WINCO

EMERGENCY POWER PACKAGE

GENERATOR

ASSEMBLY INSTRUCTIONS
OPERATING INSTRUCTIONS
SERVICE INFORMATION

AIR COOLED
DIRECT DRIVEN TYPES
TWO-POLE 60 CYCLE

PS **3000 WATT**
PS **5000 WATT**

PS **10,000 WATT**

PS **7000 WATT**

Representative models covered by this instruction book are pictured above. For complete specifications see the nameplate on the generator frame.

Write the model number and serial number of the generator in the spaces below and save this book for future reference. Be sure to give these numbers if corresponding about or ordering parts for the generator.

GENERATOR MODEL _____ SERIAL _____

A SEPARATE INSTRUCTION BOOK IS PROVIDED FOR THE ENGINE. READ IT CAREFULLY BEFORE STARTING THE ENGINE. The engine Model Number, specification number and Serial Number is stamped on the nameplate attached to the engine. Record these numbers on the engine instruction book and refer to them whenever ordering parts or requesting information from the engine service distributor or engine manufacturer.

WINCO
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INTRODUCTION

Before any generator is shipped from the factory it is thoroughly checked for performance. The generator has been run long enough to seat the brushes so that good electrical contact is made between them and the slip rings or commutator. The governor and carburetor are then adjusted and with the generator loaded to its full capacity the voltage, current and frequency are carefully checked. The normal source of power is then turned off to check the automatic electrical transfer system. The generator voltage and frequency are again checked.

No generator is shipped unless it produces its full rated capacity, nor until it has passed other rigid inspection tests.

Factory tests were made using the type of fuel specified on the shipping order, and the carburetor has been properly adjusted for best performance over the entire load range. It is suggested that if any carburetor adjustment or other adjustments are necessary that they be made after the engine is warmed up thoroughly.

If upon installation a new generator does not work properly, check all of the electrical connections and the generator speed before concluding that the generator is not performing satisfactorily. When unpacking the machine, be sure to inspect it carefully to see that no damage occurred in transit. If damage is noted, notify the transportation company immediately and have them write the nature of the damage on the freight bill, so that a claim can be filed if necessary.

NOTICE REGARDING ENGINES

This instruction book covers only the generator — not the engine. See the engine instruction book regarding any problem pertaining to the engine.

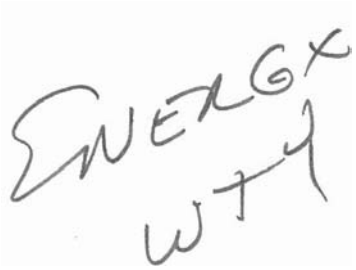
Be sure to check the oil level frequently as specified in the engine instruction book. The engine was made by a highly reputable manufacturer who has established an excellent world wide engine organization. Engine service is very likely available from a nearby authorized engine service dealer or distributor — check the Yellow Pages of your phone directory under Engines or ask the dealer from whom you purchased the generating plant.

The rated output of each generator is based on factory tests on typical units and is subject to and limited by the temperature, altitude, fuel, and other conditions specified by the manufacturer of the applicable engine. Engine power will decrease 3½% for each 1,000 feet above sea level, and 1% for each 10°F. above standard temperature of 60°F.

PREPARATION

CAUTION: Before starting the engine, fill crankcase with proper grade of oil as directed in engine instruction manual. The necessity of using the proper grade oil and of keeping the crankcase full at all times cannot be overemphasized.

A Guarantee Registration Card is enclosed with this Instruction Manual. This card must be filled in and returned to the factory within 10 days of date of purchase. The guarantee is void unless the Guarantee Register Card is returned.



INSTALLATION AND OPERATION

LOCATION

For best service from a permanently installed unit there are several factors which should be taken into consideration in choosing the best location.

1. MOISTURE. All electrical equipment should be protected from excessive moisture. Failure to do so will result in deterioration of the insulation and will result in short circuits and grounds.

2. DIRT. Foreign materials such as dust, sand, lint and abrasive materials have a tendency to cause excessive wear, not only to the engine parts, but also to the generator parts, particularly the brushes. It is, therefore, important that the unit be installed in a reasonably clean location for best service.

3. HEAT. All engines give off considerable heat when they are running. Since the engines used on these generators are all air-cooled it is important that the temperature of the room in which they are located does not exceed 110° or 120° F. Cross ventilation, provided by the opening of doors, windows or louvers is recommended whenever possible. Where natural ventilation is inadequate a fan to boost circulation should be installed.

4. COLD. Engines start easiest when they are not subjected to extreme cold. Engine-generators which are installed to operate automatically should preferably be located where the temperature does not fall below freezing.

5. EXHAUST. Exhaust gases from gasoline engines are extremely poisonous. Whenever an engine is installed indoors the exhaust fumes must be vented to the outside. The engine should be installed at least two feet from any outside wall and the exhaust recommendations given in Figure 1 should be followed. Using an exhaust pipe which is too long or too small can cause excessive back pressure which will cause the engine to heat excessively and possibly burn the valves. (SEE "Important Exhaust Notes" concerning combustible walls.)

6. SERVICE. Unit should be accessible on all sides for minor maintenance and adjustments, checking and changing oil, cleaning oil filter, saftely shutdown and fuel valve shutoff.

7. INSTALLATION. Location selected should be as close to the electrical distribution panel as possible.

DO NOT SHOCK MOUNT THE MAIN FRAME

Engine vibration will be transmitted to the electrical controls, causing erroneous start/stop cycles and premature control failure unless the main frame is held absolutely rigid.

Engine generator sub assembly is mounted on a sub frame with rubber shock mounts in such a manner that the entire generator sub assembly is free to move upward and downward slightly.

IMPORTANT EXHAUST NOTES

See Figure 1

The National Board of Fire Underwriters Standard for the Installation and Use of Combustion Engines and Gas Turbines states:

"Exhaust pipes passing directly through combustible walls or partitions shall be guarded at the point of passage by one of the following methods:

a. "Metal ventilated thimbles not less than 12 inches larger in diameter than the exhaust pipe; or

b. "Metal or burned fire clay thimbles built in brick work or other approved fire-proofing materials providing not less than 8 inches of insulation between the timble and combustible material.

"Exhaust pipes shall be connected to or pass inside of a metal, masonry, or factory-built chimney when the exhaust gases go through a floor, ceiling, attic or concealed space. When an exhaust pipe is connected to a chimney, a muffler shall be installed between the engine and the point where the exhaust pipe enters the chimney. The exhaust pipe shall be extended up into the chimney beyond any other flue collars from other fuel-burning appliances which are vented into the chimney."

