INSTRUCTION MANUAL

FOR

ONAN ELECTRIC GENERATING PLANTS

Series

1C

Alternating Current Models

•

Direct Current Models

•

Battery Charging Models

•

11-52

Onan

DIVISION OF STUDEBAKER CORPORATION
MINNEAPOLIS 14, MINNESOTA

900-24

Price $1.00

If you need help with your old Onan, visit the "Smart Guys" at The Stak. They have many years of experience and they are happy to help.
http://www.smokstak.com/forum/forumdisplay.php?f=1

Thank You; to Billy Shafer for donating this manual.

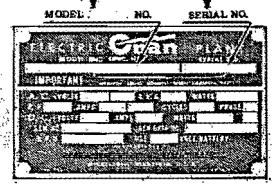
This instruction book contains information for the proper installation, operation, and maintenance of your equipment. We suggest that this book be kept handy so that it can be referred to when necessary.

This equipment is the result of proven engineering design, highest quality materials, and expert workmanship. Thorough inspection and testing assures you that this equipment will perform as expected.

If you wish to contact your dealer or the factory regarding this equipment, be sure to supply the complete MODEL and SPEC. NO., and the full serial number of the equipment as shown on the nameplate. This information is necessary to identify the equipment among the many basic and special optional types manufactured.

Important!

Always GIVE THESE NUMBERS WHEN ORDERING REPAIR PARTS OR REQUESTING SERVICE INFORMATION FOR YOUR UNIT!
WRITE IN NUMBERS SHOWN ON PLANT NAMEPLATE



IV

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. - The electric generating plants to which this manual applies are complete electric generating plants. Each plant includes an engine, generator, and necessary accessories. Each plant is thoroughly tested before leaving the factory to assure that all parts are in good condition and that each plant will produce its rated output. Inspect the plant when received, making sure that no damage occured in shipment. Damaged parts must be repaired or replaced before putting the plant into operation.

This manual is supplied to assist the operator in installing and operating the plant and in maintaining it so that it will provide maximum service at minimum cost.

TYPES OF PLANTS

BATTERY CHARGING PLANTS. - The battery charging plant is operated to generate electricity which is supplied directly to the storage battery. Electricity may be used while the plant is running, or, as limited by the charge in the battery, while the plant is not running. NEVER OPERATE THIS TYPE OF PLANT WITHOUT HAVING THE BATTERY CONNECTED.

DIRECT SERVICE PLANTS. - The direct service type plant must be operated whenever electricity is to be used. The generator output is delivered directly to the electrical load, no batteries being used. The plant is equipped for manual starting only, and has a 2 quart fuel tank mounted on the plant. The plant is particularly adaptable to applications where portability is important.

MANUAL PLANTS. - The manual type plant is equipped for manual starting only. This type of plant is equipped with a fuel tank mounted on the plant, and is designed especially for installations where portability is important. A push button is provided for stopping the plant.

REMOTE CONTROL PLANTS. - The remote control type plant is started and stopped electrically. Stop and start push button switches are provided on the plant. Additional sets of such switches may be installed at remote points within reasonable distance from the plant, and connected to the plant by proper wiring, to provide convenient remote control of starting and stopping. A twelve volt battery (or two six volt batteries in series) must be properly connected to supply power for electric starting. Current for recharging the battery is supplied by the plant while it is in operation. A separate fuel tank is supplied with the remote control plant. The plant may be started manually if necessary.

ENGINE

The engine used on alternating current plants is a vertical one cylinder, four cycle, air cooled, L head, gasoline burning engine. The cylinder bore is 2-1/4", the piston stroke is 2-1/4", and the maximum brake horsepower at 1800 rpm is 1.09.

The engine used on direct current plants is a one cylinder, upright, four cycle, air cooled, gasoline burning engine. The bore is 2-1/4"; the stroke is 2-1/4"; the rated horsepower at approximately 2000 rpm is 1.16.

The speed is controlled by a flyball type governor built into the camshaft gear. Ignition current is supplied by a flywheel type magneto. The engine is cooled by air which is drawn by a blower through the front of the blower housing and forced around the cylinder walls and head. The engine employs a splash type lubricating system. Oil is pumped from the oil base into an oil trough where it is picked up by a projection on the connecting rod and splashed to the internal working parts.

GENERATOR

The four pole, revolving armature type generator is directly connected to the engine, the armature turning at crankshaft speed. The AC armature contains both AC and DC windings, the DC output being used for exciting the field and, on the remote control plants, for charging the starting batteries. The remote control plants have a series field winding which permits use of the generator as a motor for cranking the engine. The battery charging types are shunt wound, with an additional series field winding for cranking purposes. The direct service type generator is compound wound, with shunt and series field windings providing close voltage regulation. The engine rear main bearing carries the armature weight, some models having an additional ball bearing at the end of the armature.

CONTROLS

REMOTE CONTROL PLANTS. - The controls for the remote control plants include a start relay, a reverse current relay, a battery charge rate toggle switch, start and stop buttons on the plant, a remote control start-stop switch, and an automatic choke.

MANUAL START PLANTS. - The controls for the manual start plants include a manually operated choke, a stop button on the plant, and an output receptacle.

The battery charging plants are equipped with a control box containing the necessary controls for starting the plant electrically.

IMPORTANCE OF PROPER INSTALLATION. - The plant must be properly installed and prepared for operation if it is to give satisfactory service. The plant is readily portable, and may be operated outdoors, but rain, snow, dust, dirt, and grit are unfavorable to satisfactory performance. If practicable, install the plant inside a building or closed vehicle. See Figures A, B and C.

CAUTION

PROPER VENTILATION MUST BE PROVIDED. EXHAUST GASES ARE POISONOUS. EXCESSIVE INHALATION WILL CAUSE SICKNESS OR DEATH. DO NOT OPERATE THE PLANT IN A BUILDING OR OTHER CONFINED SPACE WITHOUT PIPING ALL EXHAUST GASES OUTDOORS.

MOBILE OR INDOOR INSTALLATION. - The location selected should be as near the electrical center of the load as practicable. The room should be clean, dry, well ventilated, and if practicable, heated in very cold weather. Provide separate air inlet and outlet openings, each at least 18" x 18" in area, for proper circulation of cooling air. Mount the plant on either a timber or concrete base, using the mounting bushings to minimize vibration. The plant must set level, and should be located so as to provide at least 24" space on all sides for convenience in servicing. Pipe the exhaust gases outside the enclosure, using pipe as large as the exhaust outlet of the plant. Connect the flexible exhaust tubing to the plant exhaust outlet, a length of pipe to conduct the gases outside the enclosure, and the muffler to the pipe outside the enclosure. Keep the line several inches from any inflammable material, shielding it with metal where it passes through a wall. If the exhaust line must be pitched upward, construct a condensation trap of pipe fittings and install it at the point where the upward pitch begins.

PORTABLE INSTALLATION. - Make sure the plant will set level when in operation. Protect it as much as possible from the elements. Install the muffler directly to the engine exhaust outlet.

UNDERGROUND MUFFLER. - If so desired an underground exhaust chamber may be used instead of the automotive type supplied with the plant. However, if there is danger of the chamber filling with water at any time, it can not be used. A heavy 15 gallon drum may be used. Do not use a drum that previously contained gasoline, kerosene, turpentine, or similar inflammable liquids, as an explosion may result. The outlet pipe should extend at least 24" above ground, with a gooseneck fitting on the end.

