INSTRUCTION MANUAL

ONAN ELECTRIC GENERATING PLANTS

Series

AJ

Specification A

Alternating Current Models
Battery Charging Models

D. W. ONAN & SONS INC. MINNEAPOLIS 14, MINNESOTA

924-1 .....


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GENERAL INFORMATION

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

KEEP THIS BOOK HANDY. - Such simple mistakes as the neglect of routine servicing may result in the failure of the generator at a time when it is urgently needed. It is suggested that this book be kept near the generator 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, and Serial number of the plant. This information is absolutely necessary and may be obtained from the nameplate of the plant.

MANUFACTURER'S WARRANTY

The manufacturer warrants each new generator 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 (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 generator or such generator 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 is in lieu of all other warranties expressed or implied.

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO GENERATOR.

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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.

ORIENTATION

INTRODUCTION. - This instruction manual is supplied to assist in the proper installation, operation, and servicing of the AJ series electric generating plants. Unless otherwise stated, these instructions apply to all standard plants of the AJ series.

Electrical output characteristics of the plant appear on the nameplate, along with the serial numbers and model designation. When written together, the plant model and specification number are separated by a diagonal (/). The plant specification number consists of a Spec. Number which indicates optional equipment as desired by the purchaser, and of a Spec Letter which is advanced to coincide with a production modification by the manufacturer. Reference to the nameplate information is necessary for the operator to select the instructions in this manual which apply to the particular model in question.

Some details of these instructions may not apply to special models having modifications specified by the purchaser. Due to the wide variety of uses for which these plants are suitable, these instructions must be of a general nature. The use of auxiliary or special equipment, special installation requirements, or unusual operating conditions may require the operator of this generating plant to modify these instructions. However, by using the instructions and recommendations given in this manual as a general guide, it will be possible to make a good installation, and to properly operate and maintain the plant.

The engine end is designated as the "Front End" of the plant and the carburetor side is designated as the "Left Side" of the plant.

GENERAL DESCRIPTION

Each AJ generating plant is a complete electric power plant, consisting of an internal combustion engine, and a self excited electric generator, directly connected to the engine. Controls and accessories suitable for a normal installation and according to the particular model are supplied.

Each generating plant is given an actual running test at the factory and is carefully checked under various electrical load conditions before shipment, to assure that it is free of any defect and that it meets all performance requirements. Inspect the plant carefully for any damage which may have occurred in shipment. Any part so damaged must be repaired or replaced before putting the plant into operation.

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

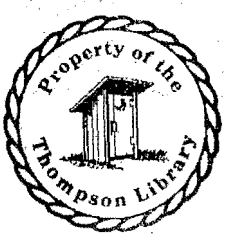
The manual type of plant is designed for applications where portability is important. A pull rope serves for hand cranking, and the plant can not be connected to batteries for electric cranking. A mounted fuel tank is provided. A convenient locking type output receptacle provides for quick connection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

The remote control type of plant is designed for applications where the installation will be more or less permanent. NEVER OPERATE THE PLANT DESIGNED TO USE STARTING BATTERIES UNLESS THE BATTERY IS PROPERLY CONNECTED TO THE PLANT. When properly connected to a 12-volt battery (or two 6-volt batteries in series), the plant may be cranked electrically at the plant, from one or more remote control switch locations, or through automatic controls. In the event of failure of the starting battery current, the plant may be started manually. The remote control type plant has a built-in charging circuit for keeping the starting battery in a well charged condition. 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.

BATTERY CHARGING PLANTS. - The battery charging type plant supplies direct current (d.c.) and 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. Charge rate is manually controlled by adjustment of the engine governor which controls the speed of the engine. Battery charging generators and controls are designed for either GROUNDED or UNGROUNDED systems, at the option of the user.

ALL PLANTS. - The net weight of the plant is approximately 160 pounds or less, and requires a shipping container of approximately 10 cubic feet.

Standard models use gasoline fuel. Certain special models are equipped for burning gas fuel.



ENGINE DETAILS

The engine is a vertical single cylinder, four stroke cycle, air cooled, L head, internal combustion type. The cylinder bore is 2-3/4 inches, the stroke 2-1/2 inches, piston displacement 14.9 cubic inches, compression ratio 6.25 to 1, the rated horsepower at 1800 rpm is 2.75, at 2400 rpm is 3.6 and at 3600 rpm is 5.0. The cast iron cylinder and crankcase is a single casting and described as a cylinder block.

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 1800 rpm for 60 cycle, 4 pole generator; 3600 rpm for 60 cycle, 2 pole a.c. plants. For d.c. plants, the preferred speed is approximately 2400 rpm and is quickly adjustable for controlling the charge rate. Ignition current is supplied by a high tension, flywheel type magneto. The ignition system is shieldedfor suppression of radio interference noise. The engine is cooled by air forced around the cylinder walls and head. Plants which are "pressure cooled" have blower fins on the flywheel which draw air in through the opening at the front of the blower housing. Special models may be "vacuum cooled or suction cooled" and have blower fins which expel heated air out through the duct at the front of the blower housing, as desirable for small enclosure installations.

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 2 quart (U.S. Measure) oil base and cylinder head are removable for servicing the engine. Positive splash type lubrication is employed on most models except on certain speed models, a gear type pump provides pressure lubrication to main and connecting rod bearings.

The horizontal draft carburetor on the 3600 rpm plants has a larger venturi than on other models.

The exhaust valve is stellite faced, seats on a stellite replaceable seat, and a positive rotator for the exhaust valve provides long trouble free performance. Tappets are adjustable self-locking.

GENERATOR DETAILS

All generators of this series generating plants are revolving armature, self excited type. All have four poles except 3600 rpm a.c. plants have two poles. 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 a.c. and d.c. 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 BATTERY CHARGING GENERATORS. - The battery charging type generator field is shunt wound and has an additional series winding which permits use of the generator as a motor for cranking the plant.

CONTROLS

AC 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.

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-start switches. Automatic or line failure transfer equipment may be connected to the plant. The carburetor is automatically choked for starting. The control box is mounted over the generator and 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 electrical starting at the plant. The control box is mounted over the generator and contains a start switch, a reverse current relay, start solenoid, a charge rate ammeter, start switch, stop switch, and battery terminals. The battery charge rate is adjustable by changing the governed speed. The carburetor on electric start models is manually choked while on models modified for remote starting the carburetor is electrically choked.

STANDARD ACCESSORIES

(Subject to change.)

MANUAL TYPE PLANT. - Manual type plants are supplied with a starting rope, muffler, instruction manual.

AC REMOTE CONTROL PLANT. - The a.c. remote control plant is supplied with the same accessories as the manual type plant, and in addition is supplied with a separate

5 gallon fuel tank with connecting fuel line, a flexible exhaust tube, 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.