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

Table 1

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

If condensed water from the exhaust can run back into the engine cylinder, make a "condensation trap" using a T connection, a short piece of pipe and a pipe cap with a petcock in it as shown in Fig. 1.

WARNING

Remember that the exhaust fumes from any gasoline engine are very poisonous if discharged in a closed room. Eliminate the danger of deadly carbon monoxide gas.

If the power plant is installed indoors, you must make some provision for getting the engine exhaust to the outside of the building. (See Fig. 1). Obtain a piece of pipe, or flexible metal hose* long enough to reach the engine to the outside of the building and connect it to the exhaust port 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 and then screw it onto the outside end of the pipe. See that the pipe extension is leak-proof and runs in a straight line or a minimum of sharp bends.

***NOTE: A Flexible Exhaust Line is supplied as standard equip. with these packaged units.**

If the exhaust pipe rises above the engine, a condensation trap should be in to prevent moisture from running into the engine which might result in serious damage. 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 to point downward and provide it with a drain plug to permit the accumulated moisture to be drained out. (See Figure 1) Drain this trap at regular intervals to prevent the trap from becoming full and over-flowing into the engine. Support the exhaust pipe two feet from the exhaust opening in the cylinder, as any length of pipe over this amount, if not supported, may break the cylinder casting.

If the exhaust pipe passes through a wall constructed of wood or any other combustible material, necessary precautions must be taken to eliminate a fire hazard. The muffler furnished with the unit may be installed at the end of the exhaust pipe outside the building to silence the exhaust.

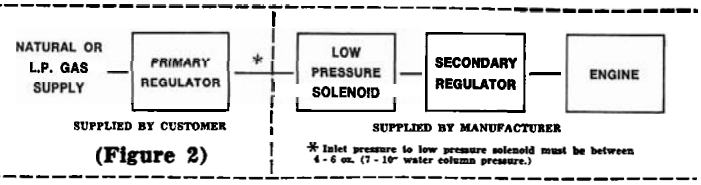
SIZE OF PIPE NORMALLY REQUIRED FOR GENERATORS OPERATING ON NATURAL GAS WITH BTU CONTENT OF 1000 BTU

Size in KW	30 ft.	50 ft.	100 ft.
18 KW	1 in.	1¼ in.	1½ in.
10 KW	1 in.	1 in.	1¼ in.
7 KW	¾ inc.	1 in.	1 in.
Up to 5 KW	¾ inc.	¾ in.	1 in.

NOTE: Allow an additional 3 feet for each standard elbow. DO NOT use Street Ells.

L. P. GAS — On L.P. Gas units use ¾ in. pipe up to 50 feet in length on units up to 5 KW. On units from 5 KW to 18 KW use 1 in. pipe up to 50 feet in length.

TABLE 2



(Figure 2)

TYPICAL L.P. OR NATURAL GAS INSTALLATION

This unit is high speed exciter cranked, which eliminates the need for a choke after the installation has been completed and the proper adjustments have been made.

BATTERY (3, 5 & 7 KW)

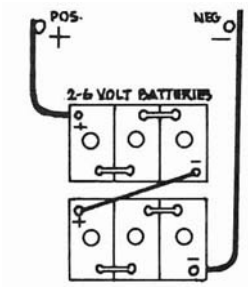
A twelve volt battery rated at 70 ampere hour or more is recommended for starting "remote start" and "electric start" plants.

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.

Caution — These Units are Negative Ground.

BATTERY (10 KW)



a large capacity (12V - 100 Amp Hour) battery is recommended. This battery may be made by connecting two 6 volt car batteries in series — that is, connecting the postive terminal of one battery to the negative terminal of the other. The remaining positive battery terminal is joined to the "Pos." battery cable from the panel and the remaining negative battery terminal to the "Neg." battery cable 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.

These generators are basically alternating current generators, and although they produce enough direct current to keep batteries charged while running under most normal operating conditions, they are not intended to be used as battery chargers. Consequently the charge rate is kept low — approximately 4 amperes.

An adjustable trickle charger, producing up to 0.2 amperes, is built into the control panel to keep the battery in top notch condition during standby periods.

All units also include a milliammeter located on the control panel, which indicates the rate at which the battery is being charged.

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.

PREPARATION

CAUTION: BEFORE STARTING THE ENGINE, FILL CRANKCASE WITH PROPER GRADE OF OIL AS DIRECTED IN ENGINE INSTRUCTION MANUAL.

THE NECESSITY OF USING THE PROPER GRADE OIL AND OF KEEPING THE CRANKCASE FULL AT ALL TIMES CANNOT BE OVER EMPHASIZED.

Figure 1a

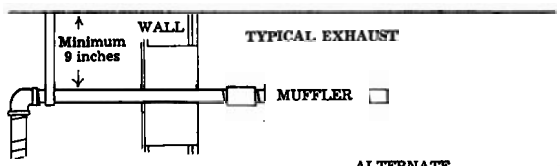
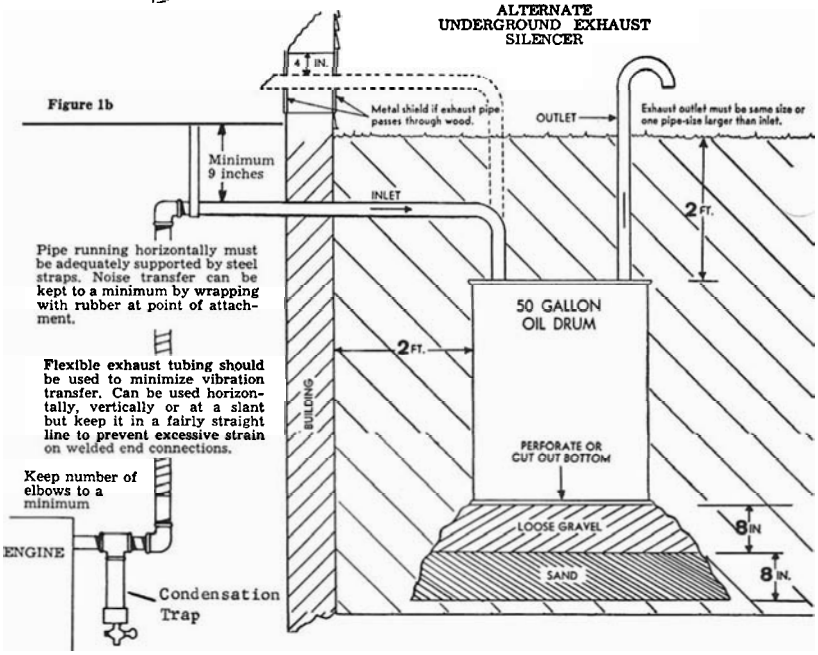


Figure 1b



WARNING: Before attempting to start engine, be certain engine crankcase is filled with the proper type, grade, and quantity of oil. Consult engine instruction book. Do not operate unit until **all** instructions have been read and understood.

