

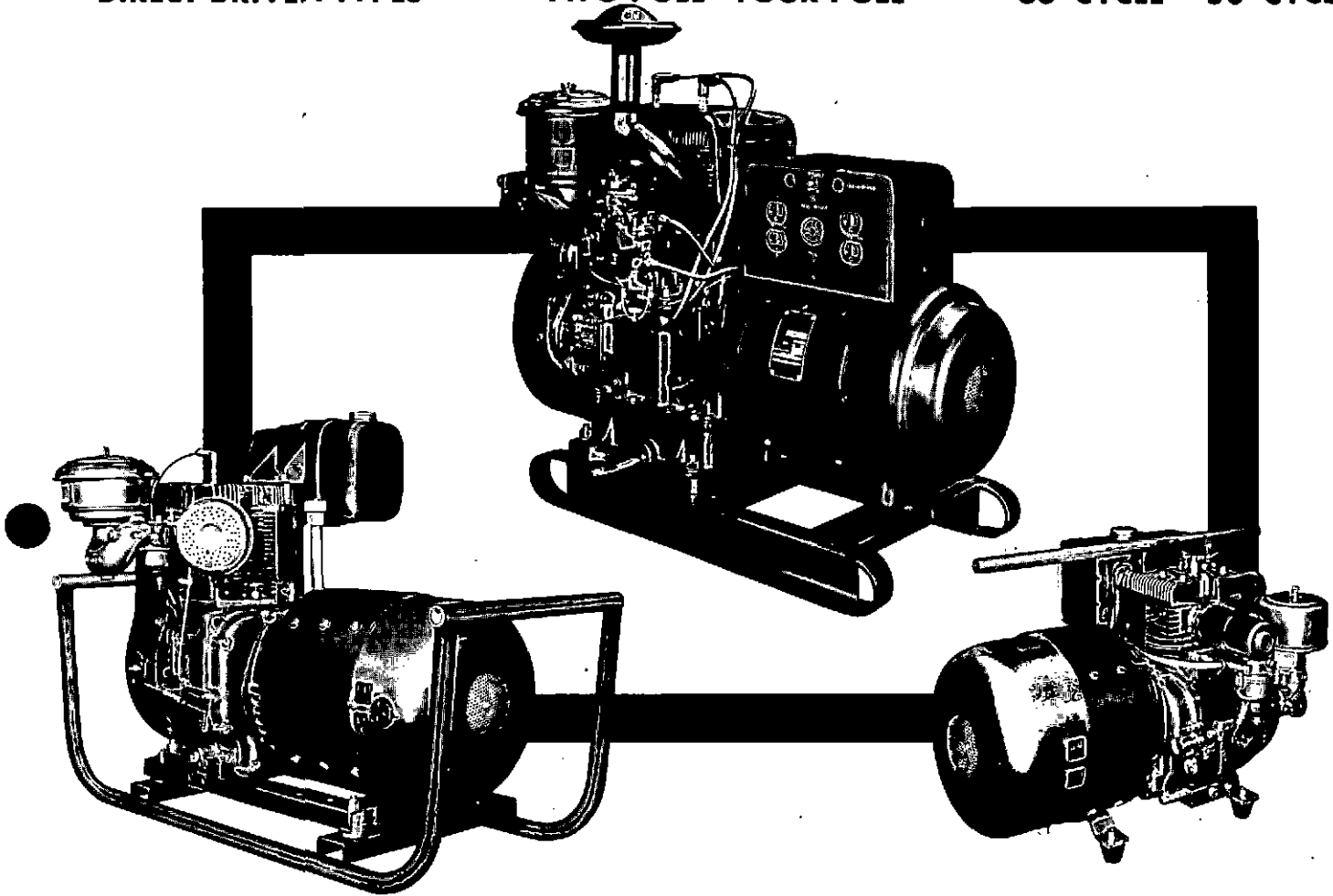
INSTALLATION and OPERATION INSTRUCTIONS

A. C. GENERATORS

★ DIRECT DRIVEN TYPES

★ TWO POLE - FOUR POLE

★ 60 CYCLE - 50 CYCLE



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 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 a 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.

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 electrical load is then turned off and the 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. Most engine generators are made to burn gasoline and were checked with this fuel, but in the event LP gas or natural gas was specified, this fuel was

used in making the tests 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 $3\frac{1}{2}\%$ 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.

GASOLINE: Fill the fuel tank with a good grade of regular gasoline. Do not use Ethyl gasoline. Make sure the

gas tank vent and the shut off valve are open. **Precaution:** Take every precaution to prevent dirt of any kind from getting into the fuel. Dirt will clog up the fuel line screen and carburetor jets. Use only clean gasoline from a clean container and use a clean funnel. Do not mix oil and gasoline.

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.