OPTIONAL ACCESSORIES

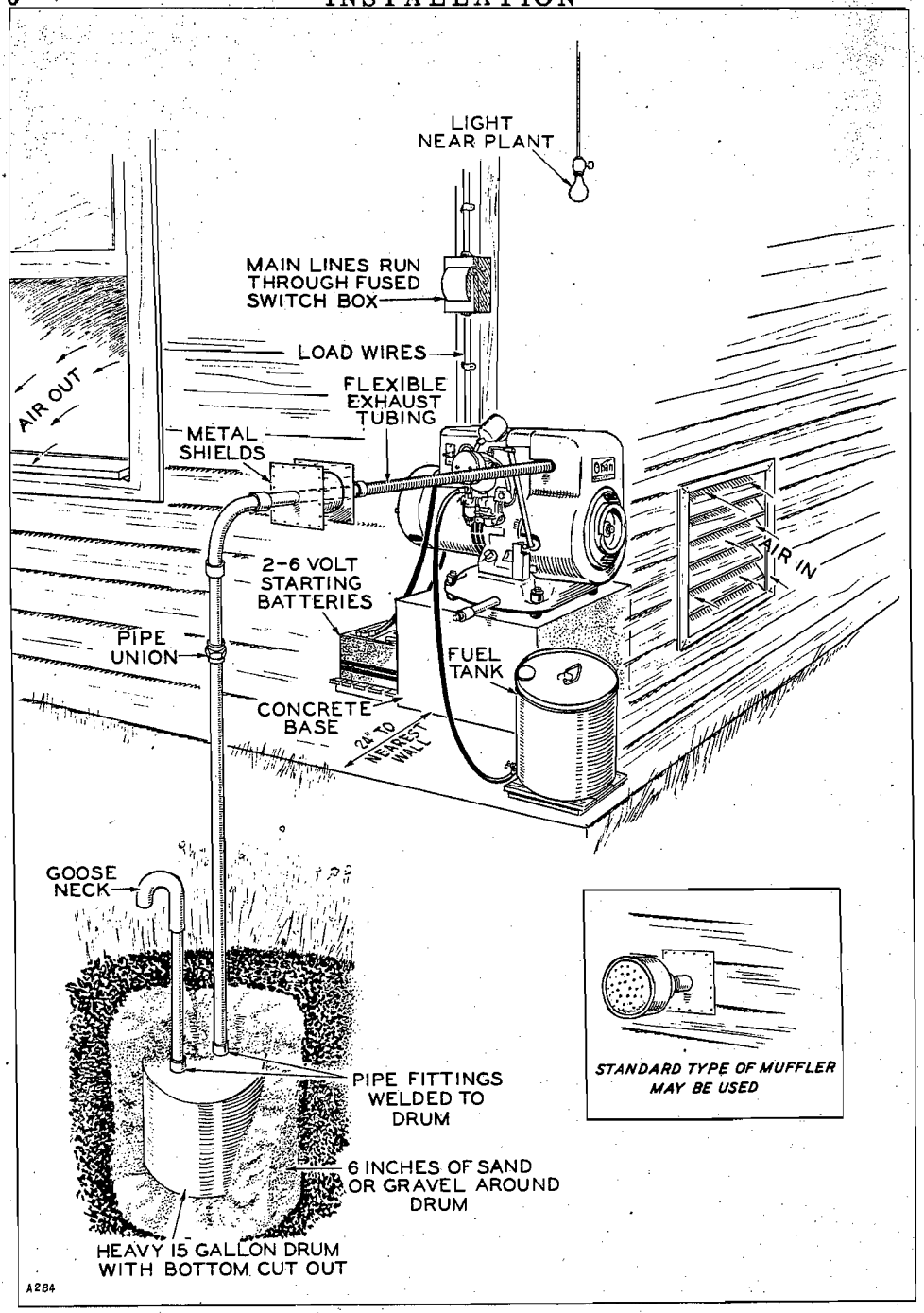
PULL-ROPE RECOIL STARTER KIT. - For added convenience and easier hand-starting, a Pull-Rope Recoil Starter Kit is available which can be easily aligned concentric with the crankshaft and mounted on the engine blower housing. The starter adds approximately 2-3/4 inches to the overall length of the plant. This equipment does not apply to vacuum-type-cooled plants.

CARRYING FRAME KIT. - The plant can be mounted in a lightweight tubular-steel carrying frame which provides easier handling when moving the plant between successive locations. The frame is intended for use with the manual starting plant having a mounted fuel tank and no starting battery.

TWO-WHEEL DOLLY. - A 2-Wheel Dolly, onto which the plant may be permanently mounted, provides easy one-man transportation of the plant. The dolly does not carry the starting battery nor the separate fuel tank used with various plants. CAUTION: Damage to the control will result from plant operation without batteries connected on remote or electric starting plants.

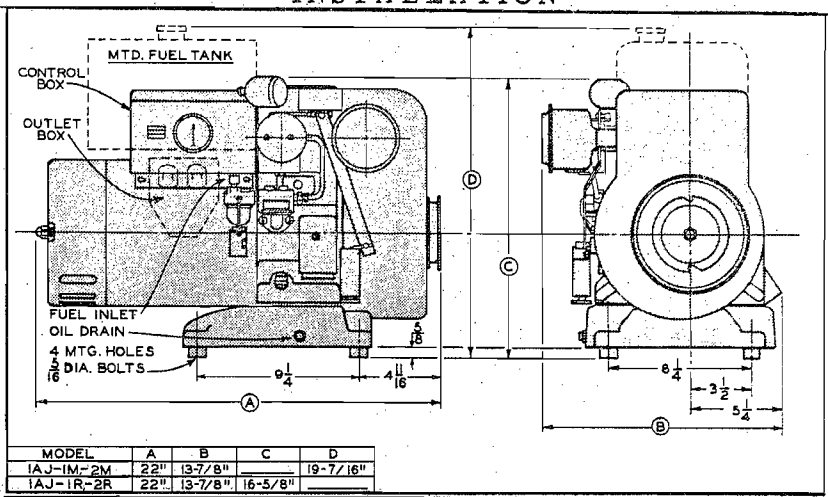
SIDE-MOUNTED FUEL TANK. - This 1.4 gallon fuel tank mounts on the side of the engine and is optional with the separate 5 gallon fuel tank furnished with certain models. This mounted tank adds approximately 5-1/4 inches to the plant overall width.

GAS CARBURETOR. - A carburetor for gas only can be installed at the factory in place of the regular gasoline carburetor. Plant rated output capacity is reduced with gas fuel.

