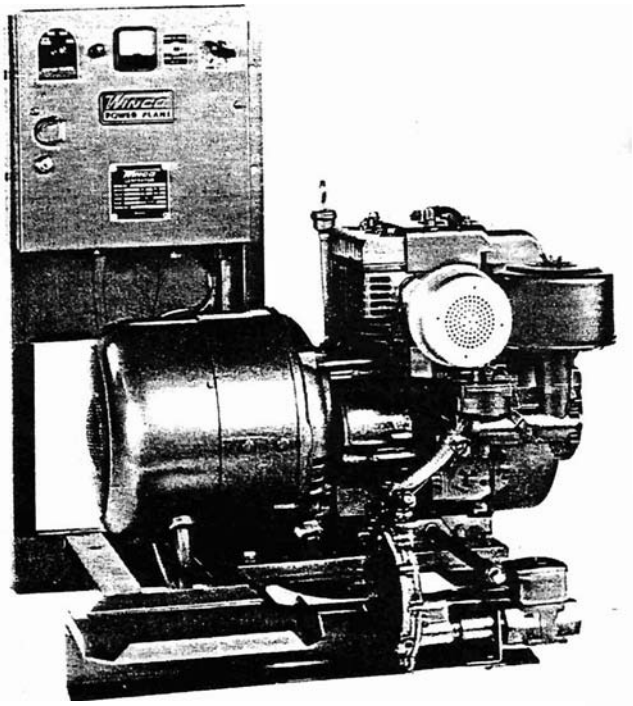
WINCO®

GENERATORS

AIR COOLED PACKAGE STANDBY 5 & 7 KW LPG/NG

INSTALLATION, OPERATION, and MAINTENANCE INSTRUCTIONS



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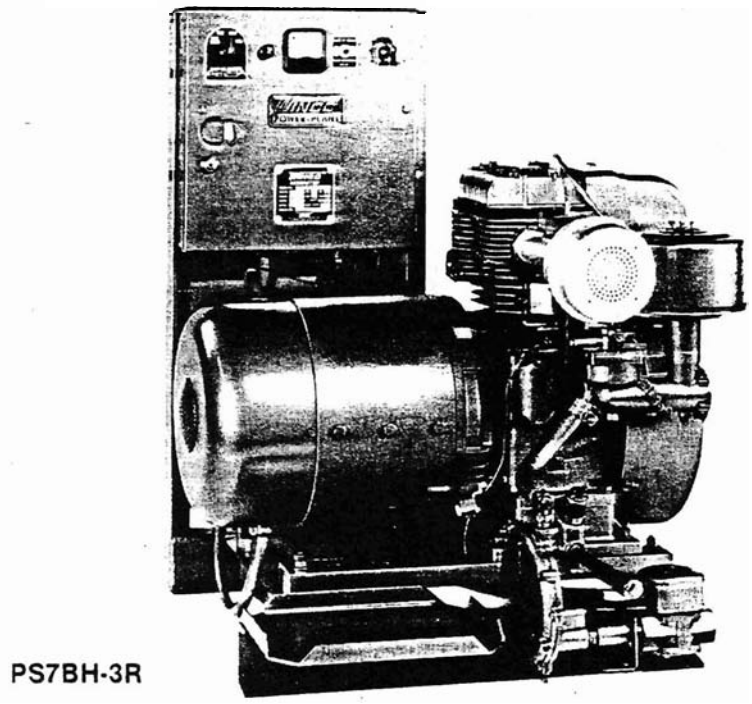

PS7BH-3R

Attention: Read all instructions in this manual before attempting to install, operate, or service the generator.

WINCO *POWER PLANTS—Over 45 Years of Leadership*

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Testing Policy

Before any generator is shipped from the factory, it is fully checked for performance. The generator is loaded to its full capacity, and the voltage, current, and frequency are carefully checked. A test card with this data is filed by unit serial number for permanent record of performance.

Rated output of generators is based on factory tests of typical units, and is subject to, and limited by, the temperature, altitude, fuel, and other conditions specified by the manufacturer of the applicable engines.

Note:	This instruction book covers only the generator, **not** the engine. See the engine manufacturer's operator's manual regarding any problems pertaining to the engine.

Limited Warranty

WINCO warrants for one year from date of shipment, it will repair or replace at its option, for the **original user,** the whole or any part of the product found upon examination by WINCO at its **factory** at 225 South Cordova Street, Le Center, Minnesota, or by any **factory-authorized service station** to be defective in material or workmanship under normal use and service.

For warranty service, return the product within **one year** from date of shipment, transportation charges **prepaid,** to the WINCO factory or to your nearest factory-authorized service station.

There is no other express warranty. To the extent permitted by law, any and all warranties, including those of merchantability and fitness for a particular purpose, are limited to one year from date of shipment, and liability for incidental or consequential damages or expenses is excluded. Some states do not allow limitations on the duration of an implied warranty, and some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights; you may have other rights which vary from state to state.

WINCO does not warrant engines or certain other component parts of the product since such items are warranted by their manufacturers.

WINCO does not warrant **alterations or repairs** which were not made by the WINCO factory or a factory-authorized service station and which affect the stability or reliability of the product.

WINCO does not warrant products which have been exposed to **misuse** and/or **negligence** or have been involved in an **accident.**

WINCO reserves the **right to change or improve** its products without incurring any obligations to make such changes or improvements on products purchased previously.

General Information

The package standby engine-generator set includes all items necessary for a completely automatic standby power system as standard equipment (except the optional 12 volt battery). The components are mounted on one common skid base, connected and wired. The entire package is then tested to insure proper operation of all components, performance and reliability.

The emergency transfer control (ETC) panel has been engineered to monitor the normal commercial power source and in the event of failure of this source will automatically start the engine generator set and transfer the load to the generator. When power is restored, control relays in the panel will transfer the load back to commercial power and shut down the engine. Other features of the panel are:

1. An over-cranking relay to stop the start sequence if the engine fails to start in approximately one minute.
2. A built-in battery trickle charger to maintain the state of charge. The charge rate may be varied with the control on the box cover.
3. A three position operation control switch to override the automatic starting and stopping of the engine-generator. The positions are:
   A. Stop—used whenever the unit is to be serviced and for emergency shut down.
   B. Automatic—normal position for emergency standby service.
   C. Check—this position enables the owner/operator to exercise and/or check the engine-generator set without transferring the load, unless a power outage occurs.