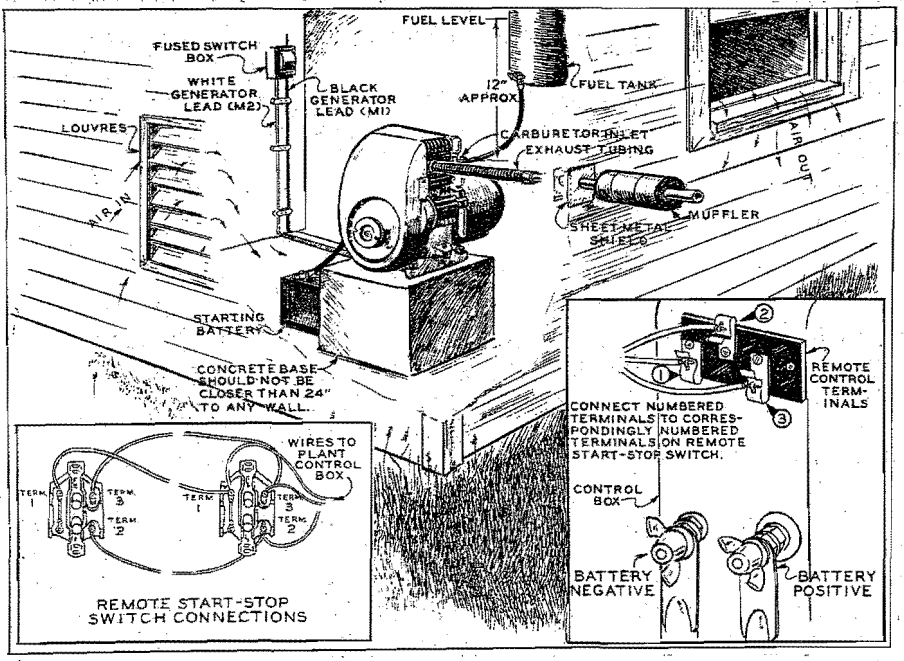


FIG. A – TYPICAL INSTALLATION - REMOTE START PLANT

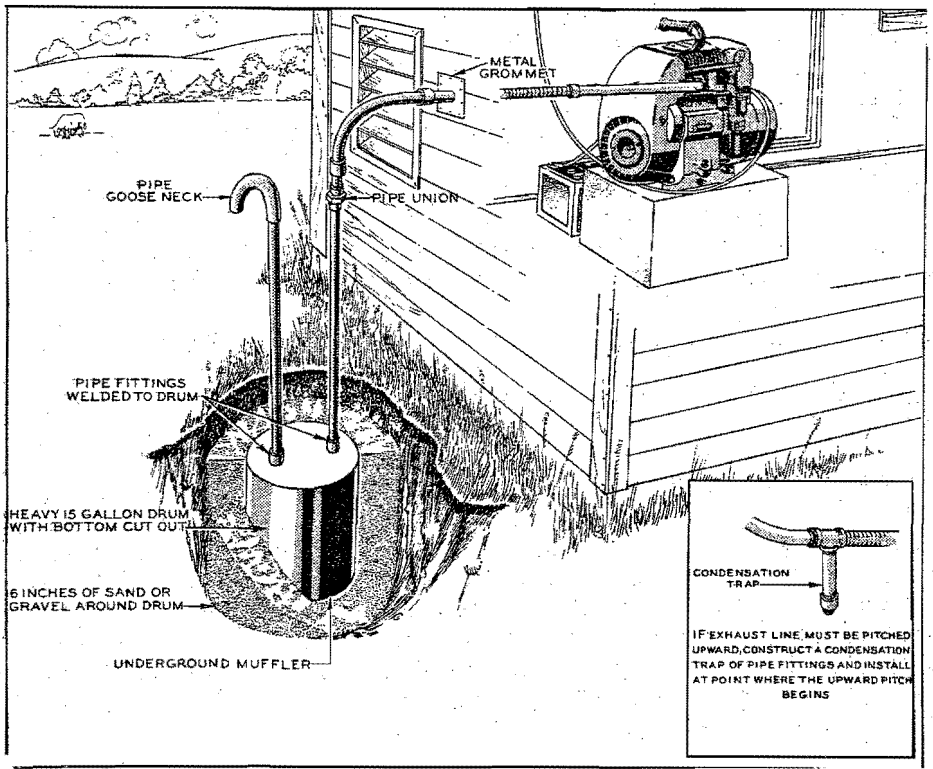


FIG. B - UNDERGROUND EXHAUST MUFFLER

FUEL TANK, ELECTRIC START PLANT. - The electric start plant is supplied with a separate 5 gallon (U.S. Measure) fuel tank which should be supported so that the level of the fuel in the tank is approximately 1 foot higher than the carburetor inlet. Do not place the fuel tank too high, as excessive pressure may cause the carburetor to flood or leak. Connect the copper fuel line between the fuel tank shut-off and the carburetor, being sure to use the small compression sleeves.

For the most satisfactory permanent installation, mount the plant on a concrete base constructed as shown below.

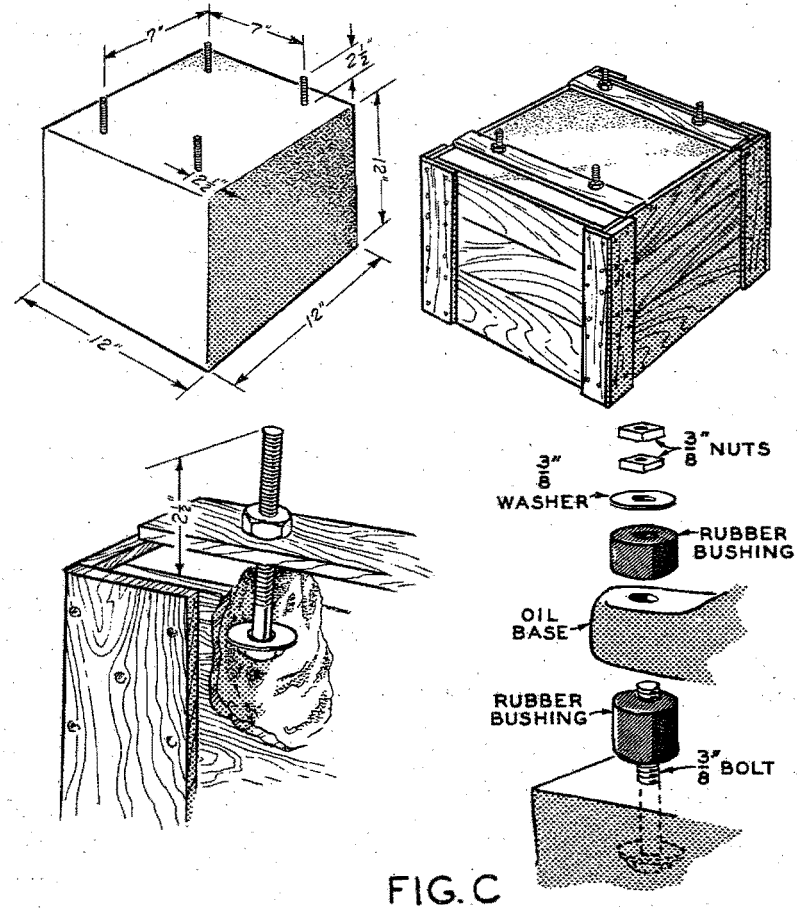


FIG. C

Construct a wooden form into which the concrete mixture can be poured. The overall dimensions of 12" are a minimum and may be larger if desired. Spacing of mounting bolts must be kept at the same distance as the

mounting holes in oil base. Be sure to build the base at least 24" from any wall.

Use four 3/8" bolts at least 5" in length. See that they extend 2-1/2" above the top of the concrete, suspending them from cross cleats as shown. Use a large washer under the head of each bolt. Be sure the top of the foundation is level and smooth to prevent breaking the plant base. Allow the foundation to harden thoroughly (about 3 days) before mounting the plant.

Use the rubber mounting bushings as shown below. Do not tighten the nuts down so tightly as to lose the shock absorbing effect of the bushings. Use two nuts on each mounting bolt, locking against each other as shown.

BATTERY, REMOTE CONTROL PLANTS. - Connect one of the battery cables between the battery positive (+) post and the BATTERY POSITIVE terminal on the plant control box. Connect the other battery cable between the battery negative (—) post and the BATTERY NEGATIVE terminal on the plant control box. A 12 volt battery is used.

On DC plants install a double pole, single throw fused switch between the generating plant and the battery.

WIRING. - Check national and local electrical codes or consult a competent electrician before installing wiring. Use sufficiently large, insulated wire between the plant and the load. The size will depend upon the distance and permissible voltage drop between the plant and the load. Install a 5 ampere circuit breaker or fused main switch in the main line near the plant.

GROUNDING THE PLANT. - If grounding is called for in local codes, or if radio interference necessitates it, provide a separate ground. 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 on the plant control box or to the white (ground) load line wire. Radio interference may result if the plant is grounded to a water pipe or to a ground used by a radio.

REMOTE START-STOP SWITCH. - One or more remote control start-stop switches may be installed at any point within 250 feet of the plant. Three terminals, #1, #2 and #3 on each switch must be connected to the corresponding clip terminals on the plant control box. Use a #18 three-wire cable to make connections between switches. Be sure to connect the switch terminal #1 to the Fahnstock clip #1 on the plant, switch terminal #2 to clip #2 and switch terminal #3 to clip #3. See Figure A.

CONNECTING THE AC LOAD WIRES. - Connect the load wires to the remote control plant by connecting the grounded (white) load wire to the lead marked M2 (or the white wire if unmarked) which extends from the generator end bell. Connect the black (ungrounded) load wire to the generator lead marked M1, or the black wire. Be sure that connections are made tight and are separately taped with electricians rubber tape, and then secured with friction tape. Leave the load line circuit breaker or 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.

MANUAL PLANTS. - The manual start plants are provided with an output receptacle atop the generator. No preliminary connections are necessary when installing the plant.

LOAD CONNECTIONS - BATTERY CHARGING PLANTS. - On some models, the control box has four terminals. The two upper terminals, marked OUTPUT or LINE on the wiring diagram, are for the load line wires. The two lower terminals are for connection to the battery. Any load connected to the plant when it is not running will register as a discharge on the plant ammeter.

On some models, two battery terminals only are provided. Load line wires may be connected to the battery side of the switch between the battery and the plant. Load connected to the battery will not register on the plant ammeter. All wiring and connections must meet electrical code specifications. Consult a licensed electrician.

LUBRICATION. - The use of a heavy duty (detergent) type oil will increase the life of piston and rings, and its use is strongly recommended. Use 1 quart of oil (U.S. Measure) to fill the oil base to the level of the filler hole. See Figure D. Use an oil of the proper SAE number as indicated in the following table, according to the lowest temperature to which the plant will be exposed when stopped.

