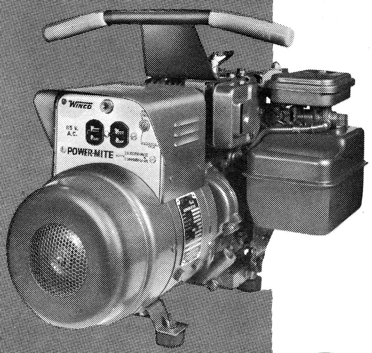
WINCO® GENERATOR

ASSEMBLY INSTRUCTIONS
OPERATING INSTRUCTIONS
SERVICE INFORMATION

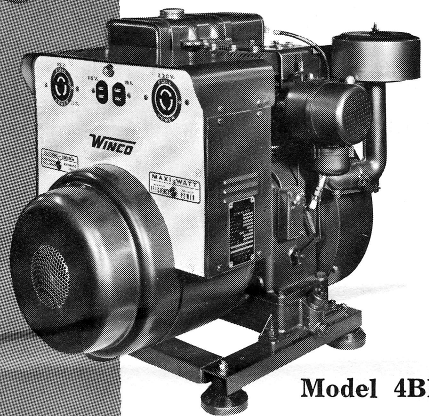
DIRECT DRIVEN TYPES

TWO-POLE - FOUR POLE

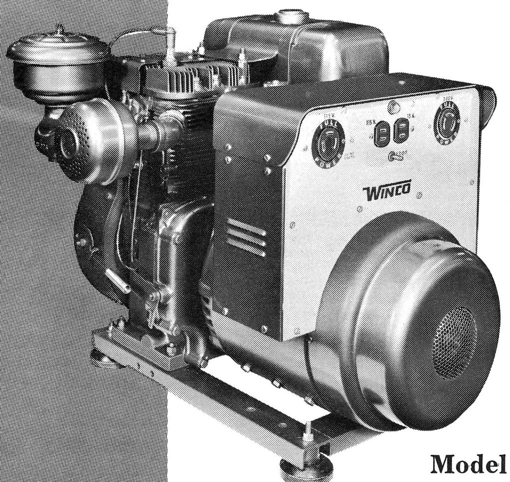
60 CYCLE - 50 CYCLE



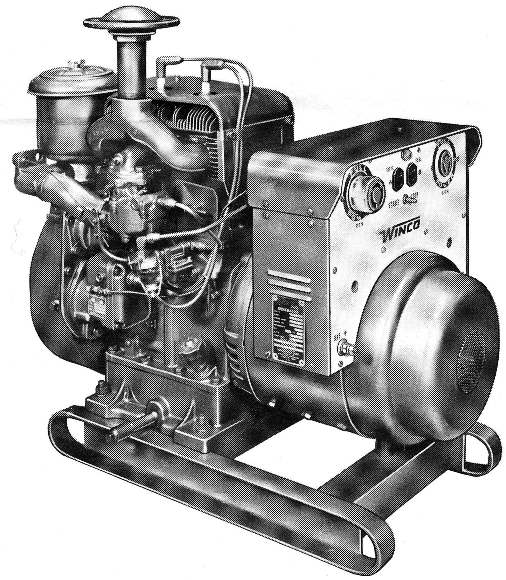
Model 108BH-1M



Model 4BH-F



Model 305WS



Model 5WS

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.

DYNA TECHNOLOGY, INC.
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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 electrical load is then turned off and the voltage and frequency are again checked. NO GENERATOR IS SHIPPED UNLESS IT PRODUCES IT 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 power of each engine generator is subject to and limited by the temperature, altitude, and all other conditions as 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.

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. You will be sent the warranty which shows your Warranty Registration Number. This number must be given if warranty service is to be considered. The guarantee is void unless the Guarantee Register Card is returned.

WARRANTY

Dyna Technology, Inc. warrants every new Winco generator (including controls and accessories) manufactured by Dyna Technology, Inc. and which are purchased from Dyna Technology, Inc. or through an authorized Dyna Technology dealer or representative, to be free from defects in material and workmanship arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing any such generator or accessory which shall within one year from the date of original customer purchase be returned prepaid, together with the warranty registration number, to Dyna Technology, Inc., Sioux City, Iowa, or to an authorized Winco service station, after proper authorization, and which shall be found by Dyna Technology, Inc., or the authorized Winco service station to have been defective under this warranty.

The obligation of Dyna Technology, Inc. does not include responsibility for any transportation expense nor does it include any engines, even when such engines are supplied with the generators. Engines are separately guaranteed by the engine manufacturer and warranty claims should be made directly against the engine manufacturer.

Dyna Technology assumes no liability for failure to perform or delay in performing its obligations with respect to the above warranty if such failure or delay results directly or indirectly from any cause beyond its control, including but not limited to acts of God, acts of government, floods, fires, shortage of materials, and labor and/or transportation difficulties.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liabilities on the part of Dyna Technology, Inc. which shall in no event be liable for any consequential or incidental damages of any kind, and Dyna Technology, Inc. does not authorize any person to assume for it the obligations contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such Dyna Technology, Inc. generator or controls and accessories thereof.

This warranty herein extends only to the original consumer purchaser and is not assignable or transferable and is not applied to any generator or controls and accessories thereof which have been repaired or replaced by anyone else other than an authorized Winco service station or Dyna Technology, Inc. or which have been subject to alteration, misuse, negligence or accident or which have had a serial number or name altered, defaced or removed.

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.

Where exhaust noises are to be kept to a minimum an underground tank made of an old oil drum can be used successfully if installed above the ground-water level. A 50 gallon oil drum vented above the ground and with the bottom knocked out or pierced with holes is satisfactory for this purpose.

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 ⅛" 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

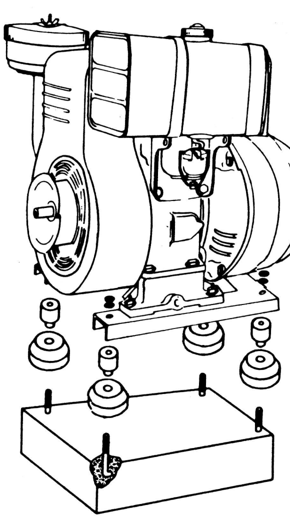
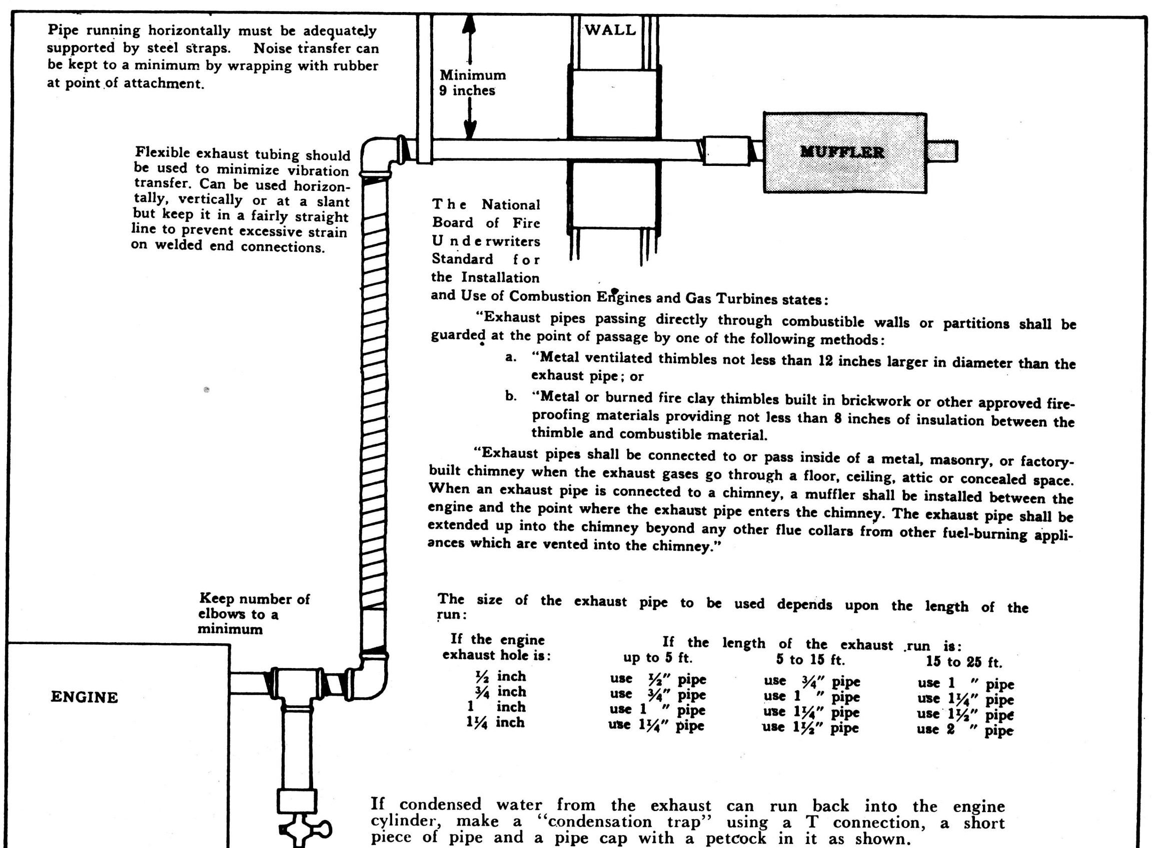