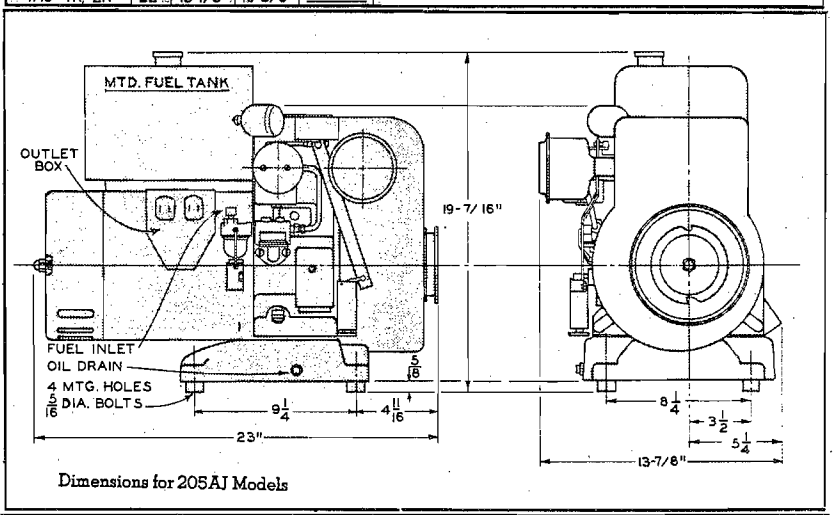


- Ventilation Applies To Pressure Cooling -

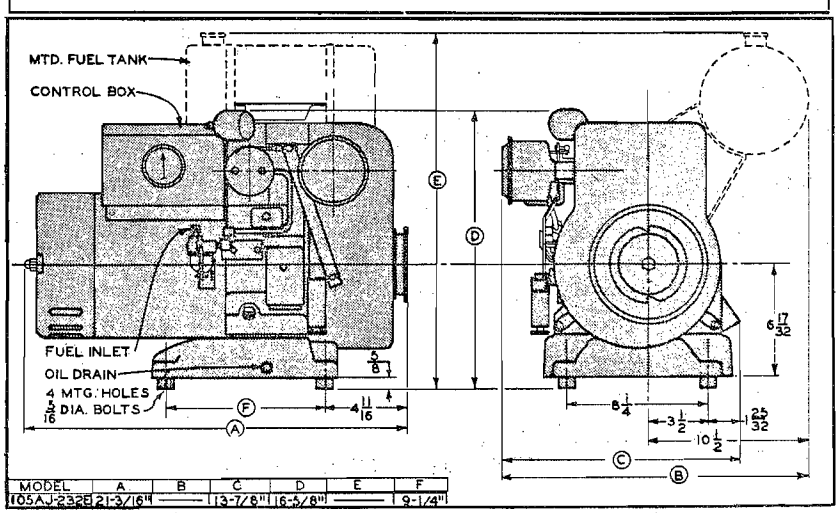
FIG. 1 - TYPICAL INSTALLATION



MODEL	A	B	C	D
1AJ-1M-2M	22"	13-7/8"	———	19-7/16"
1AJ-1R-2R	22"	13-7/8"	16-5/8"	———



Dimensions for 205AJ Models



MODEL	A	B	C	D	E	F
105AJ-232E	21-3/16"	———	13-7/8"	16-5/8"	———	9-1/4"

FIG. 2 - DIMENSIONAL OUTLINE

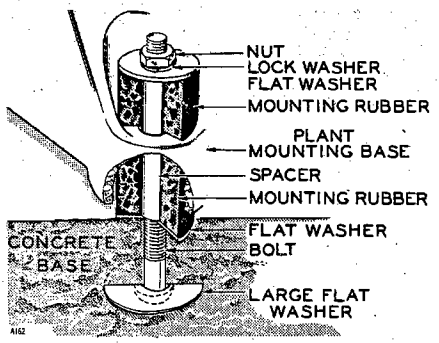
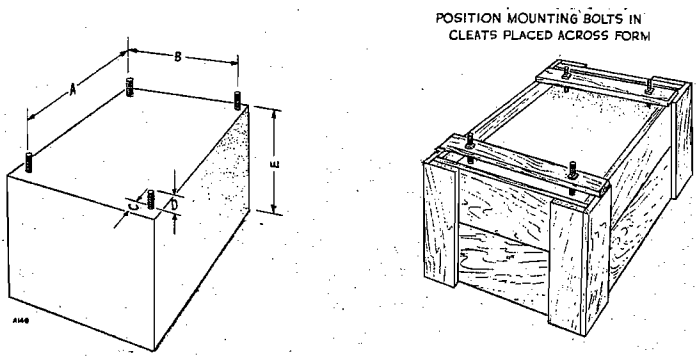


FIG. 3 - MOUNTING CUSHIONS



MOUNTING DIMENSIONS

DIMENSION	2 QUART BASE
A	9-1/4 inches
B	8-1/4 inches
C	2 inches
D	4 inches
E	12 inches

FIG. 4 - MOUNTING BASE

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.

The preferable ambient air temperature for best engine performance is well above freezing, and the preferable ambient air temperature for most efficient generator operation is well under 100°F. and should not exceed 110°F. if conditions permit controlling the temperature.

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 carrying frame, dolly, trailer, or suitable platform if desired. Install the muffler directly to the engine exhaust outlet. Be sure to provide for adequate 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. - Refer to the illustration, Typical 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. 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 cushions to minimize vibration. See the mounting detail as illustrated.

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 at least 3 square feet in area. The outlet should be nearer the ceiling.

EXHAUST. - Pipe the exhaust gases outside the enclosure, using 3/4 inch pipe or larger. Avoid sharp bends if possible by using bent pipe or sweeping elbow where necessary. 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 a flammable 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.

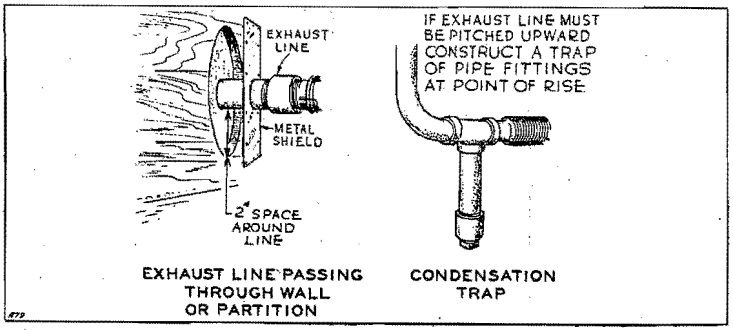


FIG. 5 - EXHAUST INSTALLATION

If exhaust noise from the standard muffler will be objectionable, an underground muffler may be constructed as illustrated. 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 inches above ground, with a gooseneck fitting on the end to prevent entry of rain or snow.

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 one inch above the carburetor fuel inlet.

On gravity feed installations, fuel leakage when idle, or flooding condition during operation, will result if the fuel tank is elevated too high. If the plant is in a vehicle and subject to transportation jars, it is advisable to close the shut-off valve when not in operation.

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.

Be sure to open the air vent at the top of the tank. The shut-off valve should be turned all the way outward until it backseats.

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 filter inlet at the plant, 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.

CARRYING FRAME (OPTIONAL ACCESSORY). - The illustration shows the position of hardware used to mount the plant. Use the existing mounting cushions, bushings, and washers supplied with the plant. The frame fits crosswise under the plant so that handles are on opposite sides.

