INSTRUCTION MANUAL

FOR

ONAN ELECTRIC GENERATING PLANTS

AH SERIES

ALTERNATING CURRENT MODELS

BATTERY CHARGING MODELS

DIRECT SERVICE MODELS

SPECIFICATIONS
A THROUGH M

D. W. ONAN & SONS INC. MINNEAPOLIS 14, MINN.
908-15 *****

GENERAL INFORMATION

THE PURPOSE OF THIS BOOK. This instruction book is furnished so that the operator may learn of the characteristics of the plant. A thorough study of the book will help the operator to keep the plant in good operating condition so that it will give efficient service. An understanding of the plant will also assist the operator in determining the cause of trouble if it occurs.

KEEP THIS BOOK HANDY. Such simple mistakes as the use of improper oil, improper fuel, or the neglect of routine servicing may result in failure of the plant at a time when it is urgently needed. It is suggested that this book be kept near the plant so that it may be referred to when necessary.

SERVICE. If trouble occurs and the operator is unable to determine the cause after a thorough study of this book, or if he is unable to determine what repair parts are required, needed information will be furnished upon request. When asking for information, be sure to state the Model, Serial, and Generator numbers of the plant. This information is absolutely necessary and may be obtained from name plates on the plant. Give all other available details.

MANUFACTURER'S WARRANTY

The manufacturer warrants each new engine or electric plant to be free from defects in material and workmanship. Under normal use and service our obligation under this warranty is limited to the furnishing of any part without charge which, within ninety (90) days after delivery to the original user shall be returned to us or our authorized service station with transportation charges prepaid, and which our examination shall disclose to have been defective.

Our liability in case of defective workmanship, material or any costs incurred in remedying any claimed defective condition in any unit or such unit having been repaired, altered, or which installation and service recommendations have not been complied with, is limited strictly to the proper adjustment authorized by the factory.

This warranty does not include or cover standard accessories used, such as carburetors, magnetos, fuel pumps, etc., made by other manufacturers. Such accessories have separate warranties made by the respective manufacturers. Repair or exchange of such accessories will be made by us on the basis of such warranties.

This warranty is in lieu of all other warranties expressed or implied.

IMPORTANT--RETURN WARRANTY CARD ATTACHED TO PLANT.

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PLANT RUNNING HOURS
COMPARED TO AUTOMOBILE RUNNING MILES

The engine of your generating plant makes as many revolutions in one hour, as the average automobile engine does when the car travels a distance of 41 miles.

100 running hours time on a generating plant engine is equivalent in total RPM's to approximately 4100 running miles on an automobile.

However, do not conclude that the wear on the generating plant engine and the wear on the automobile engine would be the same. The generating plant engine is built much more ruggedly, (having larger main bearings, bigger oil capacity and has a heavier crankshaft proportionately per horsepower) than most automobile engines. Given the proper care and periodic servicing the generating plant engine will continue to give many more hours of efficient service than an automobile engine will after having been run the equivalent number of running miles.

Compare the running time of your generating plant engine with the number of miles traveled by an automobile. The oil in an auto is checked every one or two hundred miles (3 to 5 hrs. running time) and changed every 1000 to 1500 miles (28 to 42 hrs.) Whereas in a generating plant or stationary power engine, the oil should be checked every 6 to 8 running hours (250 to 350 miles) and changed every 50 to 100 operating hours (2000 to 4000 miles) depending on operating conditions.

About every 5,000 to 10,000 miles (120 to 250 hours), services have to be performed on an auto, such as checking ignition points, replacing spark plugs, condensers, etc. Similarly on your generating plant engine, these same services have to be performed periodically except the change period is reckoned in hours. 10,000 miles on an auto is equivalent to about 250 running hours on your plant engine.

To arrive at an approximate figure of comparative generating plant running hours as against automobile engine running miles, multiply the total number of running hours by 41 to find the equivalent of running miles on an automobile.

Your generating plant engine can "take it" and will give many hours of efficient performance provided it is serviced regularly.

Below is a chart showing the comparison between a generating plant engine running hours and an automobile running miles.

	GENERATING PLANT RUNNING HOURS	AUTOMOBILE RUNNING MILES
DAILY AVERAGE	1 Hr.	41 Miles
	4 Hrs.	164 "
	6 "	246 "
	8 "	328 "
WEEKLY AVERAGE	7 "	287 "
	28 "	1,148 "
	42 "	1,722 "
	56 "	2,296 "

	GENERATING PLANT RUNNING HOURS	AUTOMOBILE RUNNING MILES
MONTHLY AVERAGE	30 Hrs.	1,230 Miles
	120 "	4,920 "
	180 "	7,380 "
	240 "	9,840 "
YEARLY AVERAGE	365 "	14,965 "
	1,460 "	59,860 "
	2,190 "	89,790 "
	2,920 "	119,720 "

NOTE: Electric generating plants do not operate economically when used to power electric refrigerators and will add from 4 to 8 operating hours per day in addition to the regular lighting load.

GENERAL DATA

GENERAL.- Each power plant is a complete electric generating plant, consisting of an internal combustion engine, a self excited generator directly connected to the engine, and such accessories as are necessary for a normal installation. Each plant is carefully inspected and given a test run to assure that all parts are properly adjusted and that the plant will produce its rated output. Carefully inspect the plant before installing it, making sure that no damage occurred in shipment. Any damaged part must be repaired or replaced before the plant is put into operation.

ALTERNATING CURRENT PLANTS.- The alternating current (AC) plant generates current similar to that supplied by most commercial power lines. This type plant must be operated whenever electric power is desired.

The manual type of plant is designed for applications where portability is important. The plant is equipped for manual starting only and can not be connected to batteries for electric starting. A mounted fuel tank is provided. A convenient locking type output receptacle provides for quick connection to the electrical load.

The remote control type of plant is designed for applications where the installation will be more or less permanent. For electrical starting, either by remote control or at the plant, a 12 volt battery must be properly connected to the plant. Additional remote start and stop control switches may be installed at convenient locations. In the event of failure of the starting battery current, the plant may be started manually. A separate 5 gallon (U.S. Measure) fuel tank requires less frequent refilling. Output leads extending from the plant control box must be connected to the electrical load wires.

DIRECT CURRENT PLANTS.- The direct current (DC) plants are of two types as follows:

DIRECT SERVICE PLANT.- The direct service type plant is designed for supplying current directly to the electrical load, and for applications where portability is important. The plant is equipped for manual starting only, and has a mounted fuel tank. The plant must be operated whenever electric current is desired. A convenient receptacle provides for quick connection to the electrical load. This plant can not be used to charge batteries.

BATTERY CHARGING PLANT.- The battery charging type plant is designed for the specific purpose of charging batteries. NEVER OPERATE THIS TYPE OF PLANT UNLESS THE BATTERY IS PROPERLY CONNECTED TO THE PLANT. Electricity may be used while the plant is running, or while the plant is not running if the battery charge condition is satisfactory.

DESCRIPTION

ENGINE

The engine is a vertical single cylinder, four stroke cycle, air cooled, L head, internal combustion type. The cylinder bore is 2-1/2 inches, the stroke 2-1/4 inches, piston displacement 11 cubic inches, compression ratio 6.2 to 1, the rated horsepower at 2600 r.p.m. is 2.4 and at 1800 r.p.m. is 1.78. The cast iron cylinder and crankcase are a single casting.

The engine speed is controlled by a flyball type governor built into the camshaft gear. The governor is adjusted at the factory for an engine speed of 1500 r.p.m. for 50 cycle; 1800 r.p.m. for 60 cycle A.C. plants. For DC plants, the speed is approximately 2600 r.p.m. Ignition current is supplied by a high tension, flywheel type magneto. The engine is cooled by air. Blower fins on the flywheel draw air in through the opening at the front of the blower housing and force the air around the cylinder walls and head.

The engine has an aluminum alloy 3 ring piston, aluminum alloy connecting rod, and full floating type piston pin. The counterbalanced crankshaft turns in two unusually large sleeve type main bearings. The oil base and cylinder head are removable for servicing the engine. Positive splash type lubrication is employed.

GENERATOR

All generators of this series generating plants are of the four pole, self excited type. The machined steel ring frame mounts the pole shoes and field coils. The armature is directly connected to the engine crankshaft through a taper fit and held in place by a stud which passes through the hollow center of the shaft.

AC GENERATORS.- The alternating current generator field is shunt wound. Remote control models have an additional series winding which permits use of the generator as a motor for cranking the plant. The armature contains both AC and DC windings. The direct current is used for energizing the field, and for the remote control type of plant is also used to charge the starting battery.

DC GENERATORS.- The direct current generators are of two basic types. The direct service type (115 or 230 volt) field is compound wound. This type generator is not designed for electric cranking. The battery charging type generator field is shunt wound, but has an additional series winding which permits use of the generator as a motor for cranking the plant.

CONTROLS

AC and DC MANUAL TYPE PLANTS.- Manual type plants are started by manually cranking with a pull rope. The carburetor is manually choked. Electrical load is connected to the plant by plugging into receptacles mounted on the plant. The plant is stopped by pushing a stop button on the plant blower housing. This type plant can not be connected to batteries for electric starting.

DESCRIPTION

AC REMOTE CONTROL PLANT.- The remote control type plant is designed for electrical starting, either at the plant or by means of remote control stop and start switches. Automatic or line failure transfer equipment may be connected to the plant. The carburetor is automatically choked for starting. The control box contains a reverse current relay, a start solenoid, a stop-start toggle switch, a hi-low charge rate switch, a charge rate ammeter, and a charge resistor. Terminals for battery connections are provided. Output leads extend from the control box, for connecting to the load wires.

BATTERY CHARGING PLANT.- The battery charging plant is equipped for electric starting. The control box contains a start switch, a reverse current relay, and a charge rate ammeter. Terminals are provided for connecting to the batteries. The stop button switch is located on the blower housing. The battery charge rate is adjustable by changing the governed speed. The carburetor is manually choked.

ACCESSORIES

MANUAL TYPE PLANT.- Manual type plants are supplied with a starting rope, muffler, breaker point wrench, instruction manual, and for models which have a generator bearing, a supply of ball bearing grease.

AC REMOTE CONTROL PLANT.- The AC remote control plant is supplied with the same accessories as the manual type plant, and in addition are supplied with a separate 5 gallon fuel tank with connecting fuel line, a flexible exhaust tube, remote control switch, and battery cables.

DC BATTERY CHARGING PLANT.- The battery charging plant is supplied with the same accessories as the manual plant with the addition of a separate 5 gallon fuel tank, connecting fuel line, and flexible exhaust tube.

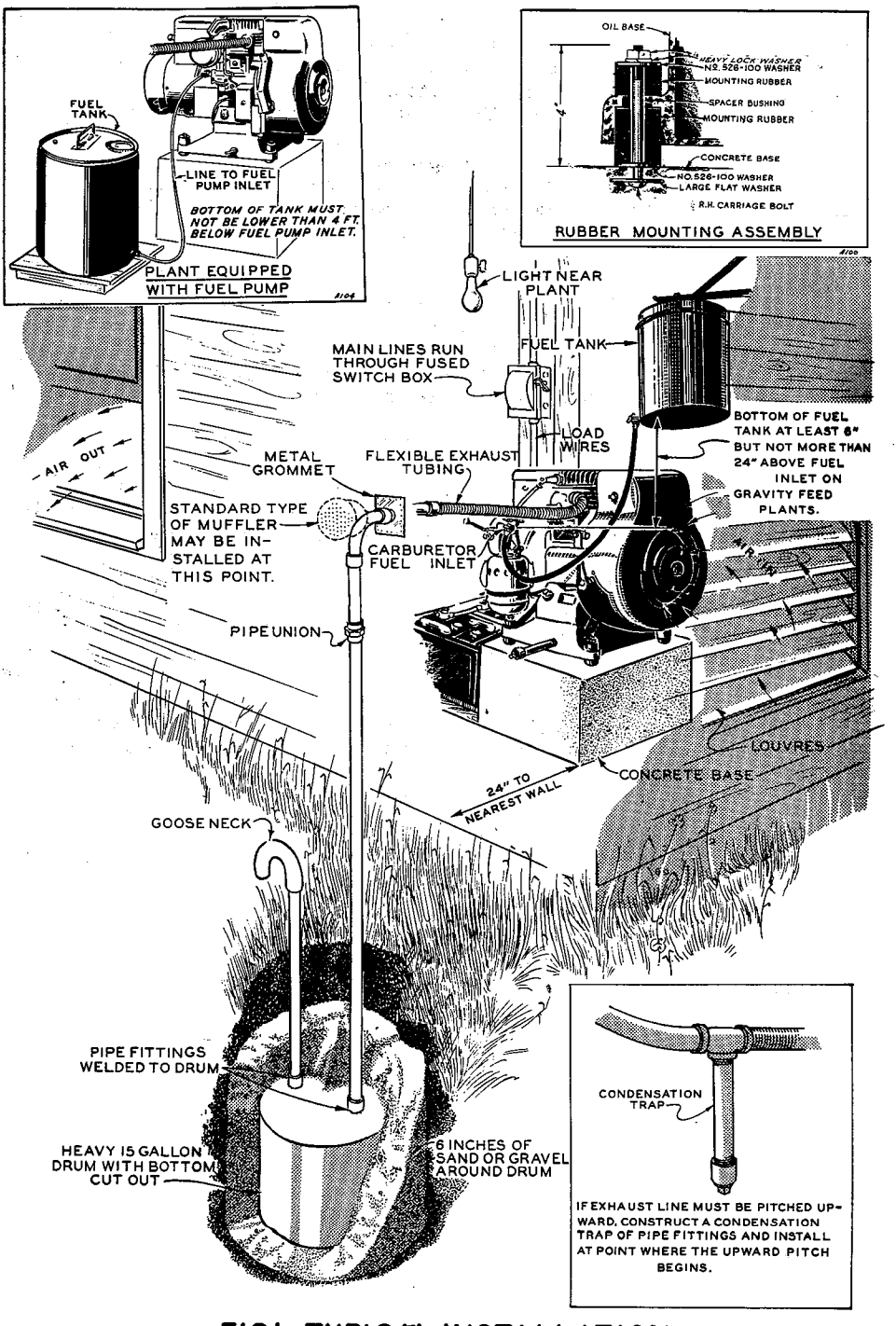


FIG I.–TYPICAL INSTALLATION

CAUTION

EXHAUST GASES FROM INTERNAL COMBUSTION ENGINES ARE DEADLY POISONOUS. EXCESSIVE INHALATION WILL CAUSE SERIOUS ILLNESS OR DEATH. NEVER OPERATE THE PLANT INSIDE A BUILDING OR OTHER CONFINED SPACE WITHOUT PIPING ALL EXHAUST GASES OUTSIDE THE ENCLOSURE.