Figure 2

shock mounts, as shown in Figure 2 are supplied for 3500, 4000, and 6000 watt 2 pole and 2500 watt 4 pole generators but can be supplied for smaller generators (Part No. 24188 Bag of Rubber Shock Mounts). Figure 3 shows how the square rubber pads are used on any of the larger size units.



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 brickwork or other approved fireproofing materials providing not less than 8 inches of insulation between the thimble 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:

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.

Figure 1

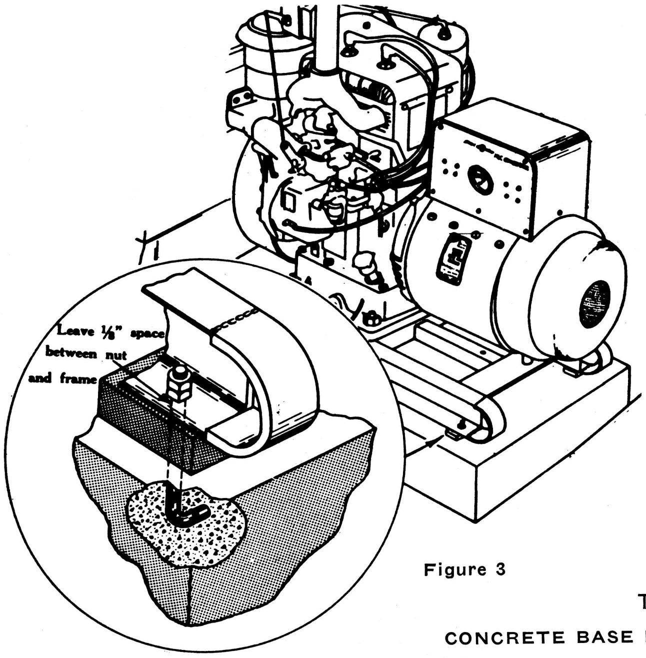


Figure 3

Table 1 and Figure 4 give the information needed to mount a unit on a concrete base.

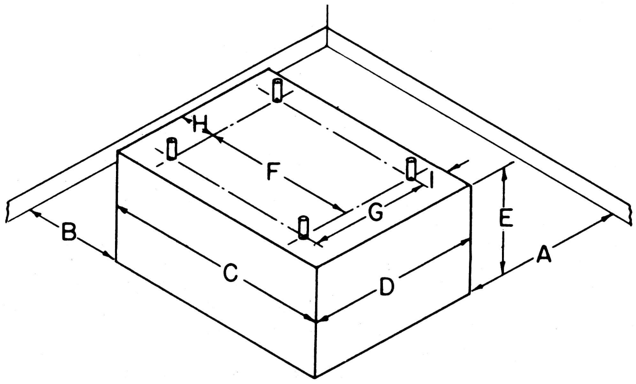


Figure 4

TABLE 1

CONCRETE BASE DIMENSIONS *6(In Inches)

Model	C	D	E	F	G	H	I	Bolt Dia.	Bolt Ht. Above Concrete
1205WS	32	22	12	24	13 9/16	4	4	3/8	2 1/4
10WS	32	22	12	24	13 9/16	4	4	3/8	2 1/4
9WS	27	22	12	18 3/8	13 7/16	4	4	3/8	2 1/4
6WH-F	26	19	12	17 3/8	10 3/8	4	4	5/16	3 1/4
5WS	27	22	12	18 3/8	13 7/16	4	4	5/16	2 1/4
4BH	20	19	12	11 3/4	10 5/8	4	4	5/16	3 1/4
4WH	20	19	12	11 3/4	10 3/8	4	4	5/16	3 1/4
305WS	26	19	12	17 3/8	10 3/8	4	4	5/16	2 1/4
205BS	20	19	12	11 3/4	10 1/4	4	4	5/16	3 1/4

*It is recommended that dimension A and B be 24". This will allow for ventilation and freedom of movement around the unit.

A. Engine-Generator, equipped with factory-installed reservoir tank.
B. Reservoir Tank
C. Fuel Line, D. Return Line, E. Vent Line — Supplied as Kits including fittings for making connections.
F. Tank, G. Locking Fill Cap, H. Vent Cap, I. Suction Pipe Assembly — All supplied in Underground Tank Kit. (Standard Pipe, purchased locally is used for vent and filler cap.)
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.

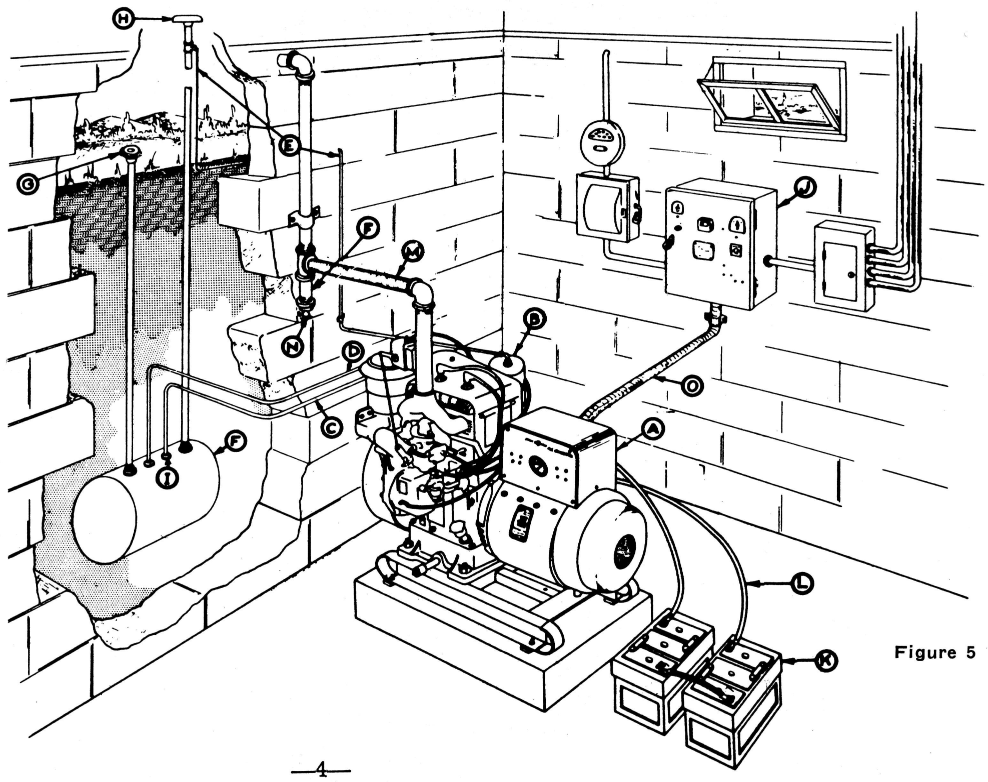


Figure 5

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.