Notice Regarding Engines

This manual covers the generator portion of these units. See the separate engine instruction manual for engine-related problems, detailed engine information and engine warranty.

CAUTION Be sure to check the engine oil level frequently, as specified in the engine manual.

A highly reputable manufacturer builds the engine portion of these power plants. The manufacturer has established an excellent worldwide engine service organization; engine service is very likely available from a nearby authorized dealer or distributor; check the yellow pages of the telephone directory under "Engines," or ask the dealer from whom you purchased the power plant.

The rated power of each engine-generator is subject to, and is limited by, the temperature, altitude and all other ambient conditions specified by the engine manufacturer. Engine power will decrease 3½% for each 1000 ft. above sea level, and will decrease an additional 1% for each 10°F above 60°F (air temperature).

Unpacking

This power plant was in good order when shipped. Inspect the power plant promptly after receiving it. If damage is noted, notify the transportation company immediately; request them to write a description of the damage on the freight bill so that a claim can be filed, if necessary.

Safety Information

CAUTION: Possible damage to equipment

CAUTION Caution notes indicate any condition or practice, which if not strictly observed or remedied, could result in damage or destruction of the equipment.

WARNING: Personal danger

Warning notes indicate any condition or practice, which if not strictly observed, could result in personal injury or possible loss of life.

Despite the safe design of this generator, operating it imprudently, neglecting its maintenance, or being careless with it can cause serious injury or death. This generator is powerful enough to deliver a fatal electric shock. Allow only a responsible and capable person to operate this generator.

1. Do not allow anyone to operate the generator without proper instruction.
2. Guard against electric shock.
3. Avoid touching live terminals or receptacles.
4. Be extremely careful if operating this generator in rain or snow.
5. Do not make or break electrical receptacle connections under load.
6. Use only grounded receptacles and extension cords.
7. This generator must be properly grounded.
8. Hot engine parts, moving parts, and generator output all can seriously injure the generator operator. The operator must use caution and remain alert when using this generator.
9. Provide safety guards for all drive systems.
10. Keep all safety guards and power shields in position and tightly secured.

Battery

A twelve-volt battery rated 70 ampere hour or greater is required for proper starting performance.

Observe polarities: Connect the positive (+) battery terminal to the (+) cable from the control panel; the negative (−) battery terminal is connected to the negative cable (ground) from the engine generator assembly.

All connections must be clean and tight. Check the electrolyte (fluid) in the battery periodically to be sure it is above the plates. Never allow the battery to remain in a discharged condition.

An adjustable trickle charger, producing up to 200 MA is built into the control panel to keep the battery in top notch condition during standby periods. The rheostat should be adjusted for a normal setting of 90 MA.

NOTE: The trickle charger will not recharge a battery which has become discharged. It produces just enough current for the battery, if fully charged, to maintain a charged condition.

Fuel

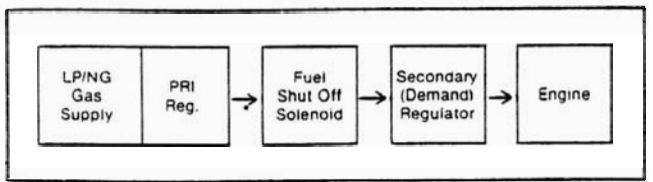
Engines are properly adjusted before they leave the factory. A tag attached to the unit specifies whether the adjustments were made for LPG or natural gas. Ordinarily no further adjustments are required on LP gas. A slight adjustment may be required on natural gas units depending on local BTU content.

Connect the fuel supply to the inlet of the fuel solenoid (see table for recommended line size). The pressure at the secondary (demand) regulator must be four to six ounces per square inch or 7 to 11 inches water column.

CAUTION Be careful when sealing gas joints. Excessive sealing compound can be drawn into the solenoid, regulator or carburetor causing an engine malfunction.

Size of Pipe Normally Required for Generators Operating on Natural/LP Gas

Size in KW	10 ft.	30 ft.	50 ft.	100 ft.
7 KW	¾ in.	¾ in.	1 in.	1 in.
5 KW	¾ in.	¾ in.	¾ in.	1 in.



*4 to 6 oz. or 7 to 11 inches water column.

Lubrication

Before starting the engine, fill the crankcase with the proper weight/grade of oil, as recommended by the engine manufacturer's maintenance instructions. The necessity of using the correct oil, and keeping the crankcase full cannot be overemphasized.

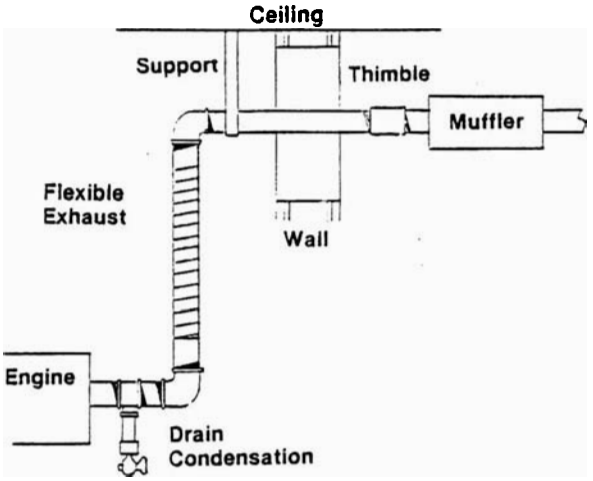


Figure 1
Exhaust Installation

Exhaust Installation

Refer to Figure 1.

Use black iron pipe for straight exhaust runs. Use flexible metal exhaust hose if needed. **Do not use electrical conduit.**

Pipe running horizontally must be adequately supported by steel straps. Noise transfer can be kept to a minimum by shock mounting at the point of attachment.