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 necessary on natural gas, depending on the local BTU content.

When burning LP gas, the engine generator plant will deliver approximately its full rated output. When burning mixed gas, natural gas, or manufactured gas with a rating of 1000 BTU, the engine generator will deliver up to 80% of its rated capacity under normal operating conditions. Whe burning manufactured gas of approximately 550 BTU, the engine generator will deliver up to 60% of its rated capacity under normal operating conditions.

Natural gas, manufactured gas, and bottle gas do not usually ignite as readily as gasoline. However, since remote start and electric start generators with exciter cranking start the engine at a high rate of speed, no difficulty in starting is ordinarily experienced at normal temperatures. Special provisions must be made when using LPG in freezing temperatures. Oversize fuel tanks, fuel tank insulation, or controlled butane/propane mixtures may be required.

GAS CONNECTIONS

CAUTION: Be careful when sealing gas joints. Excessive sealing compound can be drawn into the carburetor and cause malfunction.

(See Figure 2.) Connect the fuel supply to the inlet of the gas regulator, using copper tubing or flexible hose. The pressure at the secondary regulator must be from 4 to 6 ounces per square inch. The regulator will then automatically shut off the flow of gas when the engine demand has ceased. As a safety precaution, an automatic electrically operated solenoid valve is included in the fuel line.

OPERATION

GENERAL: The generator is inherently self regulating in that its output automatically adjusts itself to the load. No harm to the generator results if it is run with no load connected. Your generator has an overload capacity of approximately 10% to handle momentary overloads.

ADJUSTING ENGINE TO START

All necessary adjustments have been made at the factory; this plant is ready to operate. It has been thoroughly checked and tested at its rated capacity while running. Do not make any adjustments until you have studied all the insructions in this manual and the engine manual.

INITIAL START (3, 5 & 7 KW)

Check all connections — check oil level in engine — turn on fuel — switch electrical control operation selector function switch to "check" (fig. 4). Engine generator set will crank and start automatically but will not transfer the load. See troubleshooting chart in case of difficulty.

Typical Fuel components and adjustment locations.

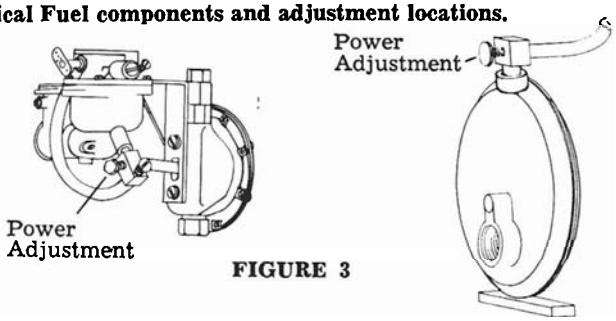


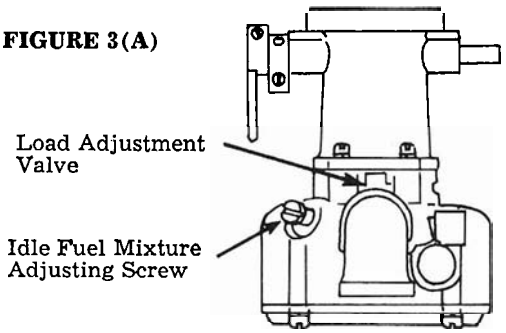
FIGURE 3

INITIAL START (10 KW)

Check all connections — check oil level in engine — turn on fuel — switch electrical control operation selector function switch to "check" (fig. 4). Engine generator set will crank and start automatically but will not transfer the load. See troubleshooting chart in case of difficulty.

Typical Fuel components and adjustment locations.

FIGURE 3(A)



FUEL ADJUSTMENTS

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. Turn the adjusting valve on the carburetor inlet slightly so that the engine runs smoothly at full load. Turn valve clockwise to reduce fuel; turn valve counterclockwise to increase fuel. After the power mixture has been adjusted properly, remove the load and adjust the idle mixture screw to obtain the smoothest operation.

REQUIRED OPERATING SPEED

THE ENGINE GENERATOR MUST BE RUN AT THE PROPER SPEED IN ORDER TO FURNISH THE ELECTRICAL POWER IT WAS BUILT TO PRODUCE.

All engines have a tendency to slow down when a load is applied. The governor on the engine is designed to hold the speed as nearly constant as possible. When the electrical load connected to the generator is increased, the engine is more heavily loaded and as a result the speed drops slightly. This slight decrease in speed, together with the "voltage drop" within the generator itself, results in a slightly lower voltage when the generator is loaded to its full capacity than when runing idle. The slight variation in speed also affects the frequency of the output current. This frequency variation has no appreciable effect in the operation of motors, lights and most appliances. However, timing devices and clocks will not keep perfect time when used on these generators.

Although individual units and models may vary slightly, the normal voltage and frequency of typical 60 cycle engine-driven generators described in this book are approximately as follows when run first with no load applied, then at half the generator capacity and finally when loaded to its full capacity as rated on the nameplate.

TABLE 3

Load Applied	Generator Speed	Frequency	Generator Voltage	
			115v.	230v.
None	3660	61	129	258
Half	3600	60	120	240
Full	3510	58½	115	230

The speed of the engine was carefully adjusted at the factory so that the generator produces the proper voltage and frequency. For all normal usage the speed setting should not be changed. If the generator is being run continuously on a very small load, it may be well to lower the speed slightly; if it is being used constantly at full load, it may be well to raise the speed slightly. Whenever making any speed adjustments check the unit with a voltmeter or tachometer and be sure the speed is neither too high or too low.

The engine must be run at the specified speed at all times. Lower voltage may damage both the generator and any appliances connected to it. Running the engine at excessively high speeds results in too high voltage which may materially shorten the life of appliances being used.

The output voltage should be checked periodically with a portable meter to insure proper operation of the generating plant and appliances.