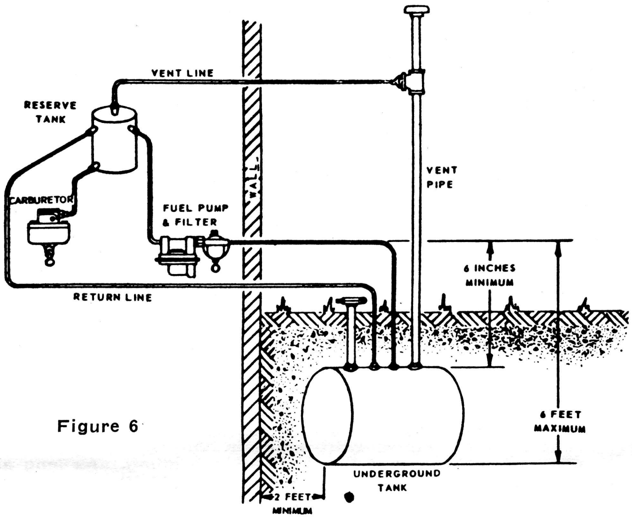


Figure 6

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.

CONNECTING THE LOAD

NOTICE—All 115 v. generators have one side of the A. C. circuit and the negative side of the D.C. circuit grounded to the generator frame. All 115/230 v. generators have the neutral wire of the A. C. circuit and the negative side of the D. C. circuit grounded to the frame. For the safest operation connect the generator frame to a grounding stake driven in moist earth. Satisfactory grounding can also be accomplished by connecting to a water pipe if such grounds do not interfere with radio reception.

1. "Manual Start" & "Electric Start" types

These generators are equipped with outlet receptacles for convenient connection of electrical loads. The output voltage of each receptacle is marked on the panel face. Do not connect any load whose electrical characteristics differ from those specified on the panel or that exceed the rating of the receptacle or the generator.

2. "Remote Start" types.

To connect the load to these units, remove the cover from the control box and connect the load directly to the generator output wires as shown in Figure 7 (some large units have na additiional 4" x 4" box on the back of the control box that houses these wires). These wires come up from the generator

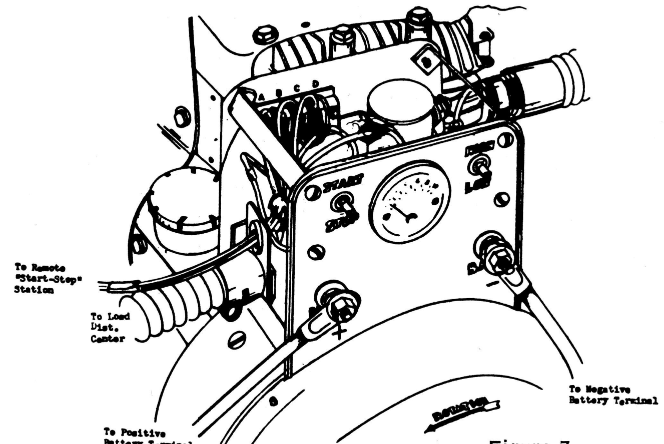


Figure 7

through a hole in the bottom of the control box and have ends that are free or come to a terminal block permitting connection to the load. The black wire (or wires) are intended for the "hot" wire(s) and the white wire is "grounded" to the generator frame. On Full Power 115/230 volt units one "hot" wire is red and the other is black while the white is still ground. For Full Power 115 volts, connect to the black "hot" wire designated as G1 and the white "ground" wire designated as G2 or G3. All 115 volt loads should be wired to the Full Power circuit which is of adequate capacity to carry the full current output of the generator. Connections should be soldered or secured with an acceptable type of connector and taped to prevent short circuits.

On 230 volt, 3 phase generators, no attention need be given to polarity in connecting the load to the receptacles. If any 3 phase motor is to be driven by the generator, check the direction of rotation when the motor is connected. If it rotates in the opposite direction as when connected to a power line, reverse two of the three load wires connected to the cap.__

BATTERY

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

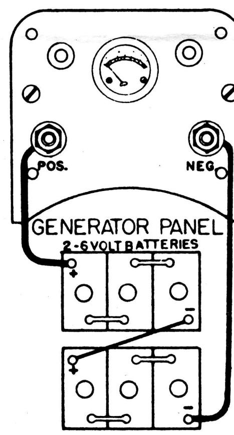


Figure 8

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.

LOAD LIMITATIONS

The electrical load should be limited to the capacity of the generator as listed on the name plate. No fuses are provided in the generator—all fusing is to be done in the external circuits. Severe over-loading for a short period of time will not result in damage to the generator, but for safest operation fuses of proper size should be used to protect the entire system.

WINCO FULL POWER

The Winco Full Power feature is a patented feature designed to give the owner full rated generator output from a single 115 volt outlet or a single 230 volt outlet without the necessity of having to carefully balance his 115 volt load between two outlets to keep from overloading the generator. This problem occurs within the conventional generator but not with Winco Full Power generators. Look at Figure 9. This shows a simplified drawing of the conventional or ordinary dual voltage generator.

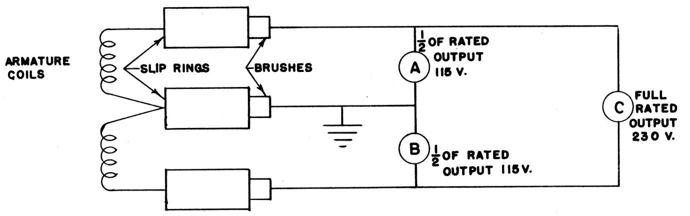


Figure 9

If this represents a 3000 watt generator, a person could take up to 1500 watts at 115 volts from A and up to 1500 watts at 115 volts from B, or 3000 watts at 230 volts from C; or he could take up to 3000 watts from C and the difference between what he does not take from C and the rated output of the generator from A and B,, but he would have to divide that difference between A and B. This would cause problems as you can see. A normal operator could damage the "ordinary" generator which is actually "half a generator" at 115 volts.

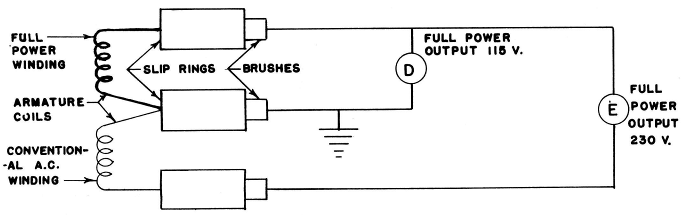


Figure 10

The Full Power winding has EXTRA HEAVY wire so that it can safely carry the ENTIRE load on ONE 115 volt circuit thus eliminating the need for balancing the load to avoid burning out an armature. The operator using this generator has the ENTIRE output available from a single 115 volt circuit, a SINGLE 230 volt circuit, or a COMBINATION of 115/230 volt circuits as long as the total load does not exceed the generator capacity.