Flexible exhaust tubing should be used to minimize vibration transfer. It can be used horizontally, vertically, or at a slant, but keep it in a fairly straight line to prevent excessive strain on the welded end connections (**do not use it as an elbow**).

Exhaust installations should conform to state and local codes. Refer to NFPA (National Fire Protection Association) Manual No. 37 for specific information. If the exhaust pipe passes through a wall or ceiling constructed of combustible material, guarding to prevent fire must be installed around the pipe, as specified in the NFPA manual.

The size of the exhaust pipe to be used depends upon the length of the run:

If the engine exhaust hole is:	If the length of the exhaust run is: Up to 5 ft.	5 to 15 ft.	15 to 25 ft.
½ inch	Use ½" pipe	Use ¾" pipe	Use 1" pipe
¾ inch	Use ¾" pipe	Use 1" pipe	Use 1¼" pipe
1 inch	Use 1" pipe	Use 1¼" pipe	Use 1½" pipe
1¼ inch	Use 1¼" pipe	Use 1½" pipe	Use 2" pipe

Exhaust extension diameter must be as large or larger than exhaust pipe furnished with engine. Unscrew the muffler that is furnished from the exhaust port of the engine and then screw it onto the outside end of the pipe. See that the pipe extension is leakproof and runs in a straight line or with a minimum of sharp bends.

If the exhaust pipe rises above the engine, a condensation trap should be installed to prevent moisture from running into the engine and possibly damaging it. This is easily accomplished by installing an ordinary pipe "T" in the exhaust pipe. At the lowest point of the "T", install a short length of pipe pointing downward, and provide it with a drain plug to permit the accumulated moisture to drain out. *(See Figure 1.)* Drain the trap at regular intervals to prevent it from becoming full and overflowing into the engine. Support the exhaust pipe two feet from the exhaust opening in the cylinder; any length of pipe over two feet, if not supported, may break the cylinder casting.

Installing and wiring a home-standby generator installation is not a "do it yourself" project. Consult a qualified, licensed electrician or contractor. The installation must comply with all national, state, and local codes.

CAUTION Place selector switch in the "STOP" position. *(See Figure 2 for selector switch position.)*

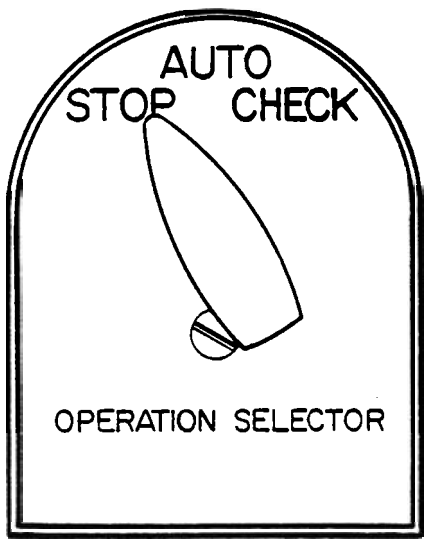


Figure 2

Before connecting the electrical transfer switch (ETC) to the commercial line and load circuits, the installation and operation of the engine generator set should be checked.

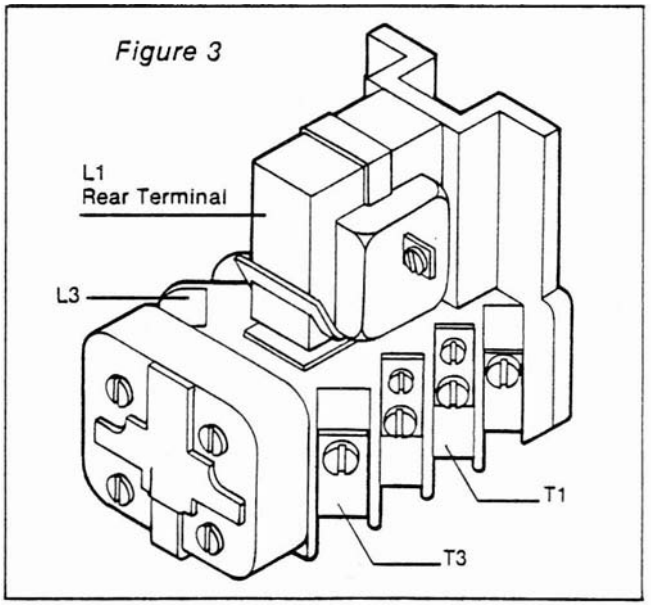
Use the following checklist for installation verfication.

Item	Check	Comment
1	Unit mounting base	
2	Engine oil. Fill as required Grade/QTY	
3	Ventilation (Louver size, inlet/outlet)	
4	Clearance on all sides	
5	Proper size fuel line and connections	
6	Remove vent plugs from regulator if installed	
7	Fuel line protected	
8	LP/NG pressure O.K. 4-6 oz. 7-11" WC	
9	Proper size exhaust line	
10	Flexible exhaust line installed	
11	Nipple installed on manifold below flexible exhaust pipe	
12	Condensation trap installed	
13	Proper muffler installed	
14	Exhaust line free of excessive elbows and restrictions	
15	Battery of proper voltage and ampere hour rating	
16	Battery properly charged	
17	Battery connections clean and tight	

After completing the above checklist, the engine-generator set is ready for the start-up test.

1. Set selector switch to the CHECK position; the engine-generator will crank and start automatically. If the engine fails to start, return selector switch to the stop position and refer to the trouble shooting section of this manual.
2. With the engine running smoothly check the no load voltage and frequency at terminals T1 and T3 of the transfer switch.
   T1 to T3 250-260 VAC FREQ. 61 61.5 HZ

Figure 3



NOTE Neutral terminal is located in bottom of the control panel.

T1 to N 125-130 VAC
T3 to N 125-130 VAC

If the voltage and frequency are not correct, turn the selector switch to the stop position and refer to the trouble-shooting procedures.

If the voltage and frequency are correct, turn the selector switch to the stop position. The unit is now ready to be connected to commercial line power and load circuits.

Turn the operation selector switch on the front of the control to the "STOP" position and turn the main power switch OFF before proceeding.