WARNING

Eliminate the danger of deadly carbon monoxide gas. Remember that the exhaust fumes from any gasoline engine are very poisonous if discharged in a closed room, but harmless if allowed to mix with the outside air. 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. 2, below). Obtain a piece of pipe, or flexible metal hose, long enough to reach from 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 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.

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 overflowing 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.

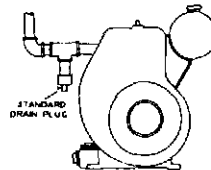


Figure 1 Condensation Trap

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.

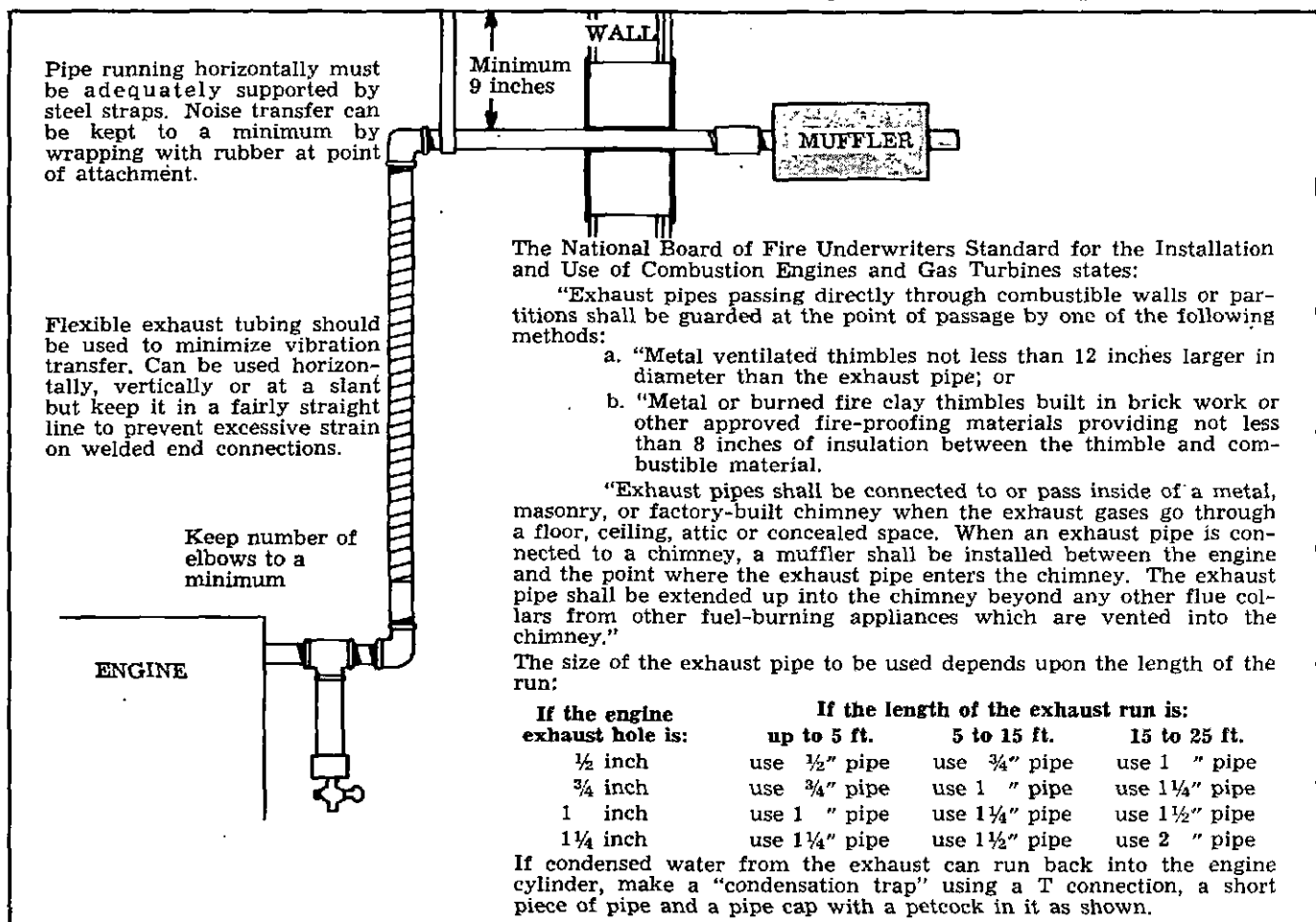


Figure 2

MOUNTING ON BASE

All engine generators should be mounted on rubber in such a manner that the whole unit is free to move upward and downward slightly. Failure to provide a resilient mounting will result in excessive vibration, more noise, and premature failure of parts which may be damaged by excessive vibration. **When bolting any engine generator to a concrete base or any other base do not tighten the nuts down so the rubber is compressed—instead, leave about $\frac{1}{8}$ " space between the nut and the frame, then put on a**

second nut, tightening it securely while holding the first one, so that both are locked securely in place. Rubber shock mounts, as shown in Figure 3 are supplied for some generators but can be supplied for smaller generators. (Contact the Factory for recommendations.) Figure 4 shows how the square rubber pads are used on any of the larger size units.

