up circuit (Section 7). 2. Faulty voltage regulator (Section 7). 3. Sticky generator brushes (Section 7). 4. Faulty generator rotor (Section 7). 5. Faulty or misconnected generator stator (Section 7).
L. Unit Overheats	1. Improper cooling (Section 10). 2. Set overloaded (Section 1). 3. Improper lubrication (Section 1). 4. Fuel mixture wrong (Section 9). 5. Valve problems (Engine Manual, ES-652). 6. Poor ignition (Section 11).
M. Unit Will Not Shut Down with Switch in Off Position	1. No ground connection to engine magneto (Section 5). 2. Faulty "CR" relay contacts (Section 5).

SECTION 5
Controller

General

All generator set functions are dependent on the controller. For operation instructions refer to Section 2. Two types of circuitry are used on these models, relay and solid state. Relay is used on later remote models only. Solid state is used on earlier remote and all automatics. To remove controller, remove cover, disconnect wiring from controller terminal strip, remove four side screws and lift controller away from generator set. Refer to the paragraphs with your type of circuitry.

Solid State Circuitry

There are two types of solid state controllers' remote (7.5R) and automatic (7.5A). Controller components are identical with the exception of the "L" load relay and toroid coil needed for load demand sensing on automatic models. See Figure 5-1 for parts identification.

Fuses

There are two 10 amp fuses and one 3 amp fuse on the controller. For their locations refer to Section 2. Their functions are described below.

10 AMP FUSE (BELOW BATTERY CHARGING SWITCH):

This 10 amp fuse protects the battery charging circuit and guards against reverse battery polarity. If this fuse is blown, no battery charging will be available.

10 AMP FUSE (BELOW RESET SWITCH):

This 10 amp fuse protects harness wiring, circuit board foil patterns and relay contacts from shorted or faulty: engine choke, optional gas valve, hourmeter, overcurrent draw by options connected thru terminal 70, voltage regulator, voltage build-up circuitry, generator rotor or "C" cranking contactor coil. If this fuse is blown, the unit will not crank.

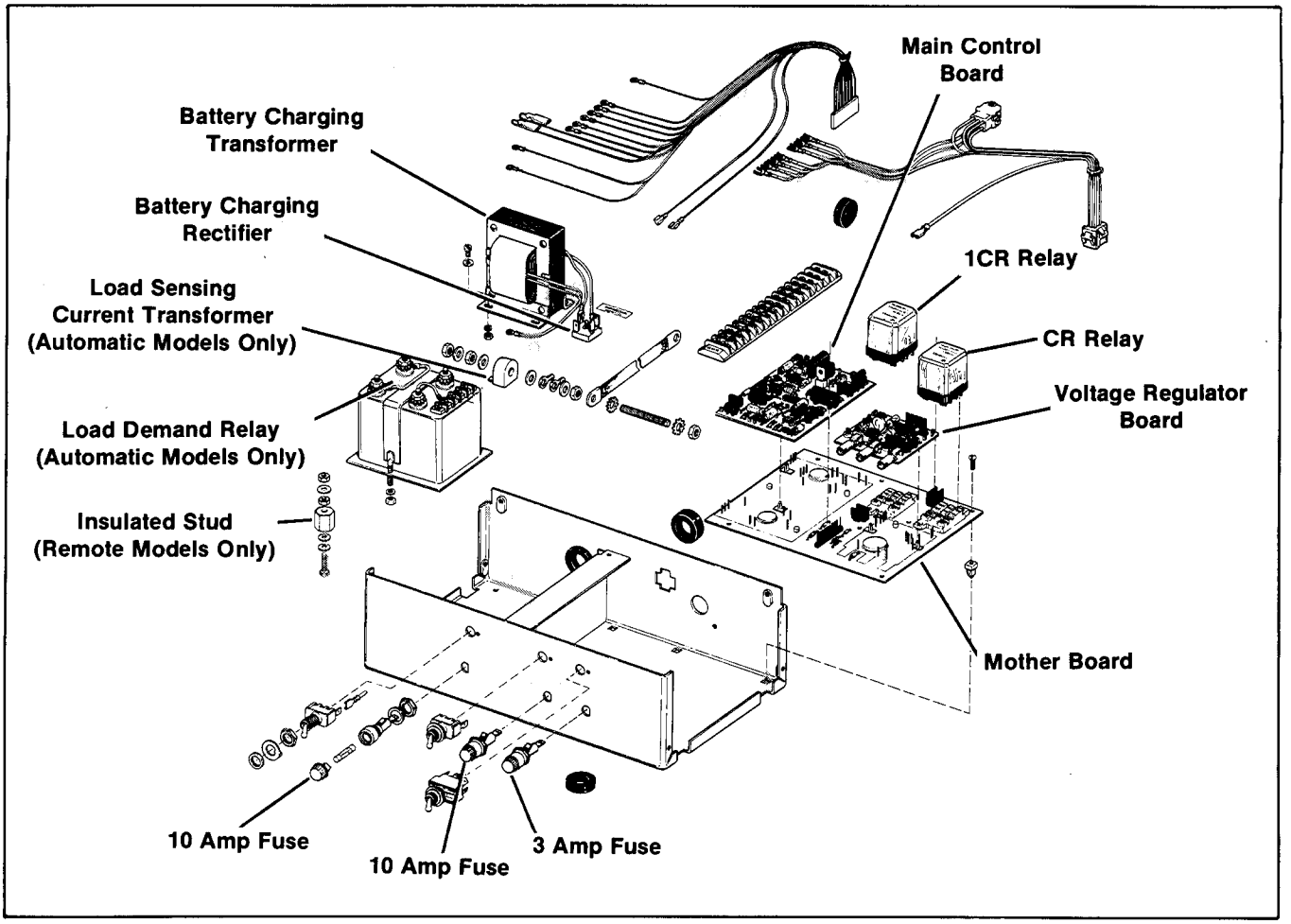


Figure 5-1. Controller, Solid State Circuitry

3 AMP FUSE (BELOW MAIN SWITCH):

This fuse protects circuit board foil and related wiring from grounded or shorted relay coils, switches or logic circuitry. The CR and 1CR relays will not operate and unit will not crank if this fuse is blown.

NOTE

Resistance from terminal 50 to ground must be at least 4 ohms with this fuse removed from holder.

Harness Assemblies

Harness and plug connectors interconnect the circuit boards and relays to engine/generator components. It is therefore, very important that a good continuity exists between mating assemblies. Continuity can be checked per the applicable wiring diagram in Section 12 with an ohmmeter.

Battery Charging

The generator will automatically provide up to 8 amps of current tapering to 0.8 amps for battery charging. This function is not required if the generator battery is charged by the propulsion engine; it may be turned off by flipping the battery charging switch on the controller to OFF.

NOTE

If the battery charging circuit is turned off, the generator will drain power from the battery during operation.

Circuit Boards

The printed circuit boards contained in the control system are as follows:

"MOTHER" BOARD (BASE):

The "mother" board (Figure 5-1) acts as a base for interconnecting harness assemblies, relays, and the voltage regulator and main control circuit boards.

VOLTAGE REGULATOR BOARD:

The regulator board (Figure 5-1) reduces and regulates the battery supply voltage to 7.5-Volts. This voltage is used to drive the logic circuit in the main control board.

MAIN CONTROL BOARD:

The main control and logic board (Figure 5-1) provides all the basic logic for operating the relays controlling engine start-up, protection while running and shutdown.

AC INTERLOCK BOARD:

The AC interlock circuit board is located in the end bracket assembly. Its function is to prevent the starter motor from re-engaging the ring gear while the engine is running. For interlock board removal and testing refer to Section 7.

Voltage Checks

Under normal operating conditions the voltages listed in Table 5-1 should be available at the points designated. If

When the starting battery is connected to the generator set (switch off) battery voltage (12-Volts DC) is available at:	• Terminals, P, B+, 42, 50 and 51 on the main terminal strip in the controller. • The H.C. and L.C. fuses. • Both terminals of the reset switches. • The center terminal of the selector switch connected to the reset switch. • All common contacts of the "CR" relay (7, 8, 9). • Common contact 7 of the "1CR" relay. • Pins 6 and 9 of the 12 circuit connector. • Pin 42 on the voltage regulator circuit board. • Pin 42 on the 14 circuit connection.
With switch off battery negative or ground potential is:	• Pin 2 on the regulator and main control circuit boards. • Terminal 31 on the main terminal strip. • Pins 1 and 4 on 12 circuit connector. • Pins 1 and 3 on 6 circuit connector. • Pin 31 on 14 circuit connector.
Moving the selector switch to the test position also places 12-Volt DC potential to ground at:	• Terminal 3 on the main terminal strip. • J49 and D2 on the mother board. • Pin 49 on the main control board. • Terminal "B" (coil) of "CR" relay. • Terminal "A" (coil) of "1CR" relay. • Pins 3, X and 1 on the regulator circuit board. • Pin 3 on the 12 circuit connector.

Table 5-1. Voltage Checks

you do not obtain the indicated voltages use Figure 5-2 to locate and correct the cause. Check for loose, corroded or broken pin connections, open foil patterns, or a faulty "daughter" or "mother" board.

Sequence of Operation

The controller is the controlling point for generator set operation. The following paragraphs cover the sequence of operation for both the remote (7.5R) and automatic (7.5A) models. See Figure 5-3 for both models.

REMOTE-MODELS 7.5R:

1. When the main switch is placed in the test position battery voltage is furnished to the input terminal pins 1 and X of the regulator board.
2. A regulator output of 7.5-Volts DC is then available at the output terminal pin 24.
3. This 7.5-Volts DC provides power to the logic circuit of the main control board-pins 5, 6 and 24.
4. Engine cranking is controlled by the "CR" relay which supplies power to the "C" contactor via pin 71 of the 12 circuit connector.
5. The "C" cranking contactor connects the battery positive connection to the starter motor during the cranking mode.

NOTE

The D4 diode connected across the coil of the contactor is a "free-wheeling" diode. Resistance of the "C" coil is 18 ohms with the D4 diode removed.

6. The "CR" relay is energized by transistor Q9 on the main control board (pin 8).

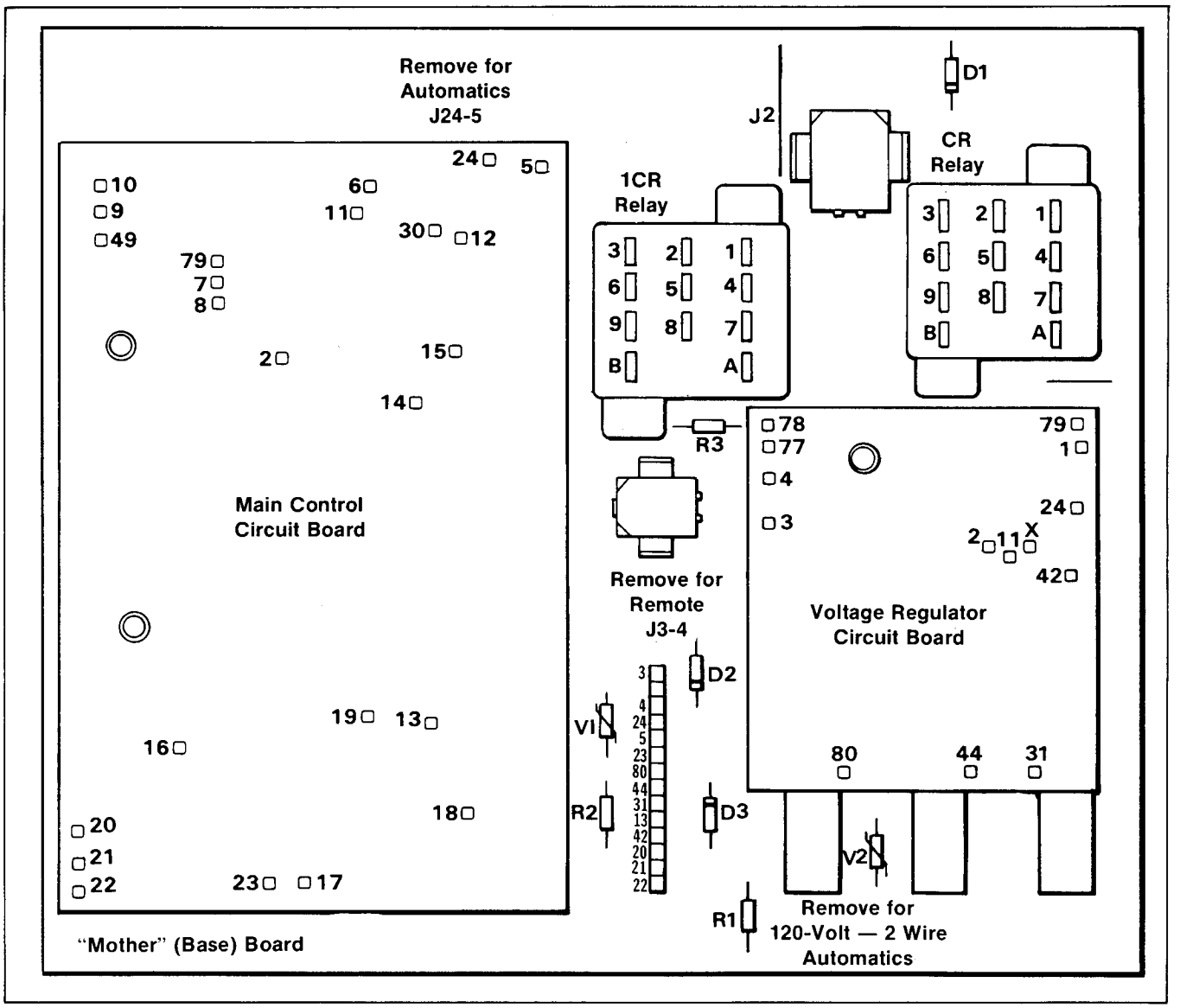


Figure 5-2. Circuit Board Pin Identification

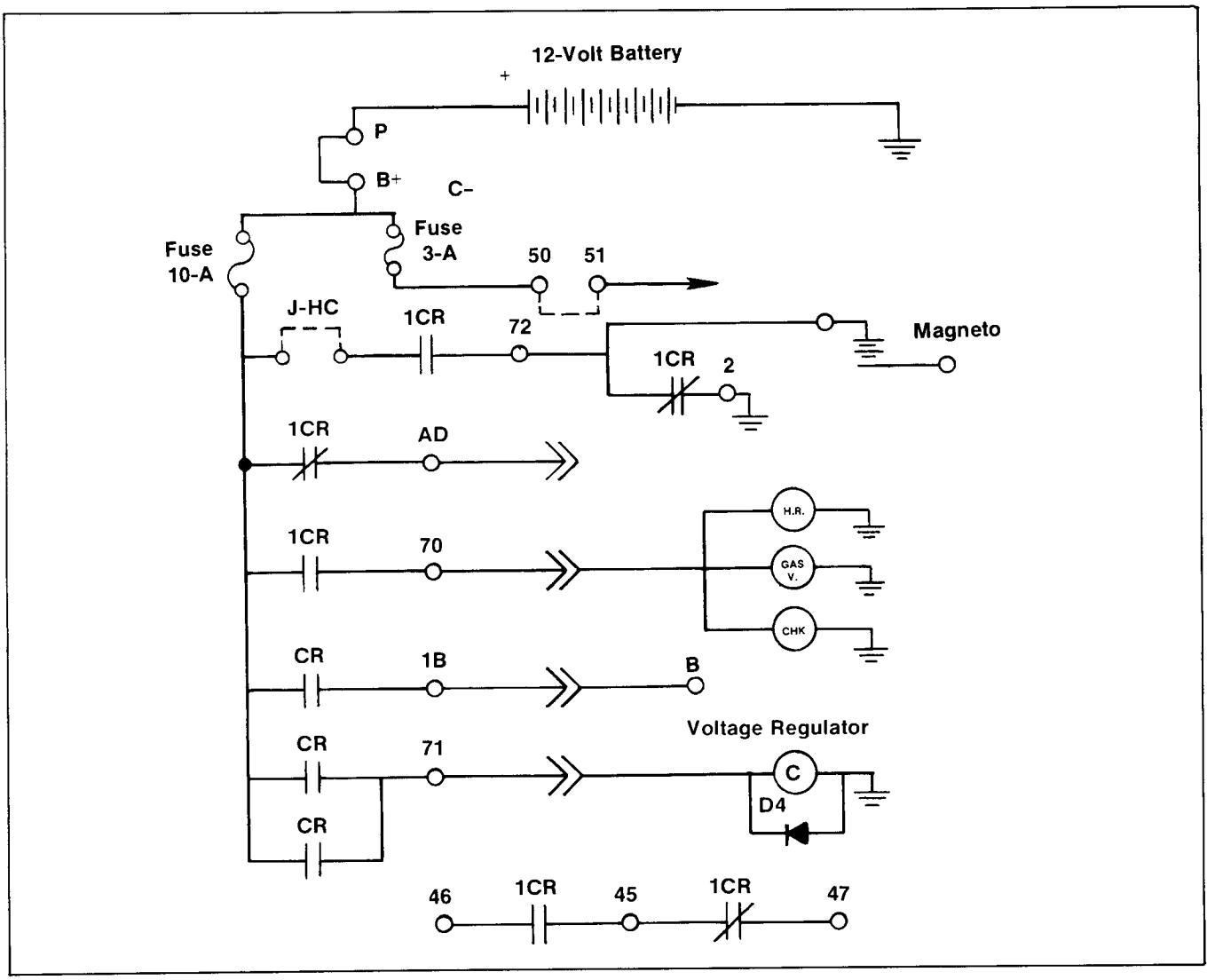


Figure 5-3. Sequence of Operation Schematic

7. Battery potential for the carburetor choke and optional circuits to terminal 70 of the main terminal strip are provided by the "1CR" relay.
8. The "1CR" relay is energized by transistor Q4 on the main control circuit board (pin 7) which provides the negative potential for the relay coil.
9. De-energizing of the "CR" relay to terminate cranking is accomplished by the speed sensor mounted in the generator end bracket.
10. A 7.5-Volt DC supply is connected to terminals 24 (+) and 2 (-) of the sensor. When the generator is rotating a ferrous metal projection mounted on the rotor shaft passes in close proximity to the sensor causing it to deliver a negative output signal at terminal (0) or pin 16 at the main control circuit board.
11. When this signal is at a fixed level determined by engine speed Q9 will be turned off. This in turn removes the negative potential at pin 8 and the coil of the "CR" relay.
12. Moving the main switch to the off position removes battery supply to the input of the regulator board and coils of the "CR" and "1CR" relay. De-energizing the "1CR" relay places a ground potential to the magneto via terminal 72 (pin 1 of the 12 circuit connector).

AUTOMATIC (LOAD DEMAND)-MODELS 7.5A:

1. Placing the main switch in the "auto" position provides battery postive potential to terminals 3 and 4 on the main terminal strip, and supply input (pins 1 and X) to the voltage regulator circuit board.
2. 7.5-Volts DC regulator output is now available to pins 24 of the regulator and main control circuit board. The circuit is now in the ready position and awaiting a load demand start.
3. When a load is connected to the generator AC output terminals L_1 and L_0 a completed circuit exists from ground through a normally closed load relay contact ("L") to pin 23 of the 14 circuit connector.

4. This provides a signal to "turn on" the Q8 transistor on the main control board and provide the 7.5-Volt DC supply to pins 5 and 6.
5. This allows both the Q4 and Q9 transistors to "turn on" and energize the crank ("CR") and run ("1CR") relays.
6. When the generator is operating at its normal output the "L" load relay energizes, the normally closed "L" contacts open and the normally open contacts close connecting the AC generator output to the load.
7. A toroid coil placed around the "LO" lead senses current flow caused by the load. The secondary leads transmit a small AC signal via pins 20 and 21 of the 14 circuit connector to pins 20 and 21 of the main control circuit board.
8. This signal maintains transistor Q8 in the "on" condition allowing a normal run mode.
9. Removing the load from the generator causes a loss of signal from the toroid coil to terminals 20 and 21.
10. A time delay prevents Q8 from "turning off" allowing the "1CR" relay to remain energized for approximately 45 seconds. This offers an engine cool down period before grounding the magneto and stopping the engine.

Relay Circuitry

Relay circuitry is used on remote (7.5R) models only. Refer to Figure 5-4 for parts identification.