MANUAL TYPE PLANT.- The manual type of plant is particularly adaptable to a wide variety of portable applications. The plant may be mounted on a dolly, trailer, or suitable platform if desired. Install the muffler directly to the engine exhaust outlet. Be sure to provide for circulation of air for proper cooling. Serious damage from overheating can result if cooling air is obstructed. The plant may be operated out of doors, but reasonable care should be taken to protect the plant as much as practicable from exposure to the elements. Be sure the plant sets level when in operation.

MOUNTING, PERMANENT INSTALLATION.- Select a site for the plant which will be clean, dry, well ventilated, and which preferably can be heated in extremely cold weather. A damp or dusty location will necessitate more frequent servicing. Fig. 1 shows a typical installation. Install batteries as close as practicable to the plant. Mount the plant on a substantial, level, concrete or timber base, preferably at least 12 inches high. Locate the base so as to provide at least 24 inches space on all sides for convenience in servicing. Use the rubber mounting bushings to minimize vibration. See the mounting detail in Fig. 1.

Provide separate air inlet and outlet openings large enough to provide for proper circulation of cooling air. The openings may be adjustable if desired, so as to partially control the temperature of the enclosure. In ordinary temperatures the inlet and outlet air openings should be approximately 3 sq. ft. in area.

EXHAUST.- Pipe the exhaust gases outside the enclosure, using 3/4" pipe or larger. Connect the flexible exhaust tube to the plant exhaust outlet, a sufficient length of pipe to conduct the gases outside the enclosure, and the muffler to the pipe outside the enclosure. Insulate or shield the exhaust pipe if it comes close to or passes through an inflammable wall or other material. If the exhaust line must be inclined upward from the plant, construct a condensation trap of pipe fittings and install it at the point where the upward pitch begins. Drain the trap periodically.

If exhaust noise from the standard muffler will be objectionable, an underground muffler may be constructed as shown in Fig. 1. Do not use an underground muffler if there is any danger of its filling with water at any time. Use a heavy metal drum, welding suitable pipe fittings in place. Do not use a drum which contained any inflammable liquid without first making sure that all explosive vapors have been driven out. Remove the bottom of the drum or drill holes in the bottom to allow condensation from exhaust gases to drain away. The muffler exhaust pipe should extend at least 24" above ground, with a gooseneck fitting on the end to prevent entry of rain or snow.

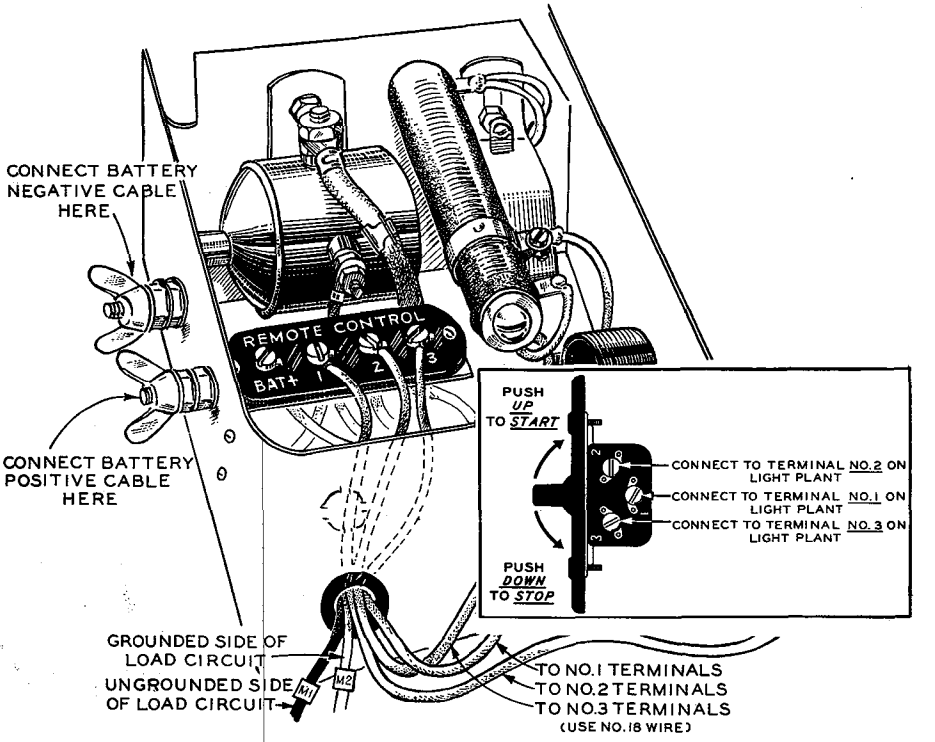


FIG.2-A.C.PLANT CONTROL BOX CONNECTIONS

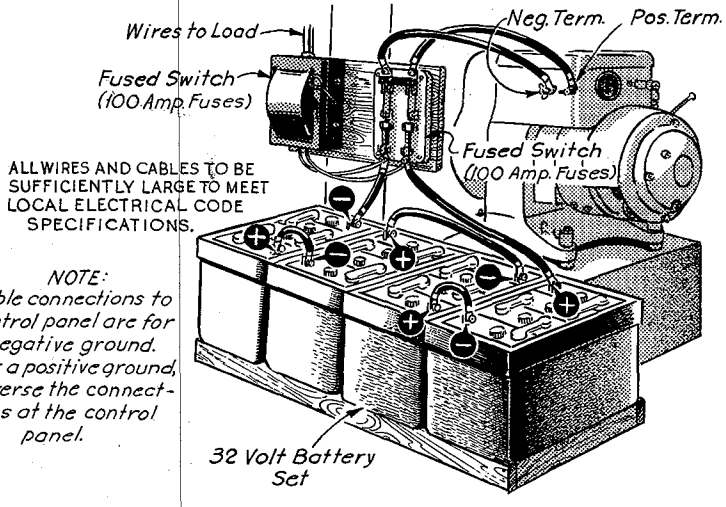


FIG.2A-BATTERY CHARGING PLANT CONTROL BOX CONNECTIONS

SEPARATE FUEL TANK.- The separate fuel tank has a capacity of 5 gallons (U. S. Measure). If the plant has no fuel pump, install the tank on a substantial support so that the bottom of the tank will be at least six inches, but not more than two feet above the carburetor fuel inlet.

If the plant has a fuel pump, install the fuel tank so that the bottom of the tank will be less than 4 feet below the fuel pump. The top of the tank must not be above the fuel pump.

Note that one end of the flexible fuel line has a swivel connector fitting, the other end solid to the line. Install the non-swivel end of the line to the fuel pump inlet, then the swivel end of the line to the tank shut off valve connection. Take care to start threads straight. The threads on the two ends of the line are different and may be damaged if the ends are reversed. Connections must be made tight.

OIL DRAIN EXTENSION.- An oil drain extension pipe and coupling are provided for cleanliness and convenience in draining oil from the oil base. Before filling the oil base with oil as directed in the following section, remove the drain plug from the oil base and install the pipe nipple and coupling in its place. Install the drain plug in the coupling. When draining the oil, remove only the plug.

BATTERY, AC REMOTE CONTROL PLANT.- The battery supplied with a plant which was shipped for ultimate use in the United States is ready for use. Check the battery for charge condition, for if the battery has been standing idle for a length of time, it may require a freshening charge to supply enough current for starting the plant. A battery supplied with a plant boxed for export shipment must be prepared for operation as directed on the tag attached to the battery, before it can be used. Connect one of the long battery cables between the positive (+) battery post and the BATTERY POSITIVE terminal on the control box. Connect the other battery cable between the negative (-) battery post and the BATTERY NEGATIVE terminal on the control box. A 12 volt battery is used. If two 6 volt batteries are used, the batteries must be connected in series by connecting a short cable between the positive post of one battery and the negative post of the other battery.

WIRING.- If necessary to install wiring, follow specifications of local and national electrical codes. If in doubt, consult a licensed electrician. Use sufficiently large, insulated wire between the plant and the load. Install a fused main switch in the load line near the plant.

GROUNDING, ALL PLANTS.- If grounding is called for in local codes, or if radio interference necessitates it provide a separate ground. Radio interference may result if the plant is grounded to a water pipe or to a ground used by a radio. Drive a 1/2" diameter pipe or rod into the ground as near to the plant as possible. Make certain that the pipe or rod penetrates moist earth. Fasten an approved ground clamp to the pipe and run a number 14 or larger wire from the clamp to either the BATTERY NEGATIVE terminal post or to the white (ground) load line wire.

REMOTE CONTROL SWITCH, AC PLANT.- One or more remote control switches may be connected to provide remote control of starting and stopping. Remote switches may be connected at any point within 250 feet of the plant, using #18 or 19 three wire cable. Connect switch terminal #1 to

the #1 terminal inside the control box, switch terminal #2 to box terminal #2, and switch terminal #3 to box terminal #3. See Fig. 2. The B+ terminal of the control box is used only with automatic or line transfer equipment, directions for which are included with the equipment.

CONNECTING THE LOAD WIRES, AC REMOTE PLANT.- Connect the load wires to the plant by connecting the ground (white) load wire to the lead marked M2 (or the white wire if not marked) which extends from the control box. Connect the black ("hot") load wire to the control box lead marked M1, or black wire if not marked. See Fig. 2. Be sure that connections are tight, are separately taped with electrical rubber tape, and then secured with friction tape. Leave the load line switch open until the plant has been started and checked. No damage to the generator will result from running the plant with no load connected.

CONTROL BOX CONNECTIONS, BATTERY CHARGING PLANT.- Install a fused, double pole, single throw switch between the battery and the battery terminals on the control box of the plant. Connect the negative battery post to the terminal post marked BAT. NEG. on the control box, through one side of the switch. Connect the positive battery post to the terminal post marked BAT. POS. in the same manner. See Fig. 2A. Install 50 amp. fuses in the switch between the battery and the plant. The electrical load line should be connected to the battery side of the plant disconnect switch, not to the plant side of the switch. Install a separate load line fused switch. Always open the switch between the battery and the plant when servicing the plant, but BE SURE THE SWITCH IS CLOSED WHENEVER THE PLANT IS STARTED AND OPERATED. Serious damage to the battery charging generator may result from operating the plant when not connected to the battery.

LOAD CONNECTION, MANUAL PLANTS - AC and DC.- Manual type plants are equipped with output receptacles. No preliminary connections are necessary.

CAUTION

DO NOT ATTEMPT TO START OR OPERATE THE PLANT UNTIL IT HAS BEEN PROPERLY PREPARED FOR OPERATION WITH OIL AND FUEL AS DIRECTED IN THIS SECTION.

LUBRICATION.- The oil capacity of the plant is 2 quarts unless the oil base is marked 3 Pts as shown in Fig. 3. Use a good quality detergent oil of the proper SAE number as indicated in the following table. Temperatures indicated are for conditions where the plant will be stopped long enough to cool to the surrounding temperature. Be sure the plant is setting level when filling with oil. Fill to the top of the threads in the oil fill hole.

TEMPERATURE	SAE NUMBER
Above 90° F. (32° C.)	50
30° F. to 90° F. (-1°C. to 32°C)	30
0° F. to 30° F. (-18°C. to -1°C)	10
Below 0° F. (-18° C.)	5W: or 10W plus 10% kerosene.

NOTE

For temperatures below 0° F. (-18° C) if SAE number 5W oil is not available, use SAE number 10 or 10W oil diluted with 10% kerosene. Use 4 ounces of kerosene to each quart of oil. Mix the oil and kerosene thoroughly just before pouring it into the engine. Fill the engine to the top of the threads of the oil fill hole.

If a change is made to the use of a detergent type oil after using non-detergent oil in the crankcase, allow only one third the normal operating hours before changing oil for the next two change periods. Change oil at the regular intervals thereafter, as recommended under PERIODIC SERVICE.

When using a detergent type oil, always use oil of the same brand when adding oil between oil changes. When mixed together, detergent oils of different manufacturers sometimes form chemical compounds that are harmful to internal engine parts.

Place a drop or two of oil on the governor arm ball joint and at the point where the governor linkage engages the carburetor throttle arm.

Two types of air cleaners are used. If the plant is equipped with the oil bath air cleaner, remove the bottom cup and fill to the indicated level with oil of the same SAE number as used in the crankcase. Be sure the clamps snap properly into place when replacing the cup. If the air cleaner is the "dry" type, remove the lock ring and screen. Remove the fibre element and dip in oil of the same SAE number as used in the crankcase. Allow to drain until dripping stops, then reassemble the air cleaner.

FUEL.- The tank mounted on the manual type plant has a capacity of 1 gallon. The separate tank supplied with stationary type plants has a 5 gallon capacity. Measures are U. S. Standards. Fill the tank nearly full with clean, fresh, automotive type gasoline of 68 to 74 octane rating. Do not use a highly leaded premium type gasoline, as its use will necessitate more frequent carbon removal and spark plug and valve service. Do not fill the tank entirely full of cold gasoline. Expansion of the fuel as the plant warms up may cause the gasoline to overflow and result in a fire. Observe the usual precautions when handling gasoline. NEVER FILL THE TANK WHEN THE PLANT IS RUNNING.

Open the fuel shut-off valve and inspect the fuel system for leaks.

If the preceding instructions have been followed, the plant should be ready for operation. Before starting the plant, however, carefully study the sections OPERATION and ABNORMAL OPERATING CONDITIONS immediately following.

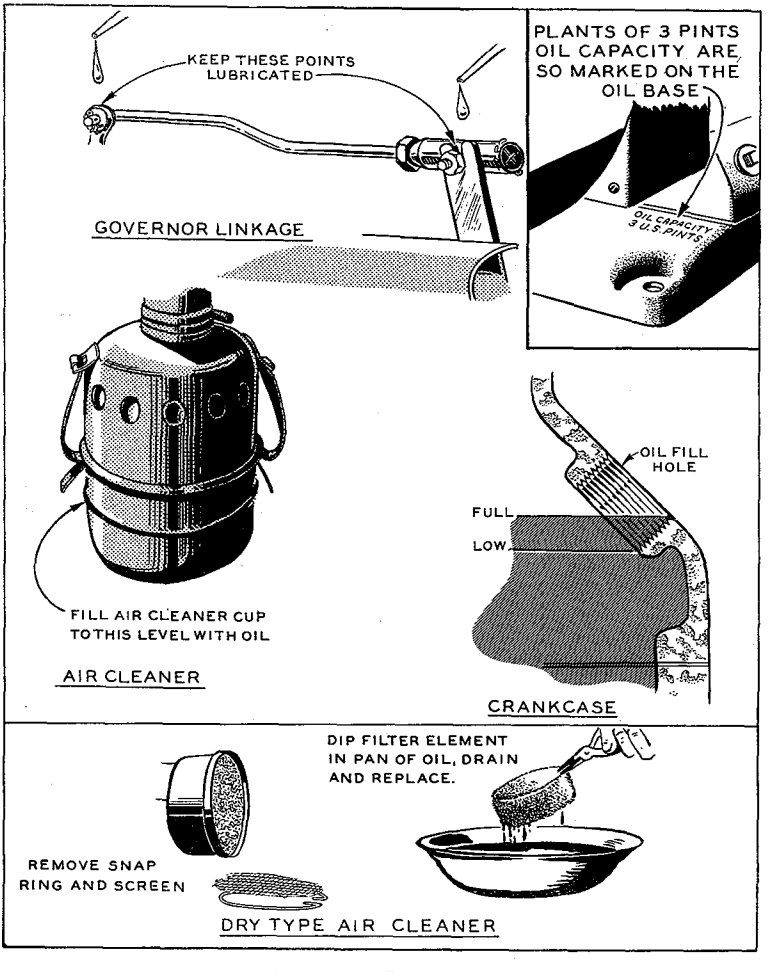


FIG.3-LUBRICATION

OPERATION

DIRECT CURRENT

BEFORE ATTEMPTING TO START THE PLANT, MAKE SURE THE PLANT HAS BEEN PROPERLY INSTALLED AND PREPARED FOR OPERATION AS DIRECTED IN THE PREVIOUS SECTIONS.