WINCO MAXI-WATT

The Winco Maxi-Watt Power Control has been designed to meet the increased need on the farm, in construction, in hospitals and etc. A major limitation of a generator is its motor starting capacity. Motors normally require up to 6 times as much current to start them as is required to run them after they have been started.

Looking at Figure 11 we see that the Maxi-Watt Power Control features an additional winding along with the normal field winding.

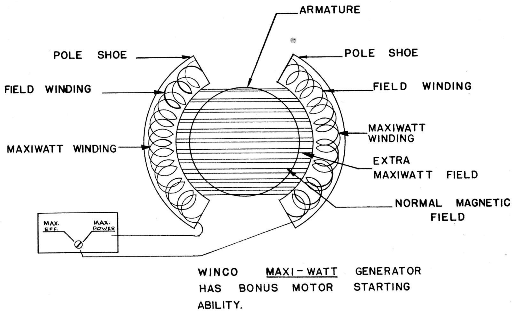


Figure 11

This extra winding can be put into the circuit by means of a switch located on the control panel. There are two positions to this switch; a MAXIMUM EFFICIENCY position and a MAXIMUM POWER position. If your loads are primarily lights and/or very small motors, turn the switch to the MAXIMUM EFFICIENCY position and leave it there. In this position the Maxi-Watt winding will not be in the circuit. If your loads are primarily large motors which require more power than the average generator can supply, turn the switch to the MAXIMUM POWER position. When in this position, the Maxi-Watt winding is in the circuit. Direct current (D.C.) is being supplied to it from either the D.C. commutator on the armature or from a rectifier which takes alternating current from an A.C. winding on the armature and changes it to direct current. (Different methods of obtaining the D.C. are used on various models). This direct current flowing through the Maxi-Watt winding increases the magnetic field through which the armature turns, thus raising the voltage slightly which enables the generator to start larger motors than could otherwise be started with a conventional generator of the same rating. This Maxi-Watt winding, in effect, takes the generator out of the ordinary "light plant" class and puts it into the "power plant" class.

WINCO AUTOMATIC CONSERVERS

The Winco Automatic Conserver is a device which automatically slows the engine to idling speed whenever the load is removed from the generator. Without an idling control the engine must run at full speed at all times regardless of whether all electrical loads are turned off or whether a small or large load is connected. With the Winco Automatic Conserver the throttle control lever moves out of the way when the load is turned on so it in no way interferes with normal governor operation; when the load is turned off it closes the throttle to an idling position. IT DOES NOT CAUSE INCORRECT OPERATION OF THE CARBURETOR OR GOVERNOR BUT NEITHER DOES IT CORRECT THEM—DO NOT BLAME THE CONSERVER IF OTHER PARTS ARE THE CAUSE OF INCORRECT OPERATION.

The WINCO SAFEGUARDED AUTOMATIC CONSERVER consists of a rectifier, relay, condenser, and transformer located in the generator control box. The WINCO ELECTRONIC CONSERVER includes a module containing condensers, resistors, transistors, and silicon controlled rectifiers encapsulated in a small black box located on the brush rack of the generator and a transformer and a resistor located in the control box. These WINCO AUTOMATIC CONSERVERS are factory installed accessories and can not be installed in the field on any generator.

1. NORMAL POSITION WITH THE CONSERVER SWITCH IN "AUTOMATIC IDLE" OR "IN" POSITION: Turn the switch on the front panel of the generator control to the "Automatic" or "In" position. When the engine is started it will run at idling speed until the equivalent of a 100 watt light bulb or heavier load is applied. (If the engine is equipped with the Winco Therma-trol, an engine warm-up control, the engine will maintain full speed until the engine temperature will permit smooth idling.) As long as the load is left on, the engine will continue to run at operating speed (3600 RPM for two pole generators). When the load is turned off, the engine will automatically return to idling speed.
2. NORMAL OPERATION WITH THE CONSERVER SWITCH IN "CONTINUOUS FULL SPEED", "MANUAL", OR "OUT" POSITION. With the conserver switch located on the control panel of the unit in this position, the engine will continue to run at operating speed, regardless of whether or not any load is applied.

ADJUSTMENT OF EITHER TYPE OF WINCO CONSERVER
The electro magnet which controls the idling speed of the unit is adjusted at the factory. If at any time additional adjustment is required, remove the cover of the electro magnet and loosen the locknuts which attach the electro magnet coil to the bracket. To increase the idling speed, lower the magnet, or to decrease the idling speed, raise the magnet. If the generator alternately speeds up or slows down, it is possible that the engine is being idled too slowly. The idling speed of the unit has a range of 1800 RPM to 2700 RPM depending on the specific model and engine used.

WINCO ELECTRONIC CONSERVER WITH MODULE

PRINCIPLES OF OPERATION:

Refer to Fig. 12. With the conserver switch in the "Automatic Idle" position, the operation of the ELECTRONIC CONSERVER CONTROL is as follows:

1. WHEN THE ENGINE IS FIRST STARTED, regardless of whether or not an electrical load is connected, the Therma-trol (engine warm-up control) will cause the engine to maintain full speed until the engine temperature will permit smooth idling.
2. AFTER THE ENGINE HAS REACHED ITS NORMAL OPERATING TEMPERATURE, and if there is no electrical load applied, the Electronic Conserver 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 slowing the engine down to idling speed.
3. WHEN A LOAD IS APPLIED TO THE GENERATOR, the Electronic Conserver 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.

WINCO ELECTRONIC CONSERVER CIRCUIT WITH MODULE

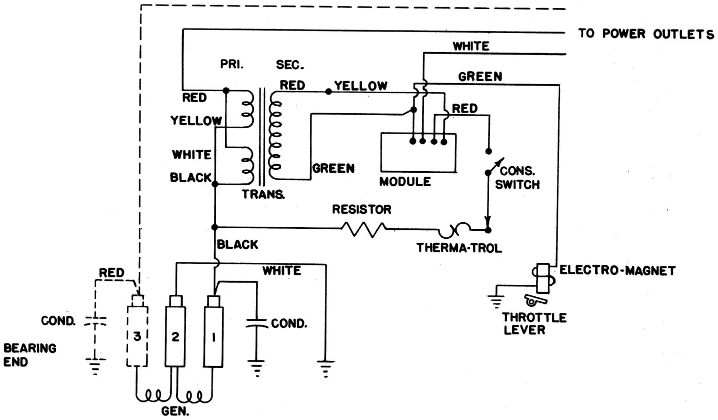


Figure 12

4. WHEN THE ELECTRICAL LOAD IS TURNED OFF, no current will flow through the transformer; as a result the Electronic Conserver will once again cause the engine to slow down to idling speed as in 2.
5. WHEN THE SWITCH IS TURNED TO THE "CONTINUOUR FULL SPEED" POSITION, the engine will retain full governed speed regardless of whether or not any load is applied.
6. If it is found that the engine will not come up to speed when a full load is applied at once, remove the load and set the Conserver Control to "Continuous" position and then reapply the load.

TROUBLE SHOOTING GUIDE FOR THE ELECTRONIC CONSERVER WITH MODULE

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 Electronic Conserver circuit.

1. Start the engine generator plant and allow the unit to run for approximately one minute (at room temperature) so the heat of the engine will close the Therma-Trol (thermostat) mounted on the engine. When the thermostat closes and no load is applied to the generator, the generator speed should drop to an idling speed of approximately 1800 - 2700 RPM.
2. If the unit does not idle when no load is applied, connect a jumper wire across the Therma-trol to determine if it is open. If this does not cause the unit to idle, connect a jumper across the terminals of the conserver switch.
3. Examine the resistor of the conserver circuit. This resistor is located in the control box. The resistor should be checked for continuity, and lead wires should be securely connected at each end.
4. 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 box. With a 100 watt load, a reading of 12 to 16 volts A.C. should be obtained.
5. 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.
6. If all of the above components check satisfactorily, then the conserver module is evidently defective and requires replacement.