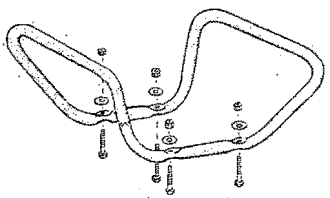


FIG. 6 - CARRYING FRAME

If the carrying frame is being ordered after purchasing the plant, supply the plant model and also specify the oil base capacity to help assure receiving the correct frame.

DOLLY ASSEMBLY (OPTIONAL ACCESSORY). - The illustration shows the position of hardware used to assemble the dolly and mount the plant. The dolly tires and feet cushions serve to absorb vibration so that mounting cushions at the oil base are not required.

Mount the plant on the dolly with the generator end toward the handles. Grease wheel bearings.

(1) On each end of the axle install a cotter pin, a washer, a wheel, a washer and a cotter pin. Spread the pins well. (2) Select the innermost, center, or outermost pair of holes in the axle plate which fit the model in question, and attach the handles, leaving the front holes in the axle plate open to mount the plant base.

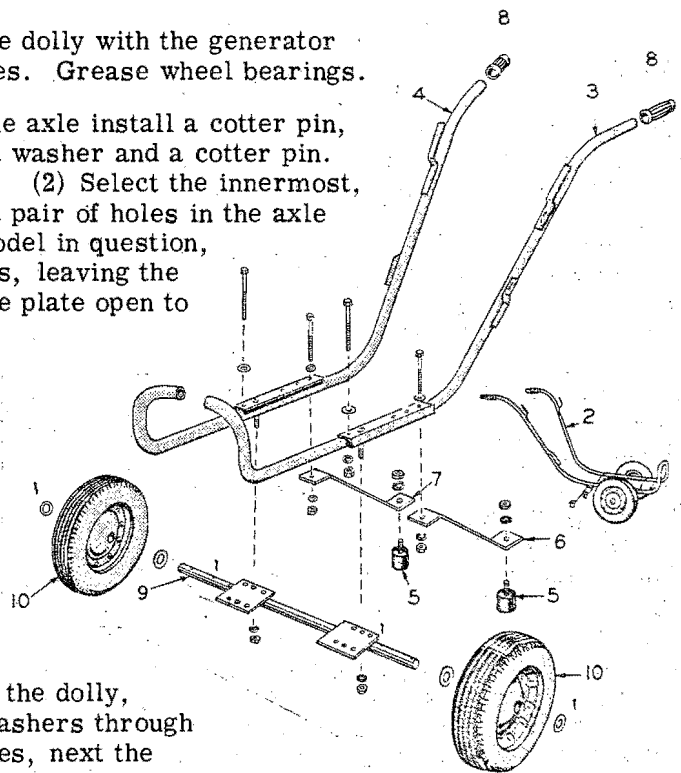


FIG. 7 - DOLLY

(3) With the plant on the dolly, install 2 bolts with washers through the front oil base holes, next the dolly handles, then the axle plates.
(4) Install 2 bolts with washers through the rear (generator end) oil base holes, next the dolly handles, then the dolly feet. (5) Install handle grips and foot cushions. Foot cushions may be staked to prevent accidental loosening. Use a lock washer under each nut and tighten all nuts.

OIL DRAIN EXTENSION. - An oil drain extension pipe and coupling will provide 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 a 3/8" pipe nipple and coupling in its place. Install the drain plug in the coupling. When draining the oil, remove only the plug.

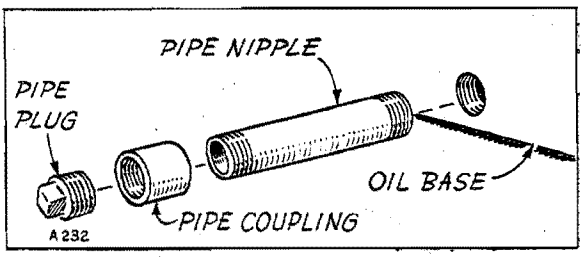


FIG. 8 - OIL DRAIN EXTENSION

BATTERY, AC REMOTE CONTROL PLANT. - A 12 volt battery is required. 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.

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.

Be sure battery connections are tight. Coat the battery clamps and posts lightly with grease or vaseline to minimize corrosion. Batteries shipped "dry" must be prepared for use as directed on the tag attached to each battery. Batteries shipped ready for use were fully charged when shipped. Such batteries slowly lose their charge when standing idle and it may be necessary to give them a "freshening" charge before putting them in use. Use a hydrometer to determine the charge condition.

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. REFER TO THE APPLICABLE PLANT WIRING DIAGRAM.

Where connections are made by joining two wires, always be sure to tape the connections thoroughly. Apply two layers of half-lapped electrician's tape and two layers of half-lapped friction tape, extending both well beyond the ends of the connection.

WIRING TABLE - 115 V.

Unity Power Factor. 2% Voltage Drop (2.3 Volts)

WIRE SIZE NO.		14	12	10	8	6	4	2
WATTS	AMPS	* Distances expressed in feet per wire size.						
100	.87	510	810	1280	2040	3250	5300	8200
200	1.74	255	405	640	1020	1625	2650	4100
300	2.61	170	270	430	680	1080	1770	2730
400	3.48	125	200	320	510	810	1325	2050
500	4.35	100	160	255	410	650	1060	1640
750	6.52	65	100	170	275	430	710	1090
1000	8.69	50	80	125	205	325	530	820
1500	13.04	35	55	85	140	215	350	550
2000	17.38	25	40	65	100	160	265	410
2500	21.73	20	35	50	80	130	210	350

* Above figures represent a point to point distance for a 2 wire run. If a 4% voltage drop is permissible, double the distance listed. If only 1% voltage drop is allowable, divide the distances listed by 2.

Single Phase 115 Volt A.C. - Use 115 Volt table above.

Single Phase 230 Volt A.C. - Double the distances listed in the 115 Volt table above. Use Amps Column.

WIRING TABLE

Table of Wire Sizes for 32 Volt - 2% (.64) Voltage Drop

WIRE SIZE NO.		12	10	8	6	4	2	0	
WATTS	AMPS	*Distances expressed in feet per wire size.							
50	1.56	120	200	320	490	800	1200		
100	3.13	60	100	160	245	400	600		
150	4.69	40	70	110	165	260	400		
200	6.25	30	50	80	125	200	300		
250	7.81	25	40	65	100	160	240		
300	9.38	20	35	55	80	130	200		
400	12.50	15	25	40	60	100	150		
500	15.63	12	20	30	50	80	120		
600	18.75	10	15	25	40	65	100		
800	25.00	--	12	20	30	50	75		
1000	31.25	--	10	15	25	40	60		
1200	37.50	--	--	12	20	30	50		
1400	43.85	--	--	10	15	25	45		
1500	46.88	--	--	--	10	20	40		
2500	78.13	--	--	--	--	15	25	40	
3500	109.39	--	--	--	--	10	15	25	

* Above figures represent a point to point distance for a 2 wire run.