STARTING THE PLANT ELECTRICALLY - BATTERY CHARGING PLANT.- Be sure the switch between the plant and the battery is closed. Never operate the plant unless the battery is connected to the plant. The extent to which the carburetor will have to be choked for starting will depend upon temperature conditions. If the plant has been standing idle in cold weather, the carburetor choke may have to be completely closed. Some plants are choked by adjusting the small carburetor lever close to the air cleaner. Turn the lever crosswise to the carburetor body for full choking action. Turn the lever almost parallel with the carburetor body as the plant warms up. On plants which have the wire choke control, pull upward on the control for choking action. See Fig. 4. In hot weather, or if the plant has been stopped temporarily and is still warm when it is to be restarted, little or no choking should be required. Avoid overchoking. To start the plant, adjust the choke control as required and firmly press the START switch on the control box. The plant should start after a few revolutions. If it does not start after a few crankings of approximately 5 seconds each, check the fuel and ignition systems, correcting any trouble found. Release the switch as soon as the plant starts.

If the battery is in too low a state of charge to provide power for cranking, the plant may be started manually as described below.

STARTING THE PLANT MANUALLY.- These directions apply to both the battery charging plant and the direct service plant. No load need be connected to the direct service type plant, as no harm will result to the generator from operating the plant without load connected. Be sure the battery is connected to the battery charging type plant.

If starting a cold engine, adjust the choke for full choking action. See the directions for choking as given for the battery charging plant. Engage the knot of the starting rope in a notch of the flywheel and wind the rope in a clockwise direction to within 6 or 8 inches of the handle. Crank the engine once with a strong, fast pull the full length of the rope. Then adjust the choke as required by temperature conditions and again crank the engine. Do not jerk the rope. The plant should start on the second or third cranking. A warm plant should start without any preliminary choking.

WARM UP PERIOD, DIRECT SERVICE PLANT.- Best results will be obtained with the direct service plant if the plant is permitted to thoroughly warm up before applying a heavy electrical load. As the plant warms up, gradually adjust the carburetor choke control until the plant will carry the full load smoothly with the choke completely open. No harm to the generator will result from running the direct service type plant with no load connected. If the plant tends to "hunt" or alternately increase and decrease speed, the engine is still too cool and should be permitted to warm up a few more minutes before applying a heavy load. If immediate electrical service is required, a slightly richer choke adjustment will usually eliminate the hunt.

WARM UP PERIOD, BATTERY CHARGING PLANT.- Best results will be obtained if the charging rate is adjusted to a minimum until the plant has thoroughly warmed up.

BATTERY CHARGING RATE.- The battery charge rate is in proportion to the engine speed and is regulated by turning the knurled governor spring adjusting nut. Increasing the spring tension raises the charging rate, as shown on the ammeter. Decreasing the spring tension lowers the charging rate. Turn the knurled nut in the proper direction while watching the charge rate ammeter. Follow the recommendations of the battery manufacturer as to the correct rate of charge. Do not overcharge the battery, nor charge at an excessive rate.

WHEN TO OPERATE THE BATTERY CHARGING PLANT.- The battery charging plant delivers current to the battery. Electricity may be used while the plant is running, if desired. The amount of electrical load which may be connected while the plant is not running will of course depend upon the capacity and charge condition of the battery. The amount of load which may be connected while the plant is running will be equal to the plant capacity plus the battery output. Operate the plant whenever it becomes necessary to recharge the battery. To avoid possible damage to the generator, NEVER OPERATE THE PLANT WITHOUT HAVING THE BATTERY CONNECTED TO THE PLANT.

Most battery manufacturers recommend "cycling" the battery. This means a fully charged battery should be used without recharging until at least 85% discharged, then recharge fully. Repeat through complete cycles of charge and discharge for maximum life of the battery. Keeping a battery at a full state of charge at all times, without permitting it to cycle, may shorten its life by as much as 75%.

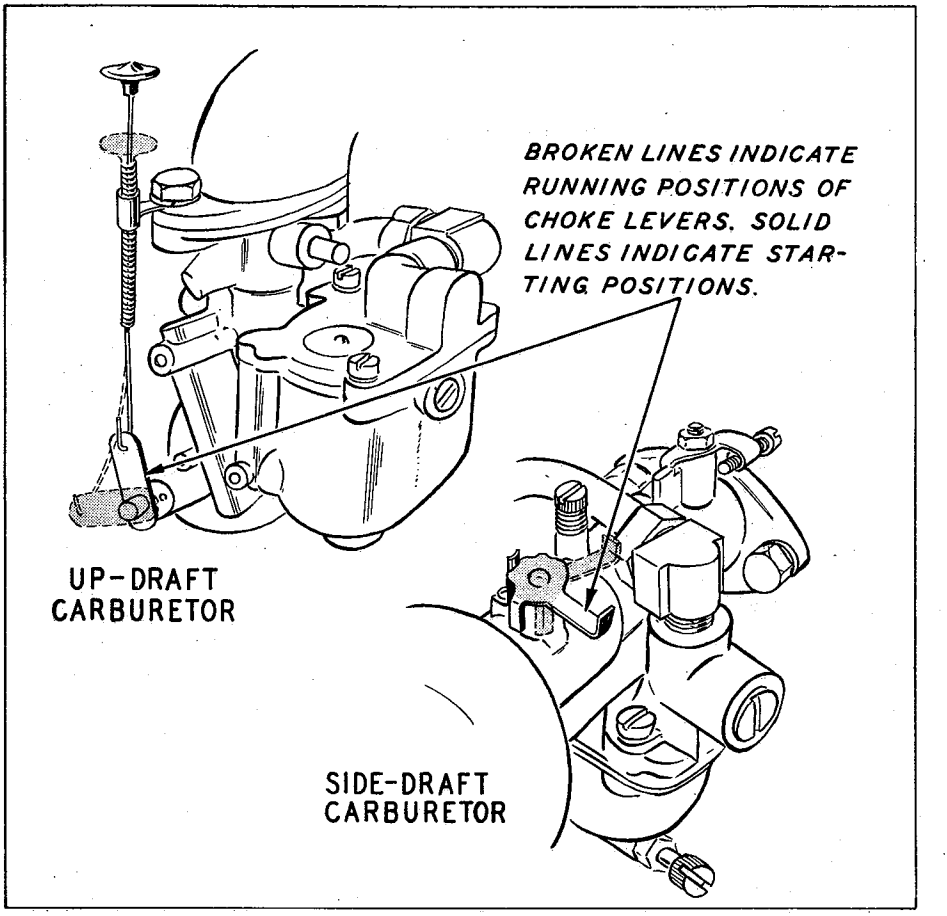
WHEN TO OPERATE THE DIRECT SERVICE PLANT.- The direct service type plant delivers current directly to the load and must be operated whenever electricity is desired. The plant may be operated with no load connected if electrical load demand is intermittant.

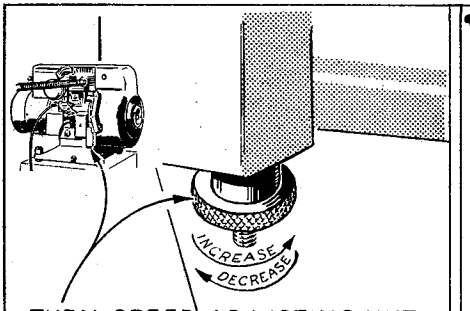
Connect the load to the direct service type plant by inserting the load plug directly into one of the receptacles at the side of the generator. Turn the plug slightly to the right to lock the plug, thus preventing accidental disconnection. Some tools or appliances have a third wire, for grounding purposes, which should be connected to the grounding stud on the outlet box.

CAUTION

> Continuous overloading of the generator will cause the generator temperature to rise to a dangerous point and may lead to serious damage to the windings. The generator will safely handle an overload temporarily, but for continuous operation keep the load within the rating of the plant as shown on the nameplate.

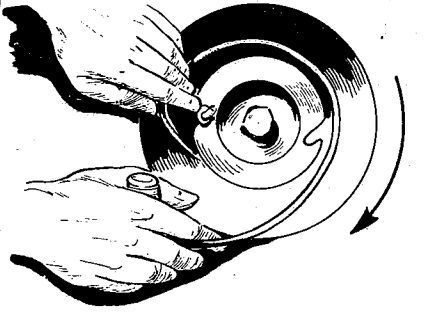
STOPPING THE PLANT.- To stop the plant, firmly press the STOP button on the blower housing until the plant comes to a complete stop. The plant will pick up speed and continue to run if the STOP button is released before the plant has come to a complete stop. In an emergency, if the STOP button fails to work, the plant may be stopped by closing the fuel shut-off valve.





TURN SPEED ADJUSTING NUT IN DIRECTION INDICATED TO INCREASE OR DECREASE THE BATTERY CHARGE RATE.

ENGINE SPEED REGULATION



WIND STARTING ROPE ON SHEAVE IN CLOCKWISE DIRECTION.

MANUAL STARTING

FIG.4-OPERATING ADJUSTMENTS

ALTERNATING CURRENT

STARTING THE REMOTE CONTROL PLANT ELECTRICALLY.- If the plant has a fuel pump, before starting a new plant the first time, or one which has run out of fuel, it will be necessary to pump gasoline into the carburetor. Crank the engine either with the manual starting rope, or by throwing the START-STOP switch to the START position. It usually takes approximately 30 revolutions of the crankshaft to properly fill the carburetor with gasoline. If fuel does not reach the carburetor, inspect carefully for an air leak between the fuel pump inlet and the fuel tank. Be sure the fuel tank shut-off valve is open.

To start the plant, push the START-STOP toggle switch to the START position. The plant should start after a few revolutions. The carburetor is automatically choked. If the plant does not start after a few crankings of approximately 5 seconds each, carefully check the fuel and ignition systems. Release the start switch as soon as the plant starts, making sure that the switch returns to the center position. If one or more remote control switches have been installed, check the installation by trying the START and STOP positions of each remote control switch.

STARTING THE REMOTE CONTROL PLANT MANUALLY.- To start the plant manually, first be sure the carburetor is properly filled with gasoline as described above under STARTING THE REMOTE CONTROL PLANT ELECTRICALLY. Do not have a heavy electrical load connected to the generator. Engage the knot of the starting rope in a notch of the flywheel rope sheave and wind the rope in a clockwise direction to within a few inches of the handle. See the illustration, Fig. 4. Crank the engine with a strong, fast pull the full length of the rope. Do not jerk the rope. Repeat the cranking as necessary. If the plant does not start readily, check the fuel and ignition systems, correcting any trouble found.

STARTING THE MANUAL TYPE PLANT.- If the plant has a fuel pump, see that the carburetor is properly filled as instructed for the remote control type plant. Adjust the manual carburetor choke (See Fig. 4) as necessary for the temperature conditions. If the plant has been standing idle in cold weather, the carburetor choke may have to be completely closed for the first cranking. In hot weather, or if the plant is still warm from recent operation, little or no choking should be required. Avoid overchoking. To start the plant, adjust the choke, and wind the starting rope on the flywheel rope sheave in a clockwise direction to within a few inches of the rope handle. Crank the engine once with a strong, fast pull the full length of the rope. If the plant fails to start at the first cranking, change the choke setting and repeat the cranking. As the plant starts, adjust the choke position to the point where the plant runs smoothly. As the plant warms up, gradually open the choke to the running position. See Fig. 4.

OPERATION

CONNECTING THE LOAD.- Best results are obtained if the plant is allowed to thoroughly warm up before connecting a heavy load. Connect the load to the remote control type plant by throwing the main line switch to the ON position. If no main line switch was installed, throw the switch for the individual load to the ON position.

Connect the load to the manual type plant by inserting the load plug directly into the receptacle at the side of the generator. Turn the plug slightly to the right to lock the plug, thus preventing accidental disconnection. Some tools or appliances have a third wire for grounding purposes which should be connected to the grounding stud on the outlet box. Throw the switch for the individual load to the ON position.

CAUTION

> Continuous overloading of the generator will cause the generator temperature to rise to a dangerous point and may lead to serious damage to the windings. The generator will safely handle an overload temporarily, but for continuous operation keep the load within the rating of the plant as shown on the nameplate.

BATTERY CHARGE RATE.- A toggle switch on the control box of the remote control type plant provides for control of the battery charging rate. The LO position of the switch provides a charge rate of approximately 2 amperes, which will keep the battery in a satisfactory state of charge under normal operating conditions. If frequent starts and short operating periods lead to the battery becoming discharged, throw the toggle switch to the HI position temporarily, returning to the LO position as the battery nears the fully charged condition. Check the charge condition of the battery frequently with a hydrometer.

STOPPING THE PLANT.- To stop the manual type engine, press the STOP button on the blower housing until the engine has come to a complete stop. To stop the remote control type plant, press the remote STOP button or throw the control box switch to the STOP position. The high tension magneto provides a firing spark even when the engine is turning at very few r.p.m. Release of the STOP button too soon will cause the plant to again pick up speed and continue to run. In an emergency, if the STOP button fails to work, the plant may be stopped by closing the fuel shut-off valve.

ABNORMAL OPERATING CONDITIONS

LOW TEMPERATURES

LUBRICATION.- Directions for the proper grade of oil to use in cold weather are given in the PREPARATION section. When changing oil in cold weather, be sure to drain the oil only when the oil is warm from running.

If an unexpected drop in the temperature causes oil in the crankcase to become too thick to run freely from the oil drain, do not attempt to start the plant. If the plant is started when the oil is congealed, serious damage may result from improper lubrication. Remove the plant to a warm location, or apply heat externally until the oil is sufficiently warm.

AIR CLEANER.- Some plants have an oil bath type air cleaner. If congealed SAE number 10W or 5W oil or frost formation within the air cleaner restricts the flow of air, remove and clean the air cleaner. Reassemble the air cleaner and use it without oil until temperature conditions permit the use of oil in the normal manner.

FUEL.- Fresh winter grade, automotive type gasoline is an aid to starting in cold weather. Premium gasoline containing a high percentage of lead should not be used. Keep gasoline supplies free of moisture condensation. Do not fill the tank completely full in cold weather as expansion may cause it to overflow.