It will be observed that the terminals on the power transfer switch are marked as follows: *(See Figure 3)*

- For connecting the Load (T): T1 and T3 (T2 is connected to the ground).
- For connecting the Line (L): L1 and L3 (L2 is connected to ground).
- For connecting the standby generator (G)*: G1*, G3*, and ground G2* (*already prewired at factory).

The load current carrying wires must be of adequate size to handle the current without excessive voltage drop.

All the wires should be installed in rigid or flexible conduit. (Knockouts are provided in the control box.)

Because of the many different types of service, feeder, and distribution equipment, no specific wiring instructions can be provided. The one essential is that when the load is connected to the generator there can positively be no feedback from the generator to the power line.

CAUTION All work should be done by a competent electrician, and must be in accordance with the national code and state and local regulations.

Connecting Transfer Switch

The electrical transfer switch connects the load (lights, furnace, outlets, etc.) to the normal power line during standby. When normal power fails, the automatic transfer switch starts the engine generator set, disconnects the power line and then connects the load to the standby generator set. When normal power is restored, the automatic switch stops the engine and retransfers the load.

To wire the automatic transfer panel into the existing wiring, first determine which circuits will be on the emergency load circuit. If the entire load is to be transferred, the transfer switch can be wired in directly after the watt-hour meter. *(See Figure 5.)*

CAUTION Load must not exceed generator or transfer switch rating.

If only specific circuits are to be powered under emergency power failure conditions, an additional distribution panel designated "Emergency Distribution Panel" must be installed.

All selected emergency circuits are removed from main distribution panel and re-installed in the Emergency Distribution Panel *(See Figure 4.)* Suggested circuits—freezer, refrigerator, furnace, emergency lights, sump pump, emergency outlet circuits, etc. Total load must not exceed generator or transfer switch rating.

The emergency distribution panel is wired to the main panel through the automatic transfer switch. L1 and L3 are connected to the main panel 230 volt breaker. L2 is neutral. T1 and T3 are connected to 230V bus in the emergency distribution panel. T2 is neutral.

The main panel circuit breaker should be large enough to power the entire emergency distribution panel under normal loads, but should not exceed the contact current rating of the automatic transfer switch or generator.