Fuses

There is one 10 ampere fuse and one 2 ampere fuse on the controller. Their locations and functions are as follows:

2 ampere fuse — located below BATTERY CHARGING decal. This fuse protects the battery charging circuitry in the event of an overload in the circuit.

10 ampere fuse — located below controller toggle switch. This fuse protects controller circuitry, cranking relay and engine functions in the event there is a malfunction in the engine electrical system.

Battery Charging

The generator will provide a trickle charge up to 1 amp of current for battery charging.

NOTE

If the battery charging circuit is turned off, the generator will drain power from the battery during operation.

Voltage Checks

Under normal conditions the voltage listed in Table 5-2 should be available at the points designated. If you do not obtain the indicated voltages use Figure 5-5 to locate and correct the cause.

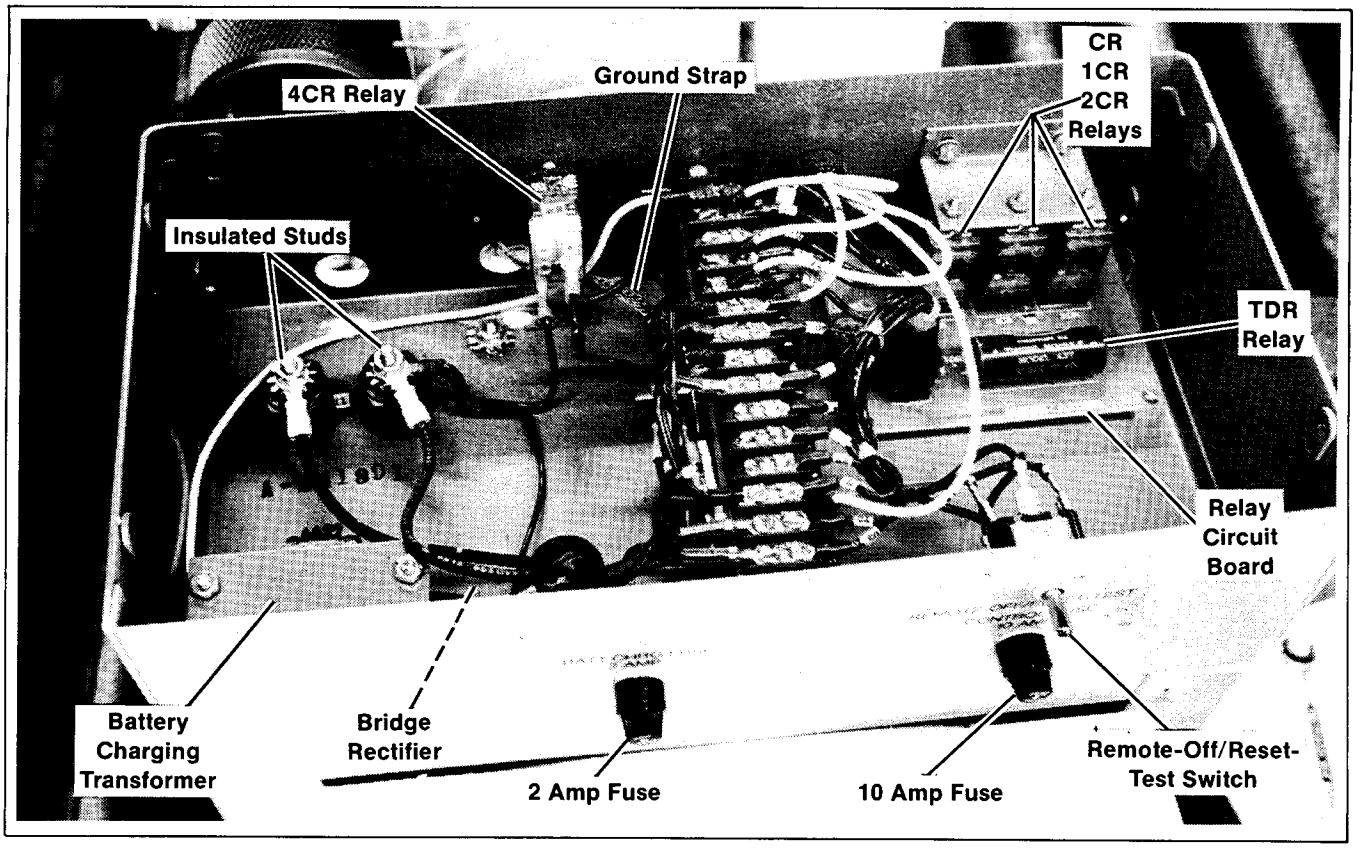


Figure 5-4. Controller, Relay Circuitry

Table 5-2. Voltage Checks

When the starting battery is connected to the generator set (Switch off) battery voltage (12 volts, DC) is available at:	• Leads P, B+. • The 2 amp and 10 amp fuse. • Lead LC at CR contact. • Common terminal of start switch.
With switch off, battery negative or ground potential is:	• At terminal N. • Starter motor frame. • Wires 13, 71, 72.
Moving the selector switch to the test position also places 12-volt DC potential to ground at:	• Terminals 3, 51 and 70.

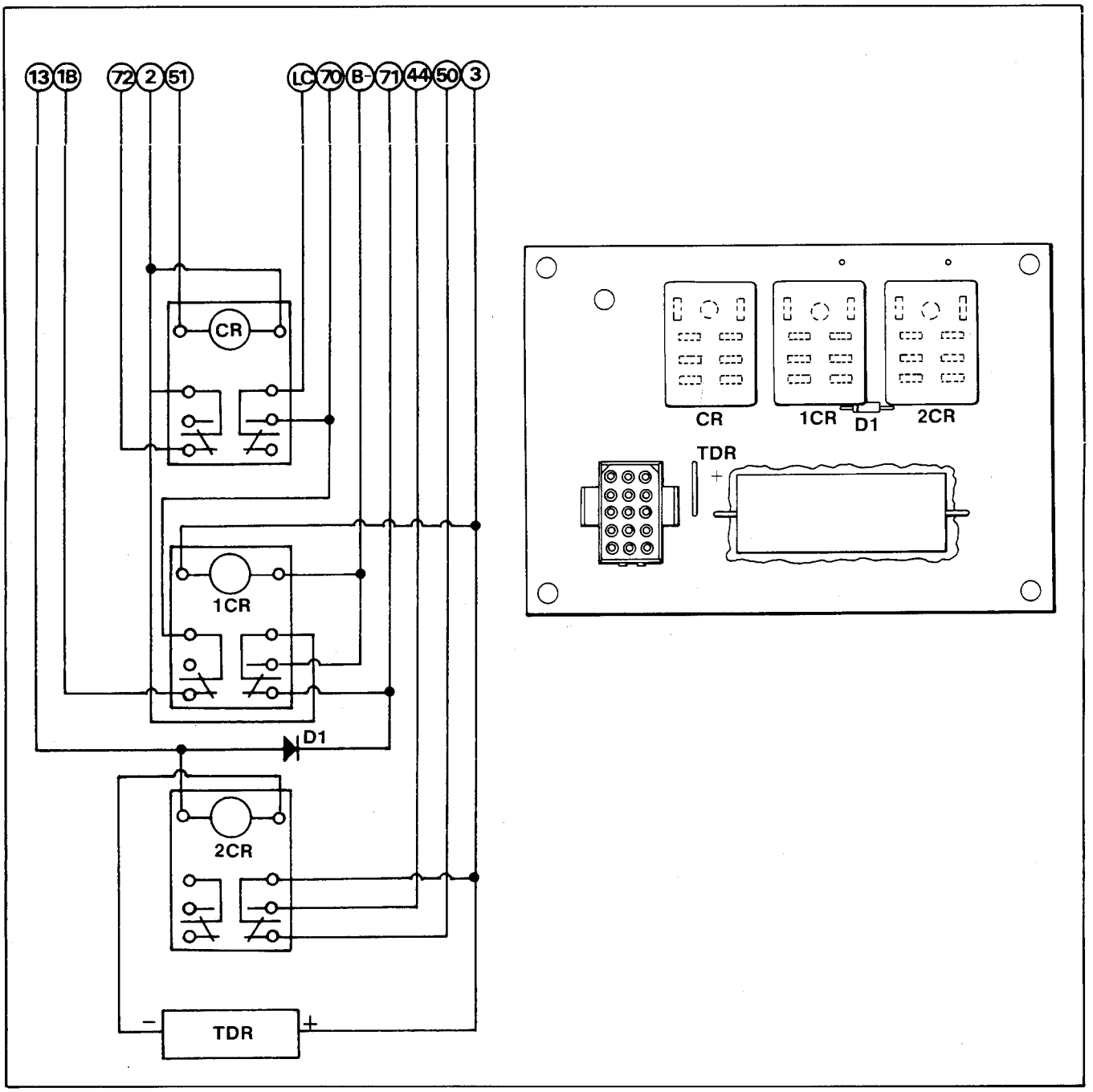


Figure 5-5. Circuit Board Identification

Sequence of Operation

The following is the sequence of operation that the controller goes through when starting, running, stopping, or fault shutdown stopping. This should serve as a starting point for controller troubleshooting. Refer to Figure 5-6 for proper wiring schematic.

Starting

- Close the start-switch between LC (B+) and 3 (TEST position); or with the switch closed between LC (B+) and 4 (REMOTE position), place the remote switch in the "START" position.
- C relay energizes. Normally open C contacts close to energize starter. The choke is energized and TDR circuit begins timing.
- CR relay energizes. Normally closed CR contacts open to unground magneto. Normally open CR contacts close to energize voltage regulator terminal B (field flashing), oil pressure gauge (if used), and water temperature gauge (if used).

Running

- Once the unit is running and comes up to proper voltage 4CR relay is energized. Normally open 4CR contacts close to energize 1CR relay and initiate battery charging.
- Battery charging is accomplished by connecting L0 and L1 to a step-down transformer TR and is converted to DC by bridge rectifier RE.
- The first set of normally closed 1CR contacts open TDR circuit preventing overcrank shutdown, and de-energize C relay. C relay contacts open to de-energize starter.
- The second set of normally closed 1CR contacts open to disconnect circuit to voltage regulator terminal B (field flashing).
- The set of normally open 1CR contacts close to help maintain battery charging and voltage to 1CR relay.
- The low oil pressure, high water temperature, and high cylinder head temperature shutdown switches can now energize the TDR circuit and cause the TDR circuit to start timing should a fault occur.

Stopping

- Open the start-switch between LC (B+) and 3 (TEST position); or with the switch closed between LC (B+) and 4 (REMOTE position), place the remote switch in the "STOP" position.
- CR relay is de-energized and normally closed CR contacts close to ground magneto.

Overcrank Shutdown

- While cranking and after the TDR times out (approximately 30 seconds) should no AC output be available, the unit will shut down due to overcrank.

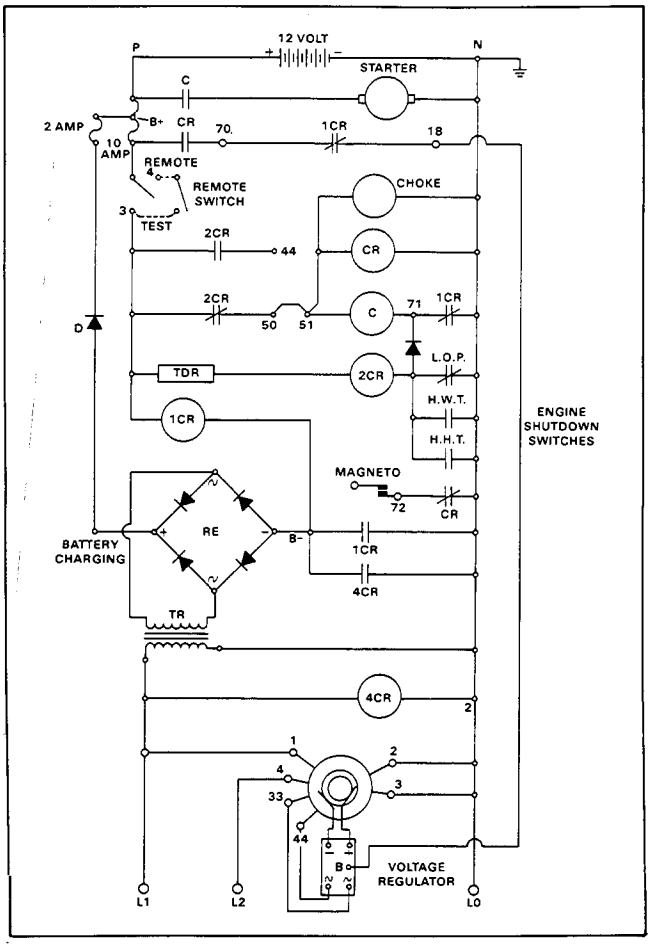


Figure 5-6. Sequence of Operation Schematic

- The 1CR relay is energized by either the AC output energizing the 4CR relay which will close the normally open 4CR contacts or by AC output connected to transformer TR and bridge rectifier RE. If no AC output is available, the 1CR relay will not energize.
- The normally closed 1CR contacts will remain closed and after the TDR times out, the 2CR relay will energize.
- Normally closed 2CR contacts will open de-energizing C relay and CR relay.
- Normally open C contacts will open to de-energize starter.
- Normally closed CR contacts will close to ground magneto.

Low Oil Pressure (LOP) Shutdown

- Low oil pressure will cause LOP contacts to close and TDR circuit will begin timing.
- After approximately 30 seconds the TDR circuit will energize the 2CR relay.
- Normally closed 2CR contacts will open de-energizing CR relay.
- Normally closed CR contacts will close grounding magneto.

High Water Temperature (HWT) Shutdown and High Cylinder Head Temperature (HCHT) Shutdown

- High temperature at one of these sources will cause shutdown switch contacts to close and TDR circuit will begin timing.
- After approximately 30 seconds the TDR circuit will energize the 2CR relay.
- Normally closed 2CR contacts will open de-energizing CR relay.
- Normally closed CR contacts will close grounding magneto.

SECTION 6
Generator Disassembly

NOTE

Tag leads to ease reinstallation. Scratch aligning marks on parts before removing to aid reassembly.

1. Disconnect battery cables.

⚠ WARNING

UNIT STARTS WITHOUT NOTICE: To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller master switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

2. Remove controller cover.
3. Disconnect the generator ground strap at the engine/generator adapter (Figure 6-1).
4. Remove engine wiring harness from the rear of the controller (Figure 6-1).

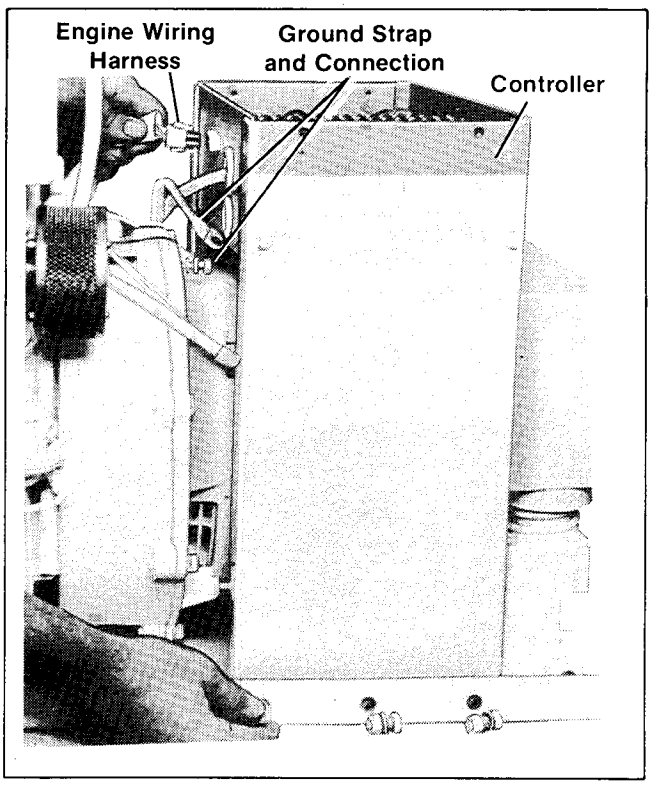


Figure 6-1. Disconnecting Wiring

5. Remove six circuit wiring harness from inside controller.
6. Disconnect stator leads 1, 2, 3 and 4 inside the controller. Refer to the applicable wiring diagram in Section 12.
7. Remove generator end panel (Figure 6-2).
8. Remove slip ring-brush cover (Figure 6-2).

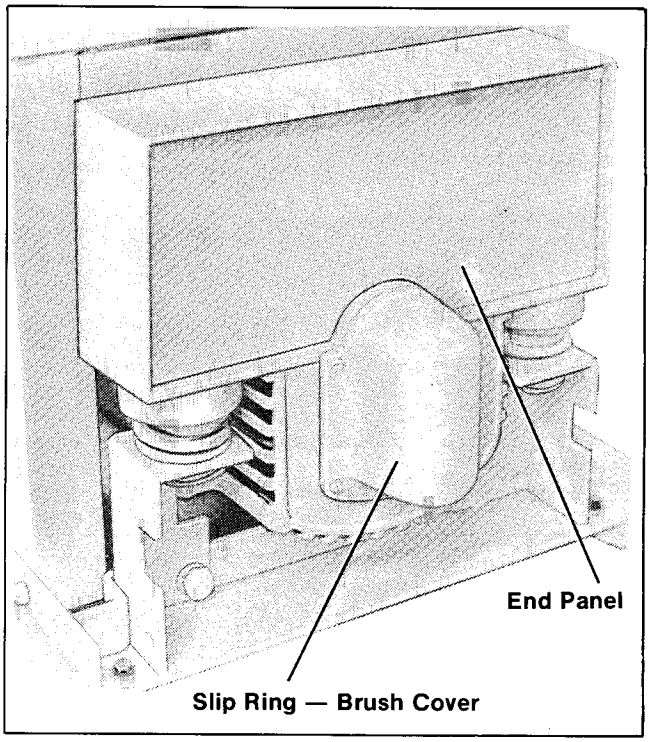


Figure 6-2. Slip Ring — Brush Cover

9. Remove the three bolts on each side of the base of the controller. The controller will now lift off (Figure 6-3). Be careful when lifting. Make sure all interconnections and stator leads are disconnected and loose.

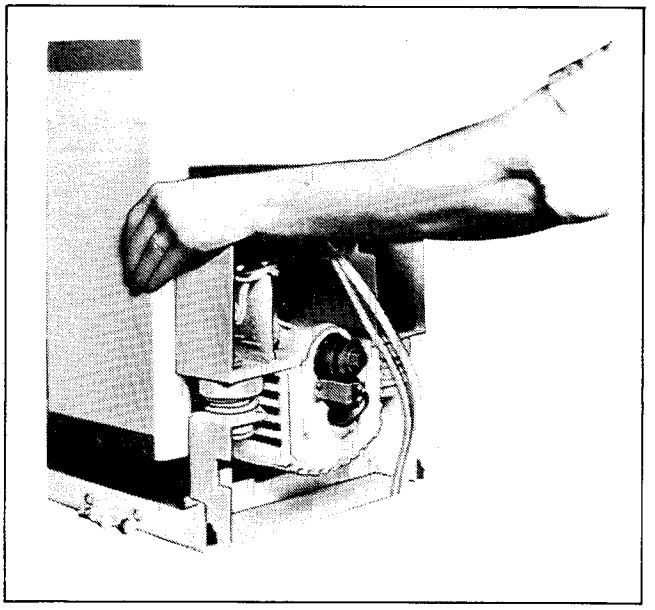


Figure 6-3. Removing Controller

10. Lift the brushes by the leads and lock in this position by inserting a retainer wire. Disconnect brush leads at grommet connector. See Figure 6-4.