TEMPERATURE	SAE NO.
Above 90°F. (32°C.)	No. 30
60°F. to 90°F. (15°C. to 32°C.)	No. 20
0°F. to 60°F. (-18°C. to 15°C.)	No. 10W
Below 0°F. (-18°C.)	10W diluted
See ABNORMAL OPERATING CONDITIONS	with 10% kerosene.

CAUTION

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

Place a drop of oil on each joint of the link between the carburetor throttle arm and the governor arm.

FUEL. - Fill the fuel tank nearly full with clean, fresh automotive type gasoline of 68 to 74 octane rating. The capacity of the tank mounted on the manual start plant is approximately 2 quarts (U.S. Measure). Do not use a premium grade of gasoline, or any gasoline which is highly leaded. The use of a highly leaded gasoline will necessitate more frequent carbon removal and spark plug and valve service. Do not fill the tank entirely full of cold gasoline, for expansion 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.

If the plant is equipped with the separate 5 gallon fuel tank, be sure the air vent at the top of the tank is open. Check all fuel connections for leaks, correcting any found. Keep the fuel tank filler cap closed tightly.

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.

NOTE

IF THE PREPARATION HAS BEEN MADE FOR COLD WEATHER, THE INITIAL FILLING OF THE CRANKCASE WITH DILUTED OIL SHOULD HAVE BEEN LEFT TO BE DONE IMMEDIATELY BEFORE STARTING THE PLANT. MAKE SURE THE CRANKCASE IS FILLED TO THE PROPER LEVEL WITH OIL OF THE CORRECT SAE NUMBER.

STARTING THE PLANT ELECTRICALLY (REMOTE CONTROL PLANT). - The remote control plant may be started electrically by pressing the START button on the control box or a remote START button if installed. Carburetor choking is automatic and the plant should start within a few revolutions. Do not press the START button for a period of more than 5 seconds. The plant will start better by crankings of short duration, rather than by continuous cranking. If the plant does not start after a few attempts, check the fuel and ignition systems, correcting any trouble found. Manual operation of the automatic choke is possible by manipulation of the looped rod extending upward from the choke body. Pull the rod upward to lessen choking action.

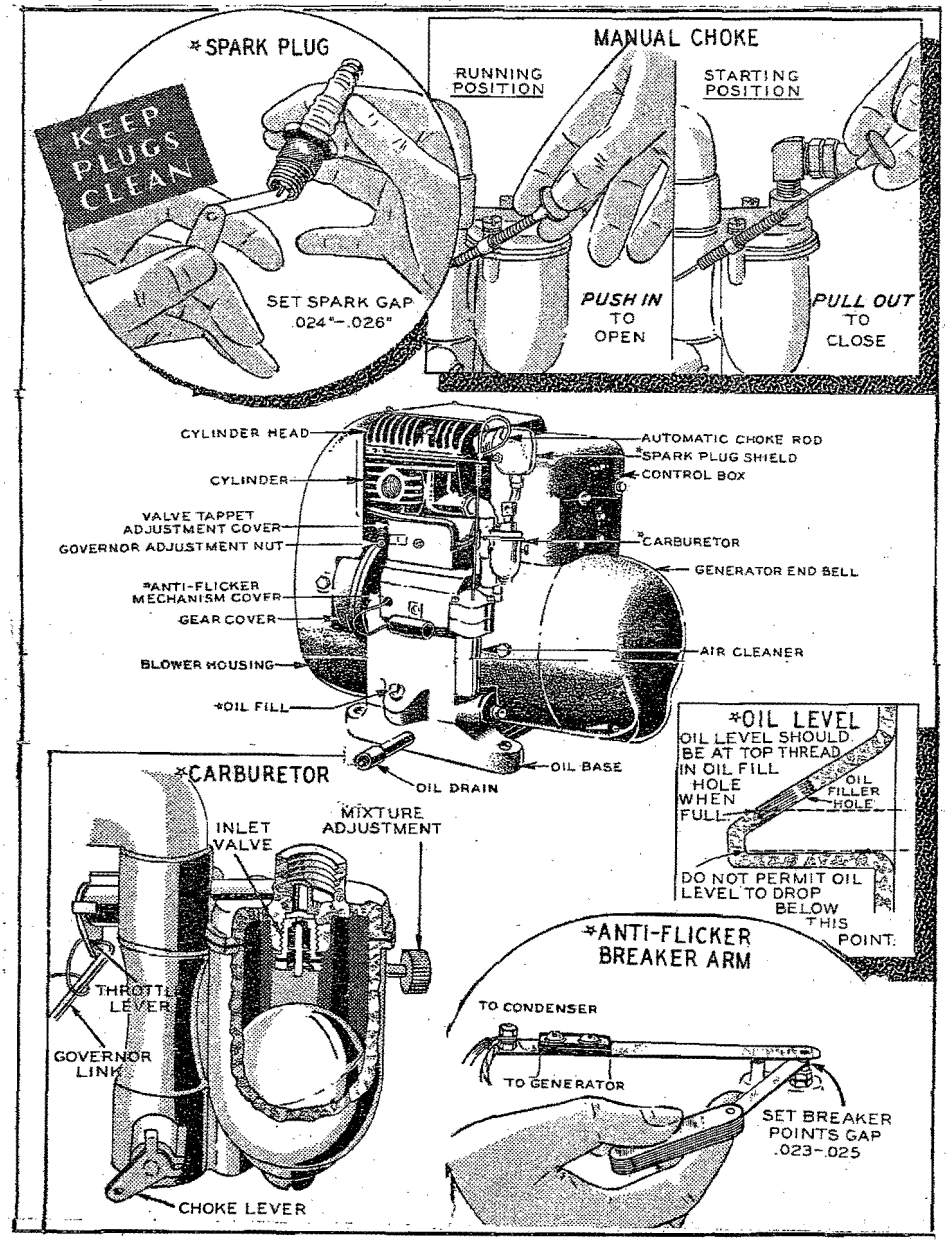
STARTING THE BATTERY CHARGING PLANT ELECTRICALLY. - Use the same procedure as above, except choking is done manually.

STARTING THE PLANT MANUALLY. - Have the choke in the same position as for starting electrically. Hook the knot of the rope in the slot of the starting sheave, wrap the rope clockwise around the sheave, leaving about six inches free. Grasp the wood handle firmly and give a strong, quick, pull the full length of the rope. Should the plant fail to start, push the choke half way in and repeat the procedure.

BATTERY CHARGE RATE SWITCH. - A toggle switch is provided on the control box of the remote control plant for control of the battery charge rate. Ordinarily the LO position of the switch, which provides approximately a 2 ampere charge rate, will keep the battery in a satisfactory state of charge. However if frequent starts lead to the battery becoming discharged, throw the switch to the HI position temporarily. The higher rate may be used for short periods of time, but the charge rate switch should be returned to the LO position as the battery nears the fully charged condition. Check the battery frequently with a hydrometer to determine the charge condition.

ADJUSTING THE CHARGING RATE ON DIRECT CURRENT PLANTS. - The speed, and therefore the charging rate, may be adjusted by turning the governor adjusting nut to the right (clockwise) to increase the charging rate or to the left (counterclockwise) to decrease it.

WHEN TO OPERATE BATTERY CHARGING PLANTS. - The plant generates electricity which is supplied to the storage battery. When battery is full charged, electricity may be used from the battery until it is discharged. Electricity may be used while the plant is running or as limited by the charge in the battery when the plant is not running. Direct Service Plant must operate whenever electricity is needed.



COLD TEMPERATURES. - Lubrication and fuel require special attention at temperatures below 0°F. or -18°C.

LUBRICATION. - For temperatures below 0°F. or -18°C., thoroughly mix 10% kerosene with each quart of SAE number 10 or 10W oil and fill the crankcase to the top of the oil filler hole. Then run the engine 10 minutes to circulate the mixture. If the crankcase is filled with undiluted oil, run the engine until warm, then drain. NEVER ADD KEROSENE ALONE TO THE CRANKCASE. When using diluted oil, change oil every 50 operating hours and check the level at least every 8 operating hours.

Do not thin any oil heavier than SAE No. 10 as the mixture may separate when the engine is stopped. When adding oil, between drain periods, use a mixture of 1/4 pint of kerosene to one quart of oil.

VENTILATION. - The cooling area around the unit must be such that cool air can circulate freely over the plant at all times. The cooling fins on the engine must be kept clean and all air passages kept open.

AIR CLEANER. - Extremely dusty conditions will require removal, and cleaning of the air cleaner more frequently. A dirty air cleaner causes excessive fuel consumption, rapid cylinder and piston wear, and may prevent the plant from running.

FUEL. - Give special attention to fuel. Fresh fuel and high test fuel aid starting. Never fill the tank entirely full with cold gasoline.

HOT TEMPERATURES. - Under extremely hot operating conditions, provide ample ventilation, and keep the crankcase oil level near the top of the oil filler hole. Keep the cooling system clean and unobstructed. Change oil every 100 operating hours.

DUST AND DIRT. - Keep the plant as clean as practicable. Check the operation oftener and service as needed. Clean the air cleaner often. Clean the commutator and brushes often and see that the brushes ride freely in their holders. Keep supplies of fuel and oil in airtight containers.

NOTE

It is very important that the plant be serviced regularly as outlined below. Follow a definite schedule of inspection and service. Keep a record of the hours of operation to assure servicing at the proper time. Service periods outlined below are for normal service and average operating conditions. For extreme load conditions or abnormal operating conditions, service more frequently.