IGNITION.- Cold weather starting is aided by a properly serviced ignition system. See that the magneto breaker points are clean and properly adjusted. Clean and adjust the spark plug.

BATTERY.- If the plant uses starting batteries, keep the batteries in a well charged condition. A discharged battery may freeze at 20° F. A fully charged battery will not freeze at -90° F.

COOLING.- The flow of air to the engine may be partiallly obstructed to keep the engine at operating temperature, if desired. However, use extreme care to avoid overheating.

HIGH TEMPERATURES

LUBRICATION.- In temperatures above 90° (32° C) use SAE number 50 oil. Keep the oil level close to the full level (See Fig. 3), and change the oil at least every 100 operating hours.

COOLING.- The engine and generator of this plant depend upon a constant supply of fresh air for proper cooling. See that nothing obstructs the circulation of air to and around the plant. Keep cooling fins clean and unobstructed. Make sure that the blower housing and cylinder air housings are properly in place and are undamaged. Keep the ignition timing properly adjusted.

DUST AND DIRT

Keep the engine as clean as practicable. Service the air cleaner as frequently as conditions require. Keep oil and gasoline supplies in air tight containers. Do not allow cooling fins of cylinders or cylinder heads to become dirty or obstructed. Keep the generator commutator, brushes and brush guides clean.

PERIODIC SERVICE

Follow a definite schedule of inspection and servicing to assure the best performance and long life of the plant. Service periods outlined below are for average service and normal operating conditions. Under unusual service or abnormal operating conditions, service the plant more frequently. Keep a record of the hours the plant is operated each day to assure servicing at the proper time.

DAILY SERVICE

If the plant is operated more than 8 hours daily, perform the following services each 8 hours of operation.

FUEL .- Check the fuel supply often enough to avoid running out of fuel. NEVER FILL THE FUEL TANK WHILE THE PLANT IS RUNNING. Use clean, fresh, regular automotive type gasoline of 68 to 74 octane rating. Use of a highly leaded premium grade of gasoline is not recommended.

CRANKCASE.- Remove the oil fill plug and check the crankcase oil level. If the oil level is below the bottom threads of the fill hole, add oil as necessary to bring the level to the top of the threads. Replace the plug securely.

AIR CLEANER, OIL BATH TYPE.- Remove the air cleaner bottom cup and inspect the oil level inside the cup. Add sufficient oil to bring the oil level to the proper point.

CLEANING.- A clean plant will give more satisfactory service. Wipe off dirt and any spilled oil.

WEEKLY SERVICE

If the plant is operated more than 50 hours weekly, perform the following services each 50 hours of operation.

CRANKCASE.- If using diluted oil, or highly leaded gasoline, change the crankcase oil each 50 hours of operation. Under normal conditions and when using oil which is not diluted, change the crankcase oil each 100 hours of operation. Do not drain the oil when the plant has been standing idle. Run the plant until the oil is thoroughly warmed up, then stop the plant and drain the oil.

AIR CLEANER, OIL BATH TYPE .- Remove the air cleaner bottom cup and clean out the old oil and sediment. Refill the cup to the proper level with fresh oil and replace. Use oil of the same SAE number as used in the crankcase, except as noted under ABNORMAL OPERATING CONDITIONS. Under dusty conditions, service the air cleaner more frequently.

AIR CLEANER, DRY TYPE.- Remove the lock ring and screen. Remove the fibre element and wash thoroughly in a solvent. Dry thoroughly and dip in oil of the same SAE number as used in the crankcase. Allow to drain until dripping stops, then reassemble.

PERIODIC SERVICE

GOVERNOR LINKAGE.- Put a drop or two of lubricating oil on the governor arm ball joint and at the point where the link engages the carburetor throttle arm.

SPARK PLUG.- Clean the spark plug and reset the gap to between .024" and .026". Test the plug under compression on a plug testing machine, if one is available.

BATTERY.- If the plant uses a starting battery, keep the connections tight and clean. Keep the electrolyte at the proper level above the separators by adding clean water. Distilled water is recommended for use in batteries. If distilled water is not obtainable, use clean soft water such as filtered rain water. Do not use water which contains alkali or minerals. Use the hydrometer to check the charge condition before adding water. In freezing weather, add water only before running the plant, to assure mixing the water with the electrolyte.

MONTHLY SERVICE

If the plant is operated more than 200 hours monthly, perform the following services each 200 hours of operation.

FUEL SYSTEM.- Drain the fuel tank and remove the shut-off valve and filter assembly. Carefully clean the filter screen. Tighten connections well when reassembling. Drain the carburetor of any sediment which may have accumulated.

MAGNETO BREAKER POINTS.- Remove the blower housing and the blower-flywheel. Inspect the magneto breaker points. Contact points which are not badly burned or pitted may be dressed smooth, using a fine abrasive stone or hone. If the points are pitted or burned deeply, replace them with new points. Excessive burning of the contact points is usually an indication of a defective condenser, which should be replaced with a new one. Adjust the gap between the points to between .018" and .022". Place a light coating of grease on the crankshaft cam which operates the magneto breaker arm.

EXHAUST SYSTEM.- Inspect all exhaust line connections carefully. Make any necessary repairs or replacements.

CARBON REMOVAL.- Regular removal of carbon deposits from the combustion chamber helps to keep engine efficiency high. The frequency with which it is advisable to remove carbon will vary considerably with the type of fuel used, the type of oil used, and operating conditions. Use of highly leaded gasoline necessitates frequent removal of carbon and lead deposits from the cylinder head, top of piston and valves, and top surface of the cylinder block.

BREATHER HOLE.- Each time the cylinder head is removed, see that the crankcase breather hole (see Fig. 10) between the intake port and the valve compartment, is not obstructed. A clogged breather hole may cause oil leaks or excessive oil consumption. If crankcase pressure builds up too high, the fuel pump may develop too much pressure, causing excessive fuel consumption.

PERIODIC SERVICE

Clean the breather valve monthly. Beginning with "Spec M" models the crankcase breather system was redesigned. The drilled hole from the intake port to the valve compartment was eliminated.

The nylon ball, contained in the breather valve, helps maintain a partial vacuum which is created in the crankcase while running. Remove the hose which carries expelled air from the breather valve at the valve compartment cover, to the air cleaner. Occasionally the valve will lift out and remain inside the hose. Wash the valve assembly in kerosene or other suitable solvent. Then dry and replace. The valve must work freely and must prevent expelled air from re-entering the crankcase. The hose must not be restricted. See Fig. 10. Reinstall parts removed.

ANTI-FLICKER BREAKER POINTS.- Keep the gap between the anti-flicker breaker points adjusted to between .023" and .025". Follow the same principles of care as given for the magneto breaker points.

GENERATOR. - Check the condition of the commutator, AC collector rings, and brushes. Clean the commutator (and AC collector rings) with a dry, lint free cloth. If heavily coated or slightly rough, sand smooth with #00 sandpaper. Do not use emery or carborundum cloth or paper. Replace rectangular shaped brushes when worn to 5/8" in length. Round brushes used on the collector rings of the 300 or 400 watt AC generator should be replaced when worn to 1/4" in length. See that all connections are tight. Remove carbon dust from the brush rig and end bell.

CONTROL BOX. - Keep the control box free of dust and dirt. See that all connections are clean and tight. Replace with a new one any part which does not function properly.

GENERAL INSPECTION. - Thoroughly inspect the entire plant for loose connections, loose screws or nuts, oil leaks, etc. Make any necessary repairs.

SEMI-YEARLY SERVICE

Service the generator ball bearing at intervals determined by the type of grease used.

Some generators do not have a ball bearing. If the generator has an end bell as shown below, pry out the plug. Other bearing covers are held in place with two screws.

The factory uses, and recommends lithium base type bearing grease. This bearing grease is superior because it does not run, and will not become hard or caked when used at temperatures ranging from minus 90°F. to 125°F. With lithium base grease, service the generator ball bearing each 5000 operating hours or each 2 years. Only a small quantity of this grease need be used. With a clean finger, remove as much as possible of the old grease. Force fresh grease into a 1/4 section of the bearing. DO NOT fill the entire bearing. Do not put a reserve of grease in the bearing recess nor in the bearing cover. IF dirt has gotten into the bearing, remove the bearing and clean it in a good solvent. Dry the bearing thoroughly and reinstall it.

If ordinary good ball bearing grease is used, service the generator ball bearing each 2000 operating hours or each 6 months. With a clean finger, remove all the old lubricant and work approximately one tablespoonful of new bearing lubricant into the bearing. Again clean out the bearing, then refill about 1/2 full, packing the lubricant well into the lower half of the bearing.

Take extreme care to avoid getting any dirt into the bearing. Replace the large plug securely.

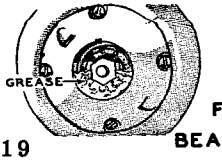


FIG. 5-ARMATURE BEARING LUBRICATION

ADJUSTMENTS

GOVERNOR.- The governor controls the speed of the engine. Engine speed determines the output voltage of the generator. By increasing the engine speed, generator voltage is increased, and by decreasing the engine speed, generator voltage is decreased. An accurate voltmeter will prove helpful in adjusting the governor.

The governor arm is fastened to a shaft which extends from the gear cover, and is connected by a ball joint and link to the carburetor throttle arm. If the carburetor has been removed, or the governor disassembled it may be necessary to readjust the governor.

A binding in the bearings of the shaft which extends from the gear cover, in the ball joint, or in the carburetor throttle assembly will cause slow governor action or poor voltage regulation. Looseness or excessive wear in the governor mechanism will cause erratic governor action or alternate increase and decrease in speed (hunting). A lean carburetor adjustment may also cause hunting. Springs of all kinds have a tendency to lose their calibrated tension through fatigue after long usage. If all governor and carburetor adjustments are properly made, and the governor action is still erratic, replacing the spring with a new one and resetting the adjustments will usually correct the trouble.

When the plant is stopped, tension of the governor spring should hold the carburetor throttle arm at the wide open position, pushed toward the generator end of the plant. The carburetor throttle open stop should just touch the stop projection on the carburetor body, or clear it by no more than 1/16". See Fig. 8. This setting can be obtained by increasing or decreasing the length of the connecting linkage as necessary by turning the ball joint on the threads of the link. Be sure to retighten the ball joint to the governor arm. This operation synchronizes governor action with the carburetor throttle action.

ADJUSTING THE GOVERNOR - 115 VOLT A.C. PLANT.- Connect the voltmeter across the output of the generator. With no electrical load connected, start the plant and adjust the speed adjusting nut (Fig. 6) to give a voltmeter reading of approximately 126 volts for a 115 volt plant. Apply a full electrical load and again observe the voltage reading, which should be approximately 110 volts. For 230 volt plants, these voltages will be approximately doubled. If the voltage spread between no load and full load conditions is too great, turn the sensitivity adjusting screw to increase the sensitivity slightly. This is done by decreasing the distance between the arm end of the governor spring and the center of the governor arm shaft. Test the governor action at various load conditions. If voltage regulation is good, but there is a tendency toward hunting at times, decrease the sensitivity adjustment slightly. Any change in the sensitivity adjustment will require a speed readjustment.

If a tachometer is used for adjusting the governor, engine speed for a 60 cycle plant should be approximately 1800 r.p.m. with a spread of approximately 100 r.p.m. between no load and full load. Speed for a 50 cycle plant should be approximately 1500 r.p.m., with the same spread.

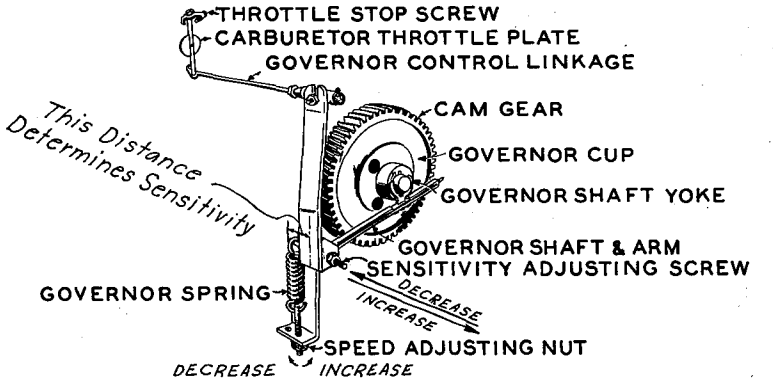


FIG. 6 - GOVERNOR ADJUSTMENT

ADJUSTING THE GOVERNOR - BATTERY CHARGING PLANT.- To adjust the governor on the battery charging generator, turn the knurled speed adjusting nut (spring tension nut) to give the desired charging rate. See Fig. 6. The rate of charge is shown on the control box ammeter. The ability of the governor to keep the charge rate steady at the desired rate depends upon the distance between the center of the governor arm shaft and the governor arm end of the spring. If the governor tends to "hunt" or alternately increase and decrease speed, turn the sensitivity adjusting stud to move the end of the spring slightly farther from the center of the governor shaft. Any change in the sensitivity adjustment will require a compensating change in the speed (spring tension) adjustment.

ADJUSTING THE GOVERNOR - 115 VOLT D.C. PLANT.- To adjust the governor action on a 115 volt D.C. plant, use an accurate voltmeter across the output leads of the generator, in parallel connection with the load. With no load on the plant, adjust the speed adjusting nut (See Fig. 6) to approximately 118 volts for a 115 volt plant. Apply a full load to the plant and again observe the voltmeter reading, which should be approximately 113 volts. For 230 volt plants, these voltages will be approximately doubled. If the voltage drop between no load and full load is more than 5 volts, increase the governor sensitivity by turning the sensitivity adjusting stud to move the governor arm end of the spring closer to the center of the governor arm shaft. If the plant tends to hunt (alternately increase and decrease speed), or if the voltage rises when a load is applied to the plant, decrease the sensitivity by turning the sensitivity adjusting stud to move the governor arm end of the spring slightly farther from the center of the governor arm shaft. Any change in the sensitivity adjustment will require a compensating change in the speed (spring tension) adjustment. If a constant load is applied to the plant, the voltage may be adjusted to 115 volts with the load connected.