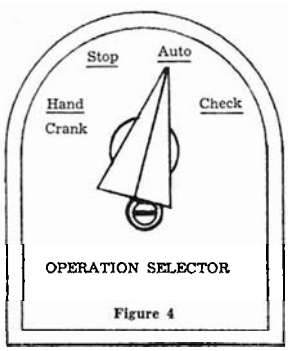


Figure 4

WIRING CONNECTIONS

ALL WIRING SHOULD BE DONE IN CONFORMANCE WITH THE NATIONAL ELECTRICAL CODE AND WITH STATE AND LOCAL REGULATIONS.

Connecting the generator to house wiring circuits is done through an electrical transfer switch. The transfer switch prevents feedback. Feedback could result in injury to linemen. The transfer switch also provides isolation which prevents damage to the generator and other circuit components if the main line power is restored while the generator is connected. It also permits the use of normal fusing. (See Figure 5).

Use sufficiently large insulated wire to connect the plant to the load. The size will depend largely on the distance, the permissible voltage drop between the plant and the load, and the amount and kind of load. Consult a competent electrician. Check national and local codes before installing.

Before doing any wiring, be sure the engine generator is operating satisfactorily.

After the unit is mounted in position, 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 contactors (transfer switch) for 115/230 volt controls are marked as follows: (See Figure 8).

For connecting the Load (T): T1 and T3 (T2 is connected to 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 may 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 or to the power line.

ALL WORK SHOULD BE DONE BY A COMPETENT ELECTRICIAN WHO THOROUGHLY UNDERSTANDS THE PROBLEM, 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 disconnects the power line, starts the engine generator set, and connects the load to the standby generator set. When normal power is restored, the automatic switch retransfers the load and stops the engine.

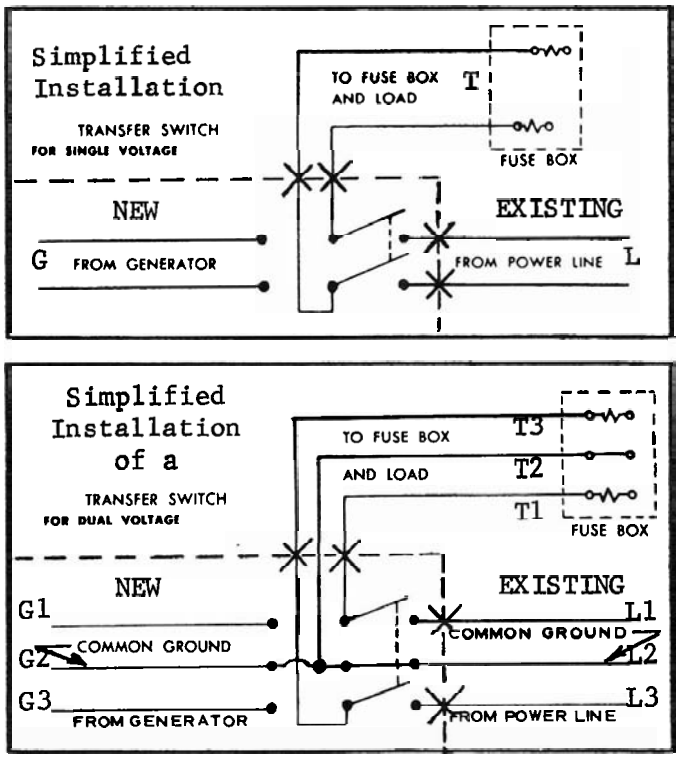


Figure 5

NOTE: Figure 5 above shows a simplified installation of an emergency power sytem. Each "X" indicates a break in the customer's line to insert he new automatic electrical transfer switch.

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 (CAUTION: Load must not exceed transfer switch rating.) (See Figure 6.)

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 Eemergency Distribution Panel (See Figure 7). Suggested circuits — freezer, refrigerator, furnace, emergency lights, sump pump, emergency outlet circuits, etc. Total load must not exceed generator rating.

The emergency distribution panel is wired to the main panel through the automatic transfer switch (Figure 8). L1 and L3 are connected to the main panel 230 volt breaker. L2 is grounded. T1 and T3 are connected to 230V bus in the emergency distribution panel. T2 is ground.

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.

CONNECT WIRE FROM	TO TERMINAL IN ETC
Hot line wire	L1
Neutral line wire	Grd.
Hot line wire	L3
Hot load wire	T1
Neutral load wire	Grd.
Hot load wire	T3

NOTE: For 115 volt (only) units, omit the references to G3, L3, and T3.