WINCO SAFEGUARDED AUTOMATIC CONSERVER

PRINCIPLES OF OPERATION:

Refer to Fig. 13. With the switch in the "AUTOMATIC" position, the operation of the WINCO SAFEGUARDED AUTOMATIC CONSERVER is as follows:

1. WHEN THE ENGINE IS FIRST STARTED AND NO ELECTRICAL LOAD IS CONNECTED, you will find the points of the relay to be closed. As soon as the generator picks up enough speed to produce about 60 to 70 volts A.C., current from the generator will be forced through the points of the relay to the coil of the electro magnet. This will produce enough magnetism to pull the throttle lever up. When this occurs, it closes the throttle on the carburetor slowing down to idling speed.
2. WHEN A LOAD IS APPLIED TO THE GENERATOR, the load current which flows through the transformer primary coil induces current to flow in the secondary. This current, when rectified and applied to the D.C. relay causes the rleay points to open. This opens the circuit to the electro magnet and as a result the throttle lever drops downward and the engine is allowed to come up to its governed speed.
3. WHEN THE ELECTRICAL LOAD IS TURNED OFF, no current flows through the transformer; as a result, no current flows through the relay coil, the relay points close, and the D.C. generator voltage is applied to the electro magnet, thus slowing the engine down to idling speed.
4. WHEN THE CONSERVER SWITCH IS TURNED TO THE "MANUAL" OR "CONTINUOUS FULL SPEED POSITION. no voltage is applied to the electro magnet and the engine retains full governed speed regarlless of whether or not any load is applied.

TROUBLE SHOOTING GUIDE FOR WINCO SAFEGUARDED AUTOMATIC CONSERVER

ENGINE WILL NOT IDLE

1. Check the switch located on the front panel of the generator plant to determine if the switch is in the "Automatic position. If this switch is in the "Manual" position, the conserver circuit is open and the generator is supposed to run at 3600 RPM. With the switch in the "Automatic" position, the generator plant should idle at approximately 1800 - 2700 RPM when no load is applied to the generator.
2. Remove the cover of the control panel on the generator and examine the points on the relay. If the points will not close, take a small piece of insulated material such as a match and gently press the contact points together. If the engine now idles, the points are out of adjustment or are dirty. Stop the engine and readjust the points if necessary. If the points are pitted or dirty, they should be cleaned with very fine sandpaper.
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 reeading on the coil which should be approximately 70 Ohms. resistance from the core of the magnet to the lead wire.
4. Examine the switch located in the control box to see if the wires are properly connected and the terminals on the rear of the switch are not broken. If they are, connect the two wires together until a replacement switch can be obtained. If the wires and terminal look all right, try "bridging" the terminlas with a short piece of insulated wire. If the unit idles, then you know the switch is defective.

ENGINE WILL NOT ACCELERATE:

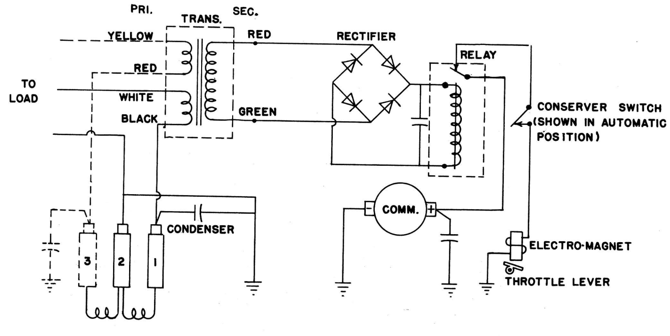
1. Pull the throttle lever down from the electro magnet coil. If the throttle lever is not pulled back to the electro magnet, it was evindently binding and should be cleaned and adjusted.
2. If the throttle lever returns to the electro magnet, the electro magnet coil is still energized. Remove the cover from the control box and press the relay armature toward the end of the relay core. This should open the points and allow the engine to resume governor speed. If it does not, the points may be improperly adjusted. Stop the generator and readjust the points so they separate enough to break the circuit.
3. With a 100 watt or larger load connected, check between the small red and green wires on the transformer. If you do not get a reading of approximately 14 volts A.C. the transformer is defective and should be replaced.
4. If you get the right voltage here, proceed to measure across the coil of the relay. You should obtain a reading of approximately 11 volts D.C. here. If you do not, the rectifier is defective and should be replaced.

STARTING AND STOPPING

All engine generators can be started manually either by use of a crank, rope, or recoil starter.

Manual start engines can be started only at the engine.

WINCO SAFEGUARDED AUTOMATIC CONSERVER



NOTES: DOTTED CIRCUIT ADDITION SHOWS 3 RING GENERATOR GIVING DUAL VOLTAGES. SINGLE VOLTAGE UNITS CAN HAVE PRIMARY WINDINGS IN SERIES OR PARALLEL, DEPENDING ON THE UNIT.

Figure 13

"Electric Start" and some "Remote Start" plants are designed with a special starting winding so the generator can USE electricity from a 12 volt battery and act as a "D. C. Motor" to start the engine. Other "Remote Start" plants use an automotive type starter which takes its power from a 12 volt battery to turn the engine over.

The "Electric Start" (E. & E.S.) type is started by a switch on the control panel. Some are stopped by moving the "Start-Stop" switch to the "Stop" position while others are stopped by shorting out the spark plug or magneto as described in the engine instruction book.

The "Remote Start" (R. & R.S.) 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 switch (Part #24219) to the terminal block as shown in Figure 14. 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

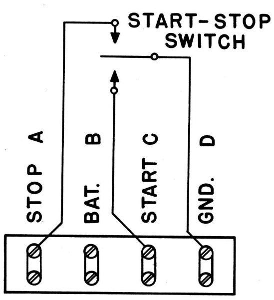


Figure 14

to be used as 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.

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

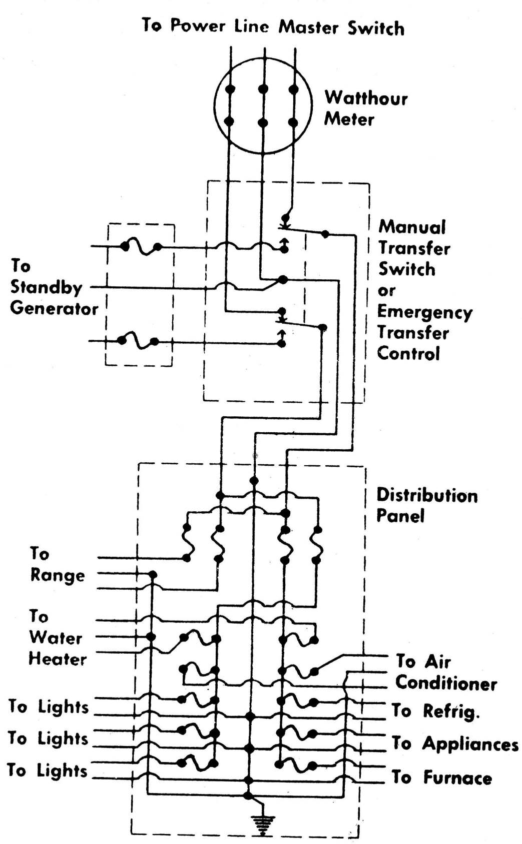


Figure 15

TRANSFER SWITCHES

Any generator which is installed for standby or emergency power must be equipped with a suitable double-throw switch for use when the power line fails. The switch transfers the load from the power line to the generator. It may be an automatic type or may be manually operated.