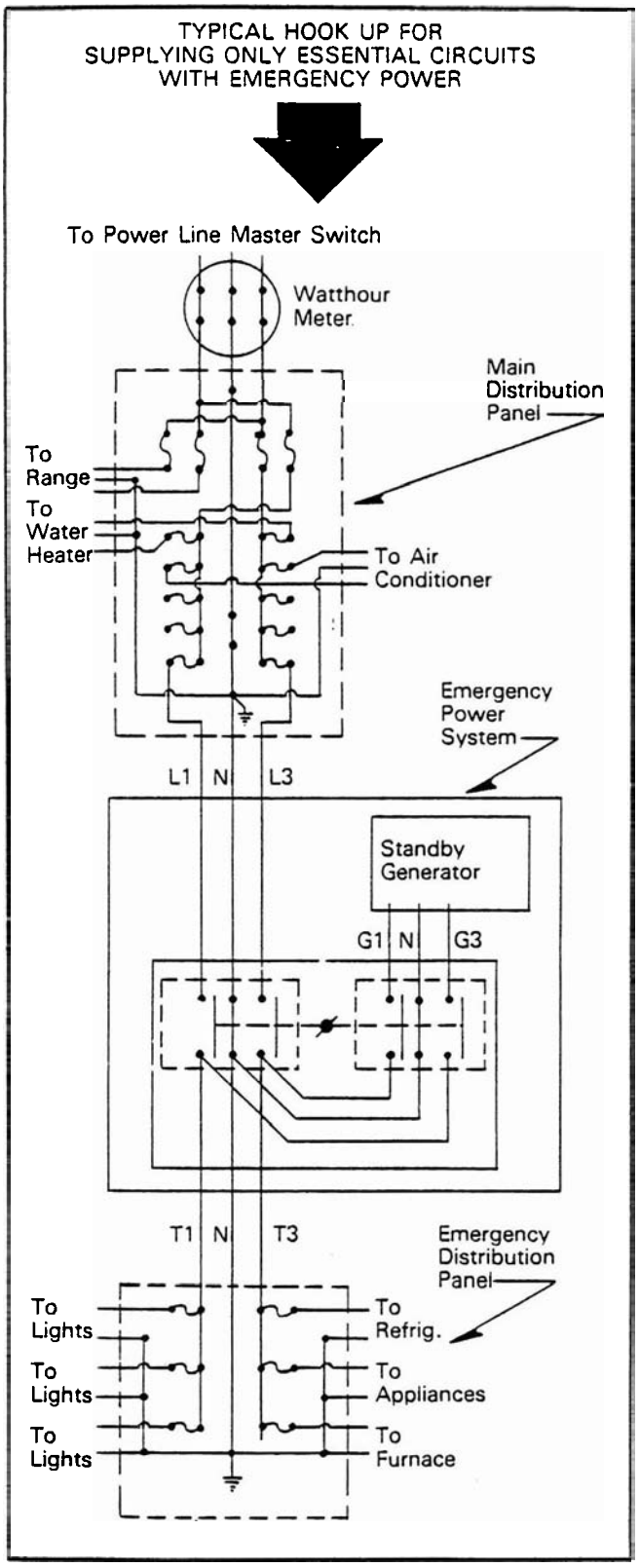


Figure 4

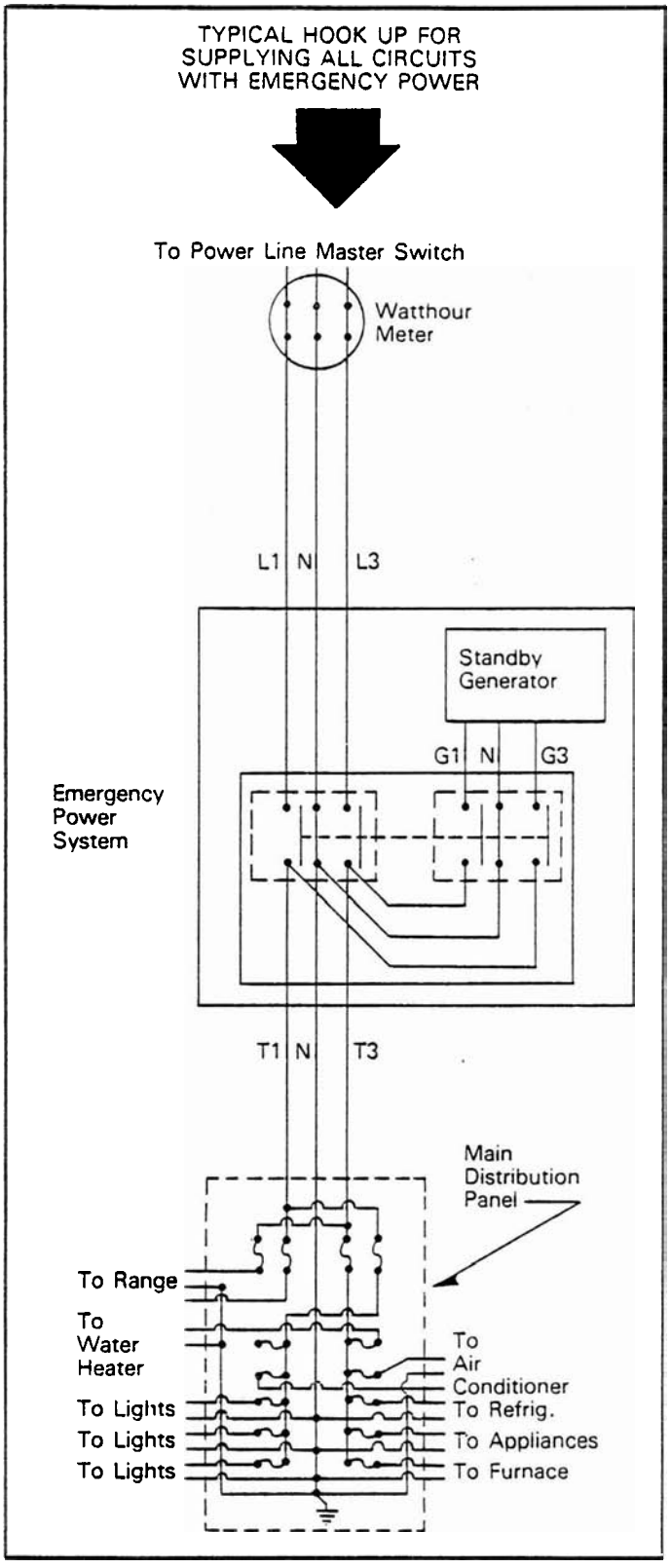


Figure 5

Operation

Functional Operation of Electrical Control

The explanation of the operation of an automatic emergency transfer control will be explained in three parts:

1. The Load Transfer Circuit
2. The Engine Control Circuit
3. The Battery Charging Circuit

1. The Load Transfer Circuit

The power transfer switch which carries the current from either the power line or the generator to the load acts as a double throw switch. There is no possibility that both sets of contacts can be closed at the same time. In normal operation, when the power line is energized, one set of points is closed connecting L1 to T1 and L3 to T3. When a power failure occurs, the standby generator is started. The generator voltage is fed to the thermal delay relay, and after approximately five seconds the relay closes and the voltage is fed to the contactor coil. This actuates the contactor and opens the contact between L1 to T1 and between L3 to T3 while closing the contact between G1 and T1 and between G3 and T3.

The following sequence of events occurs during the transfer of the load from (A) normal or power line operation to (B) interim period to (C) emergency or standby generator operation and (D) back again to normal operation.

(A) Normal operation with power line energized: Standby generator standing idle. One set of contactor points is closed, connecting load to power line.

(B) At the instant a power failure occurs the stop/start relay starts the engine (explained in section 2).

(C) When the engine generator starts, the thermal delay relay allows the generator to reach full voltage and then voltage is applied to actuate the contractor.
Three things occur:
1. The load is disconnected from the power line.
2. The load is connected to the generator.
3. The cranking circuit is open so the engine is no longer cranked.

(D) When power is restored: The start/stop relay stops the engine. When the generator voltage drops, the contactor returns to its normal position and transfers the load back from the generator to the power line.

2. The Engine Start/Stop Circuit

The "stop" wire is connected to the engine magneto. The "start" wire is connected to the coil of starting solenoid. By grounding the "stop" wire the engine is stopped; and by grounding the "start" wire it is cranked.

Refer to the wiring diagram. Note that the revolving contact of the selector switch is grounded. When a contact is in the "stop" position, the stop wire is grounded; and when it is turned to the "check" position, the start wire is grounded and the engine is cranked.

When the selector switch is turned to the "auto" position, the armature or movable contact of the start/stop relay is grounded. When the power line is energized, the coil holds the armature in position to make contact between ground and the "stop" wire. When either leg of the power line fails, spring tension moves the armature so contact is made between ground and the "start" wire and cranks the engine.

Whenever the cranking circuit is energized, the circuit is also completed through the heating coil of the over cranking relay. If the engine fails to start in about one minute, this coil becomes hot enough to trip the thermal switch. This opens the contact and interrupts the cranking. The OCR relay must be reset manually.