If 4% voltage drop is permissible, double the distances listed.
If only 1% voltage drop is allowable, divide the distances listed by 2.

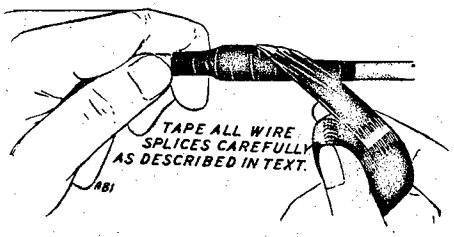


FIG. 9 - TAPING WIRE CONNECTIONS

The wire size will depend largely on the distance and permissible voltage drop between the plant and the load and the amount and kind of load. Consult a competent electrician. Check national and local codes before installing. Install a circuit breaker or a fused main switch in the load circuit 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 of the a.c. plant.

Battery charging plants have an ungrounded electrical system as desired for marine applications. If grounding is desired, a ground wire may be connected to either the positive or the negative battery terminal.

REMOTE CONTROL SWITCH, AC PLANTS. - One or more remote control switches may be connected to provide remote control of starting and stopping remote plants.

The wire length from the plant to the switch determines the wire size necessary. For distances up to 250 feet use #18 wire. Use #16 wire up to 400 feet, or use #14 wire up to 630 feet.

The four place terminal block, located in the control box, is marked "REMOTE CONTROL", B+, 1, 2, and 3 appears in the illustration. Terminal number 1 is used as a common ground, terminal number 2 connects to the stopping circuit of the plant and terminal number 3 connects to the starting circuit of the plant. The terminal marked B+ , is to be used only with an automatic control installation.

Connections for two styles of momentary contact toggle switches for use as Remote Start-Stop Stations are illustrated. Connect all number "2" or "OFF" switch terminals to the number "2" terminal on the plant terminal block. Likewise, connect together all number "3" or "ON" terminals and also, all number "1" or "SINGLE" (not marked) terminals. If the switch is to be mounted vertically, start position should be upward to conform with operation at the plant when a toggle switch is used.