There are two general classifications of transfer switch installations. Those which switch the entire electrical load from the power line to the stand-by generator as shown in Figure 15 and those which switch only parts of the circuits as shown in Figure 16. Figure 15 shows how the switch is to be connected into an existing system by installing it between the meter and the original distribution panel. If the generator does not have sufficient capacity to carry the entire electrical load it will be necessary to turn off or disconnect some of the lights or appliances. Since the switch carries all of the current when the system is connected to the power line it must have the same capacity (ampere rating) as the main service entrance.

Figure 16 shows the transfer switch wired to a circuit to transfer only part of the load. It will be noted that the range, water heater, and air conditioner will not be transfered to the generator, but are left connected as they originally were. A second distribution panel (No. 2) is added for connecting the refrigerator, appliances, furnace, lights and other devices which will be used at all times, including emergencies. The transfer switch is wired between the two distribution panels as indicated in the diagram. When connected in this manner the transfer switch does not necessarily have to be as large as the service entrance but must have an ampere rating at least equal to the circuits connected to it. In the example shown, if none of the three circuits on either side exceeds 20 amperes a switch with a 60 ampere rating is large enough.

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

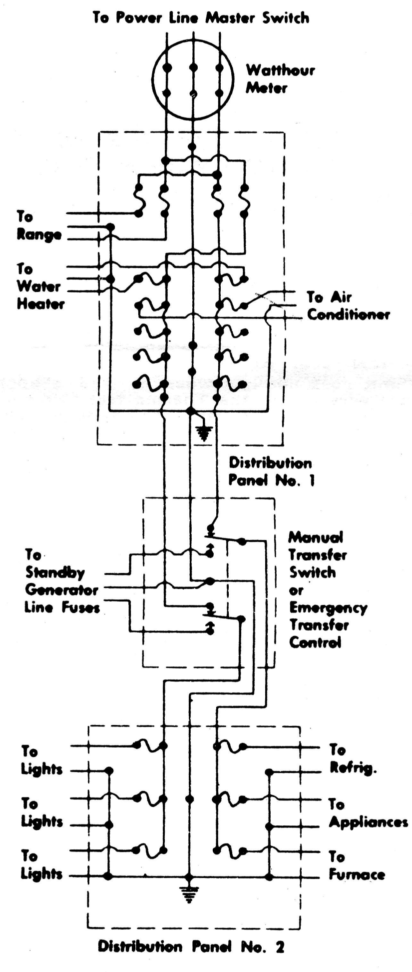


Figure 16

In Figure 15 and 16 the transfer switch is shown in its simplest form. Winco Emergency Transfer Controls include not only the transfer switch which is to be connected as shown in these illustrations, but also the necessary circuits to start and stop the generator, to keep the starting battery charged and the mechanism to operate the transfer switch. These can be used with remote-start units only and you will note remote-start units do not include an idling control. Winco Conserver Idling Controls cannot be used on generators when they are connected to Emergency Transfer Controls. When the engine slows down the voltage drops to a point where the relays cannot be relied upon to operate dependably. Conserver Idling Controls can be used successfully on stand-by systems if a manual transfer switch is used. If the generator is equipped with a Conserver Idling Control and is to be used to operate a furnace or other thermostatically controlled apparatus, using a low voltage transformer, set the Conserver switch to "continuous" position.

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 that 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	58½	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	48½	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 nor 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 con be checked with a portable meter. A convenient voltage tester, which can be plugged into any ordinary outlet, shown in Figure 17 is available from the factory under part No. 24743.

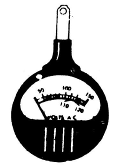


Figure 17

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 fractioinal 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 ALL TYPES	"STARTING" AMPERES		
		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	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 connecteed 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 con 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.

MAINTENANCE

For instruction on engine maintenance refer to the engine instruction book. BE SURE THE OIL LEVEL OF BRIGGS & STRATTON ENGINES IS CHECKED EVERY FIVE HOURS AND THE OIL LEVEL OF WISCONSIN ENGINES IS CHECKED AS FREQUENTLY AS RECOMMENDED BY THE ENGINE MANUFACTURER.

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 $\frac{1}{2}$ inch. Whenever replacing brushes or removing them to do other service work, remove one at a time and put the screws back into 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 — A commutator in good condition has a glossy finish and is brownish in color. If it gets greasy, rough or dirty, it may be cleaned with very fine sandpaper. (Do not use emery 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 th stud bolts which hold the field shell to the adapter end bell. See A in Figure 18. 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 19.

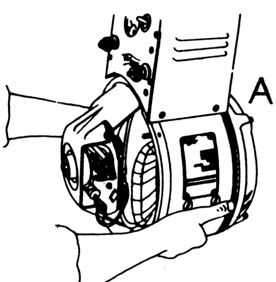


Figure 18

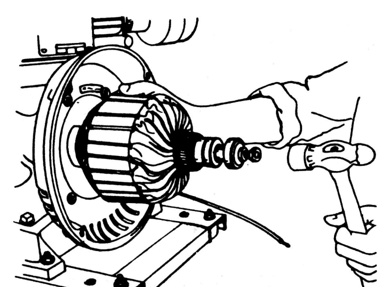


Figure 19

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-bold 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 hammer as shown in Figure 19. In difficult cases, also tap the steel core of the armature if necessary in order to break the armature loose from the engine shaft.

If the commutator or slip rings are worn they should be resurfaced by a generator shop which has special equipment to do this work.

If it is necessary to replace any of the parts in the control box it can be done most easily by loosening the screws in the front panel and tipping it forward as shown in Figure 20.

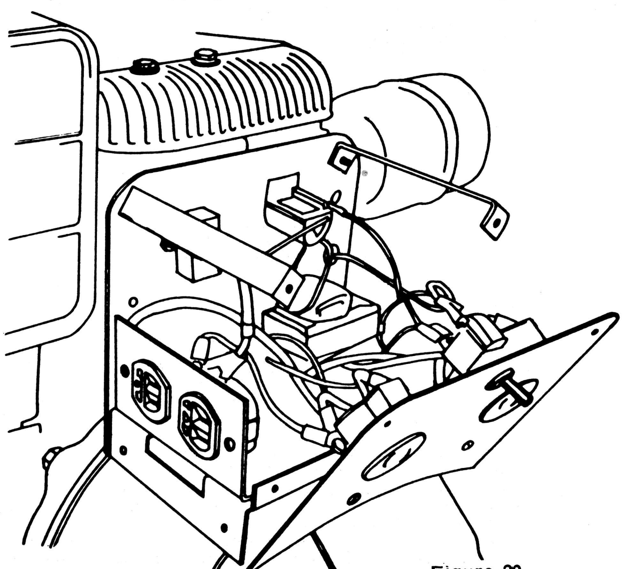


Figure 20

LOCATING TROUBLE

If the generator does not work properly, first check the conditions under which it has been operating and then if necessary make the electrical tests as outline below:

1. Sometimes a generator won't produce electricity when it is started even though it was working satisfactorily when it was turned off. This is usually caused by inadequate contact between the brushes and commutator or slip rings and occurs most often on generators in which new brushes have been installed and not completely seated. Under certain conditions, it can happen even after the brushes are seated. The problem can easily be corrected by cleaning the commutator surface with a brush seating stone or very fine sandpaper. It is seldom necessary to "flash the fields" with a battery if the brushes are making good electrical contact with a clean commutator unless the unit has stood for a considerable time and the pole shoes have lost their residual magnetism. In the event that it becomes necssary to "flash the fields", (this applies only to manual start units with a D.C. commutator) disconnect the shunt field wire connected to the positive brush and connect a heavy insulated wire from the positive terminal of an automobile battery to this field wire and a similar wire from the negative terminal of the battery to the generator frame (a second is usually sufficient time).