DAILY SERVICE

If the engine is operated more than 8 hours daily, perform the following services every 8 hours or as indicated.

FUEL. - Check the gasoline supply. The 2 quart tank mounted on the manual start plants holds sufficient gasoline for approximately 3-1/2 hours operation at full load. Do not fill the tank while the plant is running.

OIL LEVEL. - Check the oil level by removing the crankcase oil fill plug and making visual inspection. The oil should be between the top thread of the hole and the ledge of the oil fill boss. Add oil as needed.

CLEANING. - Keep the engine and generator as clean as practicable. Clean the air cleaner if dusty conditions prevail.

WEEKLY SERVICE

If the plant is operated more than 50 hours weekly, perform the following services every 50 hours.

LUBRICATION. - Change the crankcase oil each 100 operating hours when using undiluted oil. If the plant is operating on diluted oil change the oil after 50 operating hours. Put a drop of oil, same as used in the crankcase, on each joint of the governor arm to throttle link.

AIR CLEANER. - Clean the air cleaner screen in gasoline or other suitable solvent. Dry and lightly oil before reinstalling on the carburetor.

BATTERY. - If the plant uses a starting battery, be sure that all connections are clean and tight. Keep the electrolyte at the proper level, 3/8" above the separators, by adding only clean approved battery water. Check the charge condition of the battery before adding any water.

SPARK PLUG. - Keep the spark plug gap adjusted to 0.024 to 0.026 inch. Clean and adjust as necessary.

MONTHLY SERVICE

If the plant is operated more than 200 hours monthly, perform the following services every 200 hours.

FUEL SYSTEM. - Drain the fuel from the tank and remove the shut-off valve from the tank. Thoroughly clean the strainer screen and replace the valve assembly. Clean the carburetor of sediment. Be sure all connections are tight.

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

ENGINE COMPRESSION. - A compression test may be used to help in diagnosing the general condition of the engine. See MAINTENANCE and REPAIR.

CARBON REMOVAL. - Regular removal of carbon deposits from the combustion chamber helps to keep engine efficiency high. More frequent carbon removal may be necessary if a highly leaded gasoline is used. Remove the cylinder head and scrape carbon deposits from the cylinder head, top of piston and valves and top surface of the cylinder block.

MAGNETO BREAKER POINTS. - Contact points which are not badly pitted or burned may be resurfaced on a fine stone or hone. If the contact points are pitted or burned deeply replace with new ones. Keep the point gap adjusted to 0.018 to 0.022". Excessive arcing and burning of the contact points is an indication of a defective condenser, which should be replaced with a new one.

ANTI-FLICKER BREAKER POINTS. - Keep the point gap adjusted to 0.023 to 0.025 inch. Follow the principles of care as given above for the magneto points.

GENERATOR. - Check the condition of the commutator, slip rings and brushes. Clean, repair, or replace as necessary. Check the brush rig for proper alignment of the witness marks on the brush rig and generator frame.

GENERAL. - Give the plant a thorough inspection for oil leaks, loose electrical connections, loose screws, nuts etc. Make any necessary repairs.

CONTROLS (ELECTRIC START PLANTS). - Keep the control box free of dust and dirt. Clean relay contacts with a soft cloth. Replace any part which fails to function properly.

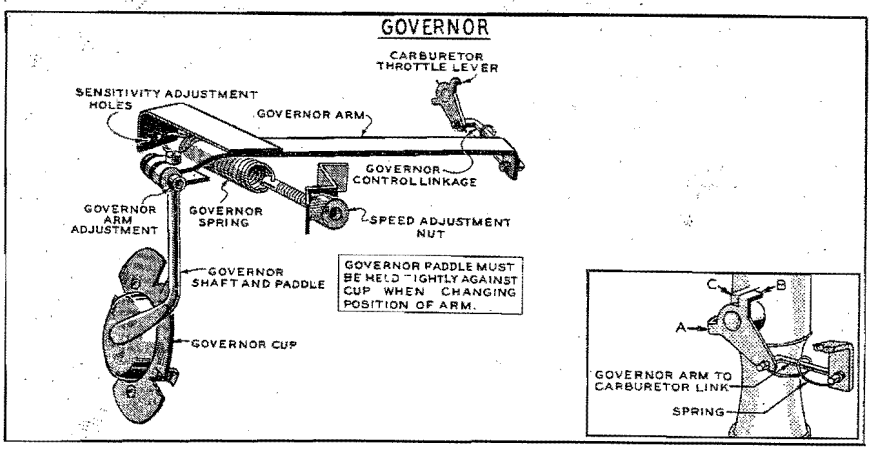
ANTI-FLICKER MECHANISM. - Breaker points and a field resistor are used to compensate for a surge in the voltage during the power stroke of the engine. The breaker points are located in a recess just below the valve chamber. The resistor is mounted on the brush rig. The breaker points gap should be kept at 0.023 to 0.025 inch. To adjust the resistor, apply the average load to the plant. Loosen the sliding clip on the resistor and, while watching a light connected to the plant load, slide the clip to the position where the least flicker occurs. Tighten the clip in this position.

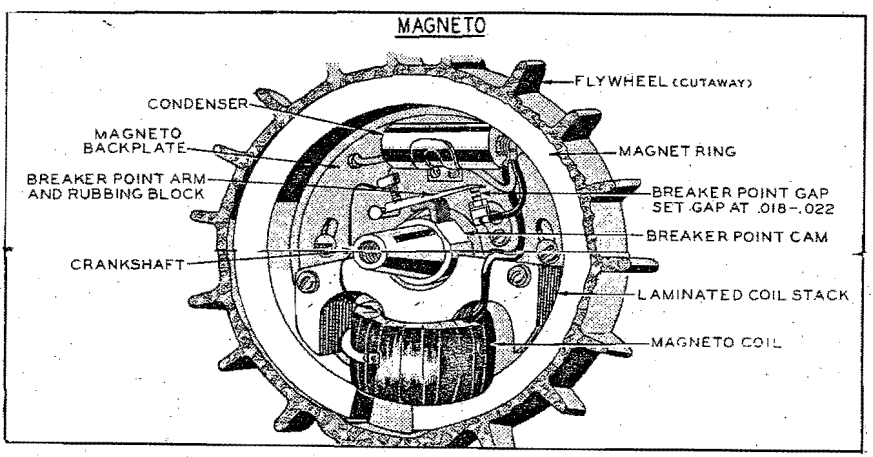
CARBURETOR. - A change in the grade of fuel used, or in operating conditions may necessitate a readjustment of the carburetor. If the carburetor has been removed for cleaning, set the adjusting screw 1-1/2 turns open, which will permit starting. Never force the adjusting screw in tightly to its seat. Allow the plant to warm up thoroughly. Adjust the carburetor with a full load on the plant. The choke must be in the fully open position. Turn the adjusting screw in (clockwise) slowly until the engine begins to lose speed from lack of fuel, then slowly turn the screw outward (counterclockwise) until the plant will carry the full load. The single adjustment gives the proper fuel mixture for both full load and no load operation.

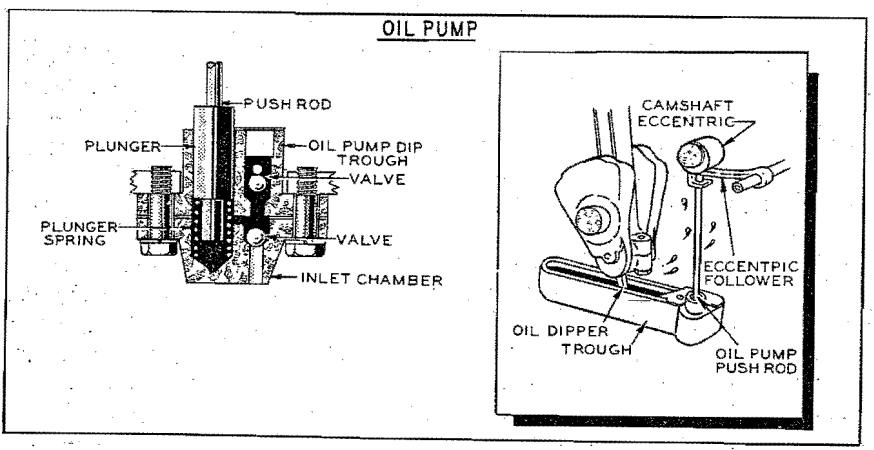
GOVERNOR. - If the governor arm has been loosened or removed from the shaft extending upward from the gear cover, or if the carburetor has been removed for servicing, reset the governor arm as follows. Remove the small cover plate from the side of the blower housing and loosen the governor arm clamp screw. Push the governor arm in toward the cylinder as far as possible, thus closing the carburetor throttle. Hold the arm in this position and use a screwdriver to turn the governor shaft clockwise as far as possible. Tighten the clamp screw just enough to cause it to bind slightly on the shaft. Slowly pull the governor arm outward, away from the cylinder, until the carburetor throttle arm stop ear is about 1/8" from the stop projection on the carburetor casting. Securely tighten the clamp screw, locking the arm in this position. Move the arm in and out several times to determine that there is no binding or jerking action. See that the link and its spring are properly installed. The speed of the engine determines the frequency of the generator output, and for the 60 cycle plant should be approximately 1800 rpm (1500 rpm for 50 cycle plants). To increase the speed, turn the spring tension nut clockwise, and to decrease the speed turn the nut counterclockwise.