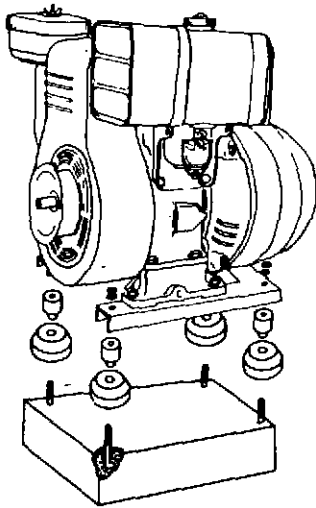


Figure 3

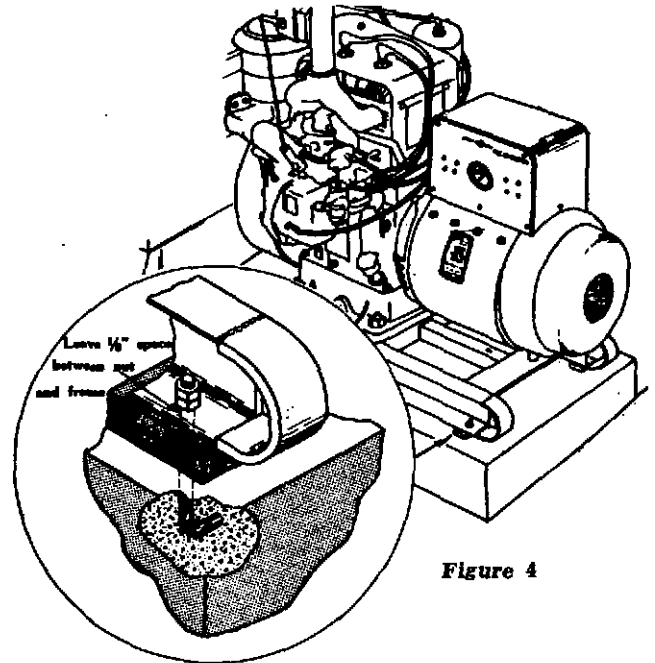


Figure 4

- A. Engine-Generator, equipped with factory-installed reservoir tank.
 - B. Reservoir Tank
 - C. Fuel Line
 - D. Return Line
 - E. Vent Line
 - F. Tank
 - G. Locking Fill Cap
 - H. Vent Cap
 - I. Suction Pipe Assembly
 - J. Emergency Transfer Control
 - K. 12 Volt Battery
 - L. Battery Cables (Supplied as Kit)
 - M. Flexible Exhaust Kit (all other parts of exhaust system consist of standard pipe, purchased locally)
 - N. Condensation Trap made by installing cock in cap.
 - O. Greenfield Conduit and other conduit and wiring all purchased locally.
- Supplied as Kits including fittings for making connections.
- All supplied in Underground Tank Kit. (Standard Pipe, purchased locally is used for vent and filler cap.