ANTI-FLICKER MECHANISM.- Breaker points and a field resistor are used on all 115 or 230 volt plants, to compensate for a surge in the voltage during the power stroke of the engine. The breaker points are located on the left side of the crankcase just behind the gear cover, protected by a sheet metal cover. The resistor on some models is mounted in a recess at the bottom left side of the adapter casting joining the generator to the engine. The resistor on other models is mounted on the gen-

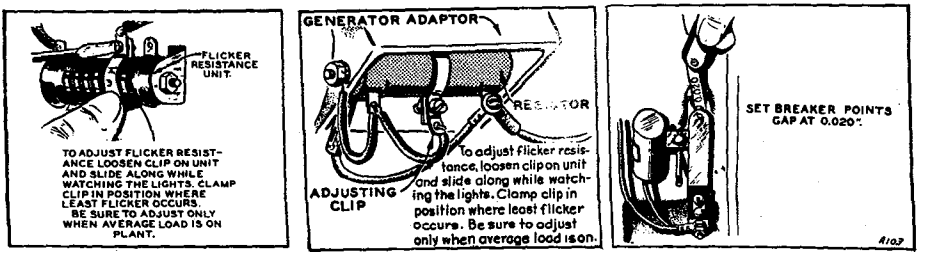


FIG.7-ANTI-FLICKER

erator brush rig. See Fig. 7. See that the breaker points are not burned or pitted. Burned or pitted points are usually an indication of a defective condenser. The points gap at full separation should be .020". If points and condenser are in good condition and light flicker is objectionable, adjust the resistor. Loosen the sliding clip on the resistor and, while watching a small light connected with an average plant load, slide the clip along the resistor to the point where the least flicker is noticeable. Tighten the clip at this position.

Alternating current generators which have the anti-flicker resistor mounted in the generator adapter, and which were built after 1952, were equipped with a fixed (non-adjustable) resistor instead of an adjustable resistor. The fixed resistor is longer lifed and will be supplied when an adjustable resistor is requested for the earlier built plants, provided the plant model is furnished. Breaker point gap setting is more critical with a fixed resistor.

CARBURETOR.- Refer to MAINTENANCE AND REPAIR - CARBURETOR if it becomes neccessary to remove the carburetor for repairs. A small piece of foreign matter lodging in a jet may cause hard starting and poor operation. Dirty gasoline may cause the jets to wear larger, resulting in excessive gasoline consumption.

The updraft type carburetor, as used on earlier built plants, has a single adjusting needle at the bottom which controls the richness of the fuel mixture.

The side draft type carburetor has two adjusting needles. The "idle" needle is the smaller one. The "main" needle is the larger and is located on top nearer the fuel inlet except on some early side draft carburetors on which it is located at the bottom.

To adjust the carburetor, turn the adjusting needles in gently to their seats. Do not force them in, as they may be damaged by seating too tightly. Back the needles out one full turn, then start the plant. Allow the plant to thoroughly warm up, then connect a full load to the plant. Slowly turn the bottom adjusting needle in (clockwise) until the plant begins to lose speed, or the voltage drops. Turn the needle out (counterclockwise) to the point where the plant will carry the full load. Check the operation at various loads. If there is a tendency to hunt (alternately increase and decrease speed) at any load, turn the adjusting needle out until the hunt is corrected, but do not turn the adjusting needle out more than $\frac{1}{2}$ turn beyond the point where maximum generator output is obtained. If the carburetor is fitted with the "idle" adjusting needle, remove all electrical load. Slowly turn the idle adjusting needle out (counterclockwise) until the plant loses speed from lack of fuel. Then turn the needle slowly in until the plant runs smoothly.

The throttle idle stop screw should be adjusted to clear the throttle stop projection on the carburetor body by 1/32" when the plant is operating at no load condition.

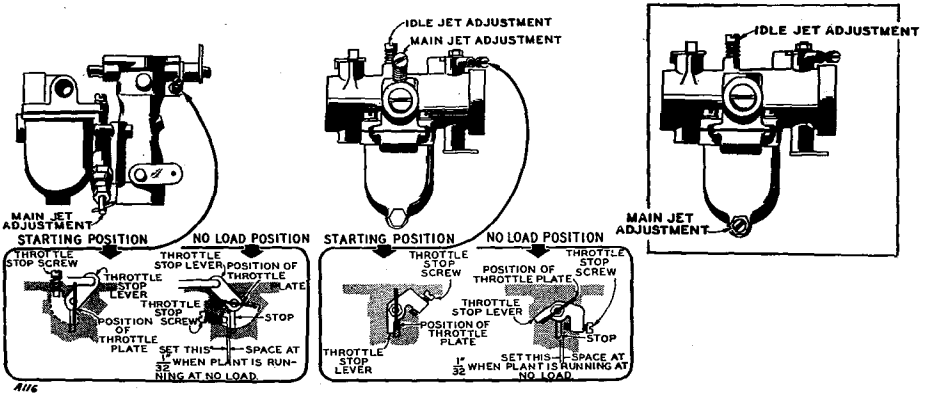


FIG.8-CARBURETOR ADJUSTMENT

AUTOMATIC CHOKE.- The A.C. remote control type plant is equipped with a thermal action automatic choke. A thermostatic coil engages the choke shaft and is set at the factory to give the correct choking action for average temperature conditions. When the plant starts, current from the generator is supplied to a small heating element in the choke cover. This heating element causes the thermal coil to turn the choke shaft, gradually opening the choke as the plant warms up. When the plant is stopped, the thermal coil cools off, causing the choke shaft to return to the correct position for the next start. At a temperature of 70° F. the choke should be approximately 1/16" from the fully closed position. Extreme temperatures may require a slight readjustment of the choke setting. Loosen the screw which locks the choke assembly on the choke shaft boss. For less choking action, turn the choke assembly slightly in a counterclockwise direction, looking at the thermal unit end. For more choking action, turn the choke assembly slightly in a clockwise direction. If the choke does not operate properly, check to see that the heating element heats properly. There must be no binding of the choke shaft or thermal coil. Be sure to retighten the lock screw after any adjustment. A manual operating knob fastened on the opposite end of the choke shaft may be used to operate the choke in the event the electric element burns out or the choke does not operate for any reason. Turn the knob clockwise (direction of arrow on knob) to open the choke, or counterclockwise to close the choke.

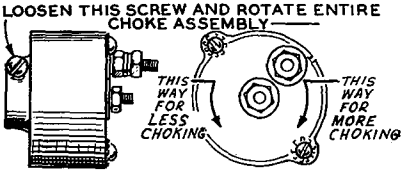


FIG. 8A - ELECTRIC CHOKE ADJUSTMENT

ENGINE

GENERAL.- Refer to the Service Diagnosis section for assistance in locating and correcting troubles which may occur. If a major repair or overhaul becomes necessary, the engine should be carefully checked and necessary repairs made by a competent mechanic. Major generator repairs should be made by a competent electrician. Maintain factory limits and clearances as given in the Table of Clearances. Clearances as shown throughout the text are for basic cast iron construction. Certain plants with aluminum cylinder blocks require different clearances for some parts and these clearances are shown only in the Table of Clearances.

CARBURETOR.- Carburetor maintenance should consist of regular cleaning. Some types of gasoline have a tendency toward formation of gum deposits inside the carburetor. This gum formation can usually be removed by soaking in alcohol or acetone. The updraft type carburetor has 2 removable jets. The main jet can be reached after removing the main adjusting needle. The compensator (idle) jet is accessible inside the bowl after first removing the bowl cover. When replacing these jets, be sure the small fibre gasket washer is replaced under the head of each jet. The side draft carburetor has one removable jet at the bottom. Remove the hex plug to reach the jet. Do not damage the well tube, nor enlarge the holes in it.

On both type carburetors, see that the float is not damaged, Be sure the throttle assembly works freely. When reinstalling adjusting needles do not force them in to their seats. Adjust to one turn open to permit starting the plant.

MAGNETO.- The high tension madneto supplies ignition current to the spark plug. Proper timing of the spark is accomplished by a breaker mechanism actuated by a cam on the crankshaft. To test the spark, disconnect the cable from the spark plug and support it so that the end of the wire is 3/16 inch from a clean metal part of the engine, such as the spark plug base. Crank the engine with the hand rope, observing the spark, which should jump the 3/16 inch gap with ease. If there is no spark, or a spark that is weak or yellowish in color, make repairs as necessary.

Remove the blower housing and loosen the flywheel center bolt a few turns. While pulling or prying outward on the flywheel, strike the flywheel bolt a sharp endwise blow to loosen the flywheel. Remove the flywheel bolt and carefully pull the flywheel off the crankshaft. Examine the magneto breaker contact points. Contact points which are not badly burned or pitted may sometimes be dressed smooth with a thin flexible abrasive stone or removed and dressed on any fine stone or hone. Badly burned or pitted points should be replaced with new ones. Adjust the gap between points to between .018" and .022" at full separation. A defective condenser must be replaced with a new one of proper capacity. A flywheel magnet which has lost its magnetism can be remagentized. If the magneto backplate has been loosened or removed, see that the gap between the coil poleshoes and the flywheel is .008" to .012". Too wide an air gap would produce a weak spark. The magneto coil with a square shaped inside hole replaces the round hole design.

TIMING THE IGNITION.- Proper timing of the spark is important, and is timed to occur 19° before top center (TC) position of piston travel. If available, use a series type test lamp for accuracy.

See that the point gap is properly adjusted to .018" to .022". Install the flywheel loosely, with its key in place, and turn the flywheel in a clockwise direction to the position where the 19° degree mark on the edge of the flywheel is in alignment with the horizontal mark on the gear cover. The points should just separate at this point. If they do not, remove the flywheel and loosen the magneto backplate mounting screws slightly. If the points do not separate soon enough, shift the entire backplate assembly slightly in a counterclockwise direction. If the points separate too soon, shift the backplate assembly clockwise. Retighten the backplate mounting screws and recheck the work for accuracy. When replacing the flywheel, always make sure the key is properly in place on the crankshaft.

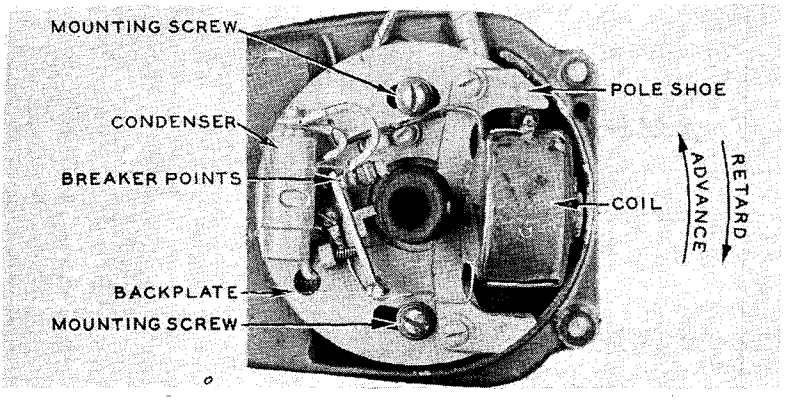


FIG.9- MAGNETO BACKPLATE ASSEMBLY

VALVE SERVICE.- Properly seating valves are essential to good engine performance. The aluminum cylinder head is removable for valve servicing. Do not use a pry to loosen the cylinder head, rap sharply on the edge with a soft faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder head, piston top, valves, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve.

Worn valve stem guides may be replaced from inside the valve chamber. The intake valve guide must have a gasket under the shoulder. This gasket must contact tightly against the upper valve chamber surface. Valve locks are the split, tapered type, the smaller diameter of which must face toward the valve head. Tappets are also replaceable from the valve chamber, after first removing the valve assemblies.

Reface valve seats and faces to a good seat. Follow standard automotive procedure in grinding the valves, grinding only enough to assure proper seating. Be sure to grind and reassemble each valve to its proper seat. Remove all traces of grinding compound before final reassembly. Lightly oil the valve assemblies when reassembling. Adjust the tappet clearances as directed below.

TAPPET ADJUSTMENT.- The tappet clearance may be easily checked after first removing the valve compartment cover and the blower housing. Crank the engine over by hand until the intake valve (the one nearest the carburetor) opens and closes. Continue turning the flywheel slowly until the TC mark on the flywheel is in alignment with the horizontal mark on the gear cover. The correct tappet clearance is .014" for both the intake and exhaust valves. Tappets are fitted with self locking adjusting screws. Use a 7/16" wrench for the screw, and a 9/16 wrench for the tappet when making any adjustment.

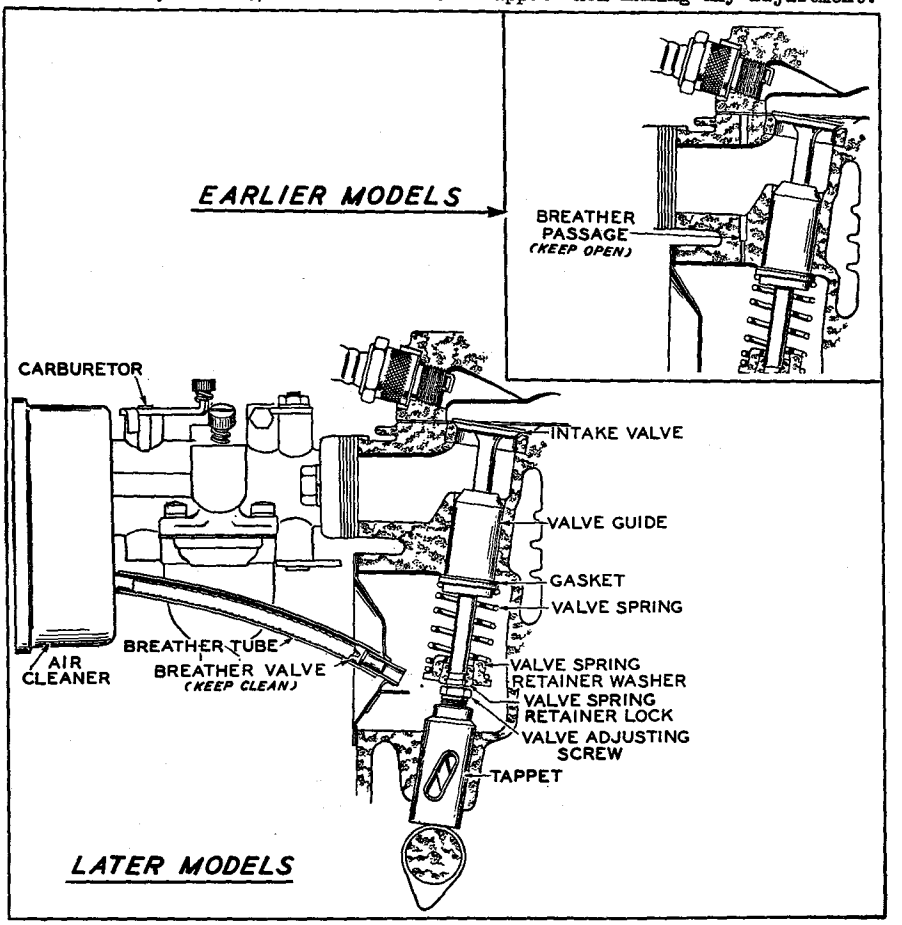


FIG.10-VALVE ASSEMBLY

GEAR COVER.- When removing the gear cover, it is not necessary to remove the magneto assembly from the cover. Just disconnect the spark plug lead at the spark plug, and the stop wire.

When installing the gear cover, make sure that the pin on the governor cup engages the slot of the governor arm yoke. Turn the governor cup so that the pin is in a position where it corresponds to the 6 o'clock position on the face of a clock. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Check to see if the pin and yoke are properly engaged by pulling outward on the arm and shaft. If the shaft can be pulled outward more than 1/2 inch the pin is not in the yoke slot and the installation procedure must be repeated. Be careful not to damage the gear cover oil seal.