If there is a tendency of the governor to hunt (alternately increase and decrease speed), check first for sticky carburetor throttle action, or a too lean fuel mixture. It may be necessary to change the position of the governor spring so that the inner end of the spring is located farther from the governor shaft. Three holes are provided for the spring. The ability of the governor to keep the speed constant under various loads (regulation) is better with the spring closer to the governor shaft, but

the tendency to hunt is increased also. Keep the spring in the hole giving the best regulation with no hunting.







GENERAL. - The plant should be carefully inspected and all necessary repairs made by a competent person who is thoroughly familiar with modern engines and generators. Maintain factory clearances as given in the TABLE OF CLEARANCES. Reference may be made to the TROUBLES AND REMEDIES section for assistance in locating and correcting troubles which may occur.

A compression test will help to ascertain the general condition of the engine. A competent mechanic can determine from such a test if a loss of compression is due to leaking valves, worn piston rings, or other causes. New engine compression, when hand cranked, is 60 pounds at sea level.

ENGINE

CARBURETOR. - Carburetor maintenance should consist of regular cleaning. Dirt lodging in the fuel valve and seat assembly may cause flooding or leaking of the carburetor. A bent or leaky float ball will cause a rich fuel mixture. Use compressed air to clean passages. Be sure the throttle assembly works freely. When reassembling the carburetor, make certain that the small hole near the edge of the gasket lines up with the hole in the body castings.

VALVE TAPPETS. - The piston should be at the top of the compression stroke when adjusting the tappet clearances. The flywheel is marked "TC" to denote when the piston is at the top of the stroke. This mark must line up with the mark on the gear cover. Adjust the tappets with the engine cold. The intake valve tappet clearance is 0.008" to 0.010". The exhaust valve tappet clearance is 0.010" to 0.012". Be sure the lock nuts are tight on the adjusting screws after adjustments are completed.

VALVE GRINDING. - Do not use a pry to loosen the aluminum cylinder head. Rap sharply on the edge with a soft faced hammer. Clean all carbon from head, piston top, valves, guides, etc. Valve seat angle is 45^{o}. Both valve faces are 44^{o}. Replace a badly burned or warped valve, refacing any old one to be reused. Lightly grind each valve to its respective seat. Be sure to clean all traces of grinding compound from engine parts. Lightly lubricate valves when reassembling. Check the tappet clearance before starting the plant, and again after approximately 10 hours operation.

PISTON RINGS. - Remove the cylinder from the crankcase to service the piston and rings. The ring gap for each ring should be between 0.007" and 0.012" when the ring is placed in the crankcase end of the cylinder. If the cylinder bore is worn more than 0.005", it is advisable to install a new cylinder, or refinish the old one to accomodate an oversize piston. Pistons are available in 0.010", .020" and .030" oversizes. Piston rings are available 0.010", 0.020", 0.030" oversizes. Use standard rings on the 0.005" oversize piston. Be sure that oil

return holes in the piston oil ring groove are open. Rings of the tapered type will be marked "TOP", or identified in some other manner, and the ring must be installed with this mark toward the closed end of the piston. Space the ring gaps 1/3 of the way around the piston from each other.

CONNECTING ROD. - If the connecting rod is removed, mark the rod to assure reassembly with the same side facing the camshaft. The clearance to the crankshaft journal may be reduced by carefully dressing the connecting rod cap.

FLYWHEEL. - The combination blower and flywheel may be removed in the following manner, after first removing the blower housing. Loosen the flywheel retaining cap screw two full turns. Insert a pry behind the flywheel and, while prying the flywheel forward, strike the cap screw a sharp endwise blow. The flywheel and crankshaft are tapered, a key preventing the flywheel from turning on the shaft. Do not drop the flywheel, as the magnet ring may become demagnetized.

OIL SEALS. - The gear cover oil seal is graphited cork ring which is cemented in place. Rear oil seal must be replaced when it leaks or a major overhaul has been made.

The rear oil seal is a metal enclosed leather type which is pressed into the crankcase. When installing the oil seal, avoid turning back or injuring in any way the thin leather edge which contacts the crankshaft. Apply a sealing compound around the outer surface of the oil seal at the point where it contacts the crankcase.

IGNITION SYSTEM. - The magneto supplies high tension current to the spark plug at the proper instant to ignite the fuel mixture in the cylinder. To test the spark, disconnect the wire from the spark plug and support the wire end 3/16" from a clean metal part of the engine. The spark should jump this 3/16" gap with ease when the plant is manually cranked. Failure to produce a good spark may be due to a defective condenser, burned contact points, or a defective coil. The stator coil and pole shoe assembly should not be distrubed unless it is necessary to install a new coil. When installing a new coil and pole shoe, make sure that the pole shoe clears the flywheel magneto ring with a clearance of 0.007" to 0.010". Too great a clearance will produce a weak spark. When installing new contact points, see that they meet squarely when closed, and that the gap when fully open is 0.018" to 0.022". Points which are only slightly burned may sometimes be reconditioned by carefully dressing them on a fine stone. Check the ignition timing after reconditioning old points or installing new ones. See the paragraph, TIMING THE IGNITION. A defective condenser may cause a complete failure to produce a firing spark, or may merely cause a weak spark and rapid burning of the contact points.

See that the insulation on all leads is in good condition, and that mounting screws are tight at all times.

Clean the spark plug in a standard plug cleaning machine, and keep the gap adjusted at 0.024" to 0.026".

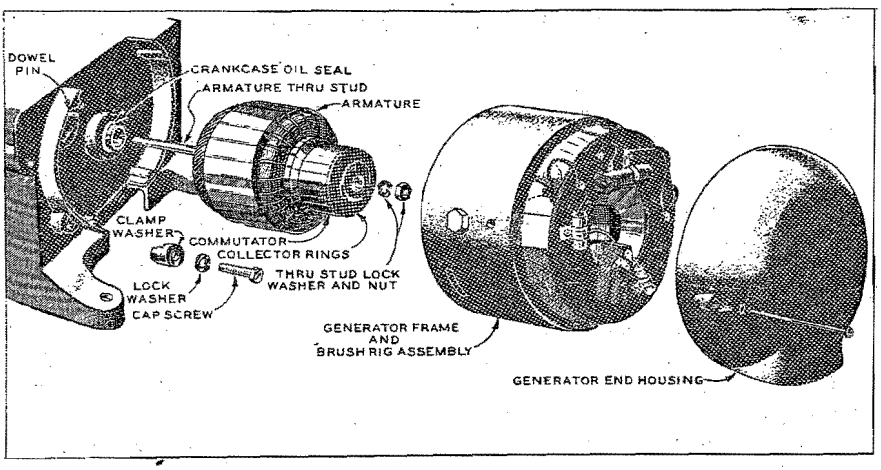
COOLING. - It is of vital importance that cooling fins be kept free of dust and dirt and that the blower housing and cylinder air housing parts be undamaged and in place.

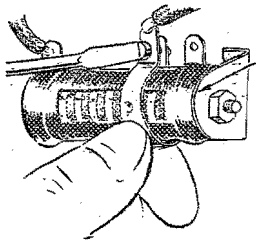
TIMING GEARS. - The crankshaft gear may be pulled from the crankshaft after first removing the large retaining nut and washer. Remove the camshaft and gear as an assembly while raising the valve tappets and the oil pump follower so they will clear the cams and rear bearing. The camshaft gear is keyed and pressed on to the camshaft. Install both gears new when replacement of either is required.

GEAR COVER. - When installing the gear cover, turn the governor shaft counterclockwise (when looking at the top of the shaft) as far as possible, holding it in this position until the gear cover is located properly on the dowel pins. Be careful not to cut front oil seal.

BEARINGS. - Crankshaft main and camshaft bearings are pressed into the crankcase, after which they are line reamed to the correct size. Crankshaft bearings must be installed with the oil hole at the top and with the groove pointing away from the oil hole in the direction of crankshaft rotation.

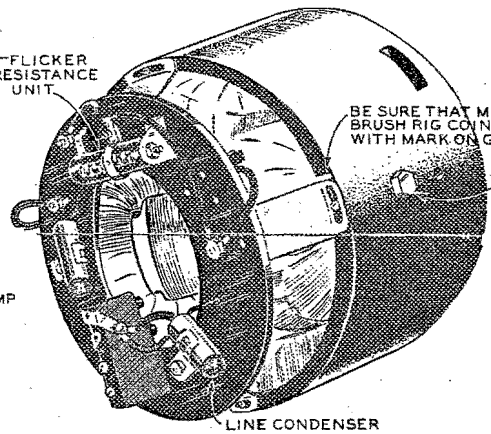
TIMING THE IGNITION. - With the flywheel removed, set the breaker point gap to 0.018" to 0.022". Mount the flywheel loosely on the crankshaft and turn until the piston is rising on the compression stroke. Align the 25° timing mark on the flywheel with the mark on the gear cover. Remove the blower wheel and loosen the magneto back plate mounting screws just enough to permit turning the plate. Turn the plate clockwise as far as it will go. Slowly turn the plate counterclockwise until the contact points just separate. If available, use a timing light for accuracy. Tighten the backplate mounting screws and check the work before reassembling.