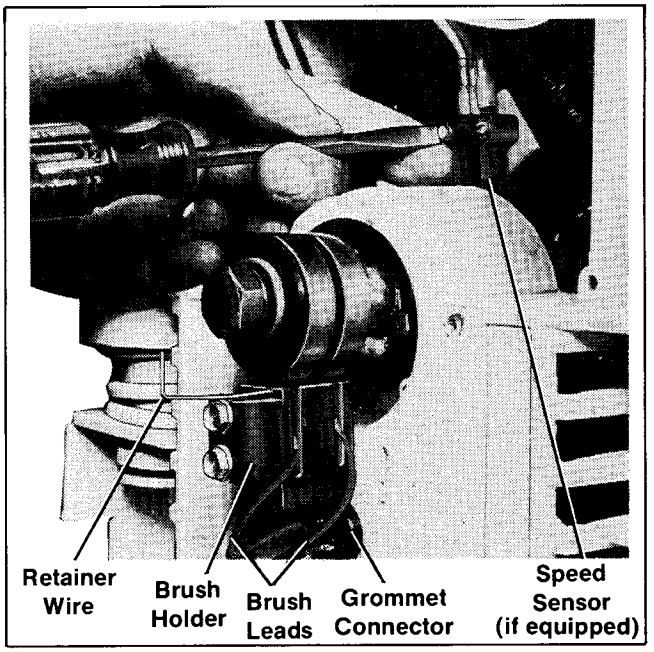


Figure 6-4. Locking Brushes and Removing Speed Sensor

11. Loosen or remove the speed sensor (Figure 6-4) to minimize the possibility of damaging it when removing generator end bracket.

12. Disconnect stator leads 33 and 44 at "quick disconnect" shown in Figure 6-5. Pull the stator leads back through the end bracket opening.

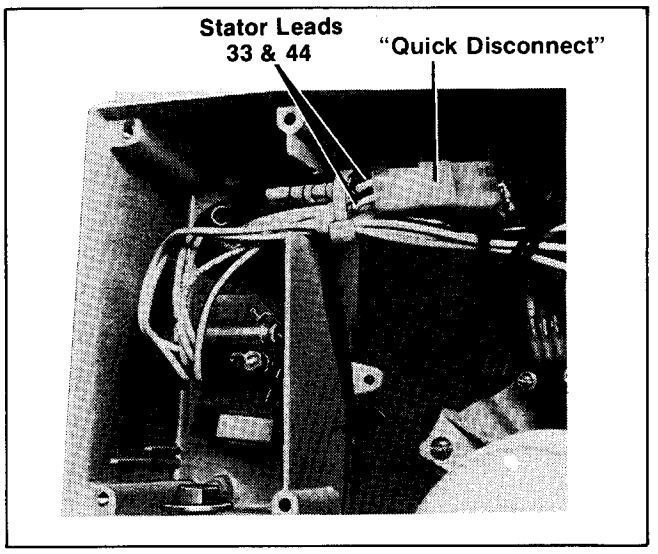


Figure 6-5. Stator Leads 33 and 44

13. Remove vibro-mount bolts, vibro-mounts and support brackets (Figure 6-6).

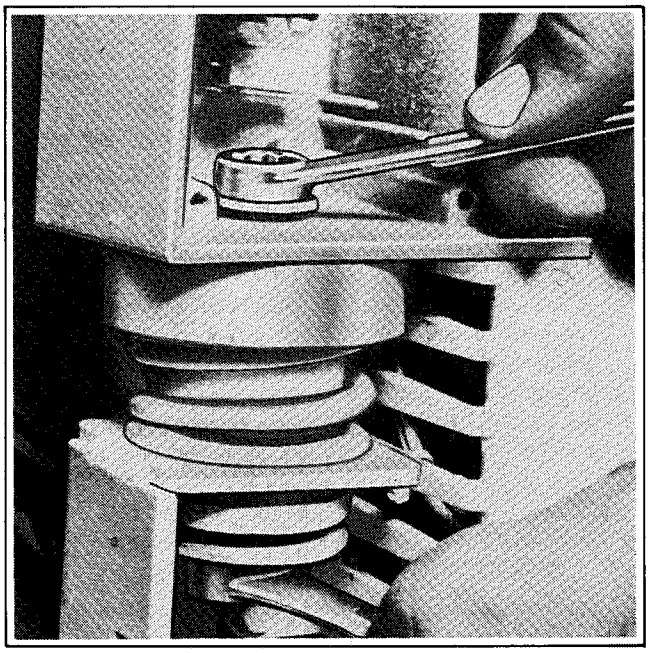


Figure 6-6. Vibro-Mounts

14. Tilt the generator end up and place blocks under the bell housing (Figure 6-7).
15. Remove the four over bolts (Figure 6-7).

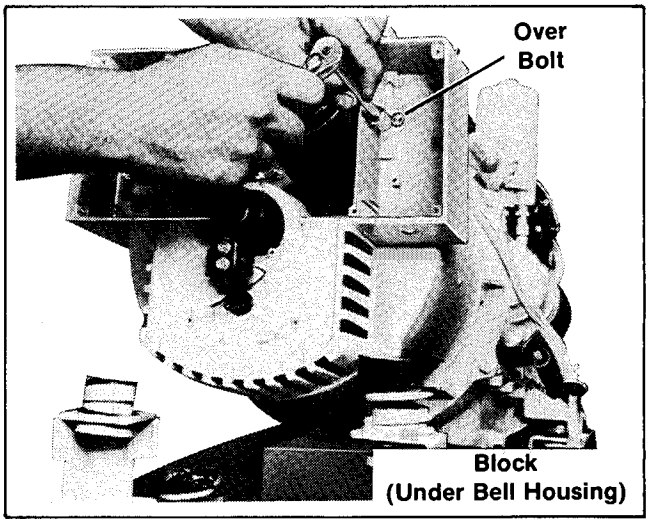


Figure 6-7. Over Bolt Removal

16. Remove generator end bracket using a rubber mallet (Figure 6-8).

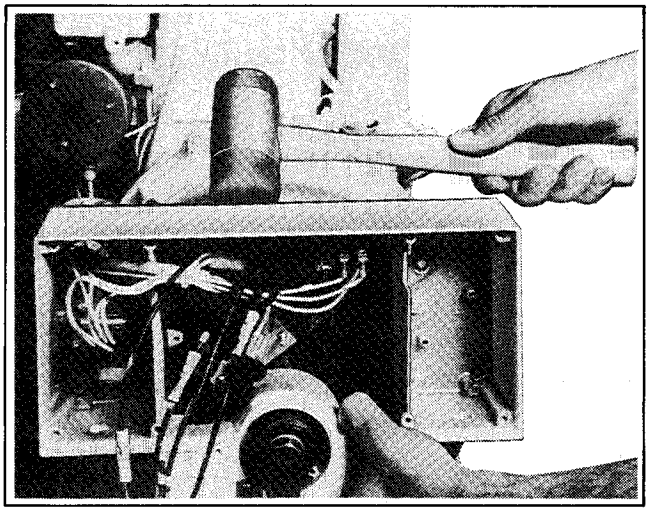


Figure 6-8. End Bracket Removal

17. Remove the stator by guiding it to the rear (Figure 6-9).

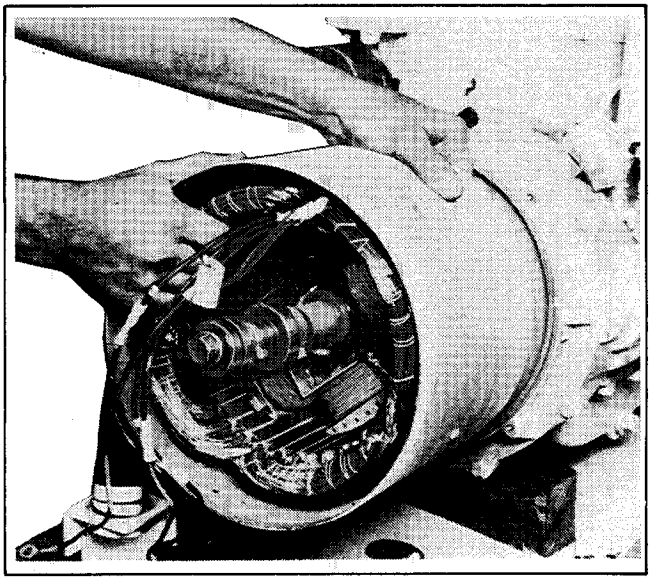


Figure 6-9. Stator Removal

18. To remove the rotor loosen the thru bolt 2-3 turns and break the rotor loose from the stub shaft taper by striking the bolt head with a heavy lead mallet (Figure 6-10).

CAUTION

If assembly does not break loose on first or second attempt replace original 1/2-13N.C.-3THD bolt with a similar bolt, but 1-2 inches (2.5-5.1 cm) longer. Use of a new 17-18 inch (43.2-45.7 cm) bolt will prevent damage or bending of the customer's thru bolt.

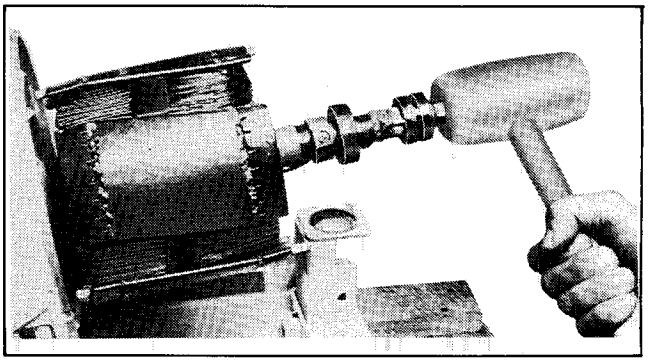


Figure 6-10. Striking Thru Bolt

19. If after striking bolt head the rotor can be rocked slightly back and forth in place, remove thru bolt and pull rotor away from engine. The generator fan will be removed with the rotor (Figure 6-11).

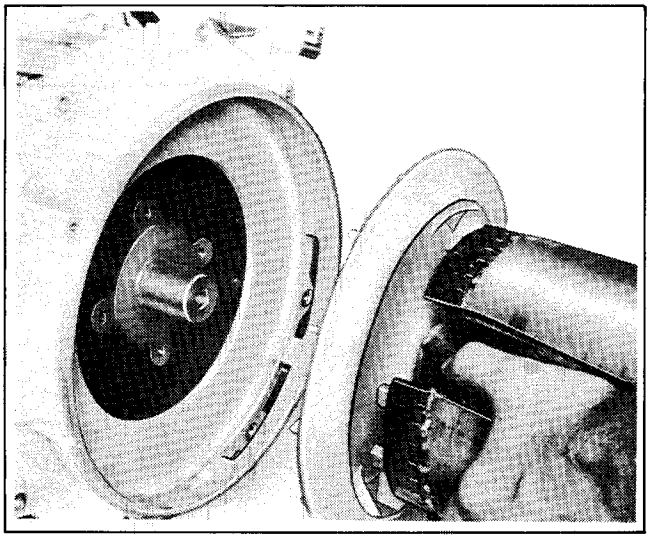


Figure 6-11. Rotor Removal

20. If the rotor seems loose but cannot be removed, the flywheel has become free of the crankshaft taper. To separate rotor from flywheel, adapter, and stub shaft proceed as follows:

    a. Remove eight bolts fastening generator adapter to bell housing (Figure 6-12).

    b. Pull rotor, adapter, and flywheel away from engine.

    c. Slide adapter over generator fan as far as possible.

    d. Remove four bolts fastening stub shaft to flywheel (Figure 6-13).

    e. The flywheel and adapter can now be removed (Figure 6-14).

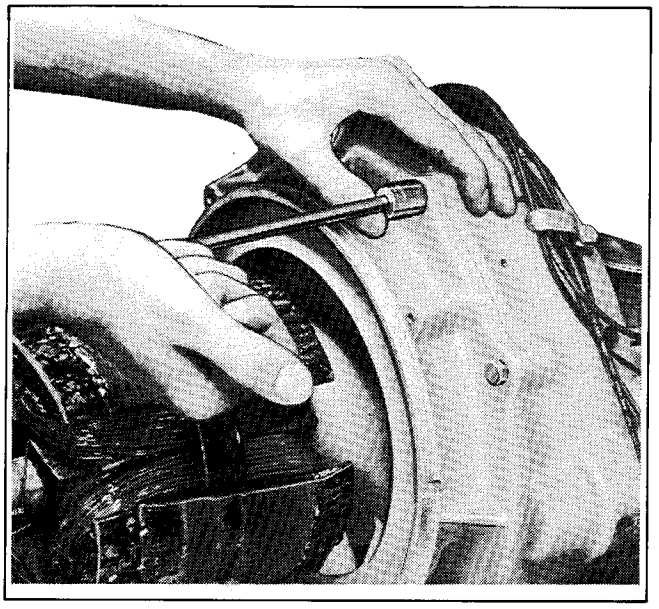


Figure 6-12. Adapter Removal

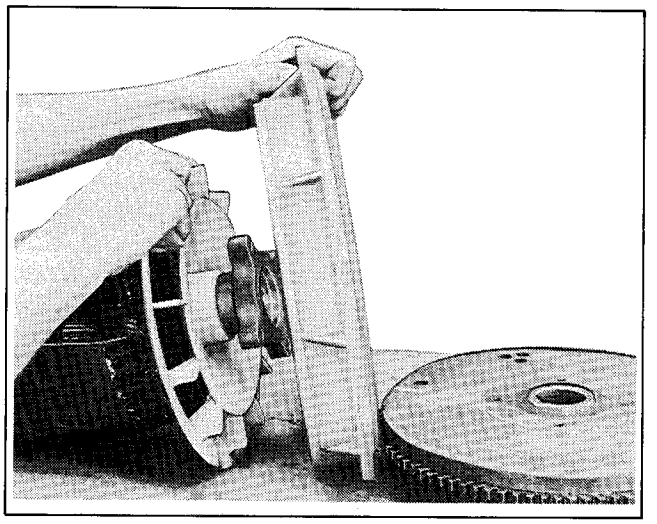


Figure 6-14. Remove Flywheel and Adapter

f. Strike downward on corner of stub shaft with a lead mallet as shown in Figure 6-15.

g. The stub shaft can now be removed.

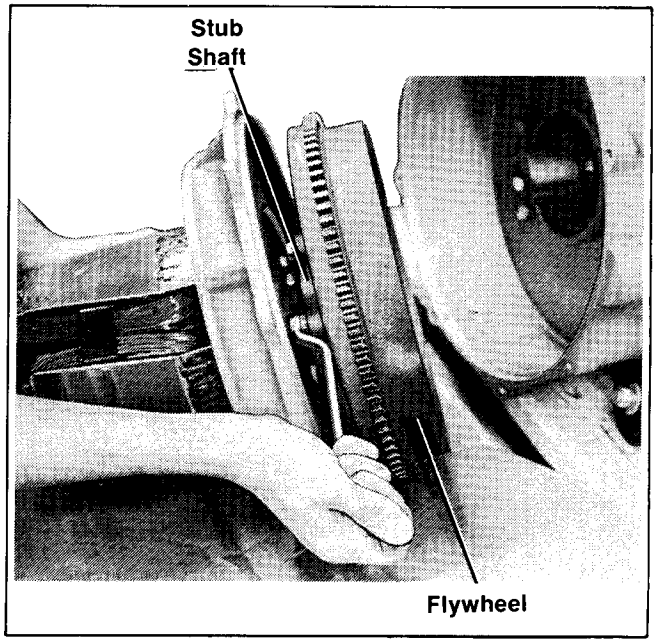


Figure 6-13. Separating Stub Shaft and Flywheel

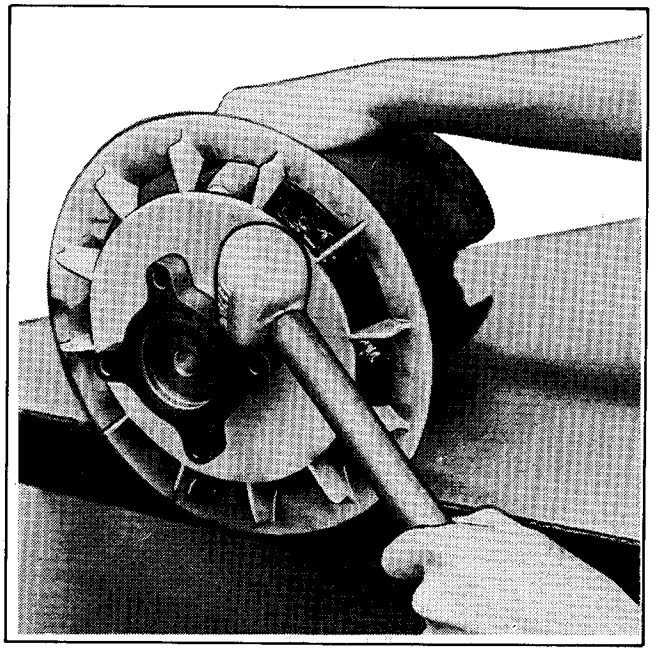


Figure 6-15. Stub Shaft Removal

SECTION 7
Generator Inspection and Service

General

This section covers inspection and testing of generator components. See Figures 7-1, 7-2, and 7-3 for parts identification. Refer to Section 4 for troubleshooting. Follow the disassembly procedure in Section 6 as far as necessary to inspect a component, then start the reassembly procedure in Section 8 at the point the component is replaced. When a fuse must be replaced always inspect the related components and wiring to locate the cause. Refer to the wiring diagrams in Section 12.

⚠ WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and that wherever electricity is present, there is the potential danger of electrocution. Take the same precautions with electrical appliances in your craft that you would observe in your home. Keep away from electrical circuits and wiring while the set is running and have electrical service performed only by qualified electricians. Make sure unqualified persons, especially children, cannot gain access to your set — keep the compartment door locked or securely latched at all times. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions.