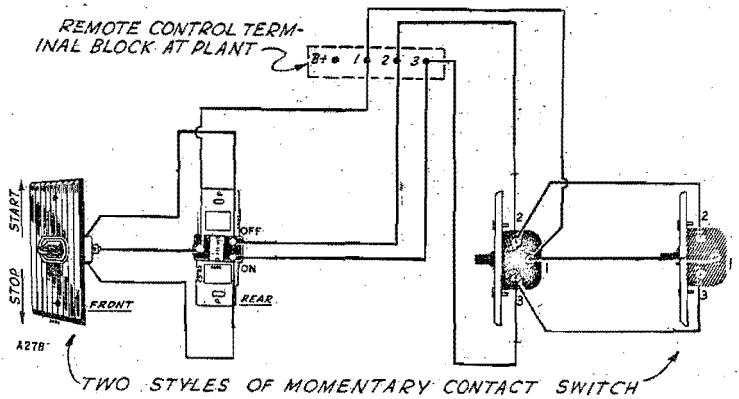


FIG. 10 - REMOTE START-STOP STATIONS

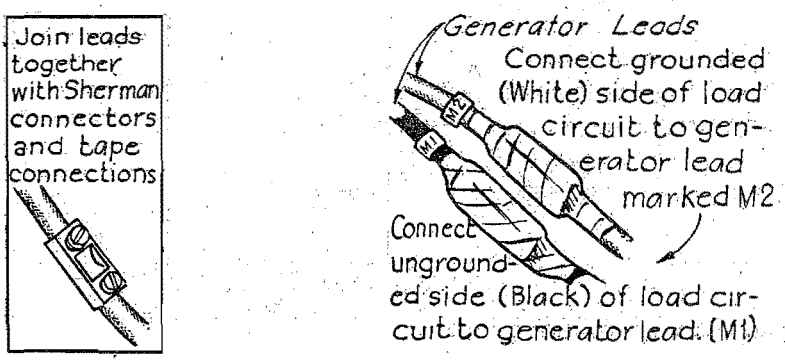


FIG. 11 - LOAD WIRE CONNECTION - AC REMOTE PLANT

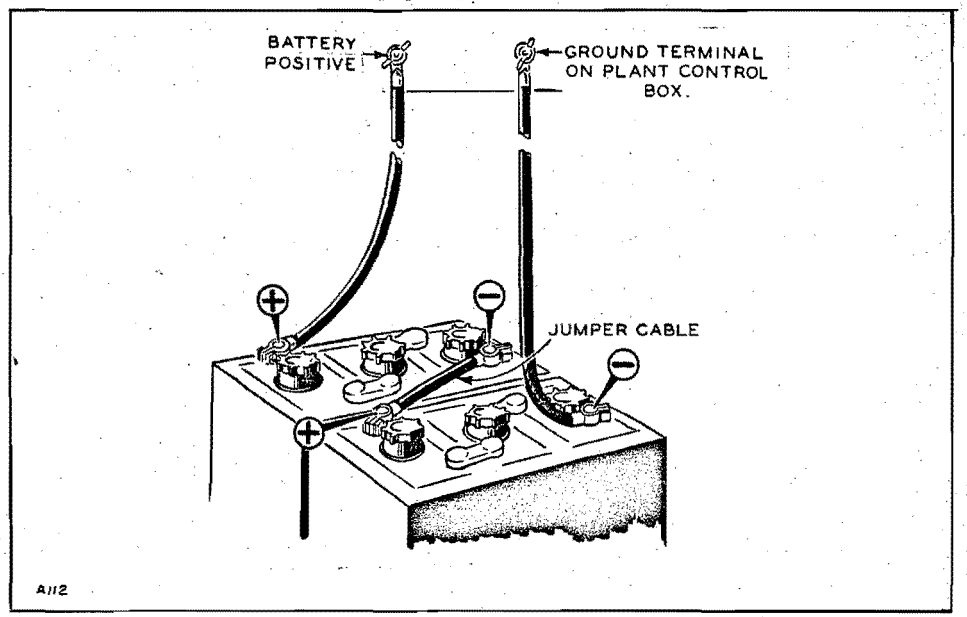


FIG. 12 - BATTERY CONNECTION - AC REMOTE PLANT

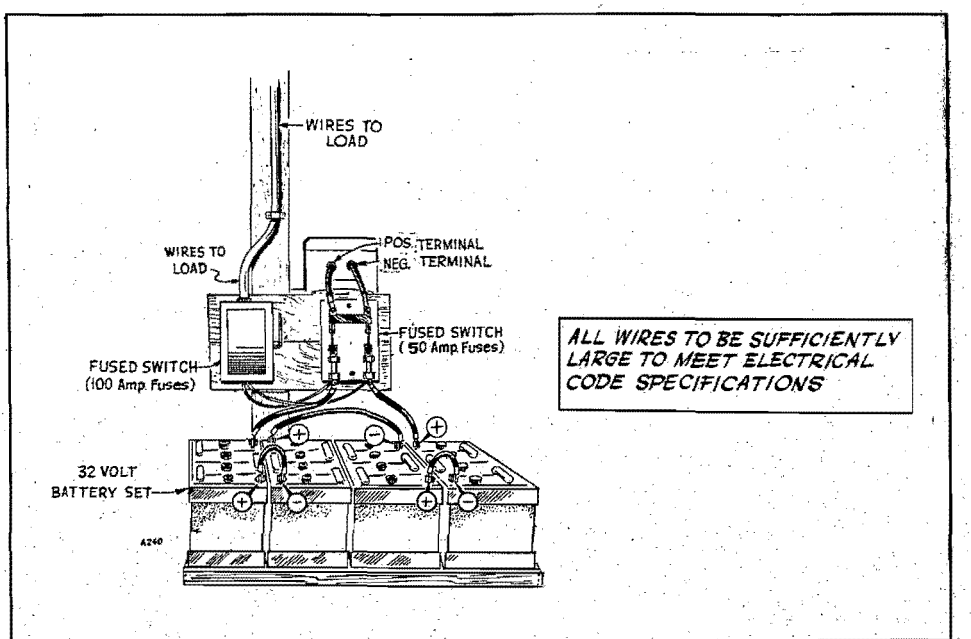


FIG. 13 - CONTROL BOX CONNECTIONS - 32-VOLT BATTERY CHARGING PLANT

CONNECTING THE LOAD WIRES, AC REMOTE PLANT. - Refer to the illustration for Control Box Connections. 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). 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 or controls will result from running the plant with no load connected provided the starting battery is connected.

CONTROL BOX CONNECTIONS, 32 -VOLT 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 BATTERY NEGATIVE on the control box, through one side of the switch. Connect the positive battery post to the terminal post marked BATTERY POSITIVE in the same manner. Install 50 amperes 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 (fused) 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 or controls may result from operating the plant when not connected to the battery.

LOAD CONNECTION, MANUAL PLANTS. - Manual type plants are equipped with output receptacles. No preliminary connections are necessary. Simply plug-in an ordinary type two prong type load wire plug, then the receptacle locks the connection when the plug is twisted a fraction of a turn.

ROPE RECOIL STARTER ACCESSORY KIT. - Refer to the separate section in this publication for installation, operation and maintenance of the starter.

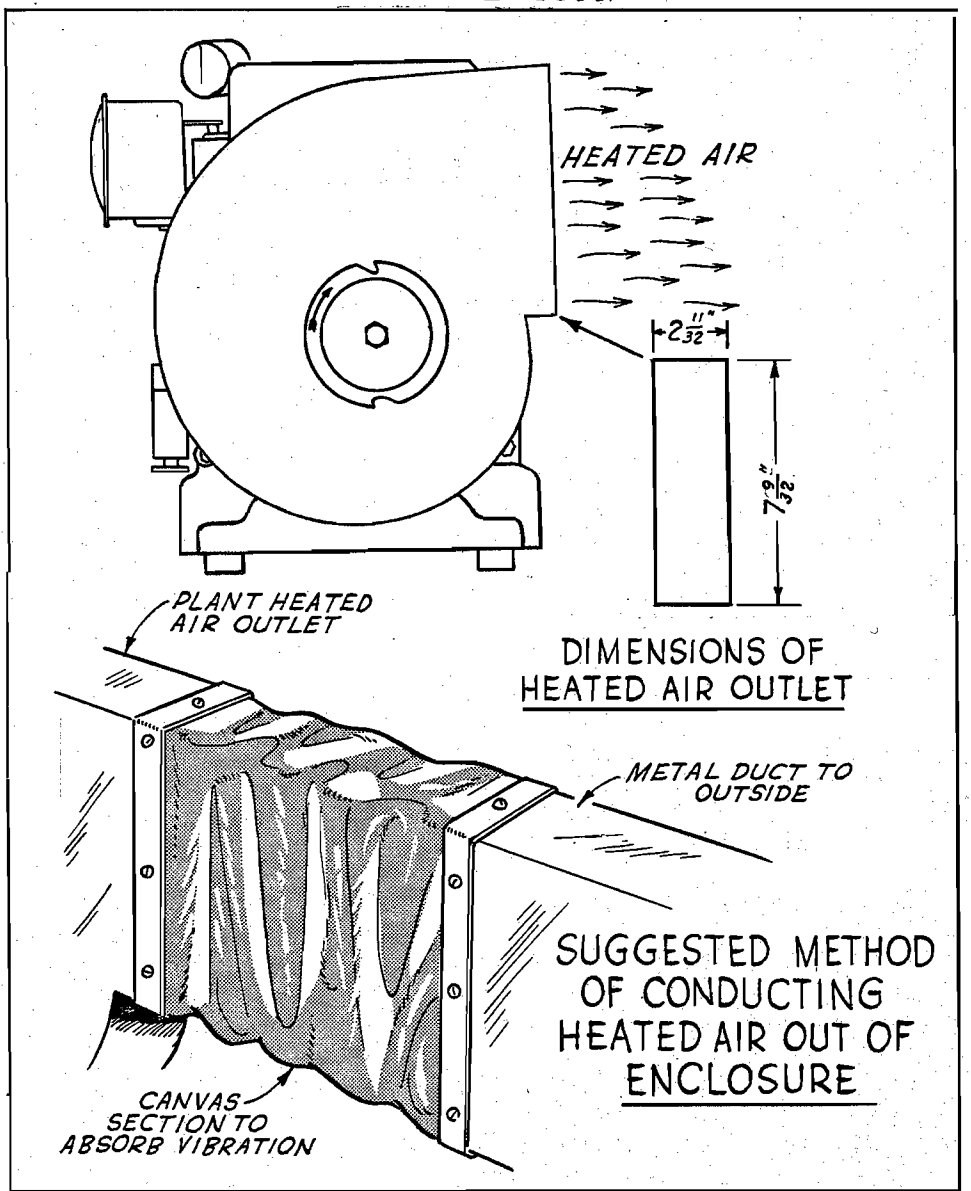


FIG. 14 - VACUUM COOLING

VACUUM COOLING (OPTIONAL EQUIPMENT). - Cooling air is drawn past the engine and and out through the front of the blower housing on plants which are vacuum cooled (also referred to as suction cooled). This type of cooling is desirable where the plant must be installed in a small enclosure. Provide adequate size openings for the entrance of fresh air. Install duct work to exhaust heated air outside of the enclosure, using flexible material next to the engine air ducting scroll. Pressure cooled plants can be converted to vacuum cooling by installing the necessary parts.

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. BE SURE BATTERIES (WHERE USED) ARE CONNECTED.

LUBRICATION. - The oil capacity of the plant is 2 quarts. 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.)	10W
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 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 at the point where the governor linkage engages the carburetor throttle arm.