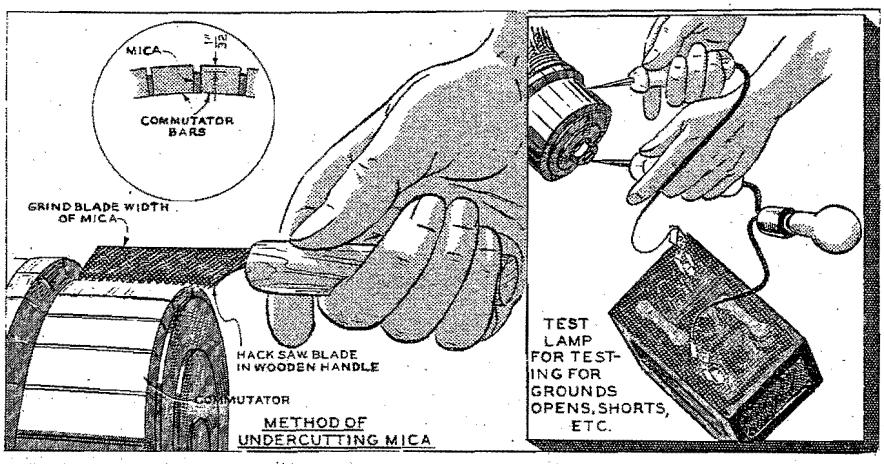




FLICKER RESISTANCE UNIT

TO ADJUST FLICKER RESISTANCE LOOSEN CLIP ON UNIT AND SLIDE ALONG WHILE WATCHING THE LIGHTS. CLAMP CLIP IN POSITION WHERE LEAST FLICKER OCCURS. BE SURE TO ADJUST ONLY WHEN AVERAGE LOAD IS ON PLANT.





FIGS.

TABLE OF CLEARANCES

	MINIMUM	MAXIMUM
Valve Tappet, Intake - Cold	0.008"	0.010"
Valve Tappet, Exhaust - Cold	0.010"	0.012"
Valve Seat Width	3/64"	5/64"
Valve Stem in Guide	0.0015"	0.003"
Crankshaft Main Bearing	0.0015"	0.0025"
Connecting Rod Bearing	0.0015"	0.003"
Connecting Rod End Play	0.005"	0.007"
Crankshaft End Play	0.006"	0.008"
Camshaft Bearing	0.0015"	0.0025"
Piston to Cylinder	0.0045"	0.006"
Piston Pin in Piston	Hand Push Fit	
Piston Pin in Connecting Rod	Thumb Push Fit	
Piston Ring Gap	0.007"	0.012"
Anti-Flicker Breaker Points	0.023"	0.025"
Magneto Breaker Points	0.018"	0.022"
Spark Plug	0.024"	0.026"
Ignition Timing	24°BTC	26°BTC
Flywheel Bolt Torque - Lbs. Ft.	25	30
Connecting Rod Bolts Torque - Lbs. Ft.	12	13
Cylinder Head Nuts Torque - Lbs. Ft.	23	25

GENERATOR

The generator normally requires little servicing other than periodic attention to the brushes, commutator and collector rings.

COMMUTATOR AND COLLECTOR RINGS. - After the generator has been in service a short time the commutator and collector rings acquire a glossy brown color, which is a normal condition. Do not attempt to maintain a bright, metallic newly machined appearance. If the commutator or collector rings become heavily coated, clean with a good cleaning solvent. Very fine sandpaper (#00) may be used to remove slight roughness. Never use emery or carborundum cloth or paper, particles of which may lodge in the commutator slots and cause a short circuit. Wipe carbon dust away when servicing the generator.

After a long period of service, the surface of the commutator may become worn to such an extent as to cause the mica insulation between the commutator bars to extend slightly above the level of the bars. This condition would cause noisy brush action, excessive brush sparking and wear and pitting of the commutator bars. High mica must be undercut to a depth of approximately 1/32", or equal to the distance between bars.

Remove the generator frame and brush rig as a unit. With a tool fashioned from a hack saw blade, carefully undercut the mica. Use care not to scratch the surface of any bar, and be sure to remove any burrs which may be formed along the edges of the bars. See that spaces between bars are completely free of any metallic particles before reassembling the generator.

Should dusty operating conditions cause the surface of the commutator or collector rings to become grooved, out of round, pitted or rough, it will be necessary to remove the armature and turn the commutator or collector rings down in a lathe. After the commutator is turned down, the mica between bars must be undercut as described above.

BRUSH RIG. - It is unnecessary to remove the brush rig from the generator frame when servicing the generator. If it has been removed mistakenly, be certain to line up the paint mark on the brush rig with the mark on the edge of the generator frame. A deviation from the proper positioning of the brush rig will lead to excessive arcing of the brushes, burning of the commutator, low generator output, and possible irreparable damage to armature windings. A defective condenser or resistance unit should be replaced with a corresponding new unit.

BRUSHES. - Install new commutator brushes when the old ones are worn to approximately 5/8" in length. The round collector ring brushes should be replaced with new ones when worn to approximately 1/4" in length, measured from the spring ledge of the brush. Do not continue to use brushes that are worn too short, as the spring tension lessens as the brush becomes shorter, and weak spring tension leads to excessive brush sparking and pitting of the commutator or collector rings. Make certain that brushes ride freely in their guides and that spring tension is uniform. Proper spring tension is 16 oz. to 18 oz. for both the commutator and collector ring brush springs. Measure spring tension with the spring even with the outer end of the brush guide.

GENERATOR WINDINGS. - Use a continuity type test lamp set to test for grounded or open circuits in the generator windings. Be sure that all brushes are lifted from contact with the commutator and collector rings, and that leads are disconnected when making the tests. When disconnecting leads, tag them to facilitate correct replacement.

The generator frame is connected to the engine crankcase by two heavy clamps and bolts. When removing the frame assembly, use care not to allow its weight to rest on the armature, which might throw the armature out of alignment. To remove the armature, loosen the armature stud nut so it is flush with the end of the stud, pull out on the armature and strike a sharp blow with a soft faced hammer on the end of the stud. The armature end is tapered to fit the engine crankshaft. Use care not to bend the stud which extends through the hollow armature shaft. After

removing the stud nut and washers, carefully slip the armature off.

Use an armature growler to test the armature for an internal short circuit. Field coil windings may be tested for an internal short circuit by comparative ohmeter readings. Condensers should be tested on approved condenser testing equipment.

If the tests indicate one or more of the field coils to be grounded, short circuited, or open circuited, install a new set of field coils. If the armature windings test open circuited, short circuited or grounded, install a new armature. Leads may be repaired or replaced as necessary.

When reinstalling the armature, make certain that the run-out at the outer end does not exceed 0.002". Excessive run-out may be due to a nick or dirt on the taper of either the crankshaft or armature shaft.

CONTROLS

CONTROL BOX EQUIPMENT. - No attempt should be made to repair such units as switches, resistors or receptacles. Keep the contact points of relays clean with a lint free cloth. Do not use a file or sandpaper on the contacts. Keep connections clean and tight. Inspect all leads for worn insulation. Replace with a new one any defective condenser. See that the battery is disconnected from the plant whenever working on any control panel equipment.

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 RAPIDLY ACCELERATED 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.
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.

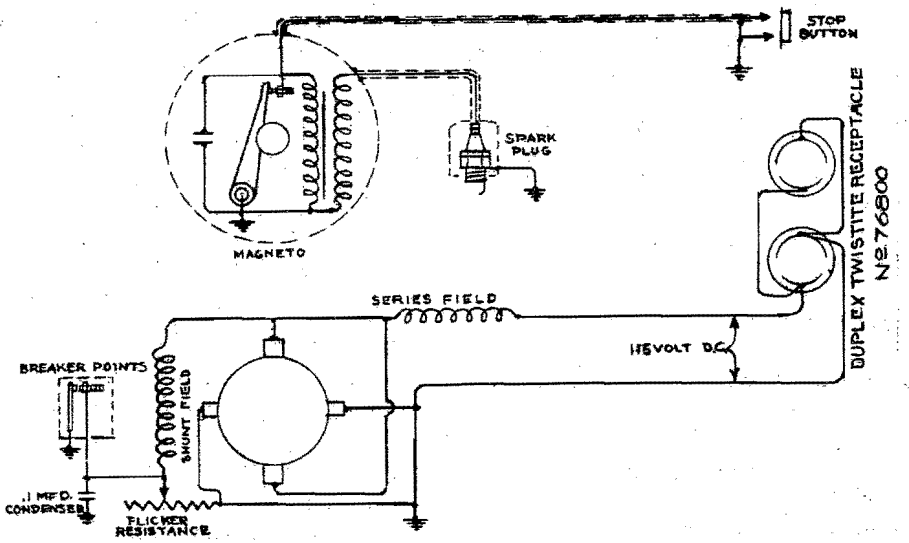
POSSIBLE CAUSE	REMEDY
LIGHT DIM AT FAR END OF LINE BUT BRIGHT NEAR POWER PLANT	
Too small line wire for load and distance.	Install larger or extra wires or reduce load.
ELECTRIC MOTOR RUNS TOO SLOWLY AND OVERHEATS AT FAR END OF LINE BUT OK IF USED NEAR POWER UNIT	
Too small line wire for load and distance.	Install larger or extra wires, or reduce load.
GENERATOR OVERHEATING	
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.
Carburetor air cleaner.	Clean.
Choke.	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 magneto.