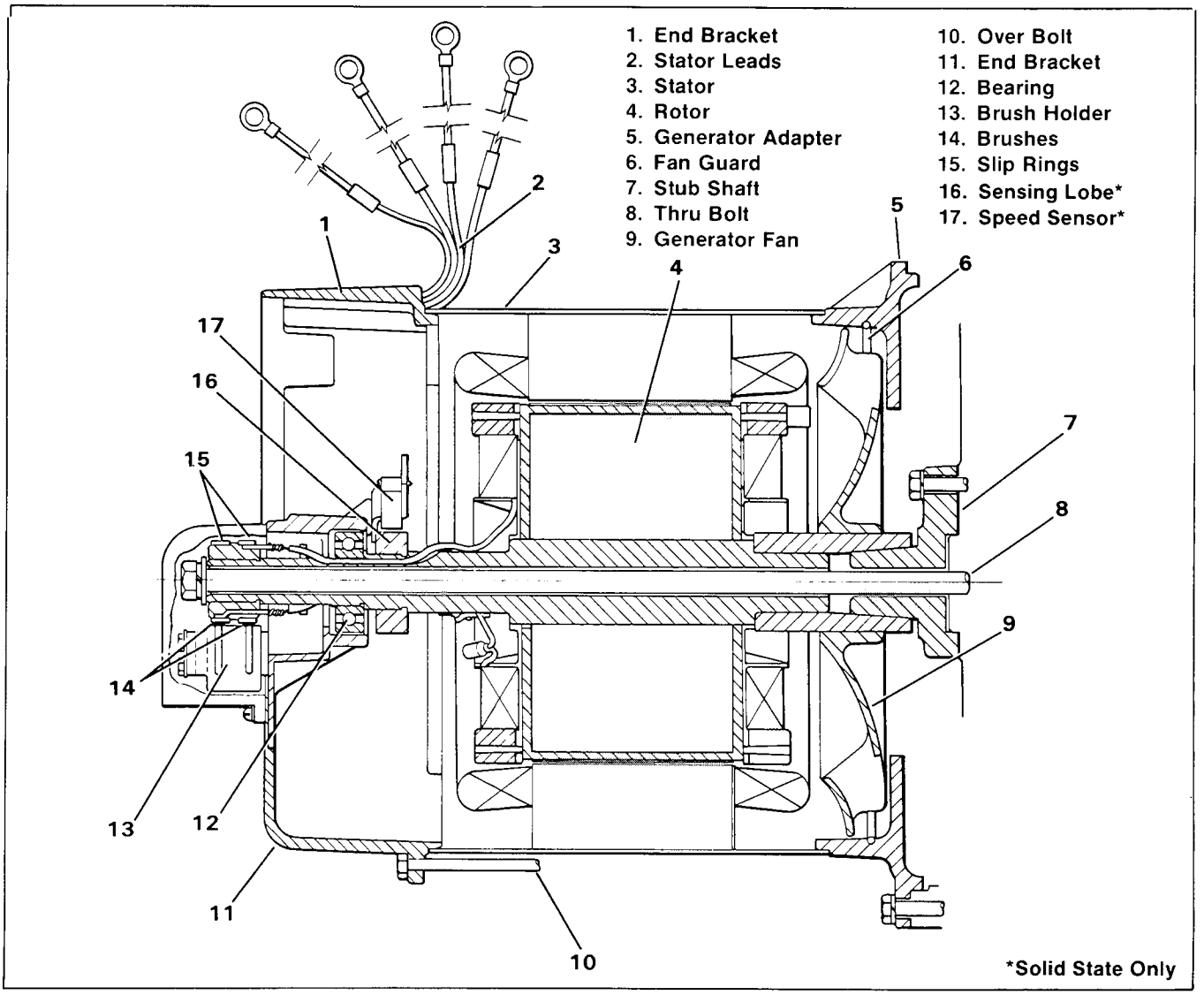


Figure 7-1. Generator, Cross Sectional View

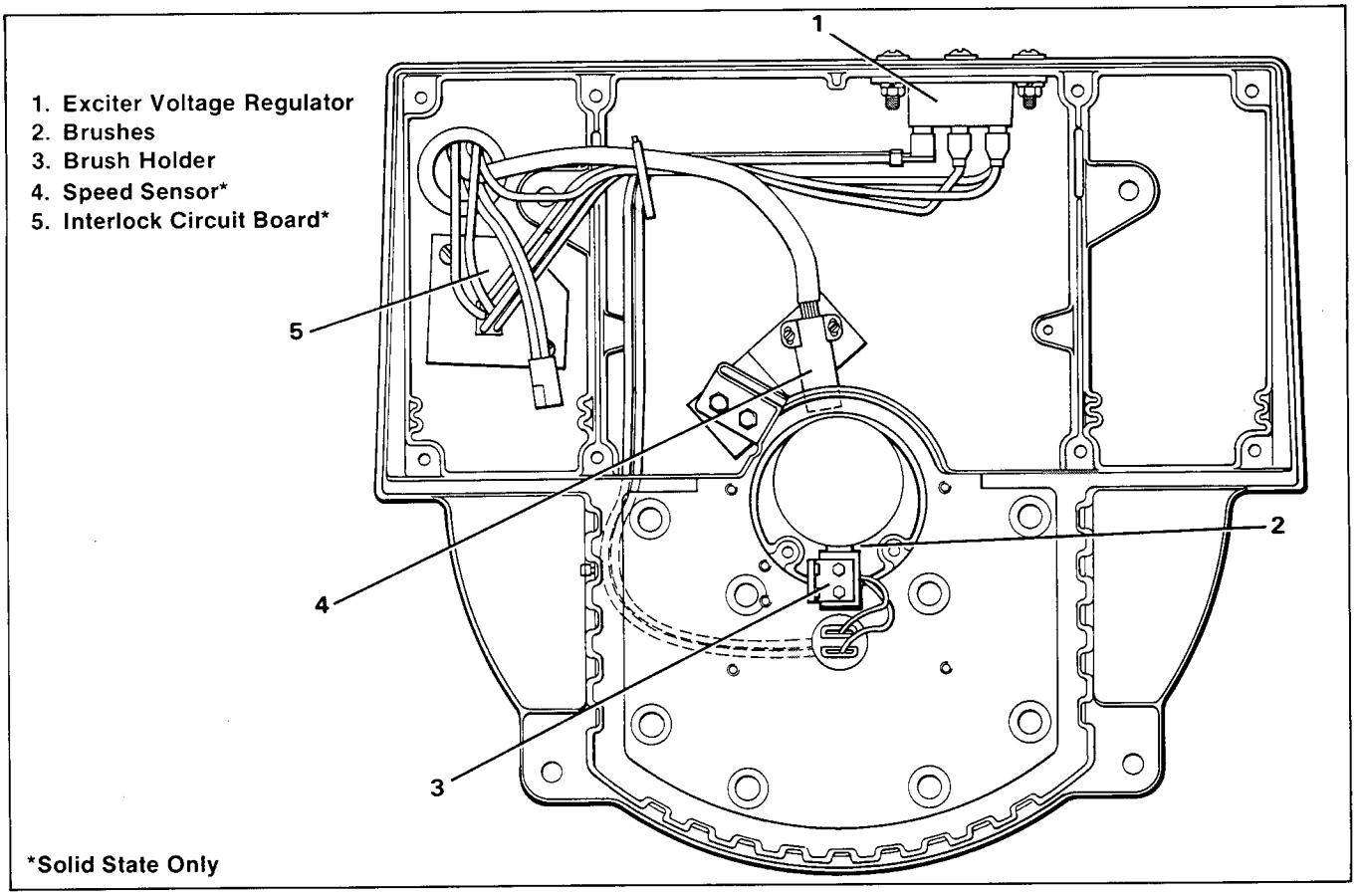


Figure 7-2. End Bracket Assembly

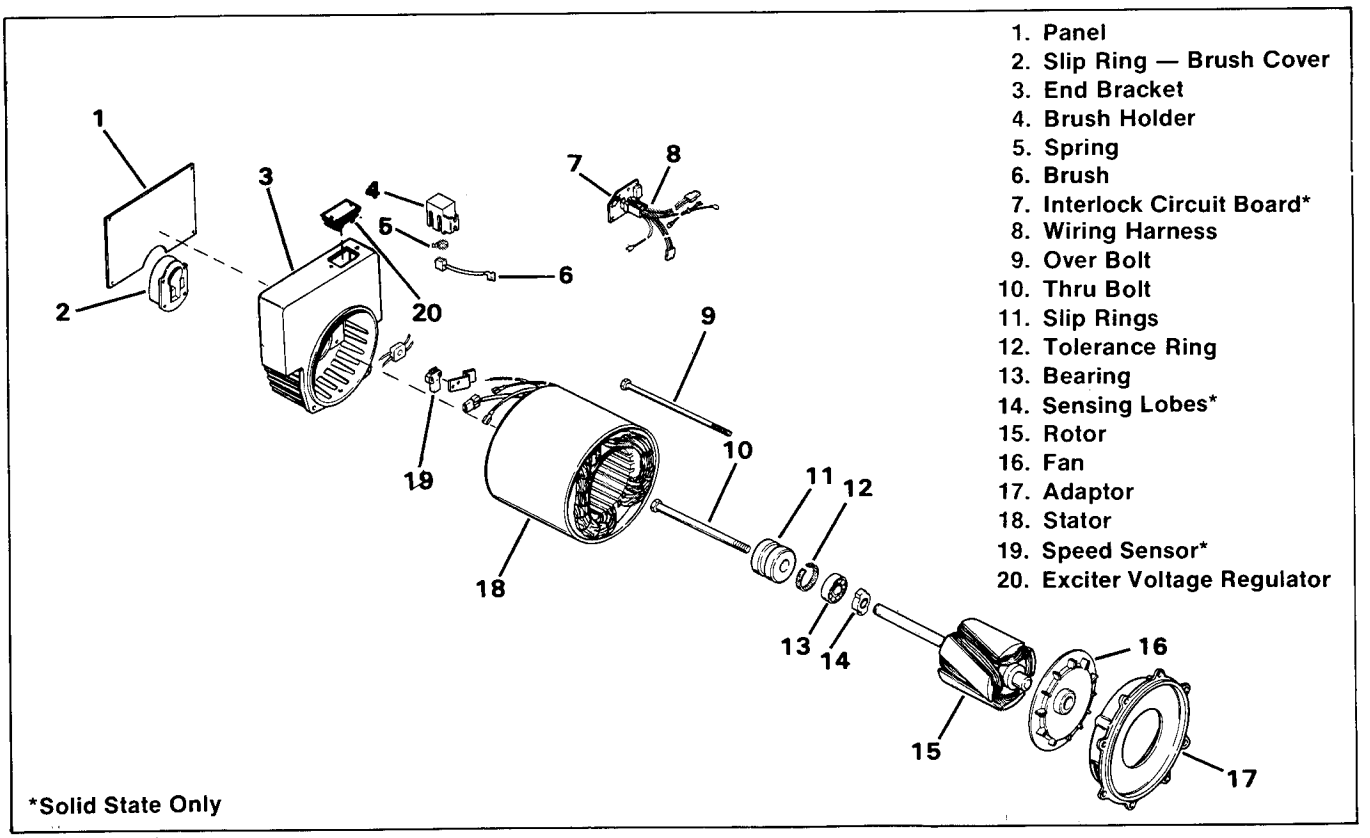


Figure 7-3. Generator Parts Identification

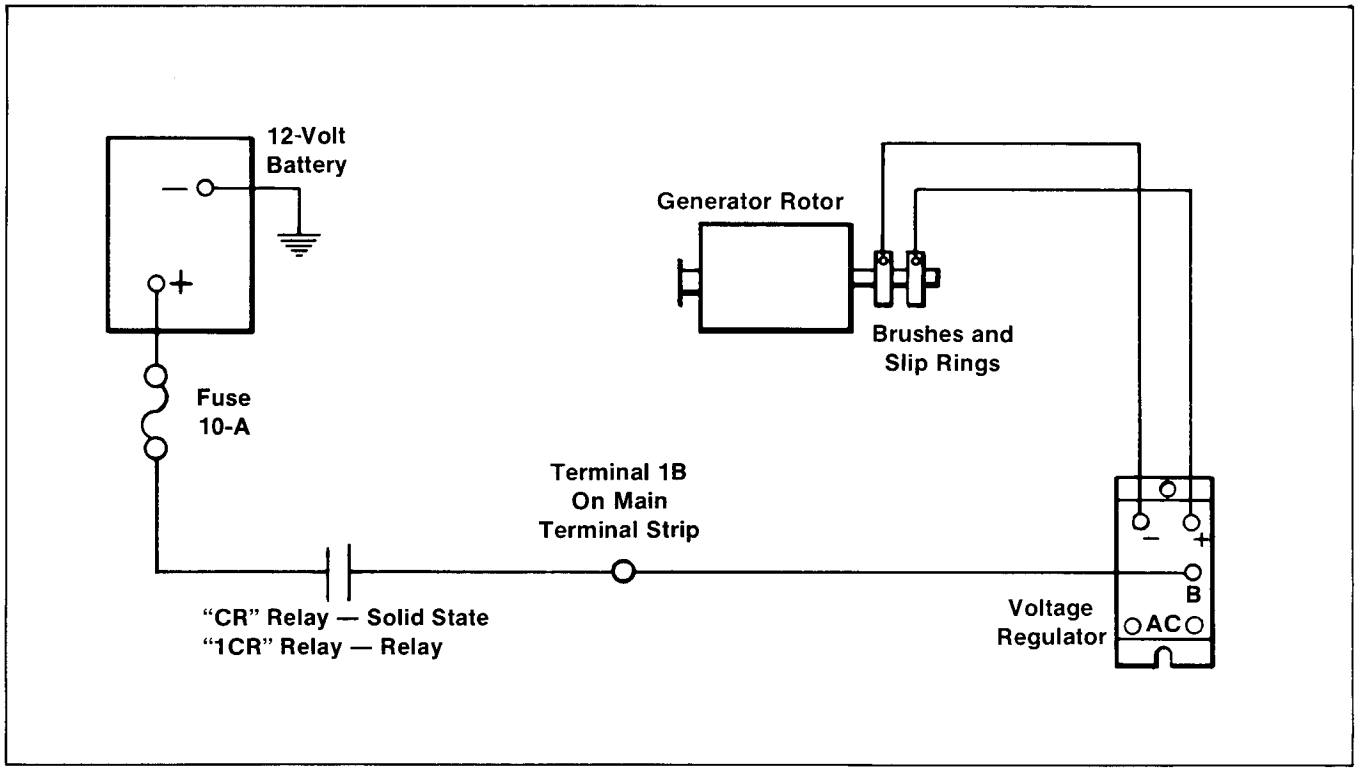


Figure 7-4. Build-Up Circuit

Build-Up Circuit

This circuit magnetizes the rotor during cranking. When the controller is activated to start, DC current flows from the battery to brushes and slip rings on the rotor. During cranking battery voltage should be available between: terminal 1B on the main terminal strip in the controller and ground, and terminal B on the voltage regulator and ground. See Figure 7-4.

Separate Field Excitation

As a preliminary aid to troubleshooting, the generator field (rotor) may be excited (magnetized) using an outside power source and the following procedure:

1. Disconnect brush leads from voltage regulator at grommet connector.

WARNING

EXPLOSIVE BATTERY GASES! The gases generated by a battery being charged are highly explosive. 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 to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Any compartment containing batteries should be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections.

WARNING

ELECTRICAL SHOCK! Battery can cause electrical burns and shocks. Exercise reasonable care when working near the battery to avoid electrical connections through tools. Remove wristwatch, rings, and any other jewelry.

2. Connect brush leads in series with a 12-Volt battery and DC ammeter as shown in Figure 7-5.

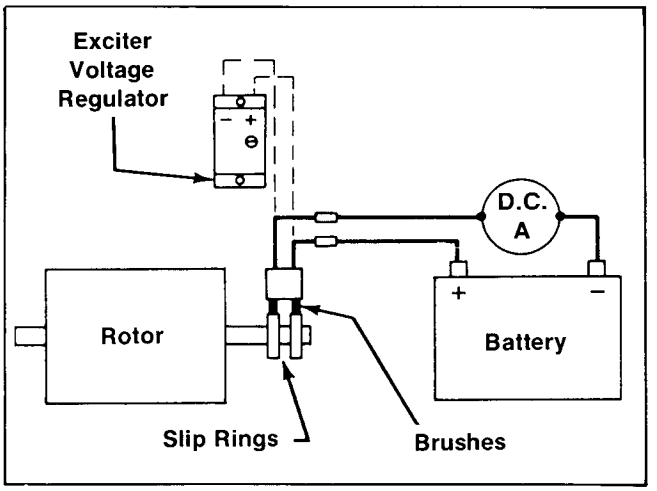


Figure 7-5. Separate Field Excitation

3. Ammeter reading should approximate battery voltage divided by specified rotor resistance (10-12 ohms).

4. Record ammeter reading.
5. Start generator set and run at NO load.
6. Observe ammeter with unit running. If current increases considerably, a running short in the rotor has been detected. If current drops to zero, an open rotor is indicated.

Brushes

GENERAL:

The brushes transfer current from the voltage regulator to slip rings. The brushes carry a very low current (approximately 2 amperes) and should last the life of the generator set. Abrasive dust on the slip rings could, however, shorten the life of the brushes. Excessive arcing at the brushes could damage the voltage regulator. Arcing could be caused by weak springs, damaged slip rings, loose holder, sticking brushes or improper brush-to-slip ring alignment.

MAINTENANCE:

1. Remove the slip ring-brush cover to gain access to the brushes.
2. The brushes must be free to move within the holder and held in proper contact by the springs. When properly positioned, spring pressure on the brush surface will cause the brush to wear evenly. Figure 7-6 shows normal brush wear.

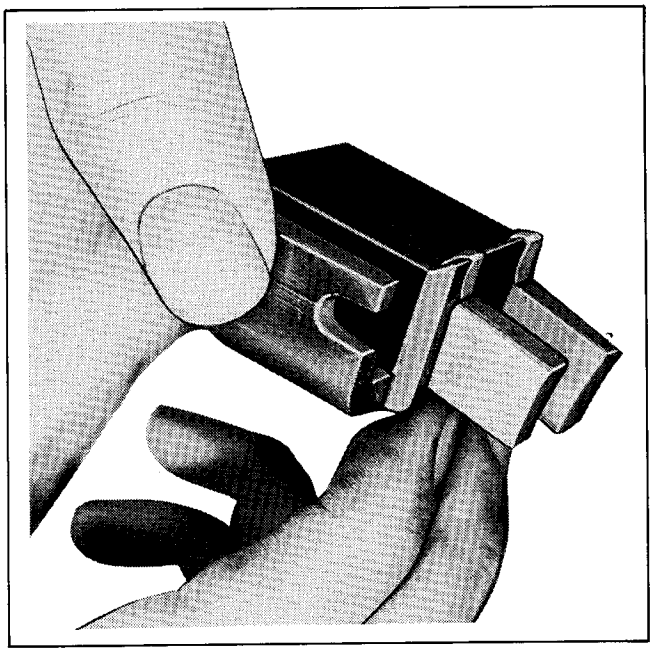


Figure 7-6. Normal Brush Wear

3. Replace the brushes if worn excessively or unevenly.
4. Replace the springs if damaged or discolored.
5. Be sure to use original or identical 1/2 inch (12.7 mm) screws when reinstalling the brush holder. Longer screws will break the holder when tightened.
6. To install the brushes and holder insert a wire to hold the brushes in (Figure 7-7). Position the brushes on the slip rings and install the two screws. Use a necessary amount of shims (Kohler No. 238248) to center brushes on slip rings. Remove the retainer wire and reconnect brush leads to connector.

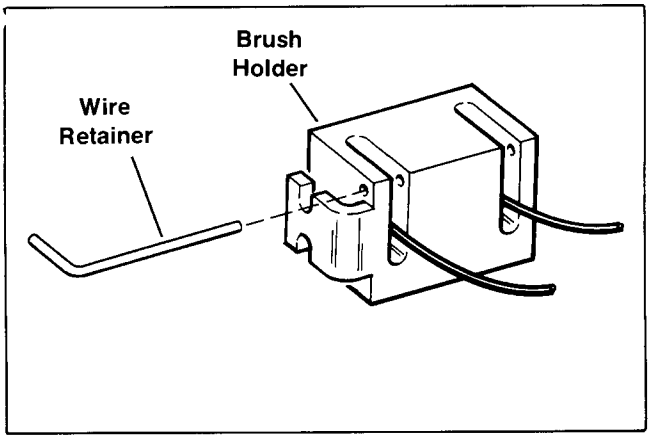


Figure 7-7. Brush Holder

Slip Rings

Slip rings (Figure 7-8) acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly machined appearance. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#00) may be used to remove roughness. Use light pressure on the sandpaper. Do not use emery or carborundum paper or cloth. Clean out all carbon dust from the generator. If the rings are black or pitted, take off the rotor and remove some of the surface material by using a lathe.

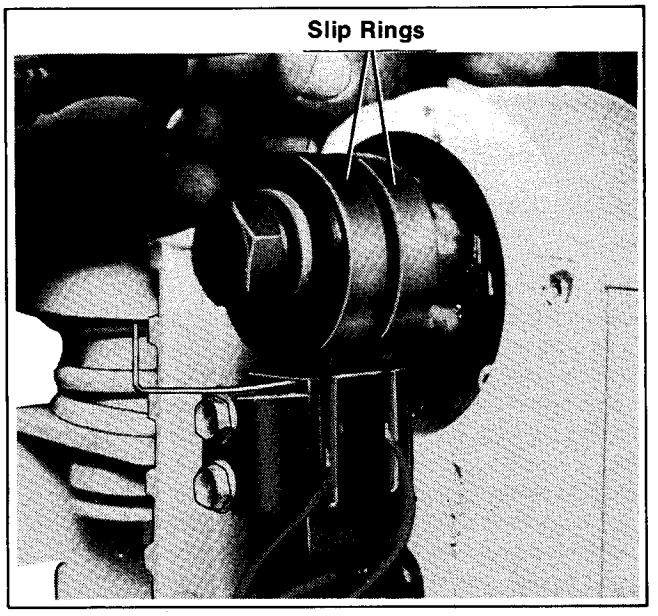


Figure 7-8. Slip Rings

Rotor

The rotor creates the magnetic field needed to induce alternating current in the stator windings. The rotors have four poles and two slip rings. Prior to testing, inspect rotor for visible damage to pole shoes, insulation, exposed coil windings, and slip ring surfaces.

⚠ WARNING

UNIT STARTS WITHOUT NOTICE! To prevent accidental starting on units with a remote start/stop switch or on automatic models, place controller master switch in OFF position and disconnect battery (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator.

Check rotor for continuity and resistance. Contact each slip ring with a meter lead. See Figure 7-8. Resistance readings for cold rotors should be 9-12 ohms. Check rotor for ground. Touch one ohmmeter lead to either slip ring and other lead to rotor poles or shaft. Meter should register no continuity. Should visual inspection or meter testing reveal any rotor faults, rotor must be replaced.

NOTE

To ensure an accurate ohmmeter reading, make certain brushes are not in contact with slip rings when checking rotor for continuity and resistance.