3. The Battery Charging Circuit

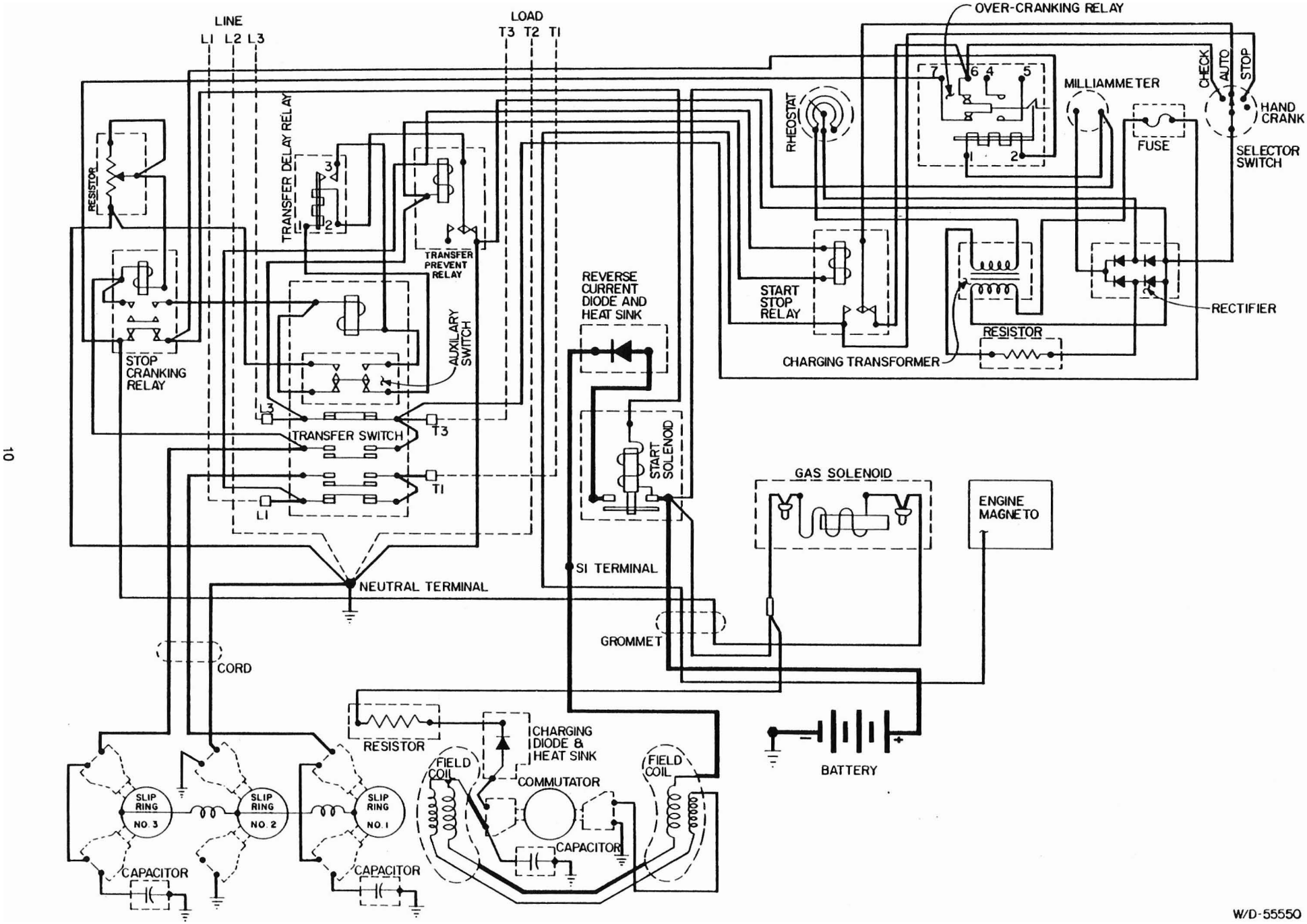
It will be observed that the primary coil of the transformer is connected to the load line through a fuse. The rheostat and the resistor are in series with the rectifier and control the charging rate. The milliammeter is connected to the DC output side of the rectifier and measures the amount of current going to the battery. The meter is connected to the over cranking relay which, in turn, is connected to the positive terminal of the cranking battery. The negative side of the battery circuit is grounded.

ETC Operational Check

Normal standby position for control "operation selector" function switch *(Figure 2)* is "Auto." Unless this switch is in the automatic position, the unit will not start automatically when a power failure occurs.

After all wiring has been completed, recheck all connections to make sure they are all clean and tight. Then test as follows to demonstrate the operation of the controls:

1. Turn on the main power switch. Power should again be available on all distribution circuits.
2. Turn the selector switch to the "Auto" (automatic) position. Then pull the main line switch to simulate a power failure. The engine generator will start and supply electricity to the emergency load.
3. Turn the main power line switch on. The controls will then stop the engine and automatically transfer the load back to the power line.
4. With the power left on, turn the selector switch to the "check" position. The engine will start and continue to run but the control will NOT transfer the load. This feature enables the owner to check the operation of the engine generator without transferring the load (unless an outage occurs while in the "check" position).
5. With the power left on, turn the selector switch back to "auto." The engine will stop.
6. Again pull the power line switch. The engine will again start and supply electricity to the emergency load. Now turn the selector switch to "stop" and the engine will stop.


LINE
L1 L2 L3
LOAD
T3 T2 T1
OVER-CRANKING RELAY
MILLIAMMETER
CHECK
AUTO
STOP
HAND CRANK
SELECTOR SWITCH
FUSE
RHEOSTAT
RESISTOR
TRANSFER DELAY RELAY
TRANSFER PREVENT RELAY
AUXILARY SWITCH
STOP CRANKING RELAY
START STOP RELAY
REVERSE CURRENT DIODE AND HEAT SINK
RECTIFIER
RESISTOR
CHARGING TRANSFORMER
TRANSFER SWITCH
T3
T1
L1
START SOLENOID
GAS SOLENOID
ENGINE MAGNETO
SI TERMINAL
NEUTRAL TERMINAL
GROMMET
CORD
RESISTOR
CHARGING DIODE & HEAT SINK
FIELD COIL
COMMUTATOR
FIELD COIL
BATTERY
SLIP RING NO. 3
SLIP RING NO. 2
SLIP RING NO. 1
CAPACITOR
CAPACITOR
CAPACITOR
W/D-55550

This feature enables the operator to change oil and check the engine during a power failure, or at any time.

Fuel Adjustments

See Figure 6

After the engine is running, apply a sufficient electrical load so that the generator is loaded to its capacity or to the maximum amount for which it will be used. Check the operation of the engine carefully to see that it runs smoothly. If it does not, a slight adjustment may be necessary to compensate for the different fuel or operating conditions. Loosen the locknut on the adjusting valve located on the secondary regulator. Turn the adjusting valve open or closed slightly so that the engine runs smoothly at full load. Then tighten the locking nut to hold the valve in this position. Turn valve clockwise to reduce fuel; turn valve counterclockwise to increase fuel.