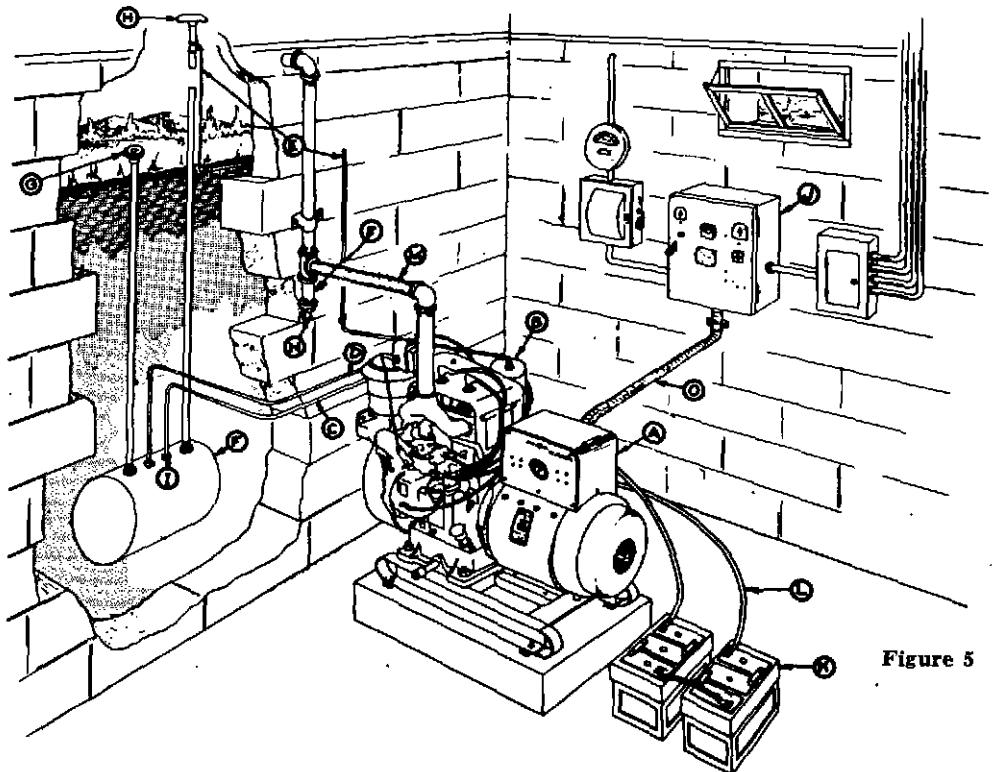


Figure 5

ENGINE FUELS

"Remote Start" generators are equipped with fuel pumps and are designed for use with small portable tanks or underground tanks. "Manual Start" and "Electric Start" plants are equipped with engine-mounted tanks.

Figure 5 shows a typical installation of an automatic "standby" generator. Many states and city codes require an underground tank such as shown in this installation if gasoline is to be used for fuel. In standby service, the engine may remain idle for a considerable period of time. If the gasoline has evaporated from the carburetor, it becomes necessary to crank the engine until fuel has been pumped up from the storage tank. A one-quart reservoir tank is therefore recommended for standby service particularly where the plant is started automatically.

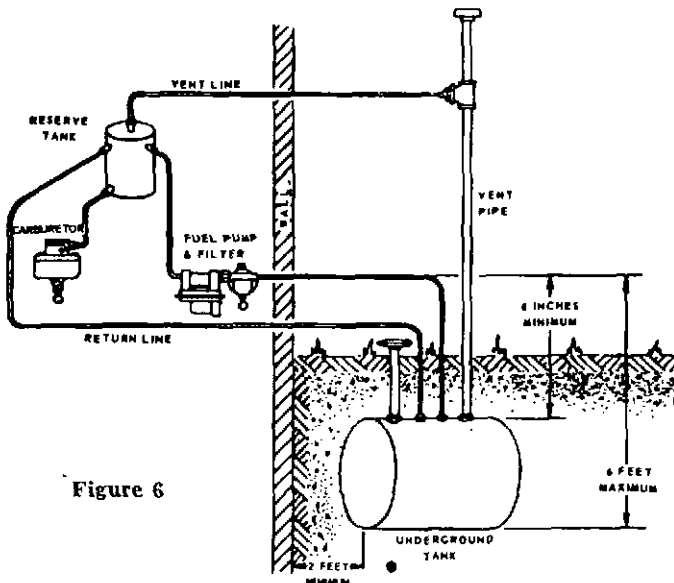


Figure 6

Figure 6 shows how a reservoir tank is connected to the fuel supply. Fuel is pumped from the underground tank to the reservoir tank. From the reservoir tank, fuel flows to the carburetor or overflows through the "return line" back to the tank. The reservoir tank is factory installed as an accessory item. The underground tank and necessary pipes of connecting and venting are supplied as separate kits. Installation instructions are supplied with such kits.

Above ground tanks are also available. The National Board of Fire Underwriters recommends that such tanks be installed outside of buildings and be used only with engines equipped with fuel pumps. They recommend only integral tanks in buildings. Such tanks shall be securely mounted on the engine assembly and protected against vibration, physical damage and excessive heat.

CONNECTIONS

(FOR STANDBY APPLICATIONS)

All wiring should be done in conformance with the National Electrical Code and with State and Local regulations.

Connecting generators to house wiring circuits should be done through a transfer switch. The transfer switch 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 7).

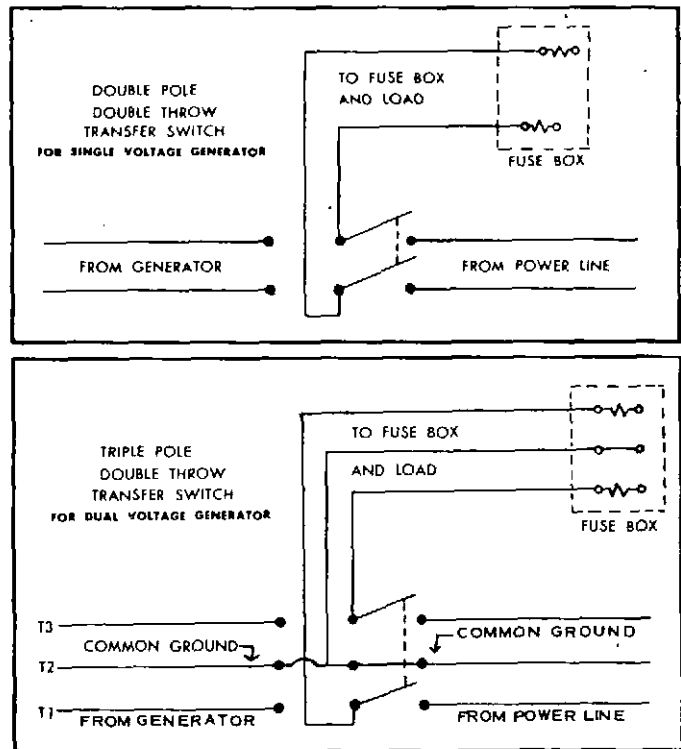


Figure 7

BATTERY

A twelve volt battery rated at 70-ampere-hour or more is recommended for starting most "remote start" and "electric start" plants. For larger sets, or under extremely adverse conditions, a larger capacity battery is recommended.