Stator

GENERAL:

The stator (Figure 7-9) consists of a series of coils of wire laid in a laminated steel frame. The stator leads (see appropriate wiring diagram) supply voltage to the AC load and the voltage regulator.

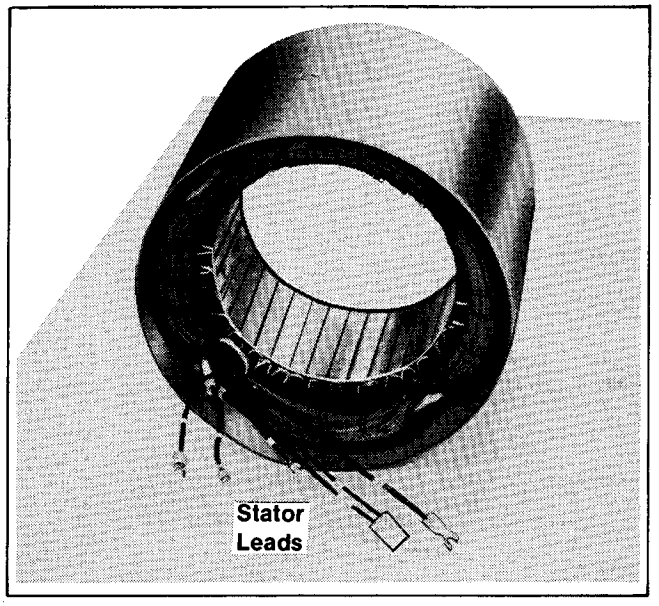


Figure 7-9. Stator

TESTING:

Prior to testing, inspect stator for visible damage to lead wires, and exposed and varnished areas of frame laminations. Make sure stator is securely riveted in housing.

NOTE

Make sure leads are not making contact with each other.

Set ohmmeter on 1-ohm (1 x Ω) scale. Contact red and black meter leads; adjust meter to zero ohms. Check stator continuity, contacting meter leads to stator leads.

- There must be continuity between leads 1 and 2.
- There must be continuity among 3, 4, 33 and 44.
- There must be NO continuity from lead 1 to leads 3, 4, 33 or 44.
- There must be NO continuity from lead 2 to leads 3, 4, 33, or 44.
- There must be NO continuity between any stator lead and ground on the stator housing or frame laminations.

Contact red and black meter leads and readjust to zero ohms. Check cold resistance of stator windings contacting meter leads to stator leads 1 and 2, then to leads 3 and 4. Slight resistance readings of less than 1-ohm should register. The stator should have approximately 0.25-ohm resistance across each winding. Should any fault be found with the stator in any of the above tests, the stator must be replaced.

Exciter Voltage Regulator

GENERAL:

The voltage regulator assembly (Figure 7-10) includes a bridge rectifier and a voltage regulating circuit. AC from the stator is received at the "AC" terminals on the regulator. This current is rectified to DC by the bridge rectifier, regulated and supplied to the rotor from terminals (+) and (-) through the brushes and slip rings. This AC is constantly monitored by the regulator to maintain ±2% variation of the stator output.

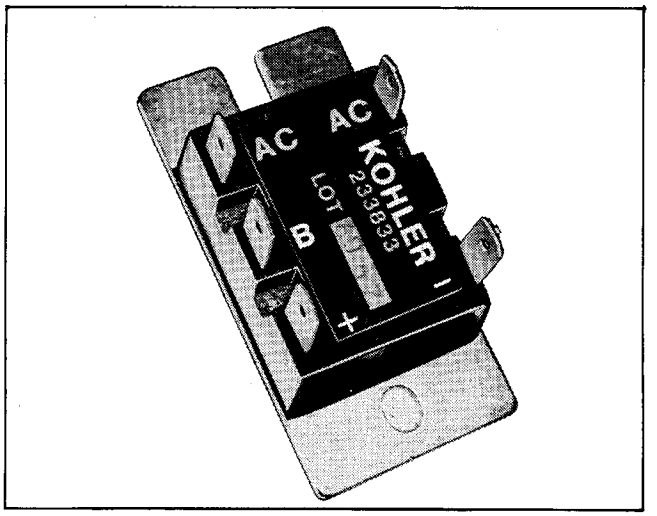


Figure 7-10. Exciter Voltage Regulator

NOTE

Although the physical appearance of your voltage regulator may differ from the one pictured in Figure 7-10, its function is identical.

TESTING:

WARNING

HIGH VOLTAGE! Remember that the function of a generator set is to produce electricity and that wherever electricity is present, there is the potential danger of electrocution. Take the same precautions with electrical appliances in your craft that you would observe in your home. Keep away from electrical circuits and wiring while the set is running and have electrical service performed only by qualified electricians. Make sure unqualified persons, especially children, cannot gain access to your set — keep the compartment door locked or securely latched at all times. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is expecially prevalent under such conditions.

WARNING

HIGH VOLTAGE! The heat sink of the voltage regulator contains high voltage. Do not touch when testing voltage regulator or electrical shock will occur.

Since this test is designed for use in the field, it only checks regulator output when cold and does not check voltage build-up.

To complete this test you'll need the following equipment:

- Two 120-Volt/100 watt bulbs and sockets.
- 110/120-Volt AC power source or variable transformer.
- Switch, (SPST) 120-Volt, 20-A minimum.
- Fuse, 2-A (in holder).
- Jumpers.
- Multimeter.

Figure 7-12 shows the typical voltage regulator terminal identifications:

1. Connect two 100W light bulbs across "+" and "–" terminals of regulator. See Figure 7-11.
2. Set multimeter range to 100-Volts DC. Connect meter across light bulbs. Check for correct polarity (refer to Figure 7-11).
3. Completely disconnect 120-Volt AC source from primary power source before connecting across regulator.

WARNING

HIGH VOLTAGE! When the power cord is plugged in during voltage regulator test, the AC pins become "hot" and there is danger of electrocution.

4. Connect one pole of (on-off) switch and the fuse to one of the "AC" terminals on the regulator. Connect other pole of switch to the 110/120-Volt AC source (Figure 7-11). Connect other "AC" terminal to 110/120-Volt AC source.
5. Turn on 110/120-Volt AC source.
6. With multimeter connected across light bulbs, turn on switch. Bulbs should light immediately, DC voltmeter should register 10 to 50-Volts.

NOTE

If bulbs flash momentarily and extinguish, flicker dimly or glow steadily the regulator is functioning properly. These conditions are caused by the amplitude of the "AC" supply voltage used. A momentary flash results when supply voltage is above the regulating voltage of regulator under test. Flickering results when supply voltage and regulating voltage are within a few volts. If a variable transformer is available, it should be used to adjust the AC supply until the bulbs glow steadily. The variable transformer will adjust the voltage to coincide with the approximate regulating voltage of the regulator.

7. Test field build-up circuit by connecting one end of jumper to either "AC" terminal. Touch the other end of

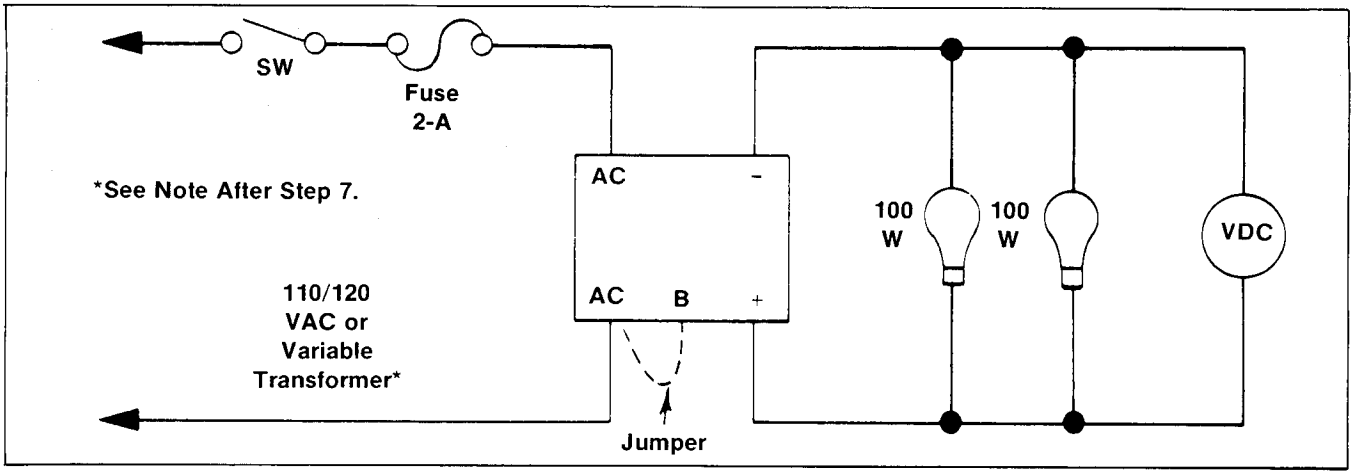


Figure 7-11. Wiring Diagram — Voltage Regulator Field Test

jumper to "B" terminal. Bulbs should glow brighter. Voltmeter should indicate 50-75-Volts DC.

WARNING

HIGH VOLTAGE! When the power cord is plugged in during voltage regulator test, the AC pins become "hot" and there is danger of electrocution.

NOTE

If voltage readings coincide with above recommended test results, regulator may be used in generator set.

WARNING

HIGH VOLTAGE! When testing voltage regulator, always unplug power cord from AC power source before connecting or disconnecting wires to prevent danger of electrocution.

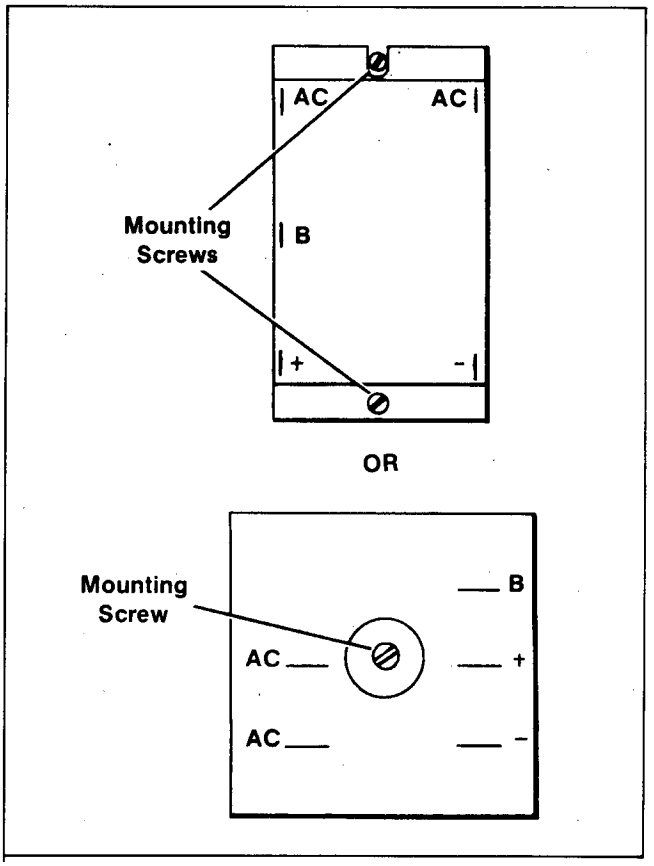


Figure 7-12. Voltage Regulator Terminal Identification

MOUNTING:

When installing exciter voltage regulator, apply a thin coating of thermal compound to back surface of regulator before mounting. Tighten regulator mounting screws (Figure 7-12) only as necessary to compress lockwashers. For regulators with two mounting screws, tighten screws to 20 in. lbs. (2.3 Nm) maximum. For center mount-type regulators, tighten screw to 15 in. lbs. (1.7 Nm) maximum.

CAUTION

Failure to apply thermal compound or overtightening regulator mounting screws may cause regulator failure.

Speed Sensor (Solid State Only)

GENERAL:

The speed sensor is mounted in the generator end bracket. When the generator is rotating a ferrous metal lobe mounted on the rotor shaft passes in close proximity to the sensor. The sensor senses the presence or absence of metal to determine engine speed. At 600 rpm cranking is disengaged. Set air gap between speed sensor and metal projection at 0.020 in. (0.508 mm) as shown in Figure 7-13.

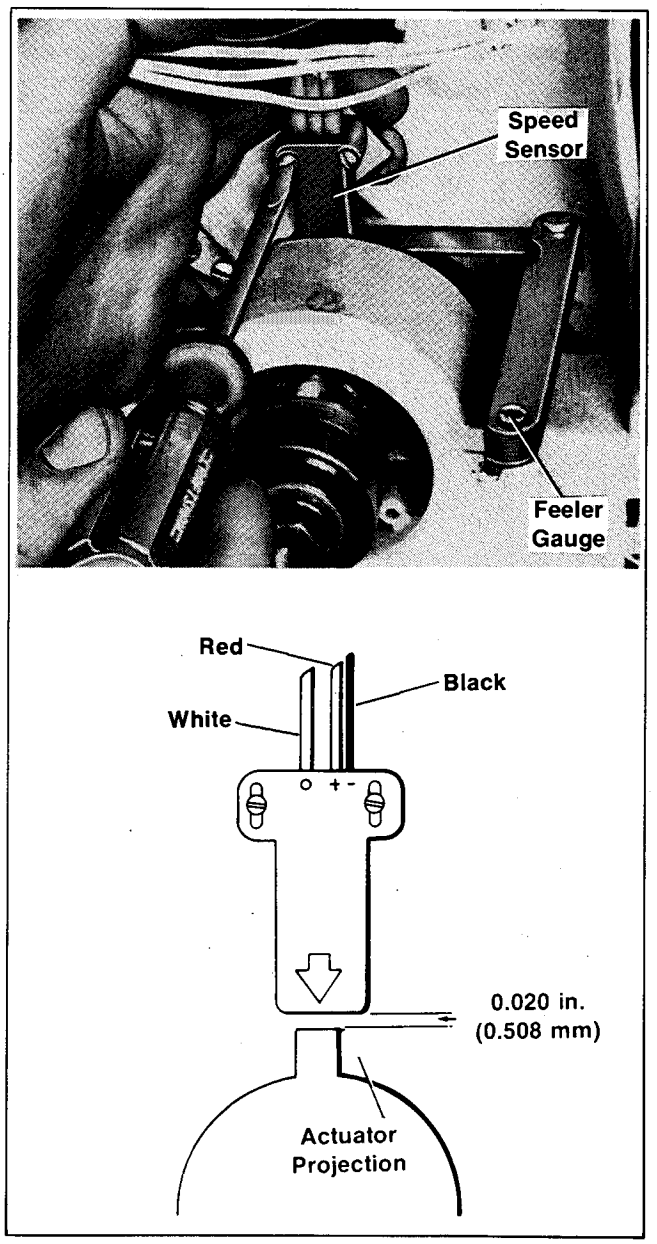


Figure 7-13. Speed Sensor

TESTING:

To determine if the signal from the speed sensor is being received at the generator set controller follow the procedure outlined below:

1. Connect DC voltmeter between pin 24 on the regulator board and ground — voltmeter reading should equal approximately 7.5-Volts.
2. With generator set running, connect DC voltmeter between pin 16 on the main control board and ground — voltmeter reading should equal voltage read in Step 1 minus approximately 1-Volt.

If the speed sensor signal is not being received at the generator set controller, test speed sensor:

1. Connect speed sensor, voltmeter and DC voltage source as shown in Figure 7-14.
2. Touch sensing surface with a flat piece of iron or steel — at least 1/4 cubic inch (4.1 cm^3).
3. Test voltmeter reading should equal voltage source volts.

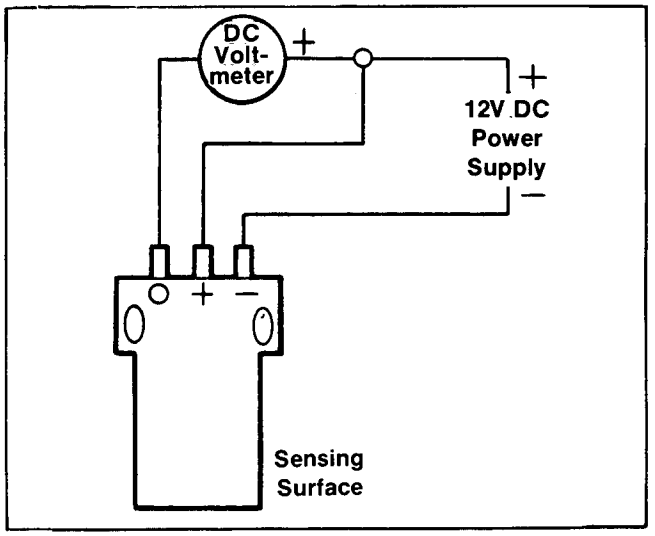


Figure 7-14. Speed Sensor Test

4. Remove iron or steel from sensing surface and observe NO test voltmeter reading.

NOTE

If voltage readings coincide with above recommended test results, speed sensor may be used in generator set.

Interlock Circuit Board (Solid State Only)

GENERAL:

The interlock circuit board (Figure 7-15) is located in the end bracket assembly. Its function is to prevent the starter motor from re-engaging the ring gear while the engine is running. It performs this function by sensing generator output voltage and sending a signal to the controller whenever this voltage is present.

REMOVAL:

1. Remove generator end panel.
2. Disconnect plug and remove mounting screws holding circuit board to the end bracket.
3. Examine front and back of circuit board for burnt components or damaged foil.

TESTING:

1. Connect a 100 or 1000-ohm resistor across pins 2 and 5 with jumpers.
2. Set a multimeter at 60-Volt DC range. Connect the meter across the resistor.
3. Apply 100-120-Volt AC source between pins 3 and 4. Using a 100 ohm resistor, voltage drop reading should be 1.15 to 1.55-Volts, DC. With a 1000-ohm resistor the reading should be 11.5 to 12.5-Volts DC. If these voltages are present, the interlock board is functioning correctly.

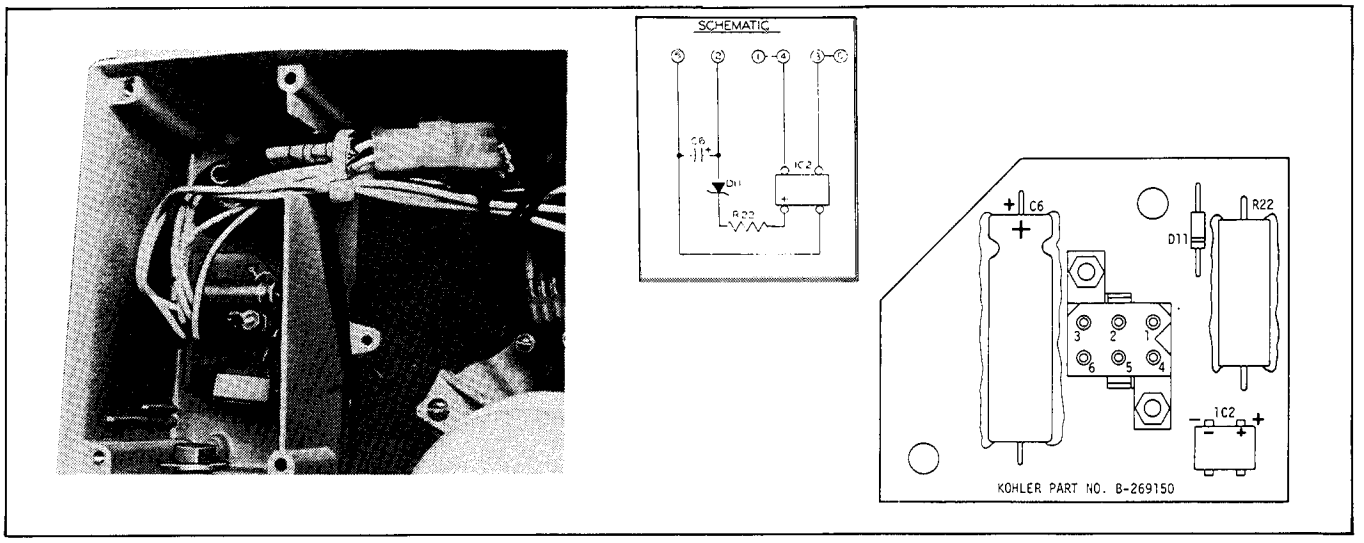


Figure 7-15. Interlock Circuit Board

SECTION 8
Generator Reassembly

1. If it became necessary to disassemble flywheel, adapter, and stub shaft to remove rotor, reassemble as follows:
   a. Replace four bolts fastening stub shaft to flywheel.
   b. Lift flywheel onto (clean) keyed taper of the crankshaft.
   c. Replace eight bolts fastening generator adapter to bell housing.
2. Clean stub shaft taper and paint with copper-graphite or some other type of releasing agent (Figure 8-1).