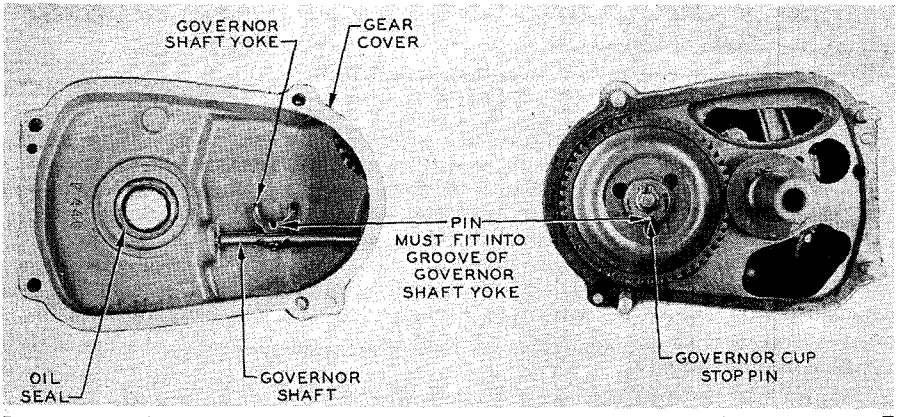


FIG. 11 - REPLACING THE GEAR COVER

GOVERNOR CUP.- The governor cup may be removed from the cam gear and shaft after first removing the small lock ring from the camshaft center pin. Catch the governor flyballs in the hand as the cup assembly is removed.

If a new governor cup is being installed, the distance from the small lock ring on the center pin to the face of the governor cup sleeve must be exactly 7/32" when the cup is pressed back against the flyballs as far as possible. If the distance is too small, carefully dress the face of the sleeve as required, being sure to remove any burr from the inside of the sleeve. If the distance is more than 7/32", carefully press the pin in the required amount. Be very careful not to damage the pin, as it is not practicable to replace it in the field. Replacement of governor flyballs is easier if the plant is tipped backward with the timing gears upward. Be sure that all 10 flyballs are replaced.

TIMING GEARS.- If replacement of either the crankshaft gear or the camshaft gear becomes necessary, install both gears new, never one only. To remove the crankshaft gear, insert two long #10-32 steel screws into the tapped gear holes and tighten the screws alternately. As the screws are tightened, the screw ends will seat against the crankshaft shoulder and force the gear off the end of the crankshaft.

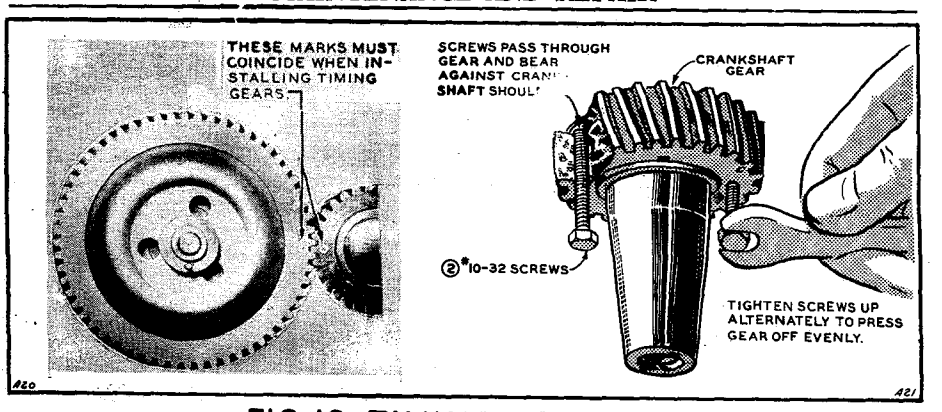


FIG. 12-TIMING GEARS

The camshaft gear is pressed on and keyed to the camshaft. The camshaft and gear must be removed as an assembly, after first removing the crankshaft gear lock ring and washer. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. On direct service plants, remove the anti-flicker breaker plunger. Remove the tappets. After removing the governor cup assembly from the gear, the camshaft may be pressed out of the gear by use of a hollow tool or pipe which will fit over the camshaft center pin. Do not press on the center pin, or damage it in any way. The governor ball spacer is a press fit to the camshaft gear.

If either the crankshaft gear or camshaft gear becomes damaged or worn, replace both gears with new ones, never one only. When pressing a camshaft gear onto the camshaft, be sure the gear is started straight and that the key is properly in place. Install the governor cup assembly before installing the camshaft and gear in the engine.

Note that each timing gear is stamped with an "O" mark near the edge. The gear teeth must mesh so that these marks exactly coincide when the gears are installed in the engine. Be sure, when installing the camshaft gear and shaft assembly, that the thrust washer is properly in place behind the camshaft gear. Replace the retaining washer and lock ring to the crankshaft.

CYLINDER.- The cylinder wears very little in normal service. If, through improper lubrication or accident, the cylinder wall should become scored or worn badly, the cylinder may be rebored and honed to accomodate a new piston and rings of one of the available oversizes. Pistons are obtainable in .005", .010", .020", and .030" oversizes. Piston rings are available in .010" and .020" and .030" oversizes. Use standard size rings on a .005" oversize piston. If the cylinder is not being reconditioned, but new piston rings are being installed, remove any ridge which may have become formed at the top of piston ring travel in the cylinder bore. Some engines were fitted at the factory with a .005" oversize piston and are so indicated by a letter "E" following the engine serial number stamped on the top of the crankcase near the cylinder, and on the plant nameplate.

PISTON AND RINGS.- The piston and connecting rod assembly are removed through the top of the cylinder. The piston is fitted with two compression rings and one oil control ring. The piston ring grooves should be cleaned of any carbon deposits, and the oil return holes in the lower groove must be open. Before installing new rings on the piston, check the ring gap by placing each ring squarely in the cylinder at a position corresponding to the bottom of its travel. The gap between the ends of the ring should be from .009" to .022". Rings which are slightly oversize may be filed as necessary to obtain the correct gap, but do not use rings which require too much filing. Standard size rings may be used on a .005" oversize piston. .010", .020" and .030" oversize rings are to be used on .010", .020", and .030" oversize pistons, respectively. Rings of the tapered type are usually marked "TOP" on one side, or identified in some other manner, and the ring must be installed with this mark toward the closed end of the piston. Space each ring gap one third of the way around the piston from the preceding one, with no gap directly in line with the piston pin. The bottom piston ring groove should be fitted with an oil control ring and the two upper grooves fitted with compression rings.

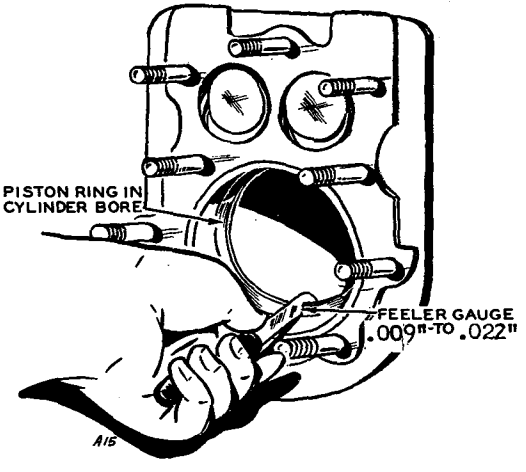


FIG. 13- FITTING PISTON RINGS TO THE CYLINDER

The piston is fitted with a full floating type piston pin. The pin is kept in place by two lock rings in the piston, one at each side. Be sure these lock rings are properly in place before installing the piston and connecting rod in the engine. Correct piston to cylinder clearance is .004" to .0055"

CONNECTING ROD.- Mark the connecting rod before removing it to assure reassembling with the same side facing the camshaft. Note that the oil dipper is installed so as to splash oil towards the camshaft side of the engine.

The connecting rod bearing clearance to the crankshaft journal may be reduced as necessary by carefully dressing the cap on a sheet of abrasive cloth placed flat on a surface plate or piece of plate glass.

The connecting rod and piston assembly must be properly aligned before reassembly to the engine. The aligning should be done on an accurate aligning gauge by a competent operator. Misalignment may cause rapid wear of piston, pin, cylinder and connecting rod.

Be sure the connecting rod oil dipper is properly installed, as it is vital to proper lubrication.

MAIN BEARINGS.- The sleeve type aluminum alloy main bearings are flanged to take the crankshaft end thrust. Because of their extra large size they seldom need replacing. If replacement does become necessary, the bearings must be pressed in, the generator adapter assembled to the crankcase, and the bearings line bored or reamed to correct size. Replacement of the bearings should not be attempted if the proper equipment is not available. Proper crankshaft end play is .008" to .012" and is obtained by using the correct thickness of gaskets between the generator adapter and the crankcase.

CAMSHAFT BEARINGS.- The steel backed, babbitt lined camshaft bearings are not flanged. These bearings, as with the crankshaft bearings, must be line bored after being pressed into the crankcase. Replacement of the camshaft bearings is not practicable without the proper equipment.

VALVE COMPARTMENT OIL DRAIN.-A drain tube extends from the valve compartment to the bottom of the crankcase. This tube must be unobstructed to provide for proper drainage of oil from the valve compartment.

OIL SEALS.- When replacing either crankshaft oil seal, be sure the open side faces toward the inside of the engine. Use care not to turn back the leather edge of the oil seal or damage it in any way. The adapter between the engine and generator must be removed to replace the rear oil seal. Remove the gear cover to replace the front oil seal.

TABLE OF CLEARANCES

	MINIMUM	MAXIMUM
Tappets - Intake and Exhaust - Cold. See Note (a)	.013"	.015"
Valve Seat Width	.047"	.078"
Valve Stem in Guide - Intake	.001"	.0025"
Valve Stem in Guide - Exhaust	.0025"	.004"
Crankshaft Bearing	.0025"	.0035"
Camshaft Bearing	.0015"	.003"
Crankshaft End Play	.008"	.012"
Connecting Rod Bearing	.0015"	.0025"
Piston Pin in Piston - 72°F.	Hand Push Fit	
Piston Pin in Rod - 72°F.	Thumb Push Fit	
Piston to Cylinder ....See Note (b)..	.004"	.0055"
Piston Ring Gap ....See Note (c)..	.009"	.022"
Magneto Breaker Point Gap	.018"	.022"
Spark Plug Gap	.024"	.026"
Magneto Pole Shoe Air Gap	.008"	.012"
Ignition Timing	19° B.T.C.	
Cylinder Head Nut, Torque	25-30 lb. ft.	
Connecting Rod Bolt, Torque	10-12 lb. ft.	
Anti-Flicker Breaker Point Gap	.020"	
Crankshaft Main Bearing Journal- Standard Size ..	1.6860"	1.6865"
Crankshaft Rod Bearing Journal - Standard Size ..	1.3745"	1.3750"
Cylinder Bore - Standard Size	2.5005"	2.5015"

With ALUMINUM Block - Note (a) Intake .007-.009", Exhaust .009-.011"; Note (b) .003-.0045" ; Note (c) .0065-.0145"

GENERATOR

Two types of generator construction are used in this series of plants. Fig. 14 shows the type using an armature bearing. Fig. 15 shows the type using no armature bearing.

BRUSH REPLACEMENT.- Install new rectangular brushes when the old ones are worn to 5/8" or less in length. The cylindrical type collector ring brush used on the 300 watt 50 cycle, 400 watt 60 cycle generator may be may be used until worn to 1/4" in length. It is not necessary to remove the end bell or brush rig to install new brushes. Remove the end bell cover band (Fig. 14) or the end housing (Fig. 15), as the case may be. Brushes and leads are then easily accessible. New brushes are shaped to fit and seldom need sanding to seat properly. Always use the correct brush as listed in the parts list, never substituting a brush which may appear to be the same, but may have different electrical characteristics. Be sure to retighten the brush lead terminal nuts tightly. If some brush sparking occurs after replacing brushes, run the plant at a light load until the brushes wear to a good seat.

BRUSH RIG POSITION.- The position of the brush rig is important. This position was carefully set at the factory and is identified on bearing models by a chisel mark on the end bell in alignment with an indented mark on the bearing hub. See Fig. 14. On other models using no bearing, the proper brush rig position is identified by a painted edge of one brush rig support which aligns with a painted chisel mark on the edge of the generator frame. As long as the original brush rig and armature are continued in service, these reference marks must be observed. If a new brush rig or armature is installed, the original alignment marks may have to be disregarded in order to find the proper neutral position.

COMMUTATOR.- The commutator, and collector rings on AC plants, acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly machined appearing surface. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#00) may be used to remove slight roughness. Use only light pressure on the sandpaper, while the plant is operating. Do not use emery or carborundum paper or cloth. Clean out all carbon dust from the generator.

After long service, the surface of the commutator may become worn down to the level of the mica insulation between the commutator bars. This condition would lead to noisy brush action, excessive brush sparking and wear and pitting of the commutator bars. Undercut the mica between the bars to 1/32" below the surface of the bars. If it is not convenient to take the armature to an electrical shop, the operation may be done with a tool fashioned from a hack saw blade. Grind the blade to a thickness equal to the thickness of the mica between the bars. Do not scratch the surface of any bar. Use sandpaper to remove any burrs left along the edges of the bars. See that spaces between the bars are perfectly clean before reassembling the generator.

If the commutator becomes damaged, or wears unevenly so that it is grooved or out of round, turn it smooth in a lathe. After turning, the mica must be undercut as described above.