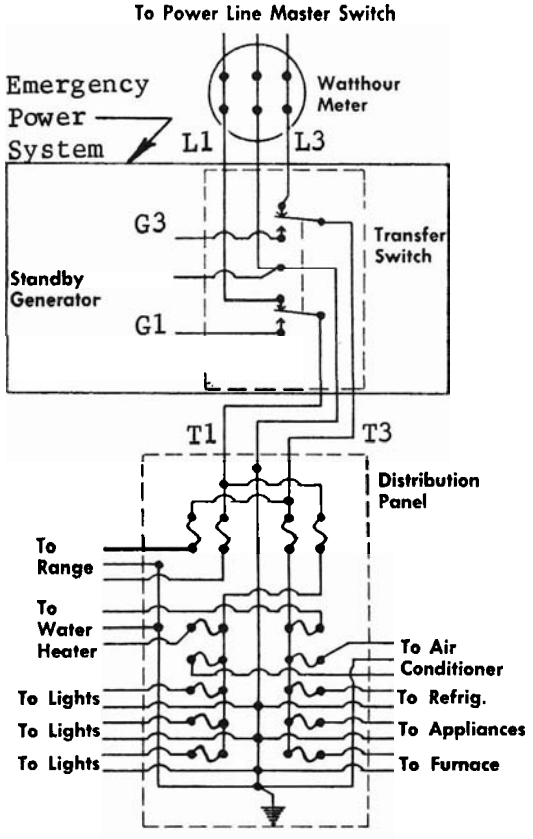


Figure 6

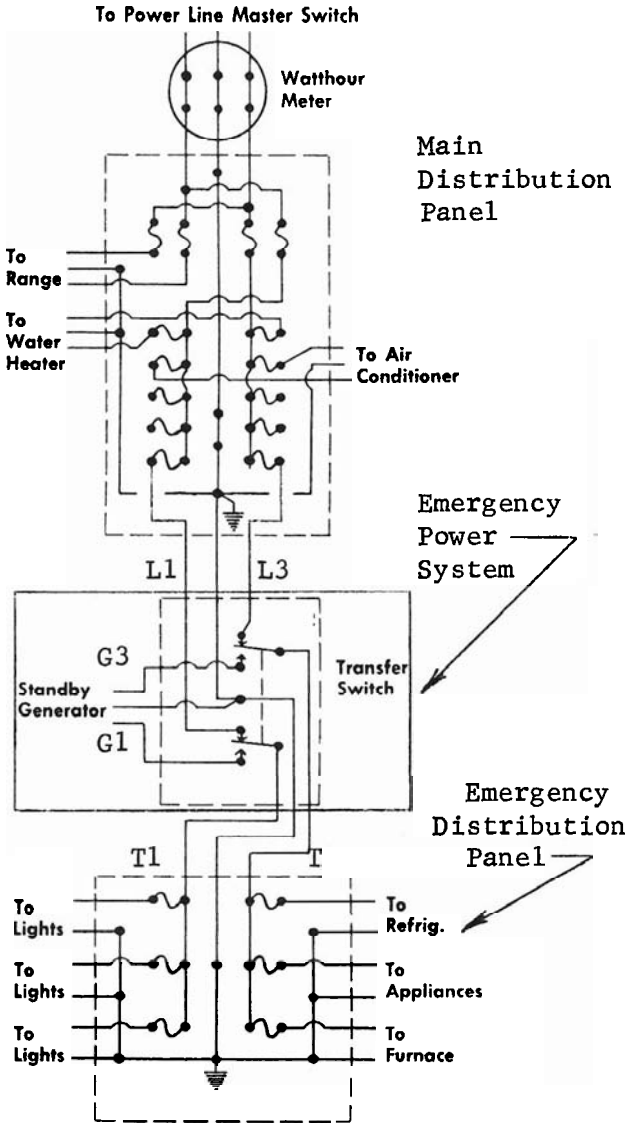


Figure 7

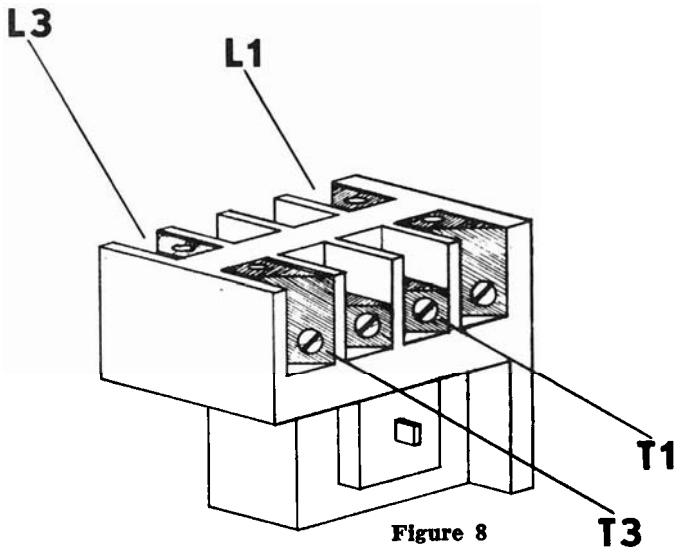


Figure 8

(Contactor switch common to the 3, 5 & 7 KW)

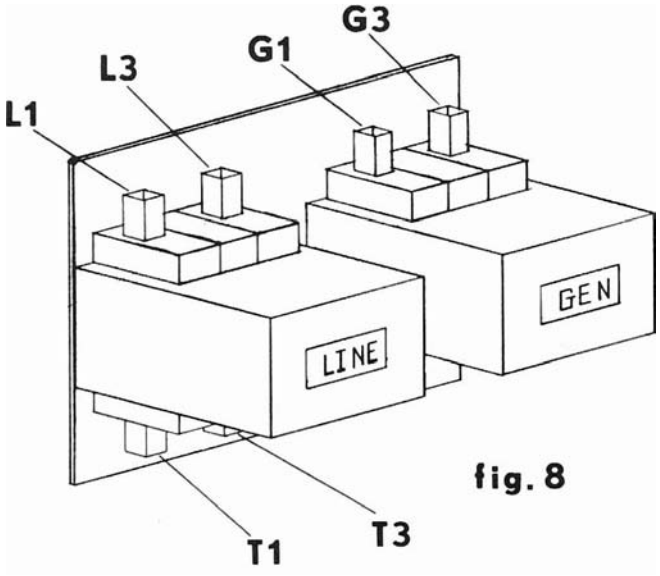


fig. 8

Figure 8(A)

(Contactor switch common to the 10 K W only)

ETC OPERATIONAL CHECK

Normal standby position for control "operation selector" function switch (Fig. 4) 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 he 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 swich 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 he 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. This feature enables the operator to change oil and check the engine during a power failure, or at any time.
   The only time the selector switch is turned to the "crank" position is when the battery is dead and the engine is to be cranked by hand. A 12 volt battery must be connected to the fuel solenoid leads if unit is to start.

MAINTENANCE AND TROUBLESHOOTING

ROUTINE GENERATOR CARE

BRUSHES

Under ordinary circumstances brushes will operate for long periods without requiring replacement. They should be inspected after 1000 hours of operation and every 100 hours of operation thereafter. Remove brushes one at a time and check for length and be sure that each moves freely in the brush holder. Brushes should be replaced when worn down to ⅜". Replace brushes in complete sets, never a single brush. Caution should be taken when replacing brushes that the lead wires are connected properly.

Poor contact between brush and commutator or slipping is caused by oil and grit, flint, or other hard substance in the brush, or by brushes not properly shaped to fit the commutator over the whole of their surface. 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 working back and forth until the brushes are the same shape as the commutator or slip-rings. (See Figure 9)

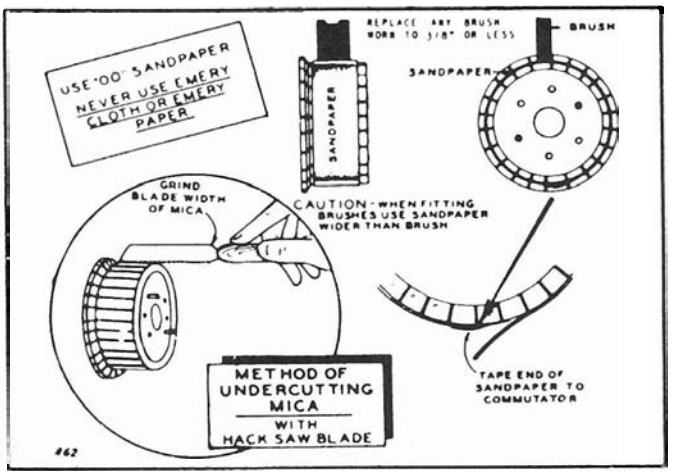


Figure 9, Care of Commutator and Brushes

COMMUTATOR: Keep the commutator free from carbon dust or other dirt. Use a lint-free cloth for this purpose. Commutator should be smooth and have shiny to chocolate-brown color. If rough or black, polish by the application of a commutator dressing stone or No. 00 sandpaper. (Never use an emery cloth.)