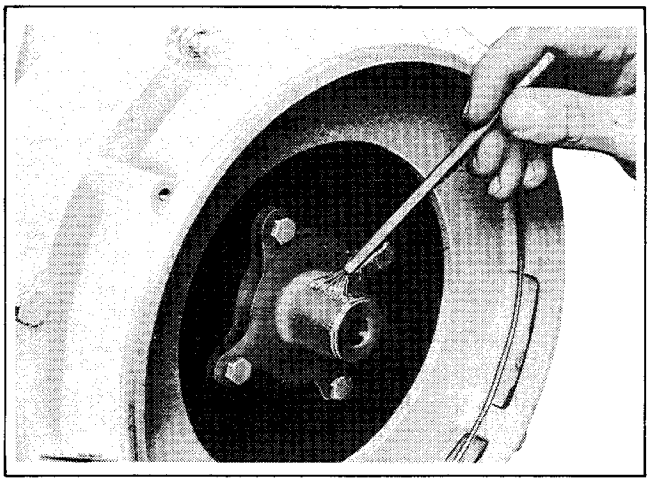


Figure 8-1. Coat Stub Shaft

3. Lift rotor assembly onto stub shaft and replace thru bolt. Torque thru bolt to 50 ft. lbs. (68 Nm). See Figure 8-2.

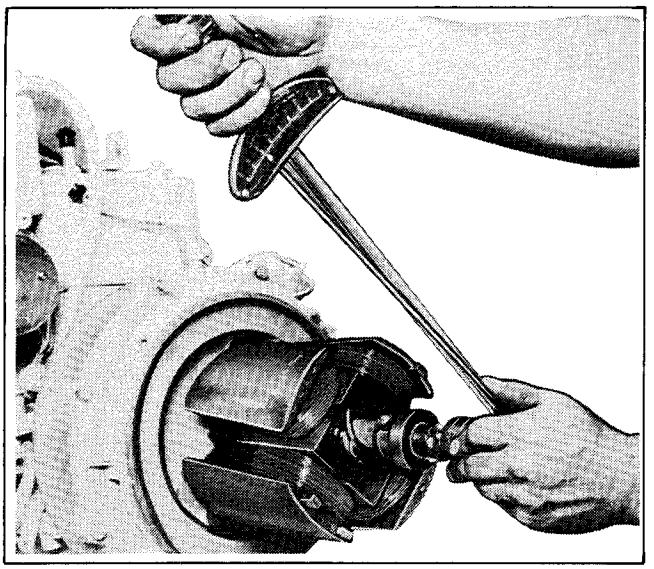


Figure 8-2. Torque Thru Bolt

4. Slide stator into position making sure leads are at 12 o'clock position.
5. Taking caution not to pinch any wires, position end bracket on stator. Bump snugly into place using a rubber mallet (Figure 8-3). Replace four long overbolts and torque to 75 in. lbs. (8.5 Nm).

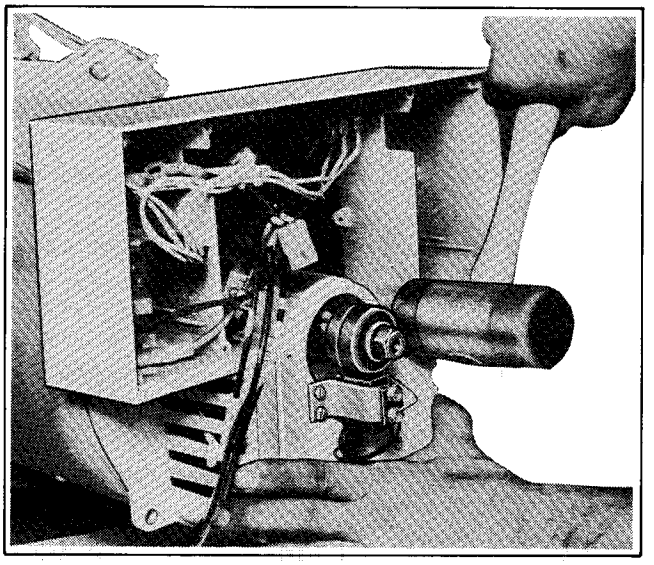


Figure 8-3. Installing End Bracket

6. If brush holder was removed, reinstall checking to see that brushes are properly centered on slip rings. Use a necessary amount of shims (Kohler No. 238248) to center brushes on slip rings (Figure 8-4). Remove retainer wire and reconnect brush leads to connector.

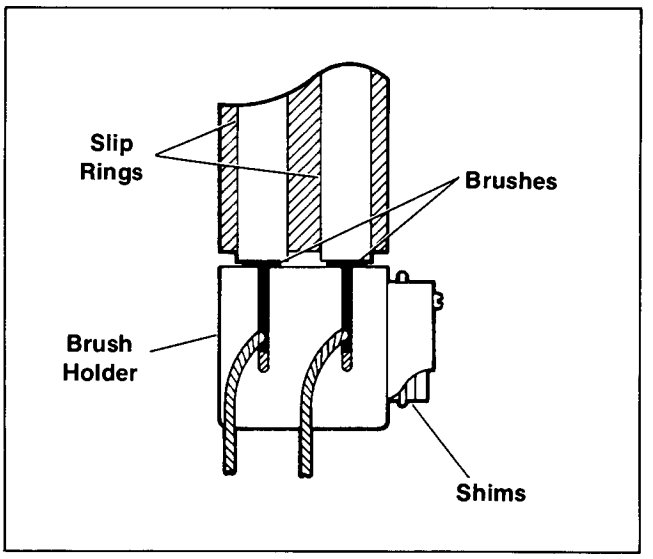


Figure 8-4. Brush Alignment

CAUTION

Improper brush-to-slip ring alignment may contribute to exciter voltage regulator failure and excessive ring wear.

CAUTION

If brush retainer wire is not removed, voltage regulator will be damaged when generator is started.

7. Replace speed sensor. Turn rotor to position sensing lobe directly below speed sensor. Use a feeler gauge to set gap between sensor and lobe at 0.020" (0.51 mm). See Figure 8-5.
8. Reconnect stator leads 33 and 44 to the voltage regulator at "quick disconnect" shown in Figure 8-6.
9. Remove blocks and return generator end to normal position.
10. Reinstall generator support brackets and vibromounts.

NOTE

Do not remove or cut down spacer sleeve in vibromount assembly. Clearance is provided to protect against vibration damage.

11. Lift controller back into position and replace three bolts on each side of the base.
12. Replace generator end panel and slip ring-brush cover.

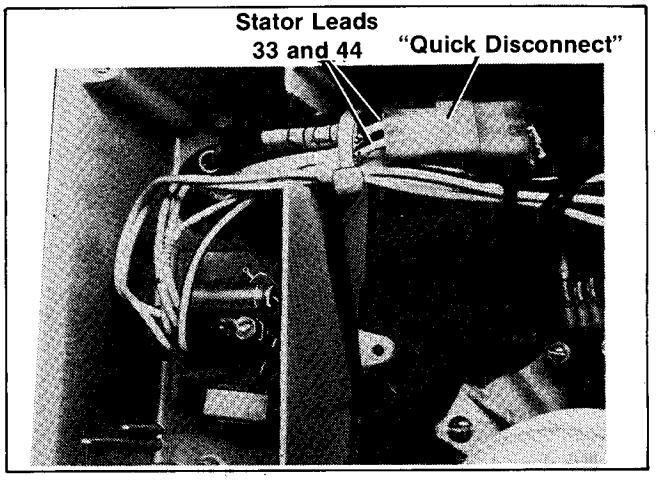


Figure 8-6. Stator Leads 33 and 44

13. Reconnect stator leads 1, 2, 3 and 4 inside the controller. Refer to the applicable wiring diagram in Section 12.
14. Reconnect six circuit wiring harness inside the controller.
15. Reconnect engine wiring harness at the rear of the controller.
16. Reconnect generator ground strap at the engine/generator adapter.
17. Replace controller cover.
18. Reconnect battery cables; reconnect ground lead last to avoid electrical shock and sparks.

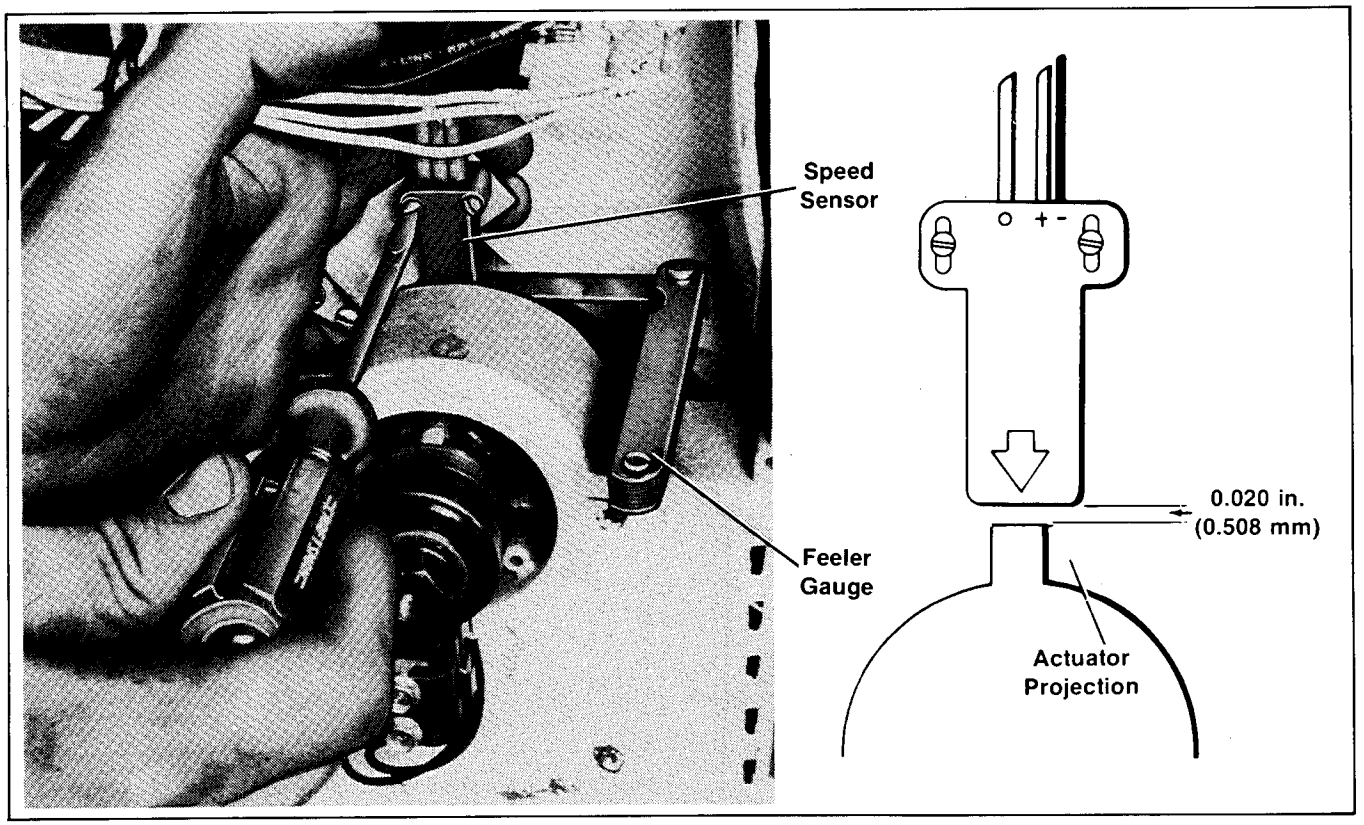


Figure 8-5. Speed Sensor Air Gap

SECTION 9
Backfire Flame Arrestor, Fuel System, Governor

Backfire Flame Arrestor

The United States Coast Guard approved backfire flame arrestor does not require service at frequent intervals. If however, it appears clogged with oil or dust, disassemble the unit and wash the metal filter element in evaporative solvent. Keep the element dry — do not oil. Make sure the parts are reassembled exactly as shown in Figure 9-1 to insure that the unit can function as a flame arrestor. If flame arrestor is damaged, replace complete assembly, using Kohler replacement flame arrestor.

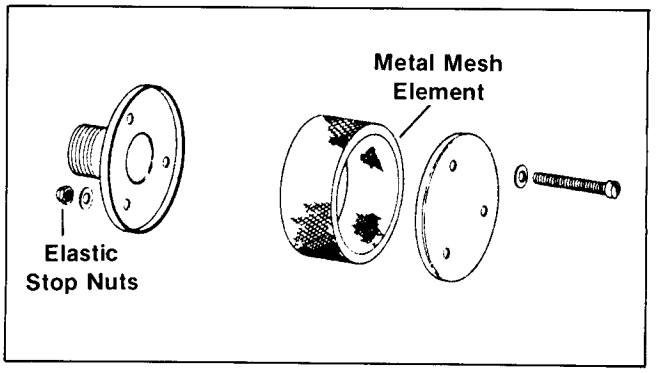


Figure 9-1. Backfire Flame Arrestor

Carburetor

GENERAL:

Carburetors are adjusted at the factory and readjustment is not normally needed unless generator set is operated at a much higher altitude or if carburetor problems develop after extended use. If engine misses and backfires, this could indicate carburetor is set too lean. If black sooty exhaust smoke is noted and engine is sluggish, the fuel mixture is probably set too rich. Continued operation with improperly adjusted or dirty carburetor can result in overheating, fouling of spark plugs, excessive valve wear and other problems.

ADJUSTMENT:

1. Turn idle fuel screw (Figure 9-2) in until lightly seated, then turn out 2 turns.
2. Turn Main Fuel adjustment all the way in (clockwise) until the needle bottoms lightly — do not force closed as this will damage needle or seat. For preliminary adjustment, turn Main Fuel adjustment nut out (counterclockwise direction) 2-1/2 full turns.

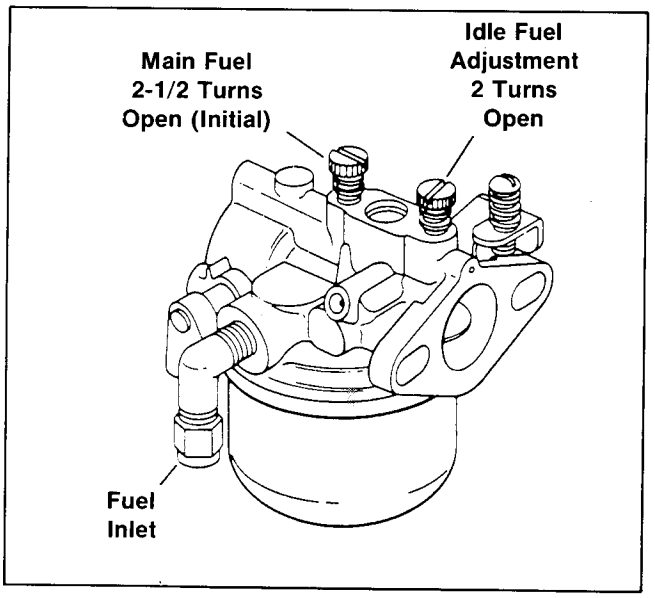


Figure 9-2. Carburetor Adjustments

3. Start engine and allow it to warm up to normal operating temperatures If possible, place under normal load when making final adjustment.
4. For final adjustment, turn Main Fuel needle (Figure 9-2) in until engine starts to slow down from too-lean mixture (note position), then back out until speed increases — continue turning richer until speed again starts to drop from over-rich setting then turn needle back in until it is positioned about halfway between lean and overrich settings.

Fuel Collection System

In observance of U.S. Coast Guard regulations, sets are equipped with a collection system to prevent fuel and fumes from entering the bilge or compartment. See Figure 9-3. Should carburetor flooding or internal fuel pump leakage occur, excess fuel is siphoned to a collection tank, and drawn into the intake manifold during engine-generator operation. If the engine runs rough, it may be due to a full collection tank (the excess fuel being drawn into the intake manifold causing too rich a fuel mixture). If this is the case, check for fuel pump leaks, diaphragm damage, or improper seating of carburetor float needle or float adjustment. For information on servicing carburetor and fuel pump refer to Kohler L654 Engine Service Manual, ES-652. The engine will run rough until the collection tank drains during engine operation.

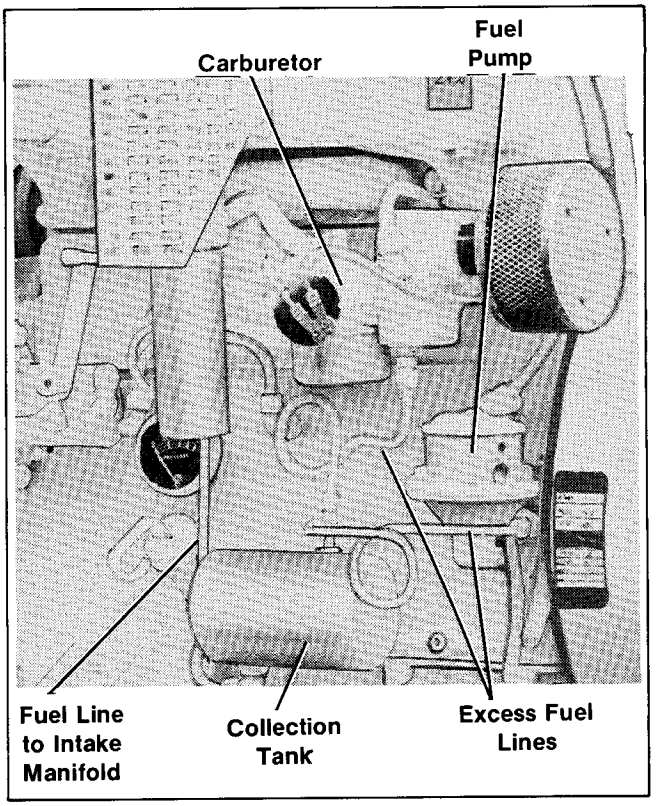


Figure 9-3. Fuel Collection System

Choke

GENERAL:

The choke is an integral part of the carburetor. The electrical lead to the choke is connected so that current flows to the thermostatic element only when the ignition is turned on. Tension of the thermostatic spring is set to allow full choke at starting. Current through a heating element furnishes heat which releases the spring tension and allows vacuum from the intake manifold to pull the choke open.

INSPECTION:

1. Ground magneto terminal with jumper wire so engine will not start.
2. Remove flame arrestor and adapter by removing two mounting screws and disconnecting crankcase breather line at two compression nuts. See Figure 9-4.
3. Move the main switch on the controller to the test position, after five seconds return to the off position. The choke should full close and then release when the main switch is returned to off.
4. If the choke does not function properly (step 3) see troubleshooting, Table 9-1.

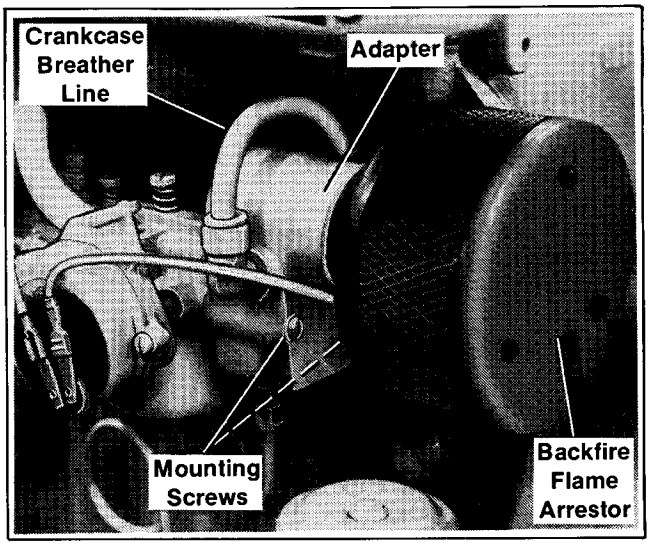


Figure 9-4. Backfire Flame Arrestor and Adapter

PROBLEMS	CAUSES	SOLUTIONS
Choke won't close during cranking	Faulty lead to choke.	1. Check for secure lead connections. 2. Make continuity check on lead. Replace if no continuity.
	Faulty lead to ground.	1. Check for secure lead connections. 2. Make continuity check on lead. Replace if no continuity.
	Poor adjustment.	1. Adjust choke. 2. Repair with kit or replace choke.
Choke will not fully open	Poor adjustment.	1. Adjust choke.
	Faulty choke.	1. Repair with kit or replace choke.