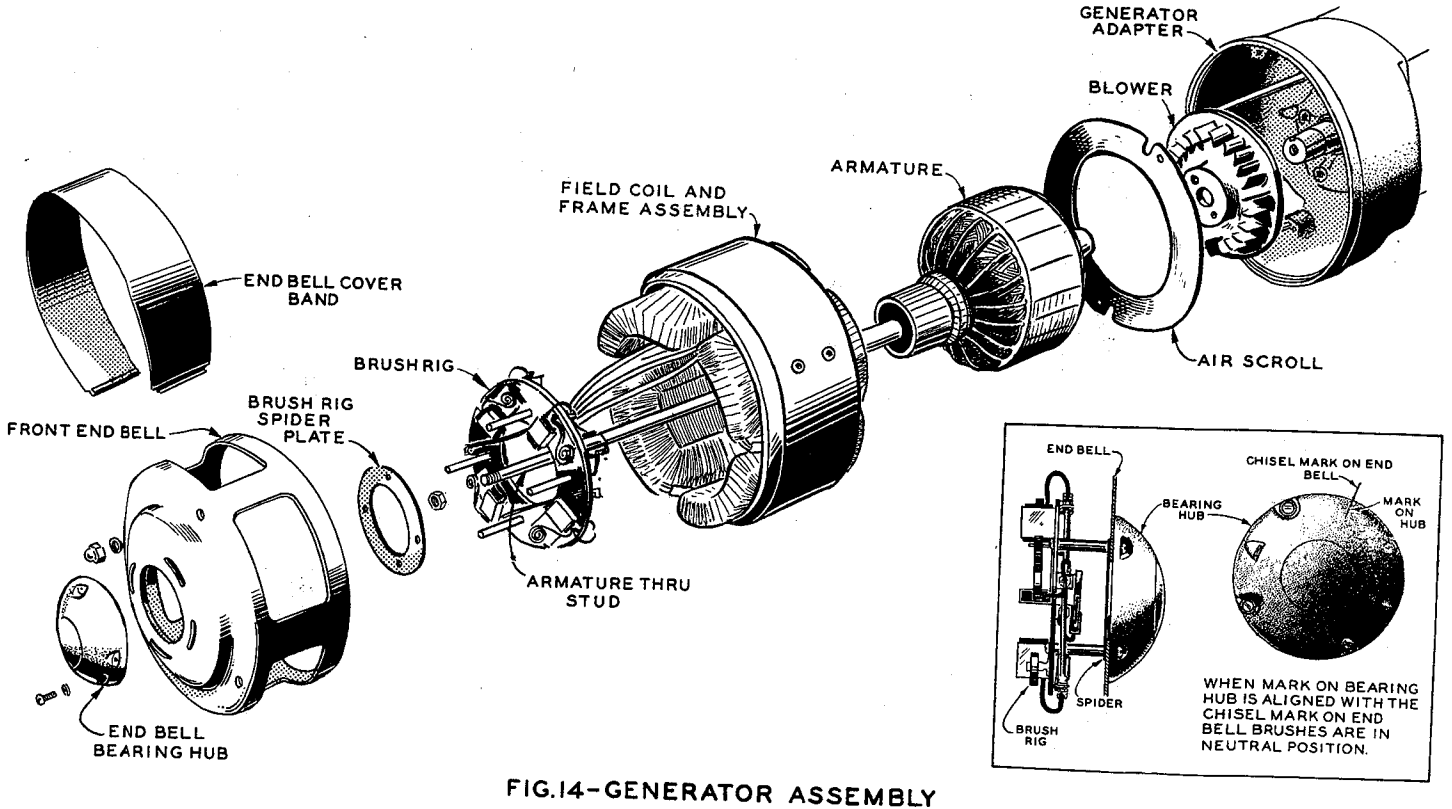


FIG.14-GENERATOR ASSEMBLY

GENERATOR DISASSEMBLY (Fig. 14).- To disassemble the generator, first remove the end bell cover band. Lift each brush high in its guide, so that the brush is held by spring pressure against its side. Tag leads which are disconnected, to assure correct replacement. After removing the two end bell nuts, the end bell and frame may be removed as a unit, the armature bearing remaining on the armature. The end bell and frame assembly may be separated, to gain access to the brush rig.

To remove the armature, first remove the blower air scroll from the generator to engine adapter. Loosen the armature center nut even with the end of the through stud. While pulling outward on the armature, strike the stud and nut a sharp endwise blow with a heavy soft faced hammer, to loosen the armature. The armature has an external taper which fits into the internal taper of the engine crankshaft. When the armature is loose, remove the stud nut and slide the armature carefully off the through stud. When reassembling the generator, be sure to line up the notch and pin on the edges of the adapter, frame, and end bell. Note also that a small spring clip on the outside edge of the armature bearing must fit into a slot in the bearing hub. Do not tighten the end bell nuts so much as to distort the end bell.

GENERATOR DISASSEMBLY (Fig. 15).- To disassemble the generator, first remove the end bell, or housing. Lift each commutator brush high in its guide, so that the brush is held by spring pressure against its side. Tag leads which are disconnected, to assure correct replacement. Remove the two heavy clamp washers which fasten the generator frame to its adapter. The frame and brush rig can then be removed as a unit.

To remove the armature, loosen the armature center nut even with the end of the through stud. While pulling outward on the armature, strike the stud and nut a sharp endwise blow with a heavy, soft faced hammer, to loosen the armature. The armature is tapered to fit the crankshaft taper. When the armature is loose, remove the stud nut and slide the armature off the through stud.

Upon reinstalling the armature, be sure the run-out at the commutator end is not more than .002". Excessive run-out may be due to a nick or dirt on the taper of either the armature or crankshaft.

FIELD WINDINGS.- A ground or open circuit in the field coils may be determined by the use of a continuity type test lamp. Disconnect (and tag) all field leads. Refer to the proper wiring diagram. Test the field winding for an open circuit by placing one test prod on each of the two terminal ends of the winding. If the test lamp does not light, the field winding is open. If the open circuit can be located in one of the external leads, the break can be easily repaired. An internal break usually requires replacement of the coil set. A grounded condition can be determined by placing one test prod on a terminal end of the winding and the other test prod on a bare metal part of the generator frame. If the test lamp lights, a ground is indicated. Find the point where the ground occurs and repair as necessary.

An internal short circuit is best located by the use of a sensitive ohmmeter. By comparing the resistance of each individual coil winding, a

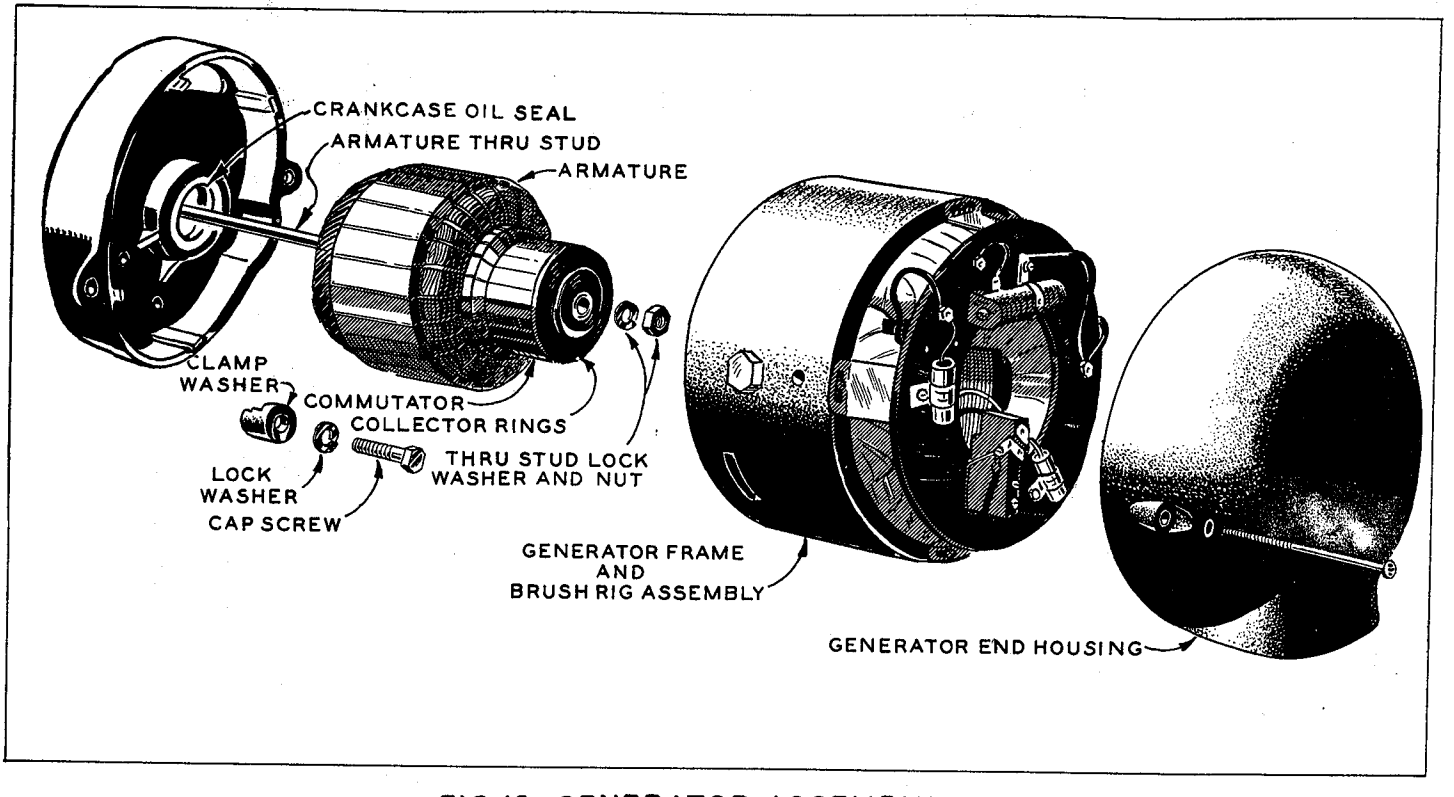


FIG. 15-GENERATOR ASSEMBLY

short circuited coil is indicated by a lower resistance reading. Replace the entire coil set assembly if a short circuit is indicated.

ARMATURE.- The armature may be tested for a ground by placing one test prod on the center shaft and the other test prod first on the commutator, then on one of the collector rings. If the test lamp lights, the armature is grounded. Place a test prod on each of the two collector rings. If the test lamp does not light, the AC winding is open circuited. The use of an armature growler is required to test the DC winding for an open circuit, and to test for a short circuit. Follow the directions of the growler manufacturer.

CONTROL BOX EQUIPMENT.- Always disconnect the battery from the plant whenever servicing any control box equipment. Keep all connections tight and clean, and inspect leads occasionally for worn insulation. If any of the control box equipment does not function properly, replace the defective part with a corresponding new unit. It is seldom practicable to repair relays, switches, etc.

# # # #

BATTERY PREPARATION FOR REMOTE START AC PLANT.- For a usual plant installation, follow the instructions for Batteries under INSTALLATION. If the installation agrees with the following description, prepare the battery to assure long battery life by REDUCING BATTERY SPECIFIC GRAVITY.

Standard automotive type storage batteries will self discharge very quickly when installed where ambient temperature is always above 90°F., such as in a boiler room. To lengthen battery life, adjust the electrolyte a normal 1.275 reading at full charge to a 1.225 reading.

The cranking power of the battery is also reduced when electrolyte is diluted to reduce acid activity and thus lengthen battery life. If temperature is consistently above 90°F.(32.2°C.) adjust the electrolyte as instructed below.

1. Fully charge the battery. DO NOT BRING AN OPEN FLAME OR BURNING CIGARETTE NEAR THE BATTERIES ON CHARGE BECAUSE THE GAS RELEASED DURING CHARGING IS VERY INFLAMMABLE.

2. While battery is on charge, use a dydrometer or filler bulb to siphon off all of the electrolyte above the plates in each cell. Don't attempt to pour of!!! Dispose of the removed electrolyte. AVOID SKIN OR CLOTHING CONTACT WITH ELECTROLYTE.

3. Fill each cell with pure distilled water.

4. Recharge the batteries for one hour at a 4 to 6 ampere rate.

5. Use a reliable battery hydrometer, to test each cell. If the specific gravity is above 1.225, repeat steps number 2,3, and 4 until the highest specific gravity reading of the fully charged battery is not over 1.225. Most batteries require repeating steps 2,3, and 4 two times.

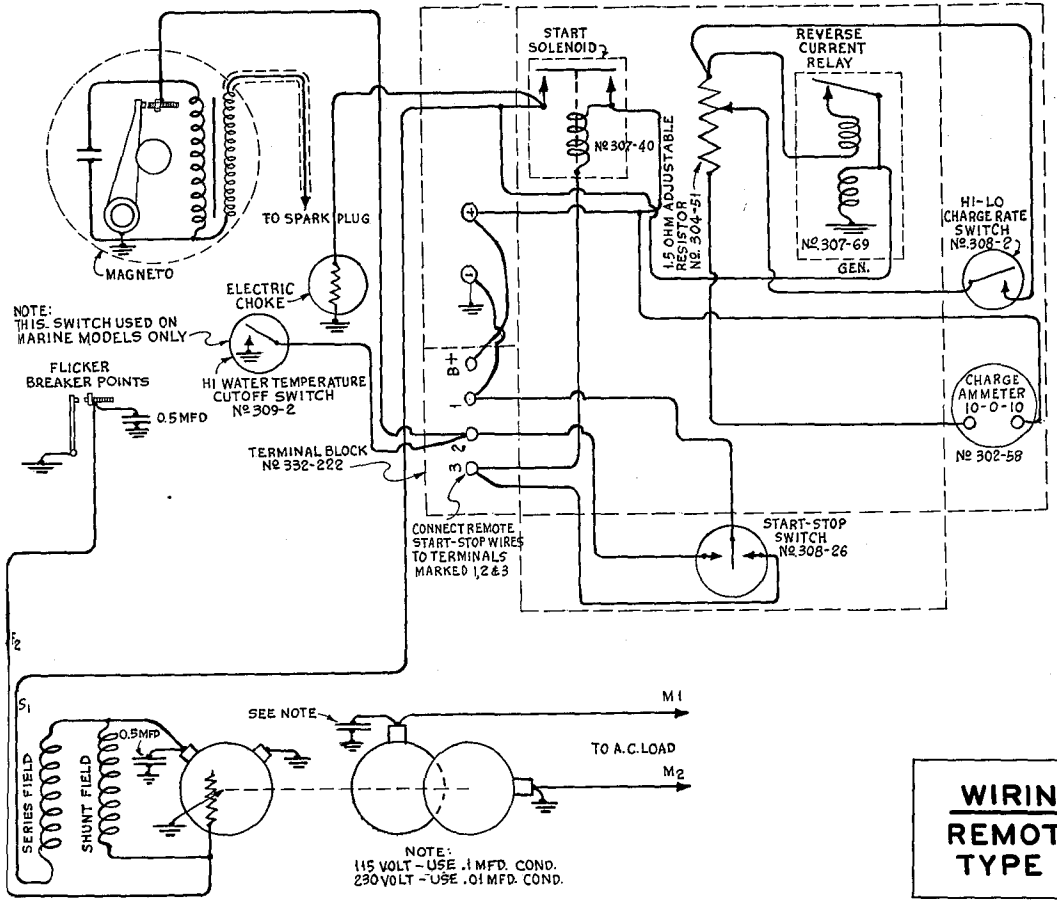
POSSIBLE CAUSE	REMEDY
GENERATOR WILL NOT CRANK ENGINE (ELECTRIC CRANKING MODELS ONLY)	
Battery discharged.	Recharge.
Loose connections.	Tighten connections.
Defective starting circuit.	Repair or replace as necessary.
Defective switch.	Replace.
ENGINE CRANKS TOO STIFFLY	
Too heavy oil in crankcase.	Drain, refill with lighter oil.
Engine stuck.	Disassemble and repair.
ENGINE WILL NOT START WHEN CRANKED	
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc., or retime magneto.
Lack of fuel or faulty carburetion.	Refill the tank. Check the fuel system. Clean, adjust, or replace parts necessary.
Clogged fuel screen.	Clean.
Cylinder flooded.	Crank few times with spark plug removed.
Poor fuel.	Drain, refill with good fuel.
Poor compression.	Tighten cylinder head and spark plug. If still not corrected, grind the valves. Replace piston rings, if necessary.
Wrong timing.	Reset breaker points or retime magneto.
ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP	
Poor commutation.	See that brushes seat well on commutator, are free in holders, are not worn shorter than 5/8 inch, and have good spring tension.
Open circuit, short circuit, or ground in generator.	See GENERATOR. Replace part necessary.