This battery may be made by connecting two 6 volt car batteries in series—that is, connecting the positive terminal of one battery to the negative terminal of the other. The remaining positive battery terminal is joined to the "Pos." terminal on the front of the generator and the remaining negative battery terminal to the "Neg." terminal on the front of the generator panel as shown in Figure 8. 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. Some units include an ammeter located on the generator panel which indicates the rate at which the battery is being charged.

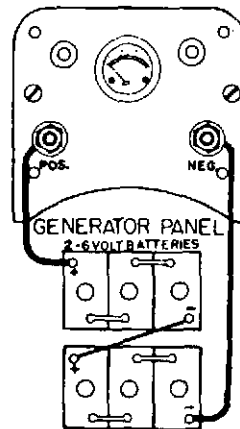


Figure 8

These generators are basically alternating current generators and although they produce enough direct current to keep batteries charged 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. **ANY OF THESE GENERATORS CAN BE OPERATED SATISFACTORILY WITHOUT A BATTERY.** That is, if the engine is started by cranking manually, no damage will result by using the generator just as though a battery were connected.

Generators, when installed for standby purposes, must be run periodically for a sufficient length of time to keep the battery charged. A trickle charger, producing about 0.1 ampere is recommended for keeping the battery in top-notch condition. Such a trickle charger will not recharge a battery which has become discharged but produces just enough current for the battery, if fully charged, to maintain a charged condition. Some trickle chargers do not have an isolation transformer but one side of the battery is connected directly to the power line. The use of such trickle chargers can result in serious damage and their use should be avoided.

WIRING

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, the amount and kind of load. Consult a competent electrician. Check national and local codes before installing.

For generators larger than 2000 watt, use No. 12 wire for distances up to 100 ft. except for motor driven loads. Use No. 10 wire for distances up to 300 ft., and motors up to 1/2 HP. Use No. 8 wire for distances over 300 ft.

For generators larger than 2500 watts use No. 10 wire for distance up to 100 ft., No. 8 wire for distance up to 300 ft., and No. 6 wire for distance over 300 ft.

For Battery Cables on generators having battery charging features, use No. 4 or larger to connect battery. Lead length should not exceed six feet.

GROUNDING PLANT

If grounding is called for in local codes or radio interference necessitates it, drive a 3/4 or 1" pipe into the ground as close to the plant as possible. This pipe must penetrate moist earth. To this pipe, connect the approved ground clamp and run a No. 10 or No. 12 wire from it to the battery negative terminal on control panel or to the ground generator lead. Do not connect to a water pipe or a ground used by a radio system.

STARTING AND STOPPING

All engine generators can be started manually either by use of a crank, rope, or recoil starter. Check oil level before starting.

Manual start engines can be started only at the engine.

Refer to engine instruction book for detailed instructions on starting and stopping engine.

The "Remote Start" (R.) type engine generators are equipped with an automatic choke so the operator does not have to be at the machine to start it. It can be started and stopped at any number of distant positions by connecting a momentary contact switch to the terminal block as shown in Figure 9. The control wires may be # 16 or larger for any distance up to 100 feet.

Controls for starting and stopping the plant automatically are also available. Emergency transfer controls are designed for automatically controlling the plant if it is to be used as

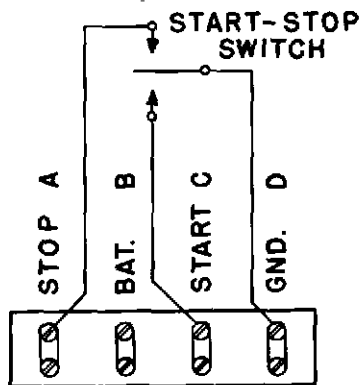


Figure 9

a standby generator in case of a power failure. If the main source of power fails, the Emergency Transfer Control (E.T.C.) will sense this and will start the engine generator and transfer the load from the main source to the engine-generator. When the power failure is corrected the E.T.C. will sense this and will transfer the load back to the main source and stop the engine-generator.

Demand Start Controls (D.S.C.) are designed for automatically controlling the plant if it is used as a prime source of power. The D.S.C. will automatically start the generator plant when a load of 100 watts or more is applied to the generator and will automatically stop the generator plant when the load is removed.

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 running 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.