Table 9-1. Troubleshooting Choke

ADJUSTMENT:

The choke unit (Figure 9-5) is set for average conditions. To readjust, loosen three screws on outside of cover plate then shift cover in clockwise direction (arrow) for richer setting or in counterclockwise direction for leaner setting. Tighten cover screws after final adjustment.

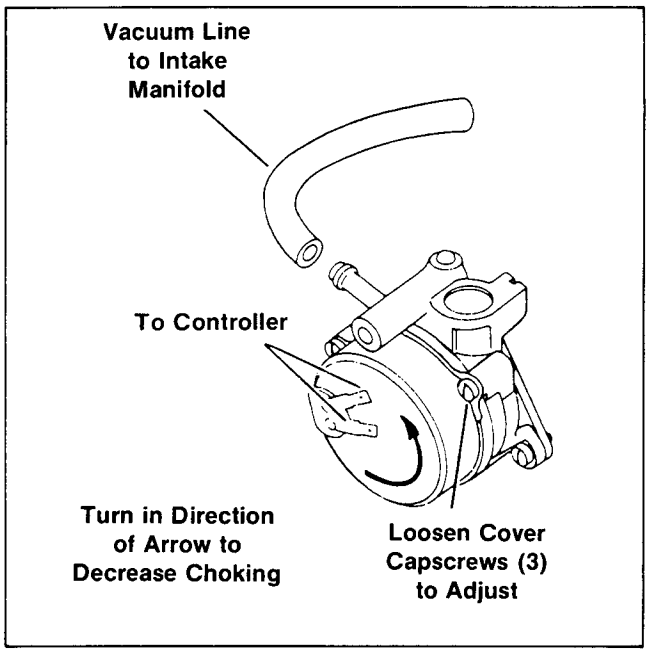


Figure 9-5. Choke Adjustment

Governor

GENERAL:

An externally mounted, centrifugal flyweight type mechanical governor is standard equipment. The governor is flange-mounted on the front support plate and driven off the camgear. Lubrication is provided by an external oil line which connects the engine lube system to the governor. No regular service is required on the unit. The governor is adjusted during run-in at the factory and further adjustment should not be needed unless greatly varying load conditions are encountered, or if poor governor control develops after extended use.

If governor setting is too sensitive, hunting or speed surging will occur with changing load. If a considerable drop in speed is experienced when normal load is applied, the governor should be adjusted for greater sensitivity.

If one of the governor settings is readjusted, the other should also be readjusted since each has an effect on the other. See Figure 9-6. With set running at full load, governed speed, readjust as follows:

NOTE

Due to variances in generator output waveshape, not all pointer type frequency meters are compatible.

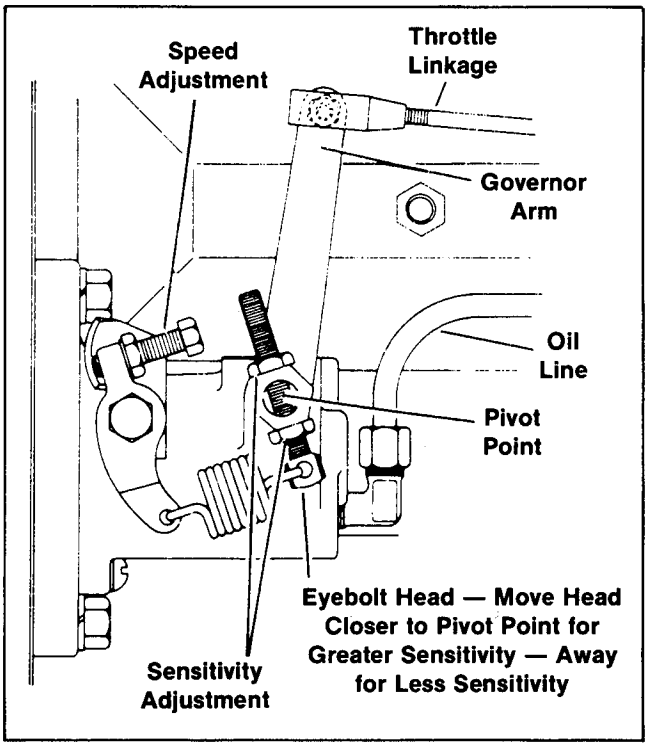


Figure 9-6. Governor Adjustments

SPEED ADJUSTMENT:

This set is desinged to operate at 60-63 Hz. 1800 rpm under full load and 1890 rpm under no load. To check speed, use hand tachometer or frequency meter. Loosen locking nut on speed adjusting screw, turn screw in clockwise direction to increase speed (and frequency) or in counterclockwise direction to decrease speed. Lock nut at new setting.

SENSITIVITY ADJUSTMENT:

Test under normal load conditions. If readjustment is needed, proceed as follows. To make governor control MORE SENSITIVE, loosen the nut at bottom of adjusting eyebolt and tighten the top nut drawing the head of the eyebolt closer to the governor arm pivot point. To make governor control LESS SENSITIVE, loosen the top nut and tighten the bottom nut to move the head of the eyebolt away from the pivot point. After sensitivity is correct, tighten the nut that was previously loosened to lock the eyebolt at the new setting. Recheck speed after sensitivity adjustment since changing this will also affect speed.

SECTION 10
Cooling System

General

Marine generator sets use heat exchanger and direct type cooling systems. The only outward difference between the two systems is in the type of cap used on the water-cooled exhaust manifold. See Figure 10-1. The heat exchanger system uses a pressure cap (with filler neck and overflow tube) while the direct type uses a solid, non-pressure type cap. To further identify the systems, the tubes of the heat exchanger can be seen or felt when the cap is removed from the manifold. Two high temperature cutouts protect generator set from damage due to overheating. See Figure 10-2. The high water temperature cutout will shut the set down due to excessive engine water temperature. A high cylinder head surface temperature cutout shuts the unit down in the event water/coolant is not available to the high water temperature sending unit. If either cutout shuts the generator set down the cause must be located and eliminated, and the reset switch on the controller actuated before the set can be restarted.

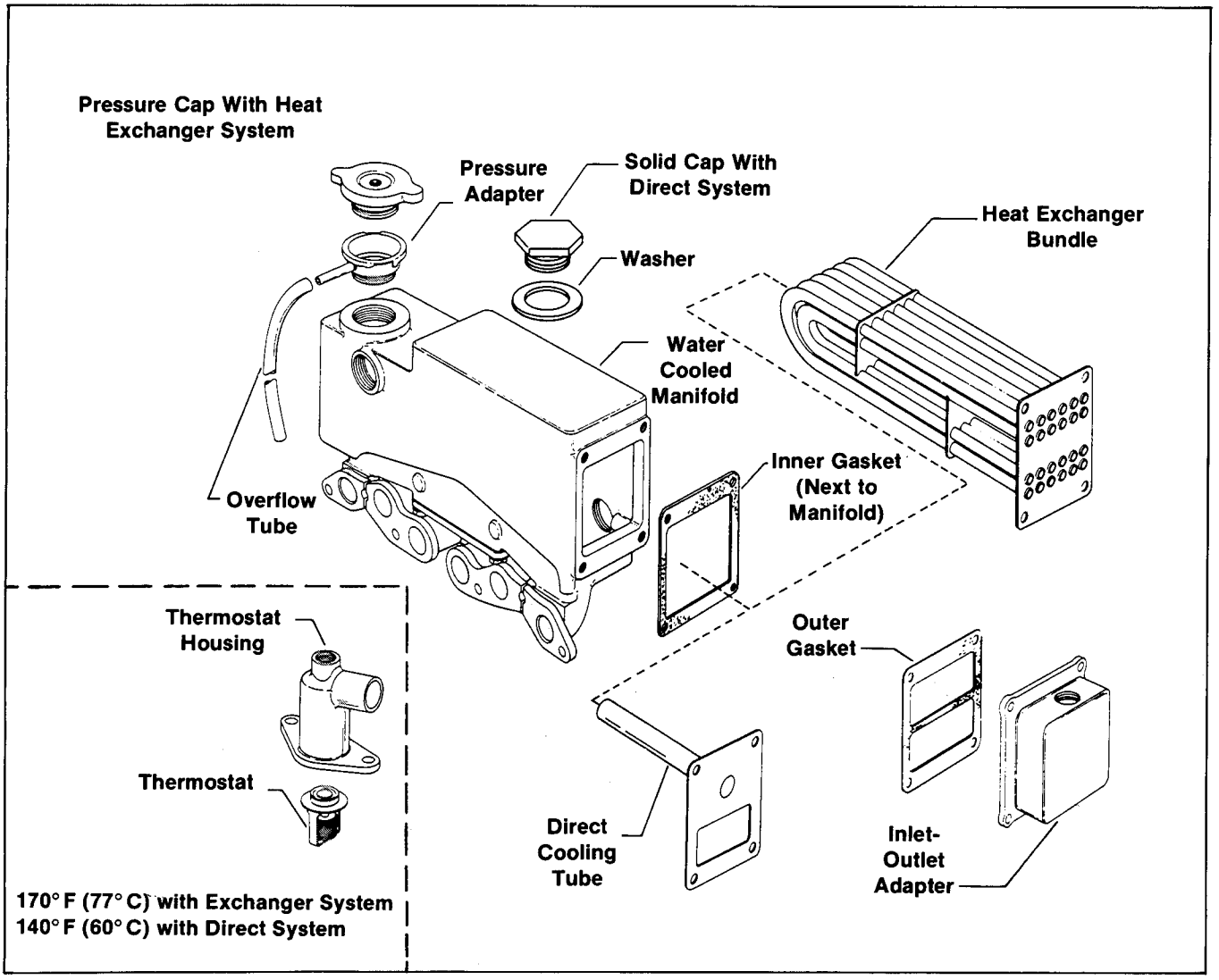


Figure 10-1. Water Cooled Manifold

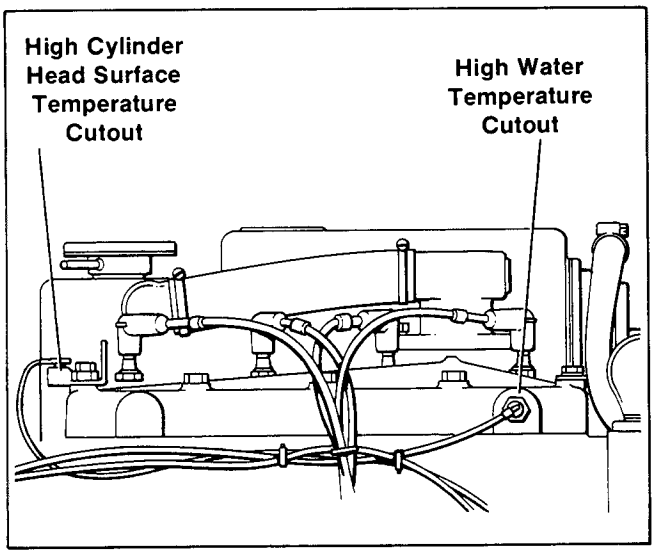


Figure 10-2. High Temperature Cutouts

Heat Exchanger

The heat exchanger system is comprised of two circuits — a closed engine circuit and the raw or sea water circuit. In the closed circuit, coolant is circulated by the engine water pump through the water jacket, manifold and returned to the pump for recirculation. Since this is a closed system anti-freeze can be added if required — system capacity is 5 to 5-1/2 quarts (4.7-5.20 L) of liquid and requires a 170° F (77° C) thermostat. In the raw water circuit, the belt driven sea water pump picks up sea water and circulates it through the tube bundle where it absorbs and carries away the heat of the closed circuit which is being circulated around the tubes. The heated water is then mixed with the engine exhaust and ejected out the exhaust outlet. See Figure 10-3.

Direct

Units using a direct type cooling system can be identified by the solid hex shaped cap mounted in the top of the water cooled manifold. This is a non-pressurized system in which the sea water pumped into the manifold circulates throughout the engine, mixes with the exhaust and is ejected out the exhaust outlet (Figure 10-3). Since this is an open system, it cannot be protected with anti-freeze and requires a 140° F (60° C) thermostat.

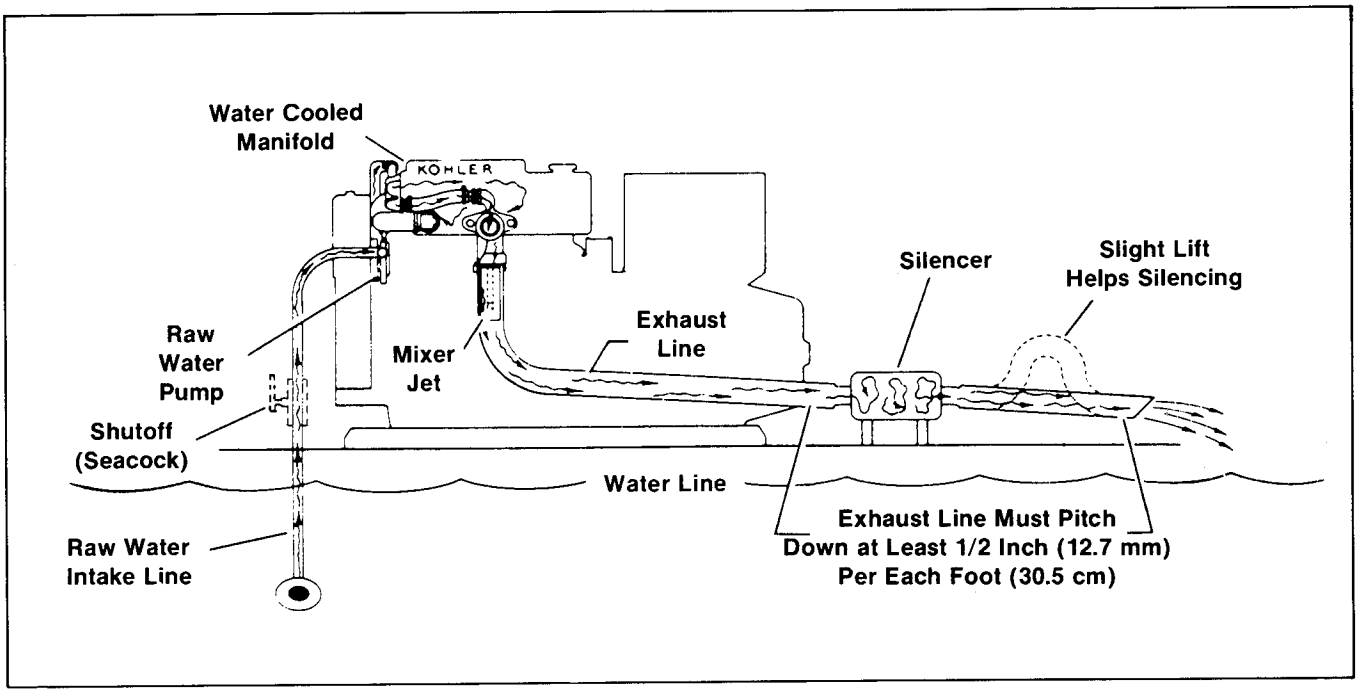


Figure 10-3. Cooling System

Belt Tension

The belt should be adjusted so that it can be depressed about 1/2 in. (12.7 mm) as shown in Figure 10-4. To adjust, remove the belt guard, loosen the adjusting plate capscrews, then shift the plate until proper belt tension is obtained. Retighten the screws holding the plate at the new setting, then replace the belt guard.

WARNING

MOVING PARTS! Belt guard is removed for adjustment of V-belt only. Belt guard must be in place when operating generator set to minimize a safety hazard.

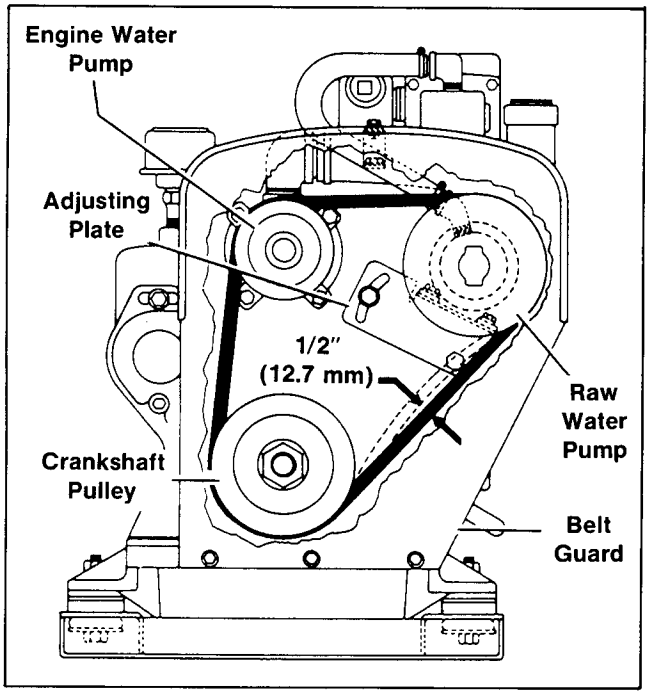


Figure 10-4. Belt Tension

SECTION 11
Ignition System

General

Several factors contribute to the overall performance of an ignition system — all components must be in good condition and the spark must be properly timed. Hard starting, low power and erratic operation can often be attributed to faulty ignition. If poor ignition is suspected, the first thing to do is to determine if this system is actually at fault. The following operational test will determine this. For complete ignition system service information refer to the Kohler L654 Engine Service Manual, ES-652.

Operational Test

⚠ WARNING

FLASH FIRE! A sudden flash fire can cause serious burns. To avoid the possibility of a flash fire, 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.

Remove the high tension lead at the spark plug, bend a paper clip and insert it into boot, then hold the end about 1/16 in. (1.5 mm) to 1/8 in. (3 mm) away (with insulated pliers to prevent electrical shock) from the cylinder head while cranking the engine. If a sharp snappy spark occurs, the trouble is apparently not in the magneto, although it could still be attributed to a poor spark plug. If no spark or a very weak spark occurs, ignition trouble is indicated. When checking out an ignition system, the components most commonly requiring service or adjustment should be checked first. Refer to Figure 11-1 when reconnecting spark plug wires.