POSSIBLE CAUSE	REMEDY
ENGINE MISFIRES AT LIGHT LOAD (Cont.)	
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.
Defective spark plug cable.	Replace.
EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST	
Poor compression, usually due to leaking valves.	Tighten cylinder head and plug. If still not corrected, grind or replace valves.
Oil leaks from oil base or connections. This does not cause smoky exhaust.	Replace gaskets. Tighten screws and connections.
Oil too light or diluted.	Drain, refill with correct oil.
Worn engine.	Repair as necessary.
Engine misfiring.	Refer to symptoms of engine misfiring.
Faulty ignition.	Clean, adjust, or replace breaker points, plug, condenser, etc., or retime magneto.
Unit operated at light or no load for long periods.	No remedy needed.
Too much oil.	Drain excess oil.

POSSIBLE CAUSE	REMEDY
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.
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.
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.

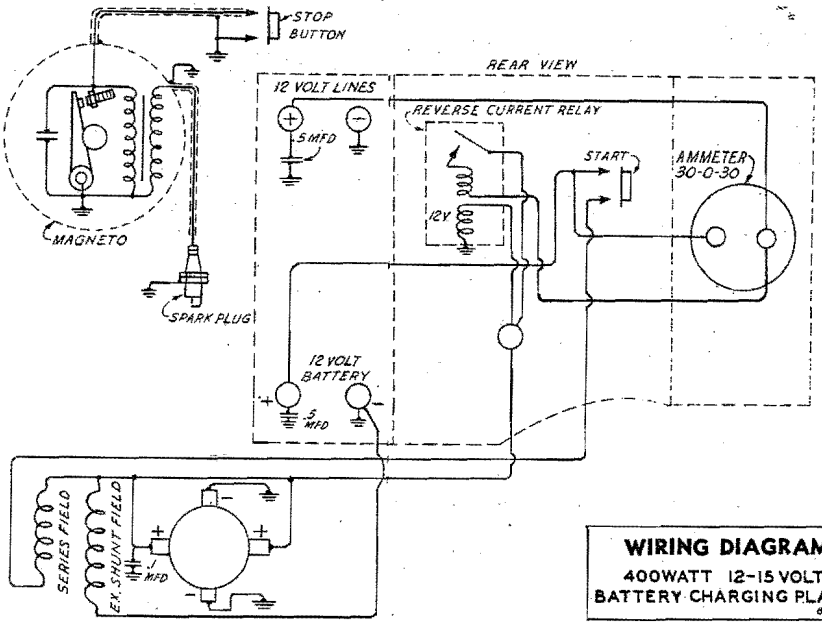
POSSIBLE CAUSE	REMEDY
ENGINE WILL NOT START WHEN CRANKED (Cont.)	
Poor fuel.	Drain, refill with good fuel.
Poor compression.	Tighten cylinder head and spark plug. If still not corrected, grind the valves. Replace piston rings, if necessary.
Wrong timing.	Reset breaker points or retime magneto.
ENGINE 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", and have good spring tension.
Open circuit, short circuit, or ground in generator.	See GENERATOR. Replace parts necessary.
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 holders, are not worn shorter than 5/8", 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.

POSSIBLE CAUSE	REMEDY
NOISY BRUSHES	
High mica between bars of commutator.	Undercut mica.
EXCESSIVE ARCING OF BRUSHES	
Rough commutator or rings.	Turn down.
Dirty commutator or rings.	Clean.
Brushes not seating properly.	Sand to a good seat.
Open circuit in armature.	Replace.
Brush rig out of position.	Line up properly.