A hard mica is used as an insulator between the commutator bars. This is undercut about 1/32 inch below the surface of the bars. As the copper wears down, the mica which is harder forms ridges which cause the brushes to jump with resultant poor contact. When this occurs, the armature should be removed from the unit and the commutator resurfaced and the mica should be undercut by a qualified repairman. (See Figure 9)

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

COLLECTOR RINGS: These are two or three continuous copper rings located at the end of the armature. The surface should be maintained in a high state of polish by occasional use of crocus cloth.

BEARING: There is only one bearing in these generators. It is a grease-sealed bearing and requires no further lubrication. If the bearing becomes worn or loose, it should be replaced.

DISASSEMBLY: If it becomes necessary to recondition or replace the armature the whole field shell assembly must be removed. This is done by proceeding as follows:

Loosen the nut on the end of the armature shaft and remove the fan. Also remove the brushes and as each brush is removed, restore the lead wire terminal to its proper location so the wires will not become confused. Remove the nuts from the stud bolts which hold the field shell to the adaptor end bell. See Figure 10. Use a hammer and chisel on any convenient place on the field frame to separate it from the adapter end bell. After movement has been started, the entire field shell and brush rigging assembly can be removed as shown in Figure 11.

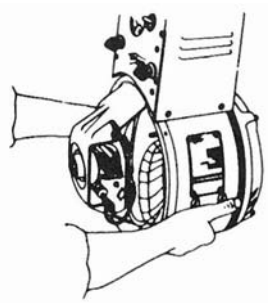


Figure 10

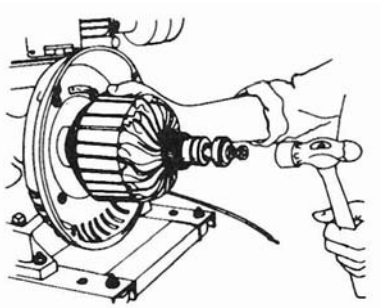


Figure 11

GENERATOR TESTING

EXCITATION (UNITS WITH COMMUTATOR)

A. Check the exciter voltage with a D.C. Voltmeter connected across the D.C. Brushes. The D.C. Voltage should be a minimum of 14 volts. If a D.C. Voltmeter is not available, a light bulb can be used. It will produce a very dim light on a 115 volt bulb. If D.C. voltage is satisfactory, omit Steps B & C.

B. Remove each of the D.C. (Commutator) Brushes to be sure that they are clean and free in the holder. Examine the brush springs to be sure that they have several ounces of tension. Replace brushes if necessary. Always replace with a complete set of brushes, not a single brush.

C. One side of the D.C. circuit is connected or grounded to the generator frame. The other side is said to be either live or hot. Any short circuit from the hot side or either circuit on any metal part of the circuit will result in a grounded connection which prevents the generator from producing electricity. Carefully inspect the hot side of the terminals for evidence of a grounded condition.

CONDENSERS: These are used for the purpose of minimizing radio interference. A short-circuited condenser will result in no output from the generator. To determine whether or not a condenser is shorted, disconnect the lead wire from the brush holder to which it is connected. If the generator produces current, replace the condenser with a new one. If it does not, failure is caused by some other trouble.

TESTING FIELD FOR OPEN CIRCUITS: First, disconnect battery wires (if any) from the generator. Raise all brushes from commutator and/or collector rings. Disconnect field leads from terminals. Using a test lamp arrangement as shown in Figure 12, connect one end of test lamp wire to one field lead. Touch other field lead with wire lead from the battery. If test lamp does not burn, field circuit is open. NOTE: Broken wires or loose connections between generator field and control panel should be checked first. An open circuit in the field winding will prevent the plant from generating.

TESTING ARMATURE/ROTOR FOR GROUNDS: Dis connect battery and A-C wires from the generator. Raise all brushes from commutator and collector rings. Place one end of test lamp wire on commutator. Place other end of test lamp wire on clean surface of armature shaft. If test lamp burns, the armature winding is grounded. If test lamp does not burn, the winding is not grounded. (See Figure 12)

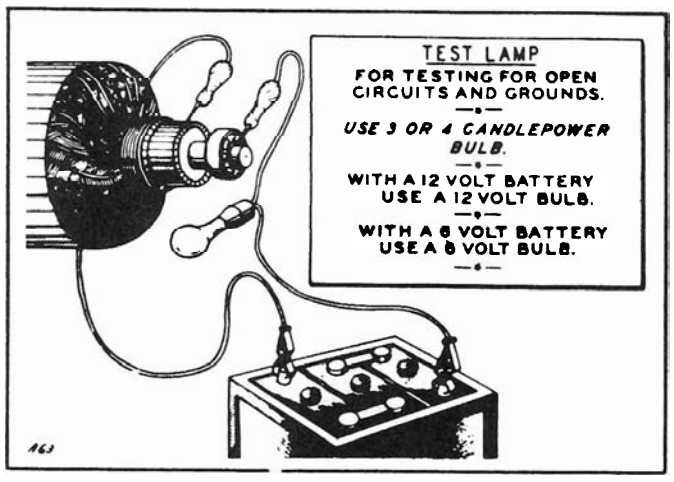


Figure 12. Maintenance and Repair

ROUTINE ELECTRICAL CONTROL CARE

Normal care for electrical control assembly consists of keeping dust and dirt out of the control, and operating unit in "check" mode periodically to insure full battery charge and engine lubrication.

NOTE: ALWAYS LEAVE THE CONTROL OPERATION SELECTOR SWITCH TURNED TO THE AUTOMATIC "AUTO" POSITION DURING NORMAL STANDBY OPERATION.

If no power failure occurs, turn the selector switch to the "check" position once a week. This starts the engine. Let it run for 15 minutes and then turn the selector switch back to the "auto" position. This occasional operation removes condensation and helps keep the engine properly lubricated for instant and best performance.

Whenever servicing the engine (whether the power is on or off) always turn the selector switch to the "stop" position.

The trickle charge rate is indicated on the milliammeter on the front of the control. The rate can be increased or decreased by adjusting the trickle charge rheostat. Leave the rheostat set for about 90 milliamperes and check the battery periodically with a hydrometer. If the specific gravity falls much below 1250, increase the charge rate slightly so that the battery will be kept fully charged.

ROUTINE ENGINE CARE

Study the engine manual supplied with your unit.