Timing Magneto to Engine

The magneto is timed to the engine at the factory. Retiming should not be necessary unless unit has been removed from the engine for reconditioning or other reasons. Use the following steps to time magneto to engine:

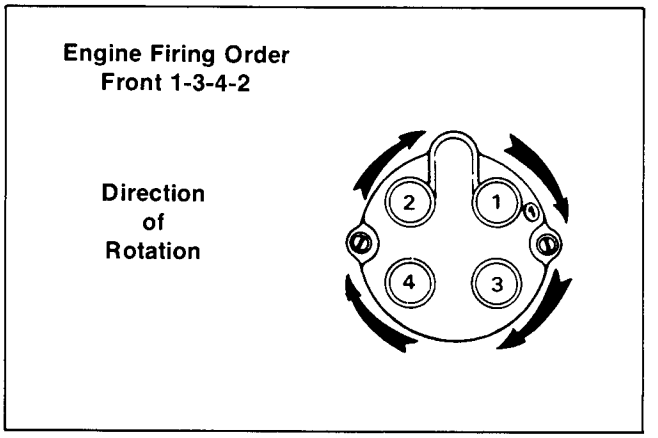


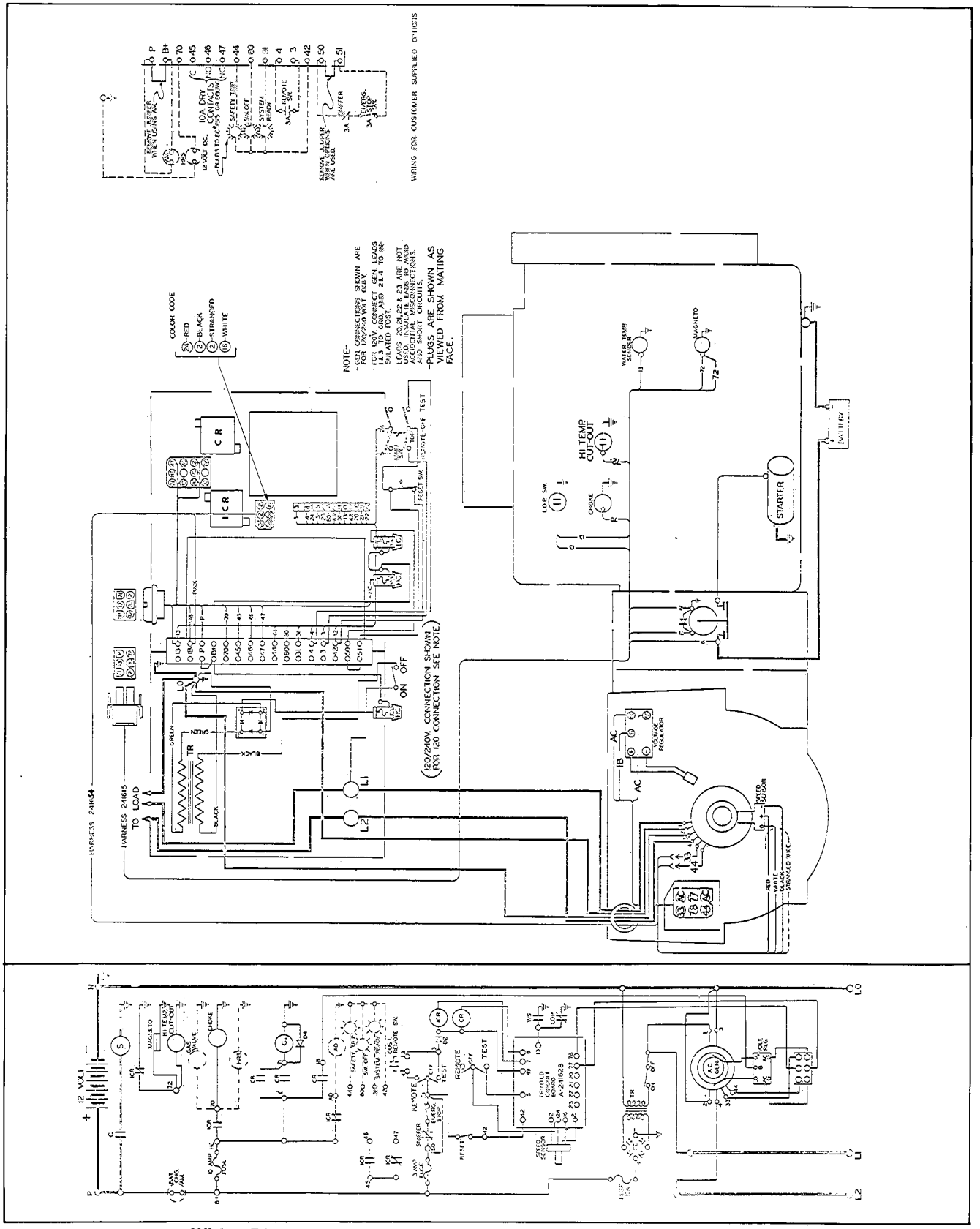
Figure 11-1. Magneto Rotation and Firing Order

1. Turn engine over until white or "SPK" timing mark on flywheel is centered in sight hole on the bell housing. On newer models, a red mark on the flywheel indicates top dead center (TDC). Remove No. 1 spark plug and check to insure No. 1 piston is at TDC.
2. Turn magneto gear counterclockwise until white or yellow mark lines up with indicator in timing window. This positions distributor for firing No. 1 spark plug — hold in this position. See Figure 11-1.
3. Position gasket, then carefully guide magneto gear into engagement with idler gear. Make sure white or yellow timing mark remains centered when installing. Secure magneto to engine.
4. Reconnect high tension leads then check ignition timing with timing light.

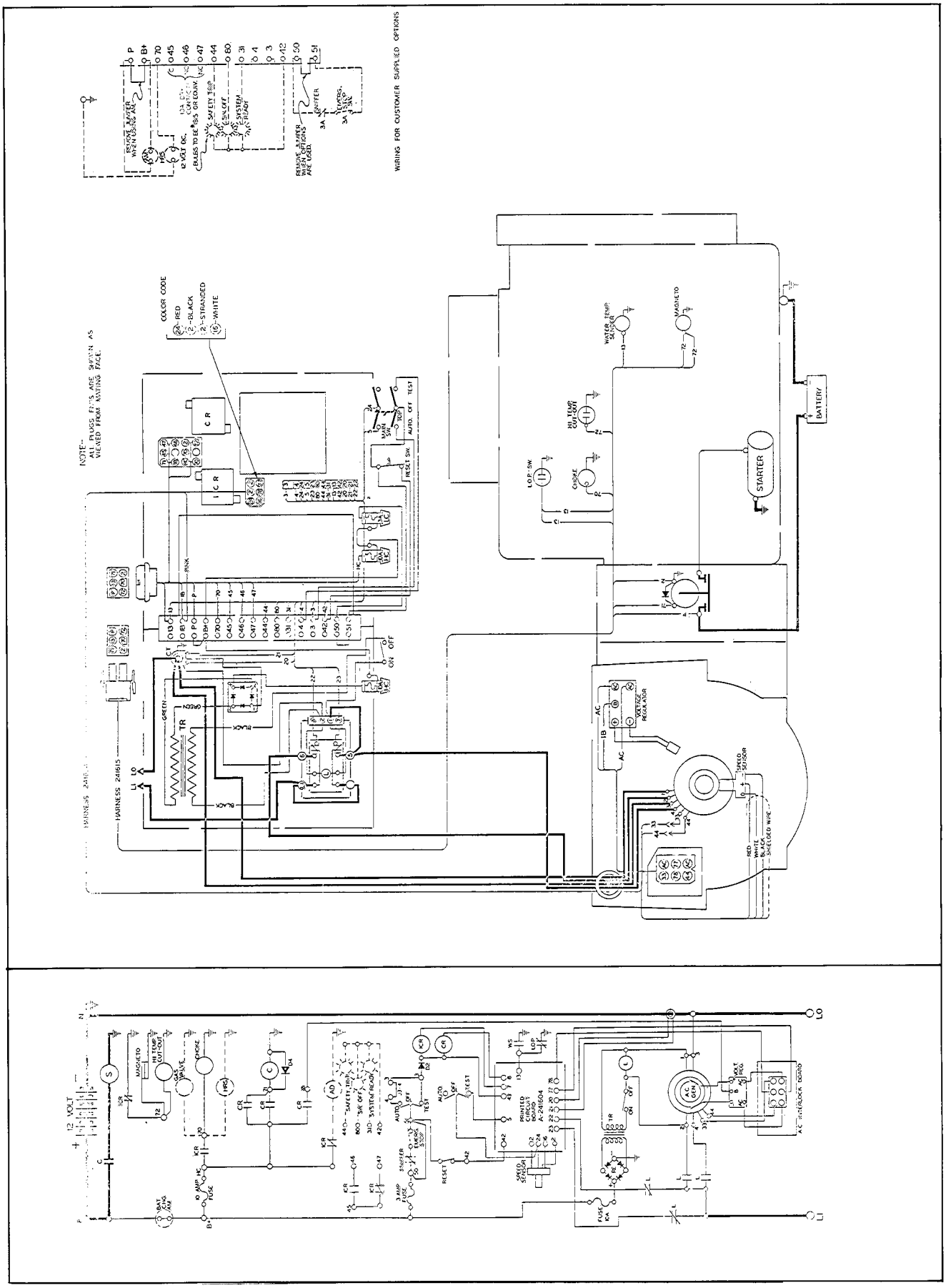
NOTE

On some sets the flywheel may not be centered directly with timing sight hole. To view the white or "SPK" mark on flywheel of these units, aim timing light into sight hole towards generator end of unit.

SECTION 12
Wiring Diagrams

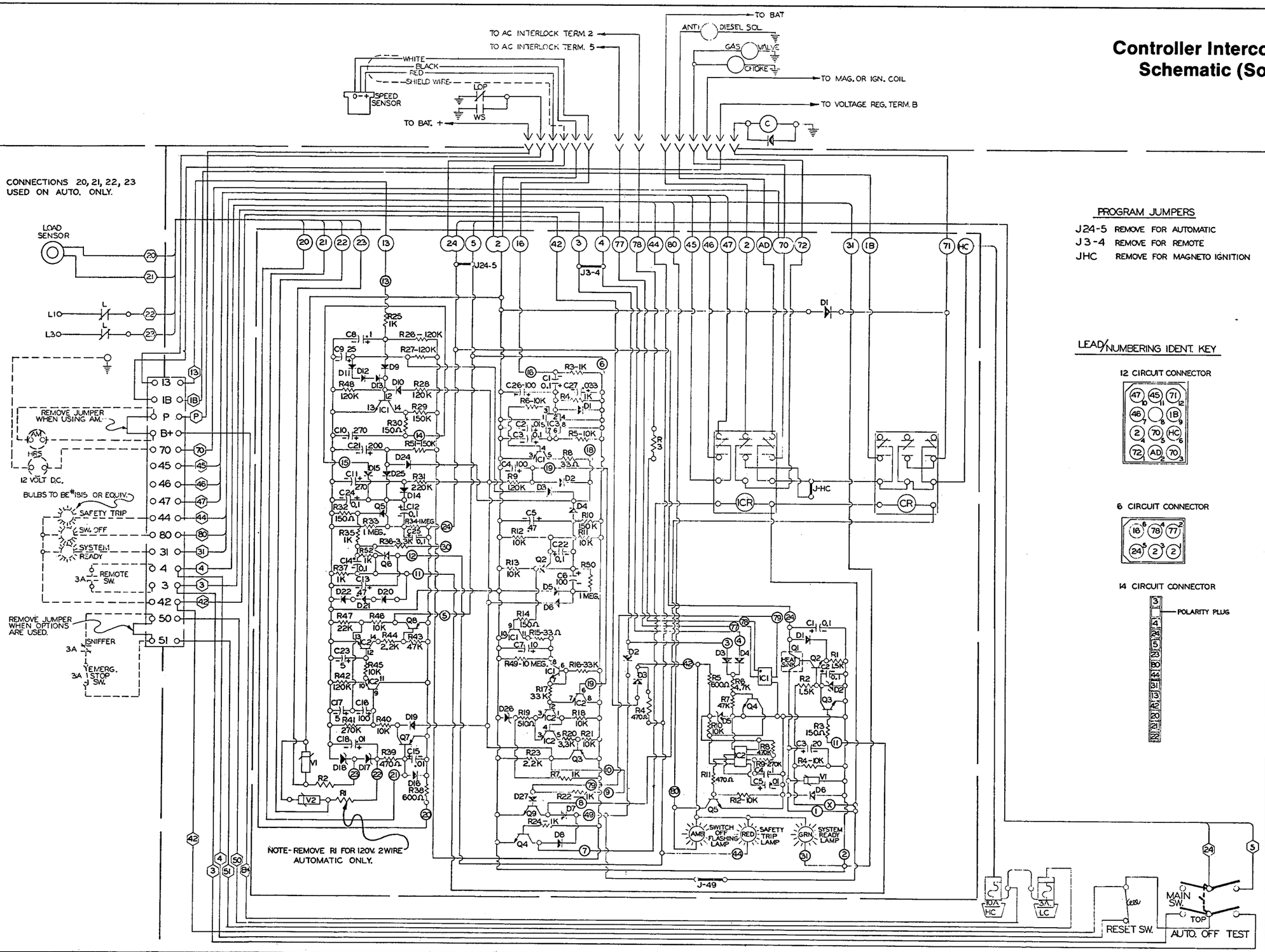


Wiring Diagram — Remote Solid State — Models (7.5R); 120, 120/240-Volt



Wiring Diagram — Automatic Solid State — Models (7.5A); 120-Volt

Controller Interconnection Schematic (Solid State)



PROGRAM JUMPERS

- J24-5 REMOVE FOR AUTOMATIC
- J3-4 REMOVE FOR REMOTE
- JHC REMOVE FOR MAGNETO IGNITION

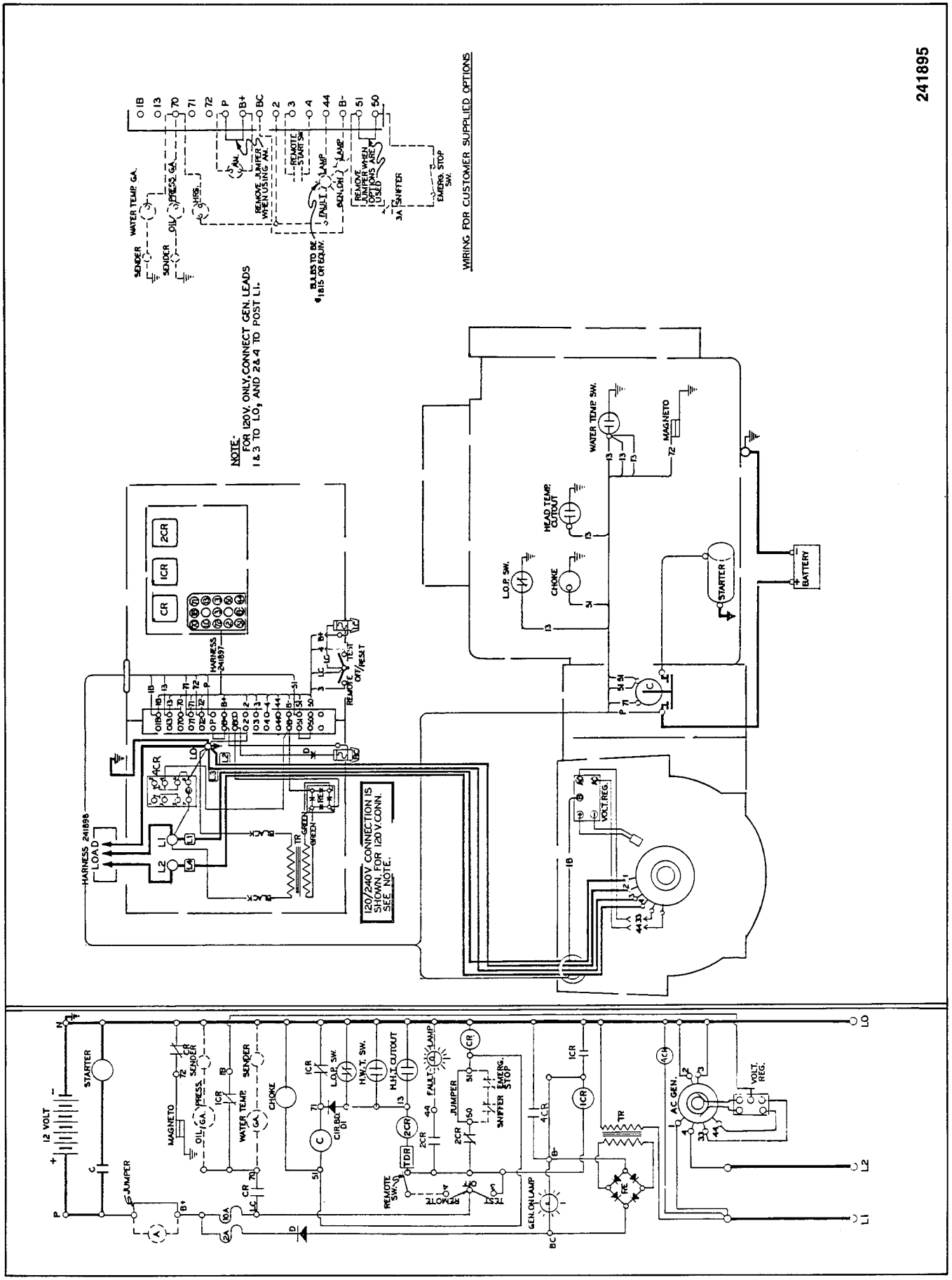
LEAD NUMBERING IDENT. KEY

12 CIRCUIT CONNECTOR

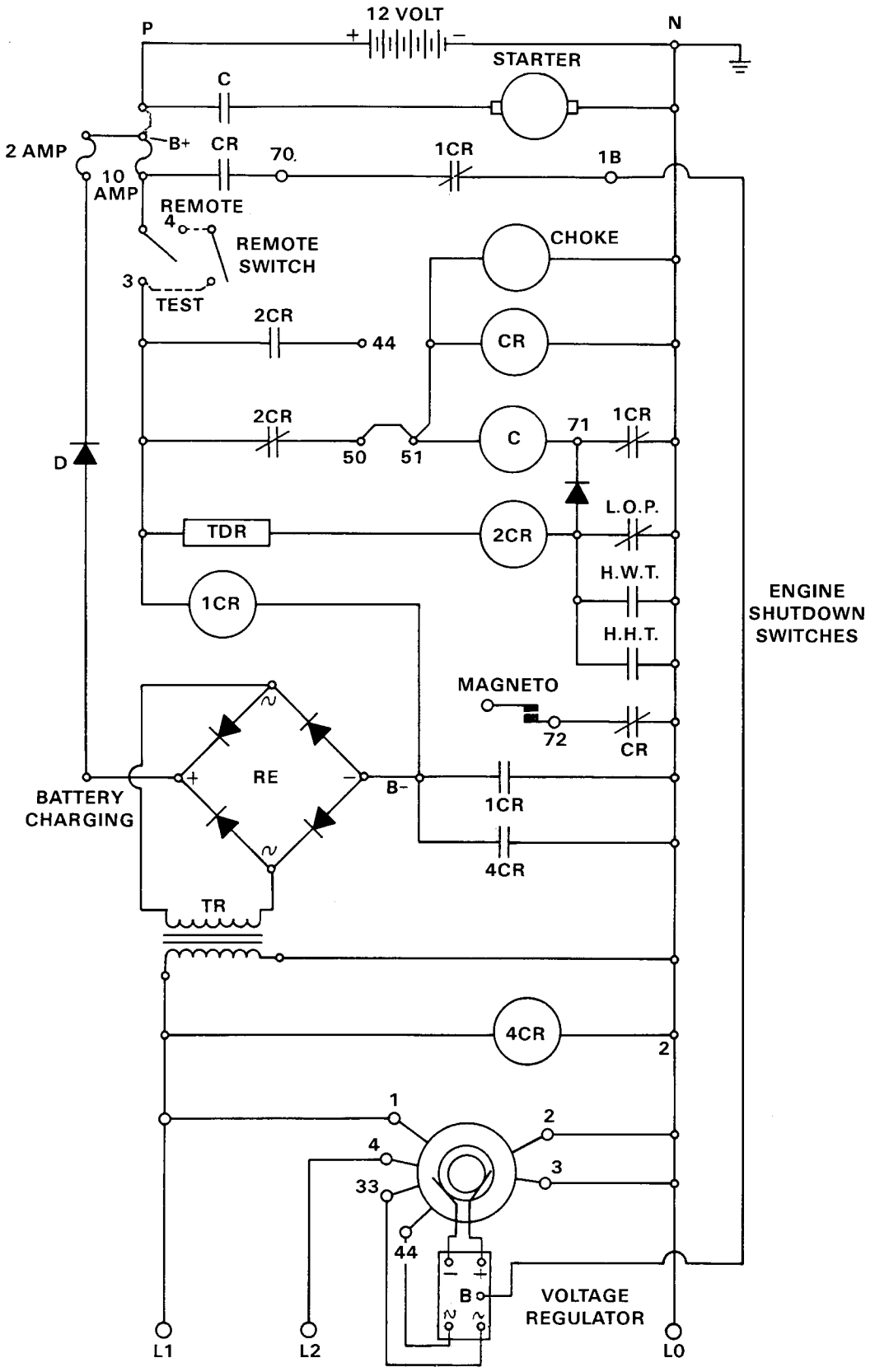
6 CIRCUIT CONNECTOR

14 CIRCUIT CONNECTOR

Controller Interconnection Schematic (All Solid State Models)



Wiring Diagram — Remote Relay — Models (7.5R); 120, 120/240-Volt



Wiring Diagram — Remote Relay 7.5R, 120/240-Volt, 1Ø, 3 Wire (Basic Circuit)

TP-5043 8/87
PRINTED IN U.S.A.

KOHLER
GENERATORS

KOHLER CO. KOHLER, WISCONSIN 53044