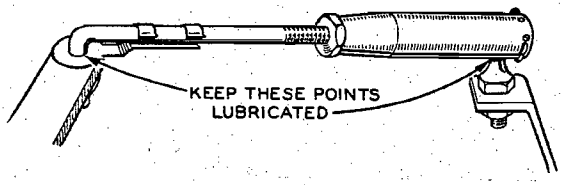


FIG. 15 - GOVERNOR LINKAGE LUBRICATION

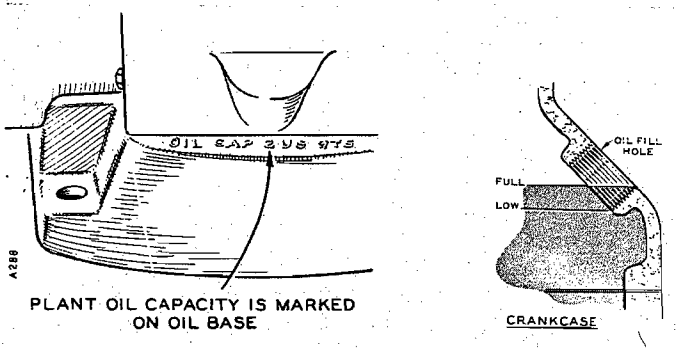


FIG. 16 - CRANKCASE OIL LEVEL

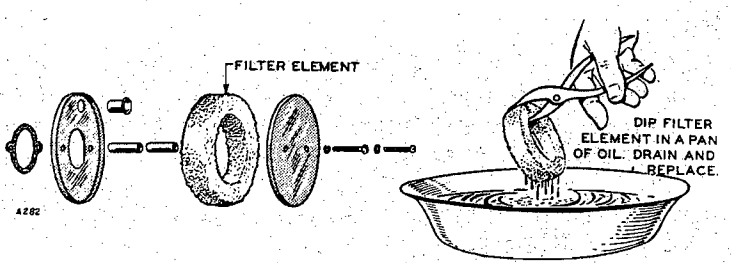


FIG. 17 - AIR CLEANER SERVICE

Lubricate the governor arm ball joint with a dry type lubricant such as powdered graphite to assure best performance and longest life of the ball joint. If graphite is not available, use a light non-gummy oil.

Remove the air cleaner from the carburetor and dip in oil of the same SAE number as used in the crankcase. Allow to drain until dripping stops, then wipe off the outside and install the air cleaner.

FUEL. - The tank mounted on the manual type plant has a capacity of 2 gallons. 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 at least 68 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 hazard. Observe the usual precautions when handling gasoline. NEVER FILL THE TANK WHEN THE PLANT IS RUNNING, BECAUSE OF FIRE HAZARD.

Open all of the fuel shut-off valves all the way to back seat 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.

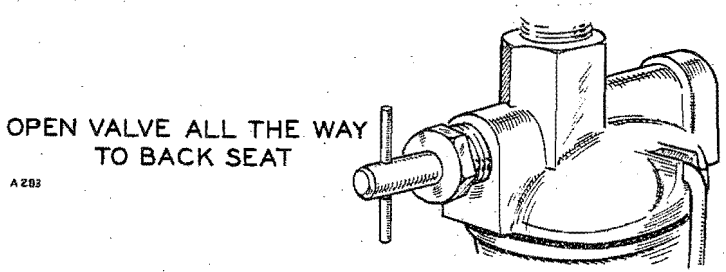


FIG. 18 - FUEL SHUT-OFF VALVE

CAUTION

AVOID DAMAGE TO

PLANTS USING BATTERIES!!!!

ALWAYS HAVE BATTERIES

PROPERLY CONNECTED

WHEN OPERATING PLANT.

IF NECESSARY TO PERFORM TRIAL RUN OF ENGINE (SUCH AS AFTER OVERHAUL) AND BATTERY IS NOT AVAILABLE, LIFT OUT ALL GENERATOR BRUSHES AND START ENGINE MANUALLY.