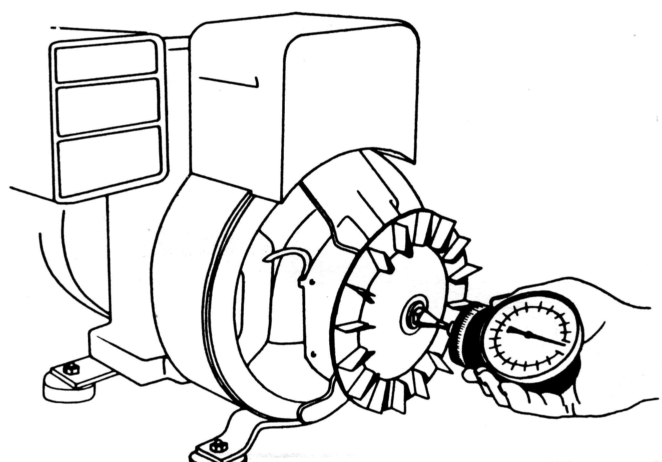


Figure 21

2. Check the engine speed. Refer to the article "Required Operating Speed". The speed of these generators can be checked easily with a tachometer by applying it directly to the end of the engine crankshaft or removing the cover from the end of the generator and applying the tachometer as shown in Figure 21. If the engine cannot be kept up to a specified speed when the generator is loaded to its rated capacity something is wrong with this engine. See the engine instruction book for probable causes.

3. Is the generator overloaded? Check the nameplate for maximum safe load and if uncertain about the amount of load, check it with an ammeter and voltmeter.

4. Is the location satisfactory? See page 3 regarding sufficient ventilation if the generator is being operated in an enclosed area. If it is being operated under dusty or dirty conditions be sure all ventilation holes and slots are cleaned periodically.

5. Is the commutation satisfactory? Remove the generator end cover and with the generator in operation, notice whether there is any appreciable arcing or sparking at either the A.C. or D.C. brushes. See the article on brushes under "Mainten-- ance on Page 10.

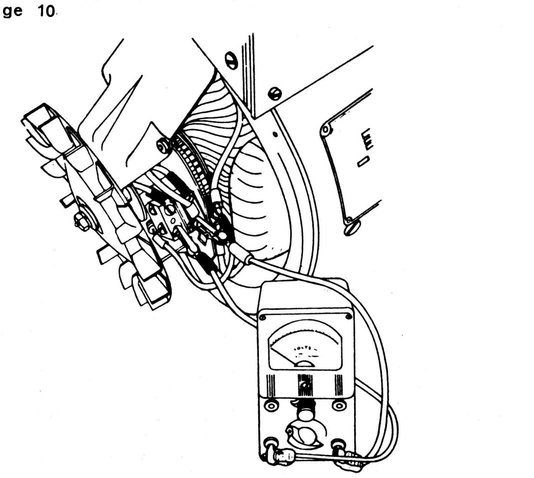


Figure 22

6. Some generators are equipped with a light bulb or voltmeter to indicate that the generator is producing electricity. If the voltmeter does not register or the bulb doesn't light, check the output with another light bulb or meter before deciding that the generator is not performing as it should.

7. If no output voltage is obtained at the outlet receptacles or output wires, disconnect all electrical loads and connect a voltmeter directly to the A.C. Brushes as shown in Figure 22.

If no voltmeter is available, use an ordinary small 115 volt bulb (230 volt bulb on 230 volt generators). If normal voltage is obtained at the A.C. Brushes but not at the output terminals, there must be an open circuit between these two points. (NOTE: The grounded A.C. ring is identified by a flat copper grounding strip which leads from the brush to ground. The A.C. lead connecteed to it will be white. Check from this "grounded" brush to each of the "hot" brushes). Disconnect the capacitors at the brushes and see if the voltage builds up. Replace the shorted capacitors.

TABLE 2

Model	A.C. Volt. (Q Wind.)	D.C. Volt. (Rectifier)	D.C. Volt. (Commutator)
1205WS	N.A.	105	N.A.
10WS	N.A.	105	17
9WH	N.A.	N.A.	55
6WH	112	95	42
5WS	N.A.	N.A.	19
4BH	115	102	35
4WH	115	102	N.A.
305WS	113	103	20
3WH	112	94	N.A.
3BH	115	105	19
205BS	N.A.	N.A.	17

★ N.A.=Not Applicable.

8. If no A.C. voltage is obtained at the brushes, check the exciter voltage by connecting a D.C. voltmeter directly to the D.C. Brushes. The voltage should be between 17 and 55 volts as shown in Table 2. This will produce a dim to bright light, dependent on the voltage output if a 115 volt bulb is used. If the D.C. voltage is satisfactory, omit Step 9 and proceed to Step 10. NOTE: Some units feature electronic excitation. One type using electronic excitation has an extra layer of wire, called a quadrature winding, on the armature. See Figure 23.

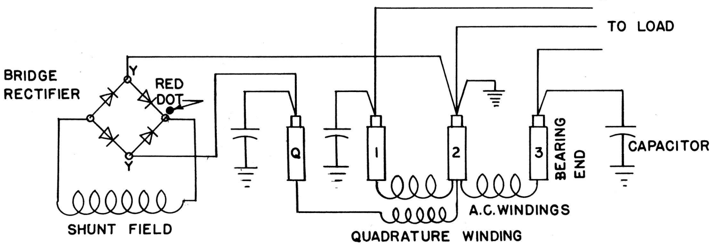


Figure 23

One end of this winding ties to Slip Ring #2 which goes to ground through the brush and the other end goes to Slip Ring Q (the ring farthest from the bearing end of the generator). From the brush on slip ring Q this A.C. voltage is conducted to a bridge rectifier where the A.C. is changed to D.C.

This D.C. is then conducted to the shunt field and provides the excitation for the generator. If your generator uses this means of exciting the field, and if no A.C. voltage is obtained at the brushes, proceed as outlined below. NOTE: The following procedure may be beyond the ability or equipment of many and the unit will have to be taken to a shop for repair.

8a. The most probable cause of no A.C. voltage is loss of excitation and this is most likely due to a defective rectifier. This rectifier module is located on the brush rack in most models; on some it is found in the control box. The red dot on the module identifies the positive terminal where the positive side of the D.C. voltmeter must be connected. The negative side of the voltmeter is connected to the terminal opposite this one. Values within 5% from Table 2 should be satisfactory. If D.C. voltage is obtained here you should check the shunt field for an "open". If no voltage is obtained here the four diodes included in the bridge rectified should be checked.

8b. 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. Check for this as in 9d. 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.

8c. If the four diodes check out, measure the A.C. voltage from the Q ring brush to ground. If you do not measure any A.C. here set the meter on a low range and see if any D.C. can be detected. If not, this is an indication that the quadrate winding is possibly defective. If the quadrature winding is shorted you can in mose cases detect this by visual inspection as the winding on the armature will be charred or burned. The likelihood of the winding being open is remote. A good check on the condition of the quardature winding is to use a 12 volt car battery to excite the shunt field and with the unit running, measure the voltage at the Q ring brush. This can be done by hooking leads from the battery terminals directly to the field wires. Obtaining a small A.C. voltage is a good indication that the Q winding is good.