Load Applied	Generator Speed		Frequency	Generator Voltage	
	2 Pole	4 Pole		115v. Plants	230v. Plants
None	3660	1830	61	129	258
Half	3600	1800	60	120	240
Full	3510	1755	58 1/2	115	230

For 50 cycle generators the corresponding speeds, frequencies and voltage would be approximately as follows:

Load Applied	Generator Speed		Frequency	Generator Voltage	
	2 Pole	4 Pole		115v. Plants	230v. Plants
None	3050	1525	51	129	258
Half	3000	1500	50	120	240
Full	2925	1462	48 1/2	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.

Unless the engine is equipped with a special idling speed control, 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 to insure proper operation of the generating plant and appliances. If the generator is not equipped with a voltmeter, it can be checked with a portable meter.



Figure 10

A convenient voltage tester, which can be plugged into any ordinary outlet, shown in Figure 10, is available.

MAINTENANCE

GENERAL DATA ON THE GENERATOR: The generator of your plant consists mainly of field frame, field coils, armature, a set of brushes, brush holder assembly, end brackets, a fan mounted on the armature to keep the generator cool, and a control box.

BRUSHES: Check the brushes for wear after about 1000 hours of operation and every few hundred hours of operation thereafter. They should be replaced when worn down to $\frac{3}{8}$ inch. Whenever replacing brushes or removing them to do other service work, remove one at a time and put the screws back in the brush holder to hold the lead wire terminals in place so there will be no difficulty in connecting the wires to the correct positions.

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 $\frac{1}{32}$ 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.

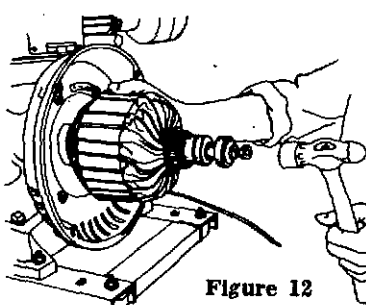
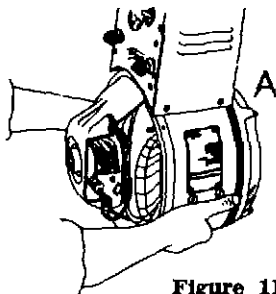
Do not use lubricants of any type on the commutator. The use of any lubricant will only cause sparking, poor contact, pitted bars and decrease the output of the generator.

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 (some small models have none). 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 A in Figure 11. Use a hammer and chisel on any convenient place on the field frame to separate it from the adaptor end bell. After movement has been started, the entire field shell and brush rigging assembly can be removed as shown in Figure 12.



The taper of the generator armature is accurately fitted to the taper on the engine crankshaft. In order to remove the armature, put the nut back on the through-bolt to protect the threads and while pulling the armature outward with one hand strike the end of the through-bolt a few sharp blows with a heavy hammer as shown in Figure 12. In difficult cases, also tap the steel core of the armature if necessary in order to break the steel core of the armature loose from the engine shaft.

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.

EXCITATION (UNITS WITH RECTIFIERS).

- A. **CHECKING RECTIFIER:** Disconnect one of the shunt field leads and using an ohmmeter proceed to measure the resistance of two adjacent terminals with the leads from the ohmmeter first connected one way and then reversed. Connected one way you should read an exceedingly high resistance and reversed a very low resistance. Proceed around the terminals clockwise taking two at a time. If any diode does not check out correctly replace the rectifier module. A possible reason for the rectifier going bad is a grounded field. If you find the field is grounded, repair or replace it and then check the diodes as explained above—perhaps the rectifier has not been damaged and will not have to be replaced. The rectifier can also be checked by separately exciting the field coils with a 12 volt automotive battery. With this excitation, output on the generator should be 70 to 90 volts with no load applied.
- B. If the field coils have lost their residual magnetism, the fields may be flashed with a 6 volt automotive battery, a 12 volt automotive battery, or by use of 2 "D" size flashlight batteries. Stop the generator and remove the end cover. You will note the positive (+) lead from the field coil is connected to the rectifier terminal with a red dot. The negative (-) lead from the field coil is connected to the grounded A.C. Brush holder. The positive (+) lead should be connected to the positive (+) side of the battery and the negative (-) lead should be connected to the negative (-) side of the battery for approximately 10 seconds.

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 13 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: Disconnect 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 13)

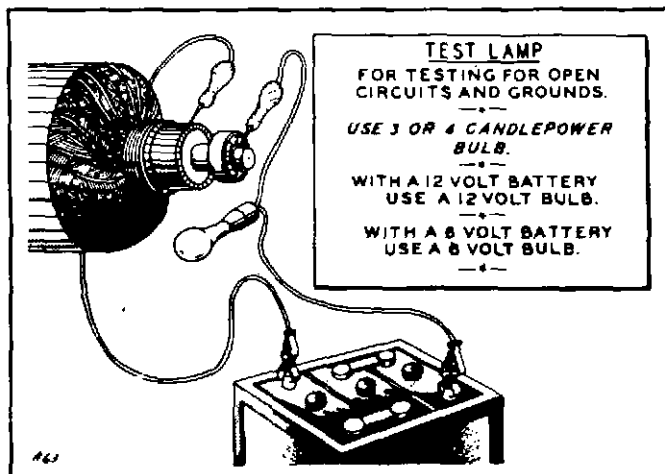


Figure 13, Maintenance and Repair

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 or gasoline. As a precautionary measure always wipe off the gasoline cap and oil filler plug and also around them before refilling. Dirt in the engine or gasoline tank will cause trouble and possible serious damage.