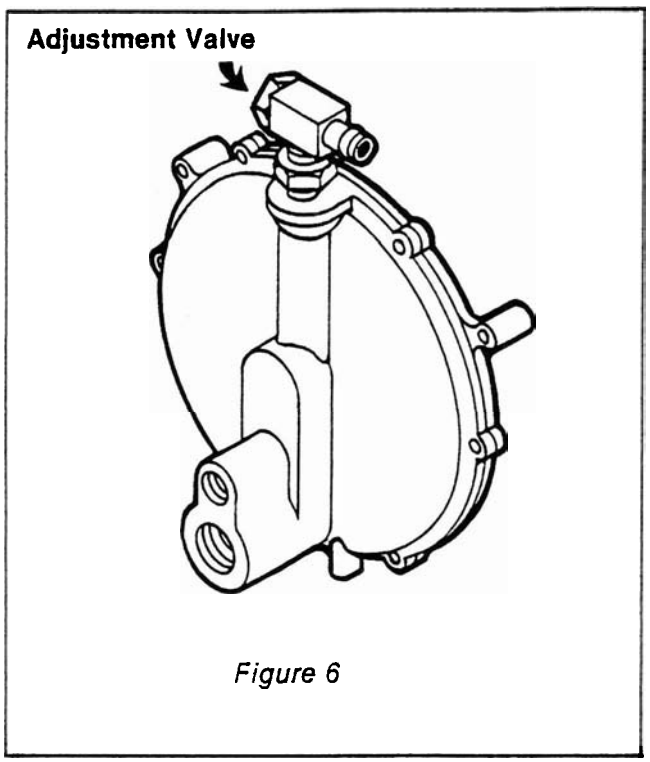


Figure 6

Maintenance

General Information

The main components of the generator are: field frame, field coils, armature, brushes, brush holder assembly, end brackets, armature, armature-mounted cooling fan, and control box.

Before performing any maintenance on the engine or generator, place the selector switch on the control panel to the STOP position.

Engine Maintenance

Refer to the engine instruction manual for normal routine engine maintenance.

Brushes

Under ordinary circumstances, brushes will operate for long periods without requiring replacement. They should be inspected after the first 1000 hours of operation, and after every 100 hours of operation thereafter. Remove brushes one at a time and check for length; be sure that each moves freely in the brush holder. Brushes should be replaced when worn down to 3/8". Replace brushes in complete sets, never singly. When replacing brushes, be careful to reconnect the lead wires properly.

Poor contact (or "skipping") between brush and commutator is caused by oil and grit, flint, or other hard substance in the brush, or by the brush not being properly shaped to fit the commutator. Remedy these defects by fitting the brushes to the commutator or slip-ring curvature. Place No. 00 sandpaper under the brushes with the abrasive side to the brushes, and work it back and forth until the brushes are the same shape as the commutator or slip-rings. *(See Figure 7.)*

Commutator

Keep the commutator free from all dirt, including carbon dust. Use a lint-free cloth for this purpose. Commutator should be smooth and shiny; its color should be in the copper to chocolate-brown range. If rough or black, polish with a commutator dressing stone or No. 00 sandpaper. **Never use emery cloth on the commutator.**

Hard mica is used as insulation between the commutator bars. It is undercut about 1/32" below the surface of the bars. As the copper wears down, the mica, which is harder, forms ridges which cause the brushes to skip, resulting in poor contact. When this occurs, the armature should be removed from the unit, the commutator resurfaced, and the mica should be undercut by a qualified repairman. *(See Figure 7.)*

Do not use lubricants of any type on the commutator. Lubricant will cause sparking, poor contact, and pitted bars, and will decrease the output of the generator.

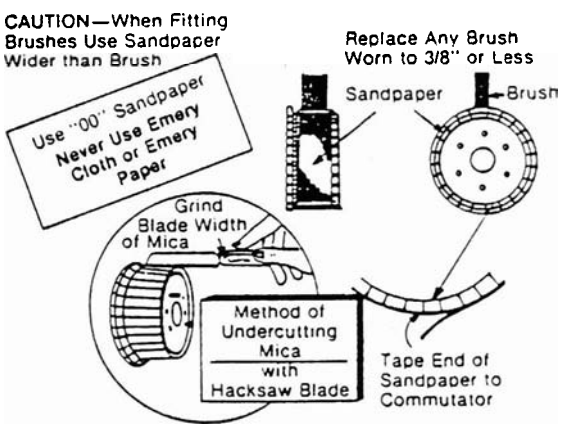


Figure 7
Care of Commutator and Brushes

Testing Generator Field for Opens and Grounds
See Figure 8

1. Disconnect battery cables from the generator (if battery is used).
2. Disconnect field leads from DC brush holders.
3. Set multimeter to read resistance, and connect the meter leads to the field leads.
   If field is open, meter will read infinite resistance. Replace field if it is open.
4. Connect one meter lead to the field shell (other lead still connected to one of the field leads).
   If meter indicates continuity (zero ohms or any reading lower than infinite resistance), the field is grounded and should be replaced.