Daily Routine Engine Care:

Your engine will give you better service if you do not tinker with it. This does not mean, however, that it does not require a certain amount of attention. Give it the right kind of fuel, oil, and care. Keep the engine clean both inside and out. You will be well repaid in trouble-free and satisfactory service. Keep the unit clean, see that no dirt or water enters the engine while filling with oil. As a precautionary measure, alway wipe off the oil filler plug and also around it before refilling. Dirt in the engine will cause trouble and possible serious damage.

Use the Right Kind of Oil:

Correct lubrication is important. We recommend the use of a high grade oil, not heavier than SAE 30 in temperatures above 32° F. Use SAE 10 oil in temperatures below 32° F. Do not mix oil with gasoline.

Add Oil Regularly:

An engine which is run without oil will be ruined within a few minutes. Avoid the possibility of such an occurrence and the resulting expense. Alway check oil reservoir to be sure it is full before starting the engine and after each eight hours. Do not operate engine when adding oil.

Change Oil Frequently:

After every 25 hours of operation, the oil should be completely drained from the crankcase. Do not remove the engine from its mounting base. Remove the oil drain plug located at end of the base and let the oil flow into a pan or other receptacle. Replace the drain plug, refill with fresh oil, and replace the filler plug.

Air Cleaner:

The air cleaner protects the engine from dust and dirt. No engine can stand up under the grinding action that takes place when dust and dirt particles are drawn into the motor by the carburetor. Clean the air cleaner occasionally by removing it and washing it with gasoline; allow to dry, then dip in clean engine oil and shake out excess motor oil. Fill to line indicated on body of filter with light engine oil on oil bath type filters.

MONTHLY PLANT SERVICE

Spark Plugs:

Clean and reset gap between electrodes to engine manufacturer's recommendation (See engine manual provided). More frequent service may be required if leaded fuels are used.

Contact Points:

Contact points in the magneto system can be resurfaced by using an ignition file (see engine manual for magneto service and tests).

Exhaust System Should Be Checked:

Tighten or replace all parts requiring replacements.

Examine the Commutator, Slip Rings, and Brushes:

Clean, adjust, or replace as needed. Brushes worn to ⅜" should be replaced in sets.

Batteries Should Be Checked:

Make certain all connections are clean and tight. Keep the electrolyte level above the plates by adding clean distilled water. Do not fill to overflowing. Follow the instruction furnished by the battery manufacturer regarding proper level.

For engine warranty and other engine service instructions, consult engine manual.

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 (3, 5 & 7 KW)

The large contactor 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 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 he 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 contactor.
Three things occur:
The load is disconnected from the power line.
The load is connected to the generator.
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.

1. The Load Transfer Circuit (10 KW)

The large contactor switch which carries the current from either the power line or the generator to the load consists of two sets of power contacts (in separate contactors) which are connected as a double throw switch. They will be referred to as the Line Contactor and the Generator Contactor. They are interlocked so there is no possibility that both sets of power contacts can be closed at the same time. That is, the load cannot become connected to both the power line and to the standby generator at the same time. On single phase panels the terminals to which the 115/230 volt load is to be connected are T1, T3, and Ground (T2). The connections to which the line is to be connected are L1, L3, and Ground (L2).

In normal operation, when the power line is energized, the line contactor power contacts are closed, connecting the load to the line or normal source of power. The in-

stant a power failure occurs, this contactor disconnects the load from the line; and after the standby generator is started and reaches sufficient voltage, the standby generator contactor closes to make contact between the generator and the load. Each contactor has its own actuating coil to close the power contacts; e.g., the line contactor power contacts are closed only when the line contactor coil is energized. Each of the contactors also contains a set of auxiliary switches which act as backup safety feature. When not connected to anything, both sets of contactor power contacts which carry the current to the load from either the generator or the line are open; both sets of auxiliary switches are closed. As soon as the line is connected to L1 and L3, the coil of the line contactor is energized and closes the line contactor power contacts and simultaneously opens the auxiliary switches on the line contactor. The other pair of auxiliary switches on the generator contactor remain closed.

When the power is turned off, the holding coil is de-energized and the power contacts of the line contactor are opened by the force of gravity. Simultaneously the generator auxiliary contact switch closes. Now if sufficient generator voltage (from the standby generator) is applied, the SCR relay will actuate.

In addition to a mechanical interlock between the two contactors, the auxiliary contact switches act as a safety feature by preventing the line voltage from being applied to the generator contactor coil while line contactor is closed. The following sequence of events occurs during the transfer of the load from (A) normal (line) operation to (B) interim period to (C) emergency (standby generator) operation and (D) back again to normal operation.

A. Normal operation:
Standby generator off
Line contactor power contacts are closed, connecting load to line.
Line contactor auxiliary switch is open.
Standby generator contactor power contacts are open.
Standby generator contactor auxiliary switch is closed.

B. At the instant a power failure occurs:
Gravity pulls the power contacts of the line contactor open and closes both sets of auxiliary switches.
The stop/start relay starts the engine (explained in section 2).

C. When the engine generator builds up sufficient voltage:
The generator voltage which is applied to the coil of stop cranking relay actuates the relay to open one set of contacts, which causes the generator to quit cranking the engine. Simultaneously the other set of contacts of this relay closes to apply the generator voltage to the thermal delay relay; and when it closes, to the generator contactor coil.
The generator contactor power contacts close, connecting the load to the standby generator.
Simultaneously the auxiliary switch on the generator contactor opens so that if electricity is again available from the line, it will not be applied to the line contactor coil until the engine has been shut off.

D. When power is restored:
The start/stop relay stops the engine and de-energizes generator contactor and allows the power contacts of generator contactor to be opened by gravity.
Simultaneously the auxiliary switch on the generator contactor closes, thus allowing voltage from the line to energize the line contactor switch coil. The power contacts of the line contactor close, again connecting the load to the 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 the starting solenoid. By grounding the "stop" wire the engine is stopped; and by grounding the "start" wire it is cranked.

Refer to the schematic diagram. Note that the revolving contact of the selector switch is grounded. When a contact is in the "stop" position, 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 contacts 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.