POSSIBLE CAUSE	REMEDY
EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST	
Poor compression, usually due to worn piston, rings, or cylinder.	Refinish cylinder. Replace piston and rings.
Oil leads from oil base or connections. This does not cause smoky exhaust.	Replace gaskets. Tighten screws and connections. Check breather hole (see page 18).
Oil too light or diluted.	Drain, refill with correct oil.
Worn engine.	Repair as necessary.
Worn intake valve guide or valve stem.	Replace.
Engine misfiring.	Refer to symptoms of engine misfiring.
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc., or retime magneto.
Too much oil.	Drain excess oil.
BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUG WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD.	
Fuel mixture too rich.	Adjust carburetor or choke. Install needed carburetor parts.
Choke not open.	See that choke opens properly.
Dirty air cleaner.	Clean.
Excessive crankcase pressure, causing excessive fuel pump pressure.	Clean breather hole - see page 18.
LIGHT POUNDING KNOCK	
Loose connecting rod bearing.	Adjust or replace.
Low oil supply.	Add oil.
Oil badly diluted.	Change oil.
ENGINE STOPS UNEXPECTEDLY	
Fuel tank empty.	Refill.
Defective ignition.	Check the ignition system. Repair or replace parts necessary.

POSSIBLE CAUSE	REMEDY
DULL METALLIC THUD. IF NOT BAD, MAY DISAPPEAR AFTER FEW MINUTES OPERATION. IF BAD, INCREASES WITH LOAD.	
Loose crankshaft bearing.	Replace unless one of the next two remedies permanently corrects the trouble.
SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE FIRST STARTED	
Low oil supply.	Add oil.
Oil badly diluted.	Change oil.
PINGING SOUND WHEN ENGINE IS SUDDENLY OR HEAVILY LOADED	
Carbon in cylinder.	Remove carbon.
Spark too early.	Adjust breaker points or retime magneto.
Wrong spark plug.	Install correct spark plug.
Spark plug burned or carboned.	Install new plug.
Valves hot.	Adjust tappet clearance.
Fuel stale or low octane.	Use good fresh fuel.
Lean fuel mixture.	Clean and adjust carburetor.
Engine hot.	Check air circulation.
TAPPING SOUND	
Tappet clearance too great.	Adjust or replace tappets.
Broken valve spring.	Install new spring.
HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD	
Loose piston.	If noise only slight and disappears when engine warms up, no immediate attention needed. Otherwise replace worn parts.
VOLTAGE LOW AT FAR END OF LINE BUT NORMAL NEAR POWER PLANT	
Too small line wire for load and distance.	Install larger or extra wires or reduce load.

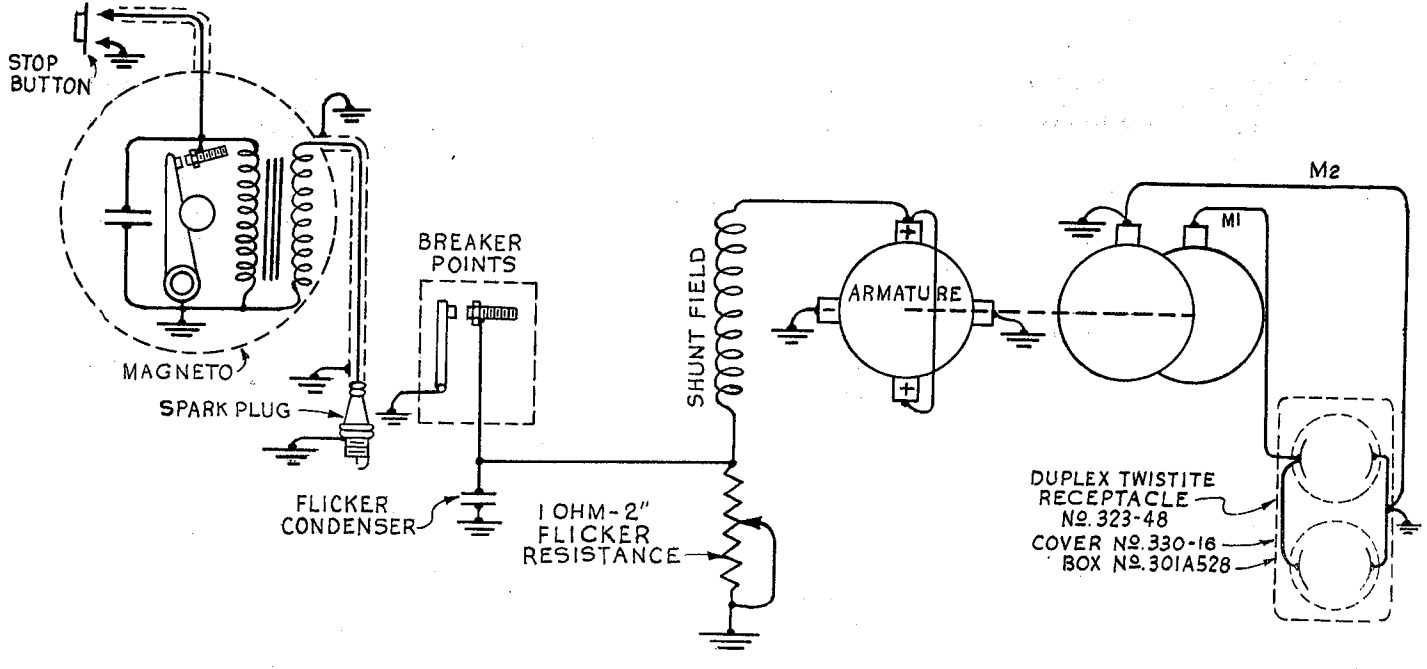
POSSIBLE CAUSE	REMEDY
ELECTRIC MOTOR RUNS TOO SLOWLY AND OVERHEATS AT FAR END OF LINE BUT OK IF USED NEAR POWER UNIT	
Too small line wire for load and distance.	Install larger or extra wires, or reduce load.
VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING	
Speed too low.	Adjust governor to correct speed.
Poor commutation or brush contact.	See that brushes seat well on commutator, are free in their holders, are not worn shorter than 5/8 inch, and have good spring tension.
Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load condition causing trouble.
ENGINE BACKFIRES AT CARBURETOR	
Lean fuel mixture.	Clean or adjust carburetor.
Clogged fuel screen.	Clean screen.
Poor fuel.	Refill with good, fresh fuel.
Spark too late.	Adjust breaker points or retime magneto.
Intake valve leaking.	Grind or replace.
NOISY BRUSHES	
High mica between bars of commutator.	Undercut mica.
EXCESSIVE ARCING OF BRUSHES	
Rough commutator.	Turn down.
Dirty commutator.	Clean.
Brushes not seating properly.	Sand to a good seat.
Open circuit in armature.	Replace.
Brush rig out of position.	Line up properly.

POSSIBLE CAUSE	REMEDY
GENERATOR OVERHEATING	
Brush rig out of position.	Adjust.
Overloaded.	Reduce load.
VOLTAGE DROPS UNDER HEAVY LOAD	
Engine lacks power.	See remedies for engine misfires under heavy load.
Poor Compression.	Tighten cylinder head and spark plug. If still not corrected, grind the valves. Replace piston rings, if necessary.
Faulty carburetion.	Check the fuel system. Clean, adjust or replace parts necessary.
Dirty air cleaner.	Clean.
Choke partially closed.	See that it opens wide.
Carbon in cylinders.	Remove carbon.
Restricted exhaust line.	Clean or increase the size.
ENGINE MISFIRES AT LIGHT LOAD	
Spark plug gap too narrow.	Adjust to correct gap.
Intake air leak.	Tighten or replace gaskets.
Faulty ignition.	Clean, adjust or replace breaker points, plug, condenser, etc., or retime ignition.
Low compression.	Tighten cylinder head and spark plug. If still not corrected, grind valves. Replace piston rings, if necessary.
ENGINE MISFIRES AT HEAVY LOAD	
Spark plug gap too wide.	Adjust gap.
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc., or retime magneto.
Clogged carburetor.	Clean jet.
Clogged fuel screen.	Clean.



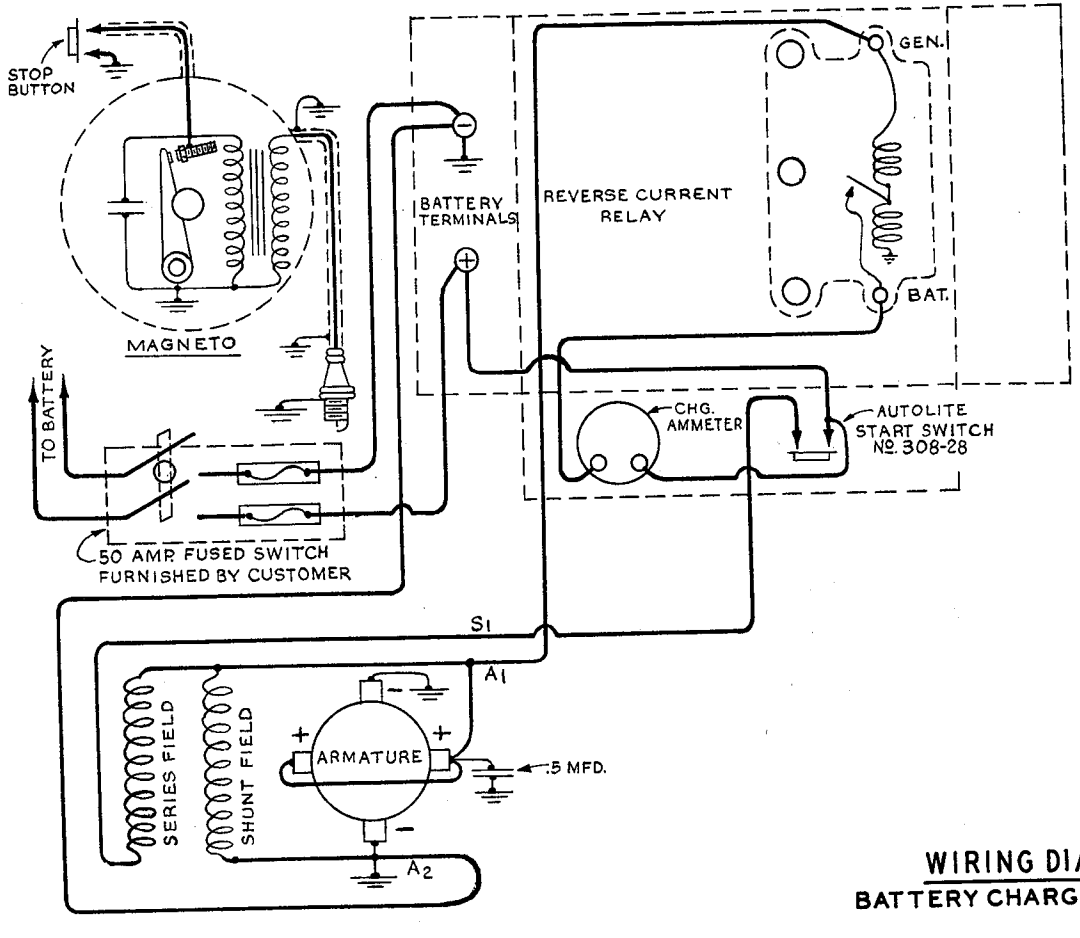
WIRING DIAGRAM
REMOTE CONTROL TYPE A.C. PLANT

61085

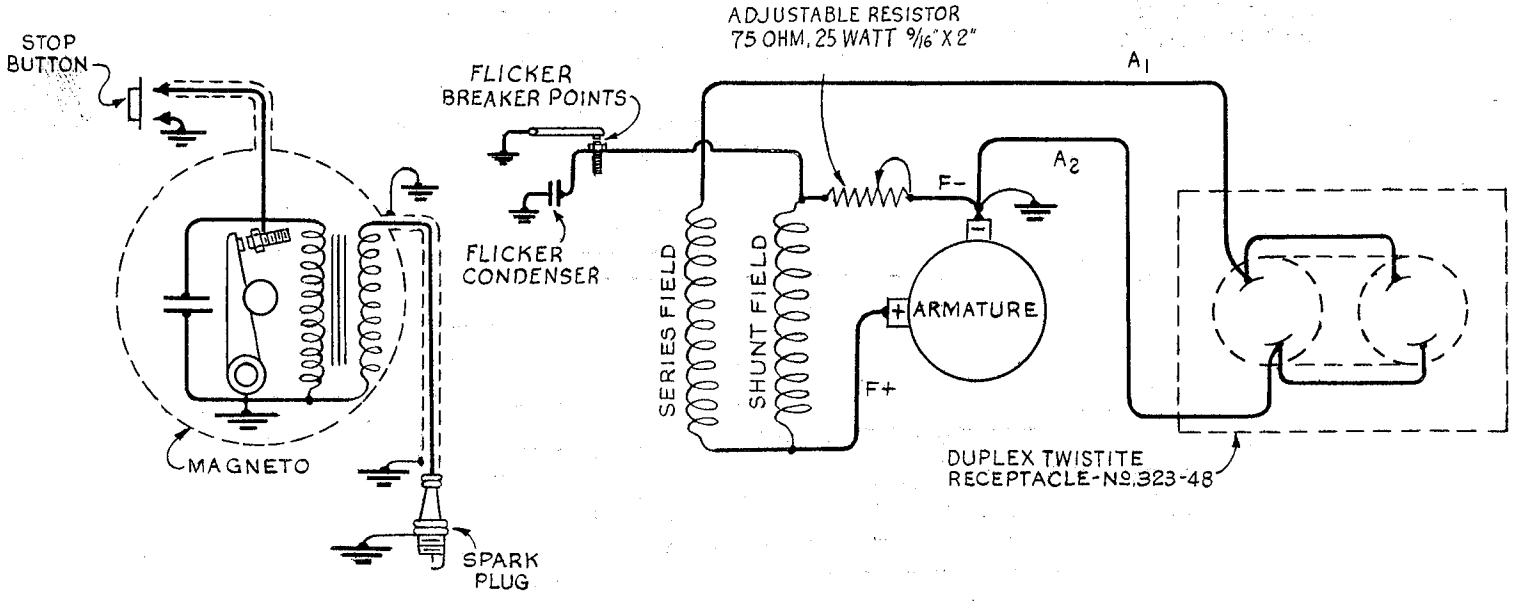


WIRING DIAGRAM

MANUAL TYPE A.C. PLANT



WIRING DIAGRAM
BATTERY CHARGING PLANT



WIRING DIAGRAM
D.C. 115 VOLT PLANT

60/A4