9. If no voltage is produced at the D.C. Brushes, proceed as follows:

a. Remove each of the D.C. Brushes to be sure they are clean and free in the holders. Examine the brush springs to make sure they have several ounces of tension. (If the generator is an "electric start" or "remote start" type that uses the D.C. section of the armature to "motor" the unit for starting the engine, this is paricularly important because if an attempt was made to start the engine with a "low" or "discharged" battery, the brushes may have become extremely hot and thus ruined the temper in the brush springs. Replace all parts necessary.

b. One side of the D.C. circuit and one side of the A.C. circuit is "grounded" to the generator frame. The other side is said to be "live "or "hot". Any short-circuit between the "hot" side of either circuit and any metal part of the generator will result in a grounded condition which prevents the generator from producing electricity. Carefully inspect all "hot" wires and terminals for evidence of a grounded condition.

c. Remove the condenser terminals from the brushes. If the generator builds up voltage with the condensers disconnected but will not build up the voltage when they are connected. one or more of the condensers are shorted. The shorted condensers should be replaced. If the generator doesn't build up D.C. voltage even when the condensers are disconnected, disconnect all other wires leading from all A.C. Brushes to the control box. If the D.C. voltage builds up with these wires disconnected, there is a short circuit in the control box. Isolate the short circuit and correct it.

d. Disconnect all field leads and with an ohmmeter, check from each field coil terminal to the generator frame to be sure the field coils are not grounded. NOTE: Some generator will have a shunt field, a Maxi-Watt field, and a series field winding. If any field shows a ground, the coil should be repaired or replaced.

e. Check the "hot" D.C. Brush Holder(s) for grounds (this applies to metallic brush holders only).

f. If these tests have not located the trouble, remove the armature and have it tested for opens, shorts, and grounds on a growler (see Figure 24).

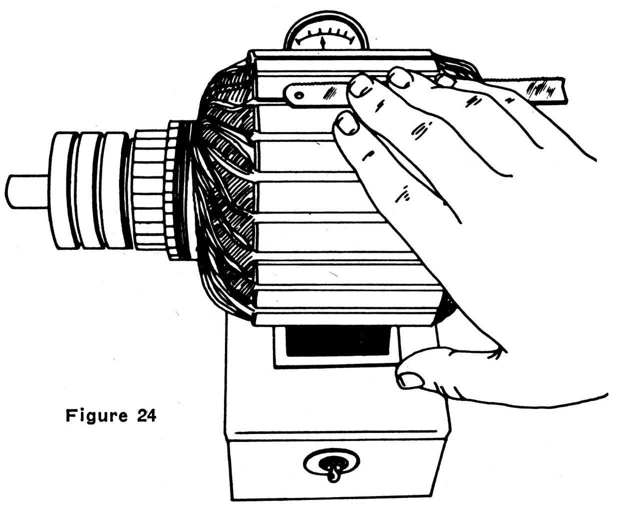


Figure 24

10. If the excitation voltage is satisfactory, but no A.C. voltage is produced, proceed as follows:

a. Check the A.C. Brushes to make sure they are making good electrical contact with the slip rings. NOTE: See brushes under "Maintenance on Page 10.

b. If the generator is equipped with a resistor in the shunt field circuit, remove the control box cover and check the field resistor. See Fig. 25.

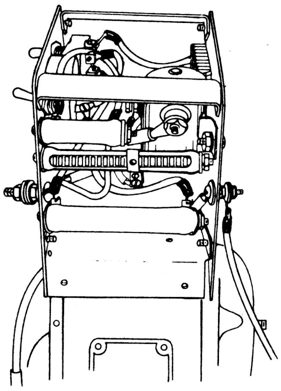


Figure 25

A lead wire from the positive brush is connected to one of the end terminals. A lead wire from the shunt field is connected to the "sliding band" terminal. Use a short piece of insulated wire to "bridge" or "jump" from one terminal to the other to short out the resistor while the engine is running.

b-1. If connecting these terminals together has no effect, apparently this is not the cause of the trouble. Proceed with 10-c.

b-2. If the voltage builds up when the resistor terminals are "bridged", there must be an open circuit in the resistor. Loosen the band screw and slide the band over. Examine the resistor element carefully. If an ohmeter is available, check the resistor for continuity. Replace the resistor if necessary. If no breaks are visible, clean the contacting areas so the projection on the sliding band makes good electrical contact with the resistor element and tighten the band srew securely.

c. Using an ohmmeter, check the continuity of the field coils. Do this by disconnecting the shunt field terminal from the generator brush and measuring form this terminal to the other field terminal or to the sliding band terminal of the field resistor referred to in 10b. If the field coils are open, disassemble the genrator and examine the coils carefully at all junction points. Repair or replace as necessary.

d. If after making these tests you still get no A.C. voltage at the brush terminals, the A.C. portion of the armature must be defective. See "Maintenance" on Page 10 for removing and testing the armature. A growler such as is shown in Figure 24 can be used for analyzing armature defects. The same equipment and procedure as is used for testing D.C. generator and motor armatures also applies to these armatures.

11. The generator battery charging circuit can be checked quite easily by removing the control box cover and using a D.C. voltmeter. Connect the negative lead to the generator frame (ground). With the engine generator running at its normal speed check the voltage first from ground to the other terminal on the reverse current diode, the ammeter, and the high-low charge switch. If there is any appreciable difference in the voltage reading of the two terminals of any of these parts it is defective and should be replaced. If these parts are satisfactory, disconnect the charge limiting resistor(s) and check each one with an ohmmeter for open circuits.

If the battery cannot be kept charged there is possibly a partial short or ground in the circuit. Disconnect one of the leads from the battery and insert an ammeter or milliammeter, in series, in the circuit. If current leakage exists, disconnect the D.C. circuit at various stages to detect the location of the short or ground. The most probable cause of trouble is the reverse current diode. This can be checked very easily with an ohmmeter. With the leads across the diode in one direction the meter will indicate an extremely high resistance; upon being reversed the meter will indicate a low resistance. If a battery is completely discharged and in bad condition the charge resistors may be burned out due to the excessive overload. Such resistors must be replaced.

12. There are 2 kinds of starting arrangements used on different engine generators. One is the automotive type start which uses the same kind of starter as is used in automobiles and the other is called the exciter starting system. In the latter, a special heavy duty series field coil is wound on the generator and the generator is used as a "D.C. motor" to turn the engine over. If the engine cannot be turned over by the battery, proceed as follows:

a. Check the Bat. + and Bat. — terminals on the control box while trying to start the engine electrically. The voltage from the 12 volt battery during the cranking period must be at least 9 volts at these terminals. If the voltage is low, check the battery terminals to be sure that they are clean and tight. If they are, and the battery voltage drops below 9 volts it is dead and should be removed and charged with a battery charger. Any of these generators may be operated satisfactorily by cranking the engine by hand and operating the generator without a battery. TRYING TO START AN ENGINE WITH A DISCHARGED BATTERY MAY CAUSE IT TO STALL ON THE COMPRESSION STROKE; THE HIGH CURRENT SURGE MAY BURN THE BRUSHES AND BRUSH SPRINGS.

b. Using a piece of insulated wire "bridge" between the grounded terminal and the one with a wire leading to the small terminal of the start-stop switch. If the engine now cranks, replace this switch.

c. If the engine still won't crank, use a heavy piece of insulated wire and bridge the two heavy connectors on the starter solenoid. If the engine turns over now it is possible the solenoid is bad. This can be checked out by "grounding" the small connector on the solenoid. If nothing happened you know the solenoid must be replaced. If the engine cranks then the wire from this small terminal to the start-stop switch is open.

d. If you find this lead wire is not open then the automotive type starter must be bad. This starter must be taken off and checked—brushes, field, armature, etc.

e. If your generator is one with an exciter cranking circuit (series field winding) then this must be checked next. Examine the D. C. Brushes and springs as explained in 9a and 9e. Also check the connections of the series field coils to see if they are good. If this does not correct the trouble proceed as in 9f.

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