USE THE RIGHT KIND OF OIL: Check engine instruction book for proper weight and type for temperature and service.

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. Always check oil reservoir to be sure it is full before starting the engine and at intervals specified in engine instruction book. 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.

USE CLEAN GASOLINE: A good grade of clean fresh regular gasoline is recommended. Be sure that the small vent hole in the gasoline tank cap is not clogged up, for air must enter the tank to allow the gasoline to flow to the carburetor. Test by blowing through the top of the cap. Drain gasoline from tank and carburetor when storing to avoid build-up of gum deposits.

MONTHLY PLANT SERVICE

SPARK PLUGS: Clean and reset gap between electrodes to .025 gap. 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).

CLEAN THE SEDIMENT BOWL AND SCREEN: Be sure the gasket is in good order before replacing. Inspect for leaks and correct if any are found.

TO CLEAN THE FUEL LINE: Disconnect the gasoline line at the carburetor. Blow through the gas line to clear it. Remove shut off valve and clean screen. If you find a gummy varnish-like substance, alcohol or acetone will dissolve it.

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 $\frac{3}{8}$ " 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 instructions furnished by the battery manufacturer regarding proper level.

For engine warranty and other engine service instructions, consult Engine Manual.

AUTOMATIC IDLER CONTROL

PRINCIPLES OF OPERATION:

Refer to Fig. 14. for typical circuit. The operation of the **Idler Control** is as follows:

1. After the engine has been started, and if there is no electrical load applied, the Idler module will sense this and will allow a current to flow to the electro magnet which will pull the throttle lever up, closing the throttle on the carburetor allowing the engine to run at idling speed.
2. When a load is applied to the generator, the Idler will sense this and will cut off the current to the electro magnet, thus allowing the throttle lever to drop down, opening the throttle on the carburetor and allowing the engine to come up to governed speed.

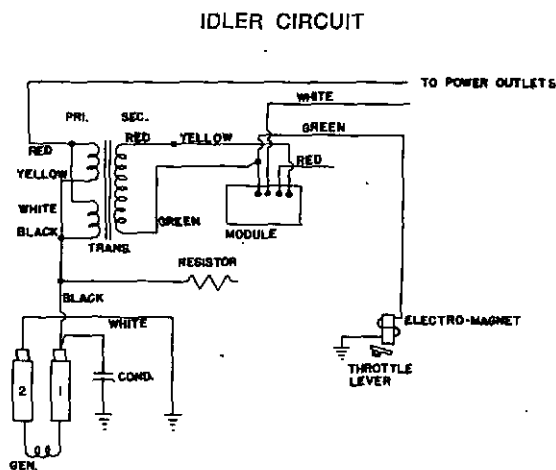


Figure 14

3. When the electrical load is turned off, no current will flow through the transformer; as a result the Idler will once again cause the engine to slow down to idling speed as in 2.
4. If it is found that the engine will not come up to speed when an extremely large load is applied, remove the load and disconnect Idler Circuit. Remove generator end cover and connect receptacle directly to brush holder.

TROUBLE SHOOTING GUIDE FOR THE IDLER CONTROL

The module itself cannot be properly tested in the field, however, it can be determined if a module is defective by checking out the balance of the components in the circuit.

1. Examine the resistor of the circuit. This resistor is located in the control assembly. The resistor should be checked for continuity, and the lead wires should be securely connected at each end.
2. Apply a load of approximately 100 watts (a light bulb is satisfactory) to the A.C. outlet and take a reading of the secondary winding (the two small wires) of the transformer located in the control assembly. With a 100 watt load, a reading of 12 to 16 volts A.C. should be obtained.
3. Examine the electro magnet to determine that the lead wire is properly connected to it. Check the core of the magnet to determine if it is magnetized when no load is applied to the generator. If it is magnetized, check the throttle lever arm to determine if it or any of the governor parts are binding or sticking because of dirt or paint. Take a resistance reading on the coil which should be approximately 70 Ohms. resistance from the core of the magnet to the lead wire.
4. If all of the above components check satisfactorily, then the module is evidently defective and requires replacement.