TROUBLE SHOOTING

CHECKS FOR GENERATOR AND AUTOMATIC CONTROL

Problem & Probable Causes	Test Checks	Corrective Action
Generator will not crank when power is off:		
Dead battery.	Check battery and battery connections. Check battery to see if it is large enough —minimum 70 ampere hour battery required.	Have battery charged at service station. Clean terminals on cables and posts. Replace battery with battery of sufficient size.
OCR Not Reset.	Check front panel for extended button.	
Defective Control Relay	Connect 12 inch long clip lead from good ground - touch too:	Check for cause of OCR trip—Reset OCR and restart unit.
Start solenoid defective	Ground small terminal on start solenoid.	If unit does not crank, replace start solenoid. If unit cranks, proceed.
Defective over cranking relay	Ground terminal #1 of over cranking relay (OCR) connect terminal 6 to terminal 17 of OCR.	If unit doesn't crank, OCR points are open. Wait two minutes and depress red button. Replace if defective. If unit cranks, proceed.
Defective stop cranking relay or series resistor.	Ground right rear terminal of stop cranking relay (SCR) — orange wire — Check resistor with meter.	If unit doesn't crank, SCR contacts are dirty or pitted; clean or replace, If unit cranks, proceed.
Start/Stop relay defective.	Ground terminal #2 of start/stop relay (SSR) — blue wire.	If unit doesn't crank, the relay is defective; replace.

Problem & Probable Causes	Test Checks	Corrective Action
Generator Cranks But Engine Will Not Start:		
Defective ignition	Check spark on engine at the spark plug.	Refer to gas engine instructions; check points, plugs, condenser, and magneto.
Defective DC Brushes	Check brush springs for loss tension.	Replace if defective.
Magneto grounded	Check for grounds in wiring and control.	Replace if defective.
Defective fuel solenoid	Check coil and wires.	Repair or replace.
Fuel system failure	Check for fuel pressure. Examine parts for defects.	Repair/replace fuel system parts. Reset to proper pressure.
Engine Will Not Stop In "Auto":		
Loose or open wire	Manually stop engine—switch to stop—check wires from magneto to control for loose or open connections.	Repair if defective.
Defective SSR	Check SSR contacts 2 & 5 (blue and yellow)	Clean contacts or replace if necessary.
Load Will Not Transfer In "Auto":		
	Set switch to "auto"; simulate power failure.	If controls in proper position, proceed.
Defective contactor coil	Check coil with ohmmeter.	Replace if defective.
Defective aux. switch contacts	Bypass AUX contacts with jumper to check.	Clean or replace AUX switch.
Defective transfer delay (TDR) or contact	Bypass to check Connect jumper from TDR terminal #2 to #3.	Replace TDR if defective.
Defective transfer prevent relay (TPR) contacts	Bypass TPR contacts with jumper.	Replace TPR if defective.
Defective stop cranking relay (SCR)	Manually operate SCR contacts with an insulated probe.	Repair or replace SCR.
Low Generator Output Voltage:	Apply partial load—check generator output voltage—must be 110 (or 220 V) min.	See "Voltage too low".
Generator fails to generate:		
Short circuit.	Check for short circuits.	Remove short circuit.
Too weak residual magnetism.	Very low output voltage (e.g. ½ volt) as read on sensitive voltmeter.	Flash the fields with a 12V.D.C. battery.
Short circuited armature.	Check for breaks in armature insulation and for dirt on commutator bars.	Remove dirt, etc. Replace armature.
Open armature.	Check to see if coil lead is disconnected or coil open.	Resolder coil lead or have repaired by a competent repairman.
Grounded, open or shorted field winding.	Check for breaks or shorts in the field.	Open or shorted fields should be replaced. A grounded field may be repaired by insulating at the point where ground occurs.
Brushes not making contact.	Check to see if brushes are stuck.	Make sure that brushes move freely in holders. Replace with new brushes if necessary. Clean brush holders.
Voltage too low: Engine speed low.	Check speed with tachometer.	Increase speed of engine by adjusting speed regulator.
Too much load.	Check voltmeter reading to make sure it indicates voltage as marked on the nameplate.	Reduce load.
Brushes not seated properly. Dirty brushes and commutator.	Remove brushes and check for uneven wear or dirt on brushes or commutator.	Clean commutator and seat brushes with sandpaper.
Brushes sticking in the holders.	Check to see that brushes move freely in holders.	Clean brush holders and brushes.
Open armature.	Check to see if coil lead is disconnected or coil open.	Resolder coil lead or have repaired by a competent repairman.

Problem & Probable Causes	Test Checks	Corrective Action
Grounded, open or shorted field winding.	Check for breaks or shorts in the field.	Open or shorted fields should be replaced. A ground field may be repaired by insulating at the point where ground occurs.
Voltage too high: Speed of engine too high.	Check engine speed with tachometer.	Adjust speed by means of speed regulator.
Generator overheating: Overload.	Check voltmeter reading to make sure it indicates voltage and current as marked on the nameplate.	Reduce the load.
Armature striking on pole pieces.	Check the generator bearings to make sure they are not worn out and also the alignment of the brackets.	Replace bearings and realign bracket if necessary. Tighten all bolts.
Poor ventilation.	Check air space around generator.	Make sure there is at least a 2 foot clearance on all sides of generator.
Short circuit in field.	Localizing overheating.	Open or shorted fields should be replaced. A grounded field may be repaired by insulating at the point where the ground occurs.
Short circuited armature.	Check for breaks in armature insulation and for dirt on commutator bars. Look for localized overheating.	Remove dirt, etc. Replace armature.
Sparking at the brushes: Too much load.	Check voltmeter reading to make sure it indicates voltage as marked on the name plate.	Reduce the load.
Brushes not seated properly. Dirty brushes and commutator.	Remove brushes and check for uneven wear or dirt on brushes or commutator.	Clean commutator and seat brushes with sandpaper.
Rough or eccentric commutator.	Check for uneven wear on commuator and brushes.	If only slightly rough, use fine sandpaper. If very rough, pitted, or eccentric, have refinished by a competent repairman.
Open armature.	Check to see if coil lead is disconnected or coil open.	Resolder coil lead or have repaired by a competent repairman.
Brushes sticking in the holders.	Check to see that brushes move freely in holders.	Clean brush holders and brushes.
DC brushes lose tension.	Remove and examine DC brushes to check if brush springs have collapsed.	Replace DC brushes. Failure was most likely caused by a defective or low battery used to crank the generator.
Battery discharges when setting idle:	Check reverse current diode with ohmmeter to determine if diode is shorted.	Replace defective reverse current diode.
If generator does not charge battery:	Put ammeter in series with battery.	Reverse current diode is evidently open and should be replaced.
Battery will not take a charge: Charge resistor open.	Examine charge resistor located below control box or on generator brush rack.	Replace, if defective; solder connection if there is open in circuit.
Defective Trickle Charger.	Check fuse, rectifier, transformer, meter.	Repair or replace defective components.

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