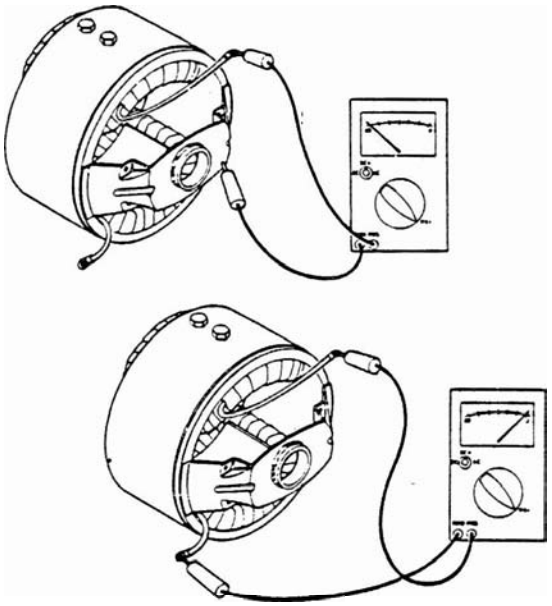


Figure 8
Field Coil Testing

Testing Armature for Opens and Grounds
See Figure 9

1. Disconnect battery cables from generator (if battery is used).
2. Remove all brushes, AC and DC.
3. Ground Test
   Set multimeter to read resistance. Holding one meter lead against a clean spot on the armature shaft, touch the other lead to each of the metal bars of the commutator (one at a time) while observing the meter.
   If meter indicates continuity (zero ohms or any reading lower than infinite resistance), the armature is grounded. Dirt on the commutator bars can cause grounding. Carefully clean the dirt off the commutator if grounding was indicated, then recheck it. Replace the armature if it is grounded.
4. Check each of the three collector rings for grounding in the same manner as described for checking the commutator in step 3.
5. Testing for Opens
   (Meter still set to read resistance.) Holding one meter lead on surface of collector ring No. 1, touch other meter lead to surface of collector ring No. 2 while observing the meter. Meter should indicate continuity (low resistance). If not (i.e. if meter indicates infinite resistance) part of armature windings are open and armature should be replaced.
   Check for open between collector rings No.'s 2 and 3 in same manner as you did between rings 1 and 2 (previous paragraph).

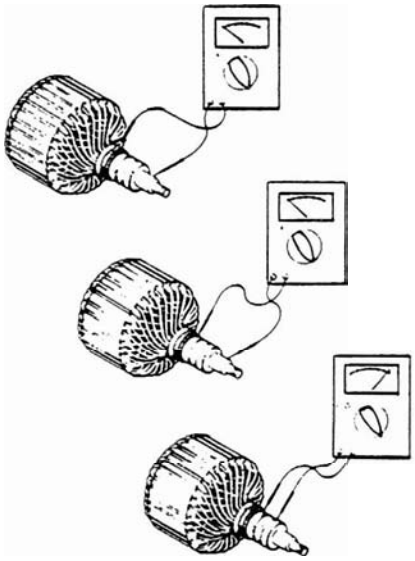


Figure 9
Testing Armature for Opens and Grounds

Collector Rings
The two or three continuous copper rings located at the end of the armature are the collector rings. For proper generator output, the surface of the collector rings must have a highly polished finish. Polish the ring surfaces occasionally with a crocus cloth to maintain the finish.

Condenser Testing
Condensers are built into the generator circuit to minimize radio interference during operation. If a condenser shorts out, it blocks the generator output. To determine whether a condenser is shorted, turn off the engine-generator, disconnect the lead wire from the brush holder to which the condenser is connected, turn the engine-generator back on and check the output. If the generator then provides power, the condenser was at fault and should be replaced. (If the generator did not provide power after the lead wire was disconnected, the problem was not caused by that condenser. Reconnect the lead wire.)

Battery
Check the electrolyte (battery fluid) periodically to insure the fluid level is above the plates. Never allow the battery to remain in a discharged condition.

Exhaust Condensation Trap
Drain the trap *(shown in Figure 1)* at regular intervals to prevent exhaust condensation from overflowing into the engine.

Trouble Shooting Table

Symptom	Cause(s)	Corrective Action
Generator will not crank when power is off.	Low or dead battery.	Check fluid level and specific gravity.
	Loose or dirty terminal connections.	Clean and tighten connections.
	Battery not large enough.	70 ampere hour (minimum) battery required.
	Overcranking relay tripped.	Reset Red button on front panel.
	Defective overcranking relay.	If relay trips in less than 50 seconds or does not trip after 60 seconds, replace relay.
	Defective DC brushes/springs.	Check brushes for wear, chips and contour, replace if worn or cracked. Recontour if not seated properly. Replace brushes with weak springs.
	Start/stop relay defective.	Check for broken wires, dirty or pitted contacts, open coil. Repair or replace.
Generator cranks but engine will not start.	Incorrect fuel pressure.	Fuel pressure to the unit must be 4 to 6 oz. or 7 to 11 inches water column.
	Defective engine ignition system.	Refer to engine operator manual.
	Defective fuel shut off.	Check for loose/broken connections or open coil. Repair or replace.
Engine will not stop with switch in AUTO position.	Loose or open wire between the selector switch and magneto.	Set selector switch to the stop position. If engine does not stop, short out the spark plug. Use a screw driver with a well insulated handle.
	Start/stop relay N.O. contacts dirty or corroded.	Repair or replace wire. Clean contacts or replace relay.
Load will not transfer with selector switch in AUTO position.	Open contactor coil.	Replace contactor switch.
	Defective auxiliary switch contacts.	Replace auxiliary switch contacts.
	Defective transfer delay relay.	Replace relay.
No output or low output voltage.	Open or shorted armature.	Replace armature.
	Open or shorted field coil(s).	Replace field coil(s).
	Low excitation voltage.	Check commutator condition, clean and redress (see maintenance), check that DC and AC brushes are making good contact.
	Engine not operating at proper speed.	Refer to engine operators manual.
	Generator overloaded	Reduce load to generator nameplate specifications.
Output voltage too high.	Engine speed too high.	See engine manual.
Generator overheating.	Generator overloaded.	Reduce load.
	Armature rubbing pole shoes.	Check bearing condition. Check field shell bearing bracket alignment.
	Poor ventilation.	Clear inlet and outlet air vents of debris. If unit is housed, insure at least 2 ft. clearance on all sides and inlet and outlet vents are of adequate size.
Sparking at the brushes.	Generator overloaded.	Reduce load.
	Brushes not seated properly.	Contour brushes (see maintenance).
	Commutator/slip rings rough or eccentric.	Redress commutator/slip rings (see maintenance).
	Brush spring tension incorrect.	Replace brushes.
No battery charging when engine-generator is not running.	Defective fuse, meter, rectifier, rheostat.	Replace defective component(s).
No battery charging when engine-generator is running.	Defective reverse current charging diode.	Replace diode.
	Open charge resistor.	Replace resistor.
	Loose or broken wire/connection.	Repair/replace wire or connection.
Battery discharges when engine-generator is not running.	Defective reverse current diode.	Replace diode.

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