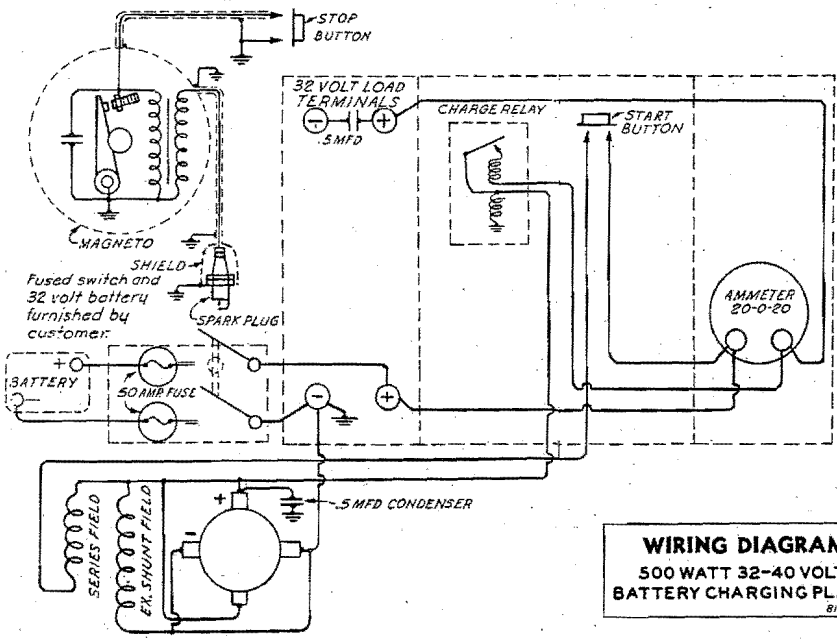


600 WATTS
115 VOLTS
DIRECT SERVICE

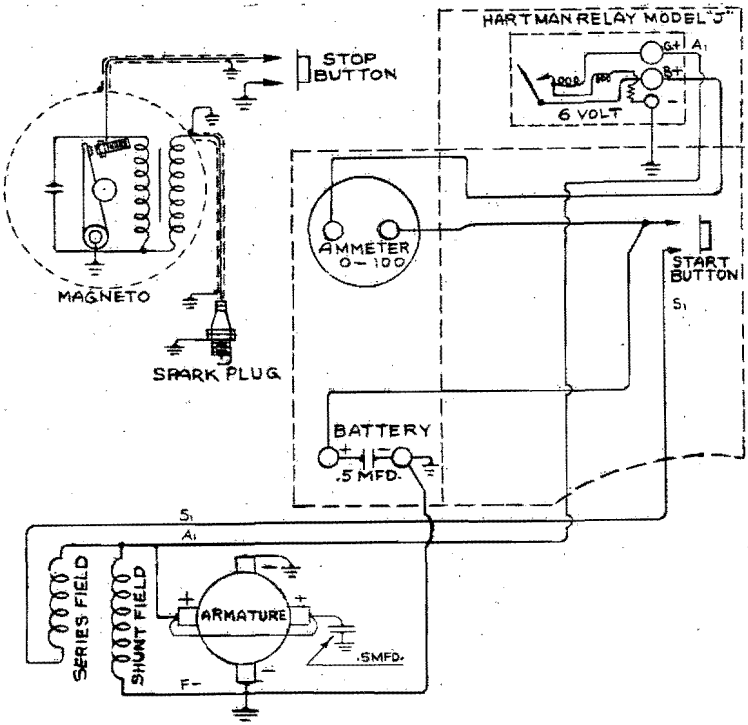
80036

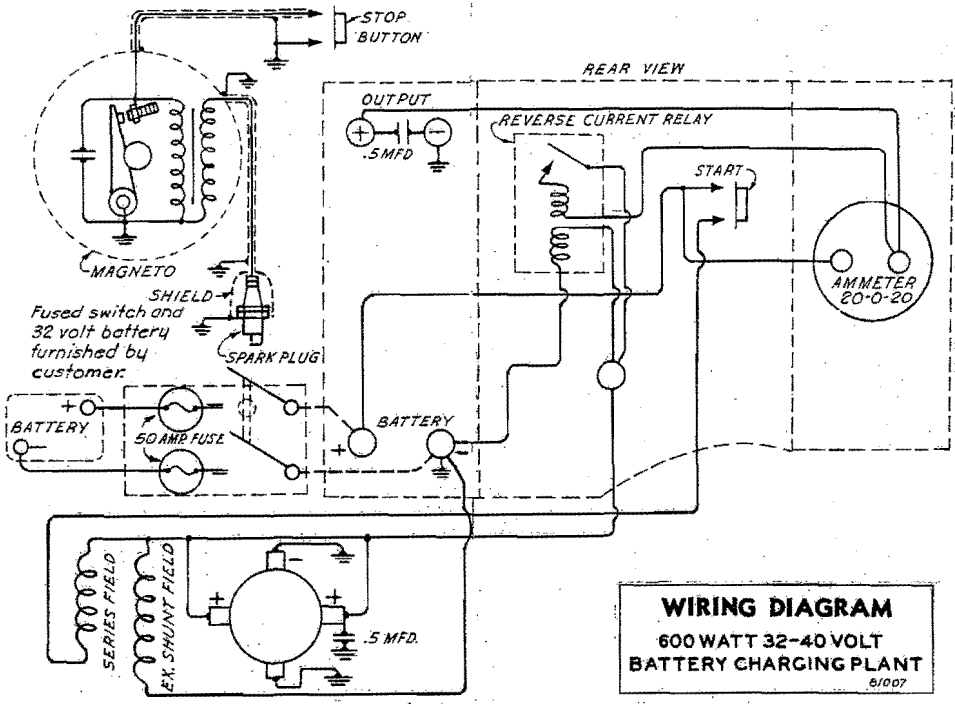


WIRING DIAGRAM
400WATT 12-15 VOLT
BATTERY CHARGING PLANT
81052



WIRING DIAGRAM
500 WATT 32-40 VOLT
BATTERY CHARGING PLANT
81001

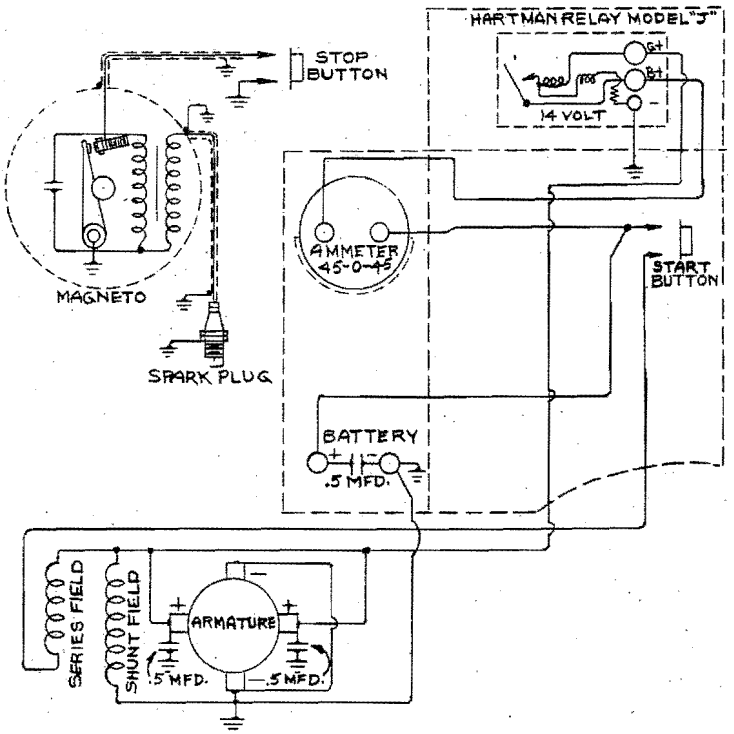




WIRING DIAGRAM

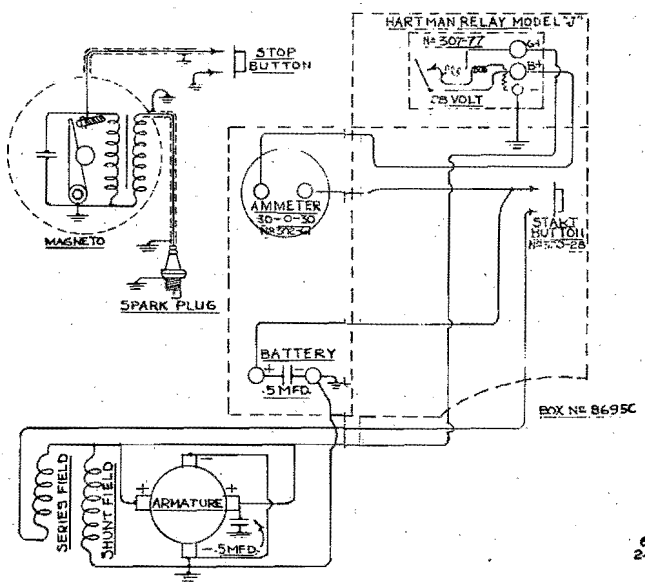
600 WATT 32-40 VOLT BATTERY CHARGING PLANT

81007



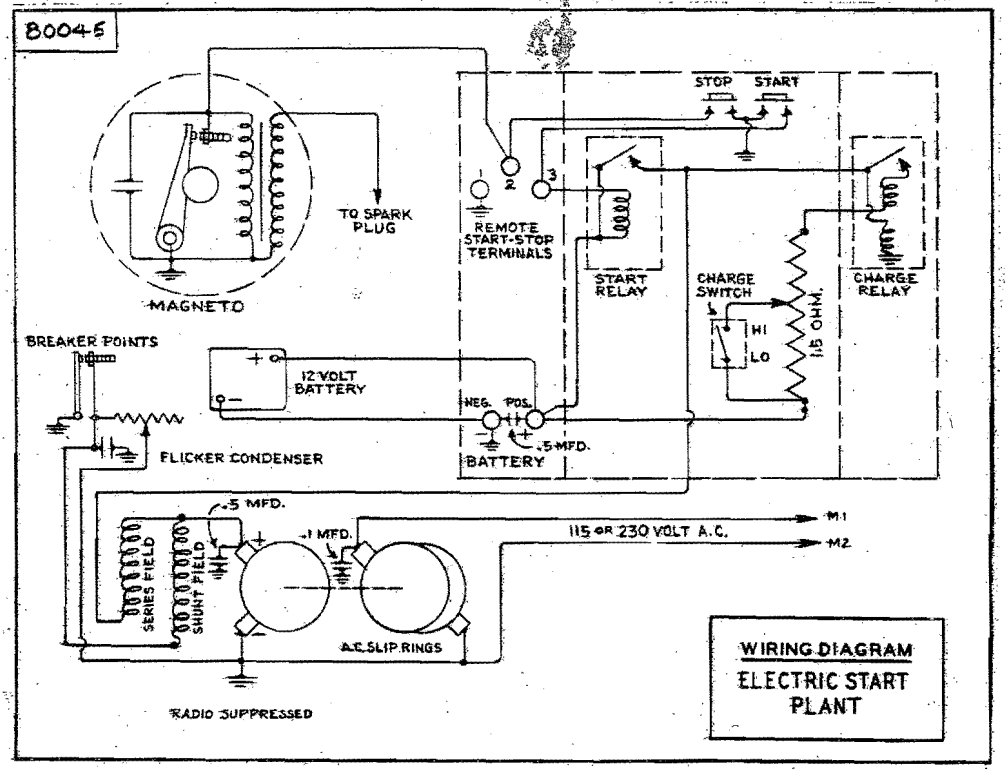
600 WATTS
12-15 VOLTS

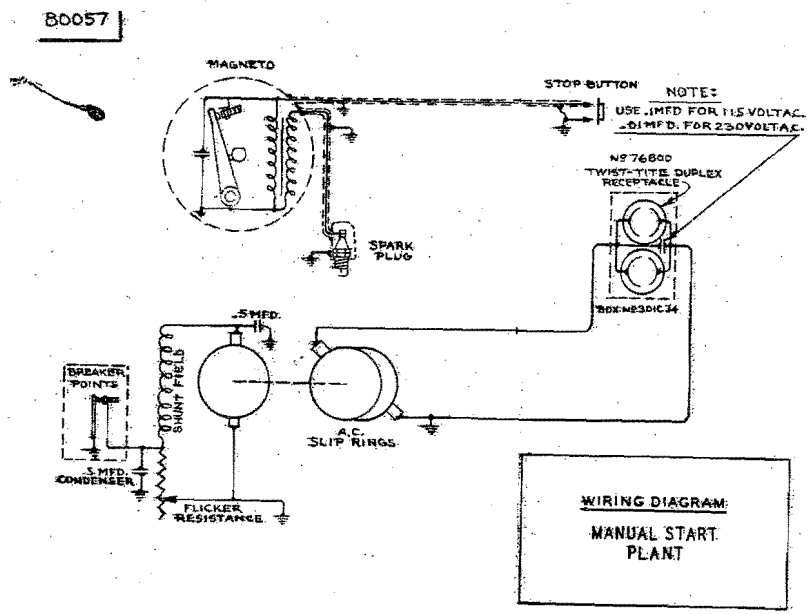
81013



600 WATTS
24-28 VOLTS

81016


B0045
MAGNETO
TO SPARK PLUG
REMOTE START-STOP TERMINALS
STOP
START
START RELAY
CHARGE SWITCH
HI
LO
115 OHM.
CHARGE RELAY
BREAKER POINTS
12 VOLT BATTERY
NEG.
POS.
.5 MFD.
BATTERY
FLICKER CONDENSER
.5 MFD.
.1 MFD.
SERIES FIELD
SHUNT FIELD
A.C. SLIP RINGS
115 OR 230 VOLT A.C.
M1
M2
RADIO SUPPRESSED
WIRING DIAGRAM
ELECTRIC START
PLANT


B0057
MAGNETO
STOP BUTTON
NOTE:
USE .1MFD FOR 115 VOLT A.C.
.05 MFD. FOR 230 VOLT A.C.
No 76800
TWIST-TITE DUPLEX RECEPTACLE
BOX-NB3DIC34
SPARK PLUG
.5 MFD.
BREAKER POINTS
SHUNT FIELD
.5 MFD. CONDENSER
FLICKER RESISTANCE
A.C. SLIP RINGS
WIRING DIAGRAM:
MANUAL START
PLANT