SERVICE GUIDE CHART — GENERATOR

Causes	How Determined	Action
1. Sparking at the brushes: Too much load.	Check output voltage with a voltmeter to make sure it indicates voltage as marked on the nameplate.	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 commutator 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.
2. Voltage too low: Engine speed low .	Check speed with tachometer.	Increase speed of engine by adjusting speed regulator.
Too much load.	Check output voltage with a voltmeter 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.
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 sticking in the holders.	Check to see that brushes move freely in holders.	Clean brush holders and brushes.
3. Voltage too high: Speed of engine too high.	Check engine speed with tachometer.	Adjust speed by means of speed regulator.
4. Generator overheating: Overload.	Check output voltage with a voltmeter 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.

Causes	How Determined	Action
5. 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.
Defective Rectifier.	See "Checking Rectifier" on Page 7.	See "Checking Rectifier" on Page 7.
6. Generator will not crank:	Check battery and battery connections. Check battery to see if it is large enough—minimum 70 ampere hour battery required. Check start switch or solenoid by connecting heavy jumper across large terminals.	Have battery charged at service station. Clean terminals on cables and posts. Replace battery with battery of sufficient size. Replace if defective.
Battery discharges when setting idle:	Check reverse current diode with ohmmeter to determine if diode is shorted.	Replace defective reverse current diode.
Battery will not take a charge:	Examine charge resistor.	Replace, if defective, solder connection if there is open in circuit.
If generator does not charge battery:	Put ammeter in series with battery.	Reverse current diode is evidently open and should be replaced.
Generator cranks but engine will not start:	Check spark on engine at the spark plug.	Refer to gas engine instructions, check points, plugs, condenser, and magneto.

USE OF ELECTRIC MOTORS

Electric motors require much more current (amperes) to start them than to run them. Some motors, particularly cheap split-phase motors are very hard to start and require 5 to 7 times as much current to start them as to run them. Capacitor motors are easier to start and usually require 2 to 4 times as much current to start them as to run them. Repulsion Induction Motors are the easiest to start and usually require 1½ to 2½ times as much to start them as to run them.

The following amperes are produced at 115 volts and at 230 volts for the wattages shown for various sizes of generators.

WATTS	AMPERES AT 115 VOLTS	AMPERES AT 230 VOLTS
2500	22	11
3000	26	13
3500	30	15
4000	35	17
5000	43	21
6000	52	26
7500	66	33
10000	87	43
12500	109	54

Most fractional horsepower motors take about the same amount of current to run them whether they are of the Repulsion-Induction (RI), Capacitor (Cap.), or Split-Phase (SP) type. The chart below shows the approximate current required to start and run various types and sizes of 115 volt 60 cycle motors under average load conditions.

H. P.	RUNNING Amperes	"STARTING" AMPERES		
	All Types	S. P.	Cap.	R. I.
1/6	3.2	16 to 22	6 to 13	5 to 8
1/4	4.5	22 to 32	9 to 18	7 to 12
1/3	5.2	26 to 35	10 to 21	8 to 17
1/2	7.2	Not Made	14 to 29	11 to 18
1	13.0	Not Made	26 to 52	20 to 33

The figures given above are for average load such as a blower or fan. If the electric motor is connected to a hard starting load such as an air compressor, it will require more starting current. If it is connected to a light load, or no load such as a power saw, it will require less starting current. The exact requirement will also vary with the brand or design of the motor.

For 230 volt motors the "running" current is half as much as shown for the 115 volt motors of the same size. Some dual voltage 115/230 volt motors are difficult to start on 230 volts when driven by engine-generators and can be started more easily when connected to operate on 115 volts. This is particularly true of "capacitor start—induction run" motors. Sometimes a 230 volt motor which cannot be started on the 230 volt circuit of a 115/230 volt generator can be started on a 115 volt circuit and then quickly switched to the 230 volt circuit after it is started. This can be done in applications where the motor is manually controlled and is started under "no load" conditions.

A self-excited generator responds differently to severe overloading than a transformer connected to a power line. To illustrate, suppose that a 230 volt 5 H.P. "Capacitor Start—Induction Run" motor is connected to a small transformer with a maximum rating of 2500 watts and then to a generator of 2500 watts capacity. The transformer would not be able to supply enough power to bring the motor up to operating speed but would be very severely overloaded and probably would burn out in a short time. The motor might also be damaged. When this motor is connected to a self-excited 2500 watt generator, its output voltage drops to practically zero. Also, the excitor voltage drops to practically zero. Thus, there is virtually no load on the generator or the engine, and no harm is done to either. Under these conditions the motor may revolve a few times when it is first turned on, and then stop.

On the other hand, suppose an electric motor that requires just a little more output than the generator can produce is connected to it. It will run but will not reach a high enough speed for the centrifugal switch to disconnect the starting winding. The generator output voltage, instead of being 115, may drop to 70 or 80 volts. Running the generator under these conditions may result in burning out the generator armature as well as the motor windings.

Because the heavy surge of current required for starting motors is required for only an instant, the generator will not be damaged if it can bring the motor up to speed in a few seconds of time. If difficulty is experienced in starting motors, turn off all other electrical loads and if possible reduce the load on the electric motor.