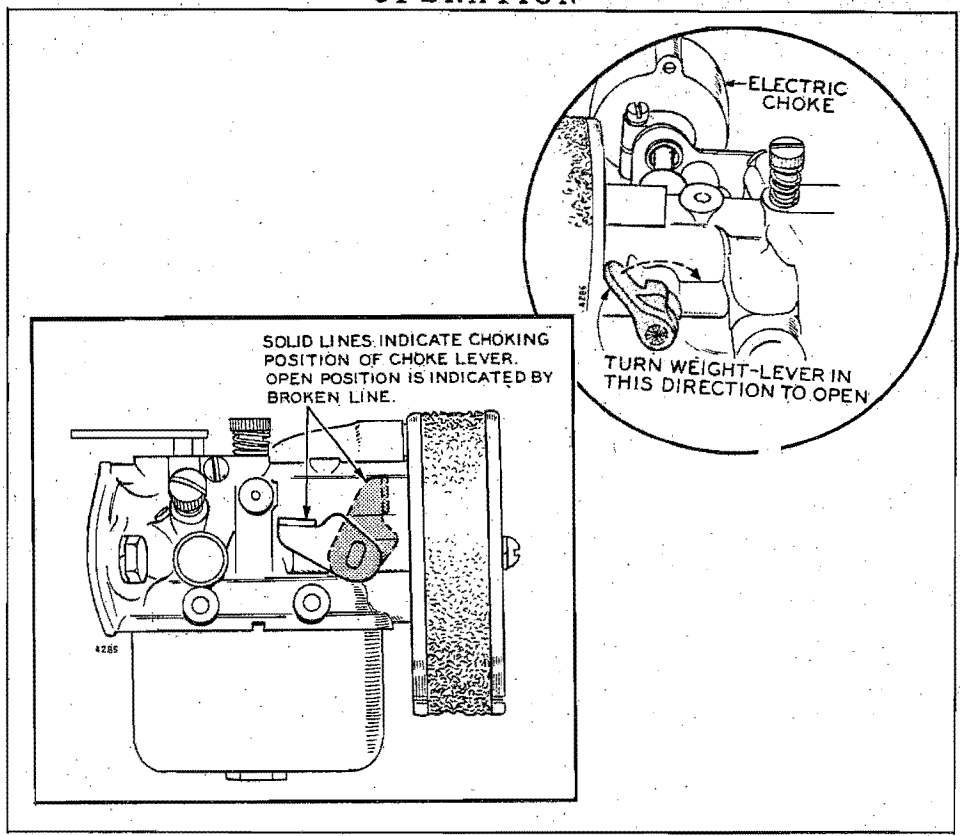


FIG. 19 - CARBURETOR CHOKING

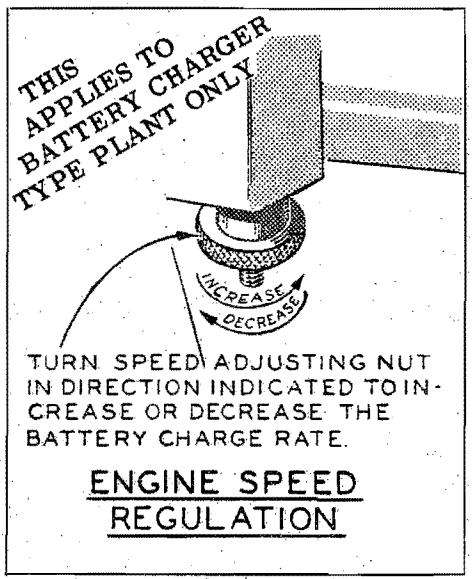


FIG. 20 - CHARGING RATE

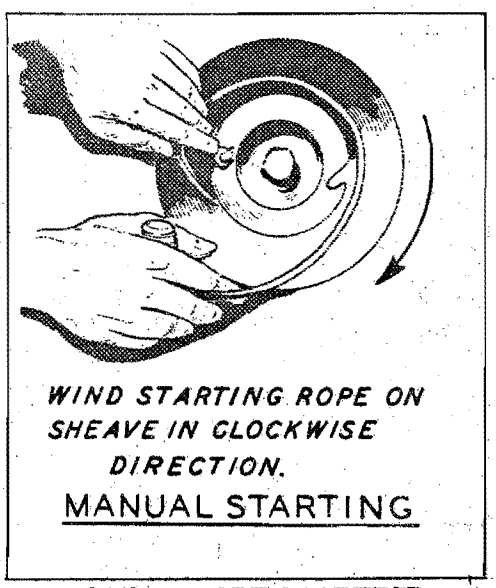


FIG. 21 - ROPE STARTING

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

ALTERNATING CURRENT PLANTS

STARTING THE REMOTE CONTROL PLANT ELECTRICALLY. - 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. Work the fuel pump primer lever or allow the plant to crank electrically by holding the START-STOP switch at 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 all valves are open and the pump primer lever is returned to inward position. The air vent on the separate tank must be partially open. Return the priming lever to disengaged (inward) position.

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 R EMOTE CONTROL PLANT ELECTRICALLY. Do not have a heavy electrical load connected to the generator. On plants not equipped with a recoil starter accessory kit, 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. 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. Be sure the starting batteries are connected.

STARTING THE MANUAL TYPE PLANT. - See that the carburetor is properly filled as instructed for the remote control type plant. Adjust the manual carburetor choke (as illustrated) 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. Before cranking, adjust the choke. On plants not equipped with a recoil starter accessory kit, 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, as illustrated.

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. When possible apply portions of the load in steps.

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. The user should provide a ground on the plant in these cases. 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, hold the remote STOP switch or hold the control box switch at the STOP position. The high tension magneto provides a firing spark even when the engine is running at very few rpm. Release of the STOP switch too soon will allow 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.

DIRECT CURRENT PLANTS

The following instructions apply to the standard battery charging plants. For those plants adapted to remote starting, as necessary on certain marine installations, apply the operating instructions relative to electrical choking as given for remote a.c. type plants.

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. Work the fuel pump primer lever (where used) a few strokes and return it to the inward position, so as to not restrict normal pump operation. 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. These plants are choked by adjusting the small carburetor lever close to the air cleaner. Turn the lever almost parallel with the carburetor body for full choking action. Turn the lever crosswise(clockwise)to the carburetor body to open the choke as the plant warms up. A spring loaded ball installed in the carburetor holds the choke shaft at open position. 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 - BATTERY CHARGING PLANTS. - Be sure the battery is connected to the battery charging type plant.

If starting a cold engine, adjust the choke for full choking action. On plants not equipped with a recoil starter accessory kit, 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 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. Correct breaker point gap is vital to easy starting.

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.

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. If the plant tends to "hunt" or (alternately increase and decrease speed), the engine is too cool and a slightly richer choke adjustment will usually eliminate the hunt.

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%.

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.

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.

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 partially 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, 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.

BATTERY PREPARATION FOR REMOTE START AC PLANT. For a usual plant installation, follow the instructions for Batteries under INSTAL-

LATION. 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 FLAMMABLE.

2. While battery is on charge, use a hydrometer or filler bulb to siphon off all of the electrolyte above the plates in each cell. Do not attempt to pour off!! 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.

DUST AND DIRT

CLEANLINESS. - 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.

LUBRICATION. - Change the crankcase oil every 50 operating hours, instead of every 100 operating hours, during severely dusty operating conditions.

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 at least 68 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.

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, DRY TYPE. - Remove and disassemble the air cleaner. Remove the 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.

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

Lubricate the governor arm ball joint with a dry type lubricant such as powdered graphite to assure best performance and longest life of the ball joint. If graphite is not available, use a light non-gummy oil.

SPARK PLUG. - Clean the spark plug and reset the gap as given in the Table of Clearances. Test the plug under compression on a plug testing machine, if one is available. Replace a defective plug.

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 a 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. - On plants with a separate fuel tank, drain the fuel tank and remove the shut-off valve and filter assembly. Carefully clean the filter screen. Tighten connections well when reassembling. Empty carburetor bowl and fuel filter bowl 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 a new point set. 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 as given in the Table of Clearances. Reoil the wick on the point set, if dry. CLEAN BREAKER POINTS ACCURATELY ADJUSTED AID STARTING.

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 VALVE. - 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. Reinstall parts removed. See the illustration, Valve Service, under Maintenance and Repair. Loosen valve with pliers.

ANTI-FLICKER BREAKER POINTS. - Keep the gap between the anti-flicker breaker points adjusted as given in the Table of Clearances. Follow the same principles of care as given for the magneto breaker points.

GENERATOR. - Check the condition of the commutator, a.c. collector rings, and brushes. Clean the commutator (and a.c. 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.

Install new commutator brushes and other rectangular brushes when the old ones are worn to 5/8" or less in length. The cylindrical type or nearly square (1/4 x 3/8") type collector ring brush which is spring loaded, may be used until worn to 5/16" in length.

See that all connections are tight. Remove carbon dust from the generator.

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. Always disconnect the battery ground before servicing controls to avoid accidental shorts.

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

See that equipment which serves for radio noise suppression is in place and with clean tight connections. Suppression equipment includes spark plug shield, shielded ignition leads and by-pass capacitors in generator and control.

NOTE:-A double sealed, prelubricated ball bearing is used on certain generators. No periodic service is required.

Generating plant satisfactory performance is dependent upon correct adjustments. Adjustments can not fully compensate for troubles such as low engine power due to engine condition.

GOVERNOR. - The governor controls the speed of the engine. Always have the starting batteries (where used) properly connected when operating the plant.

On a.c. generating plants, engine speed determines the output voltage and current frequency of the generator. By increasing the engine speed, generator voltage and frequency is increased, and by decreasing the engine speed, generator voltage and frequency is decreased. An accurate voltmeter is required in adjusting the governor of a.c. plants. A small speed drop not noticeable without instruments will result in an objectionable voltage drop.

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 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. At wide open position, the lever on the throttle shaft should just touch the carburetor body or clear it by no more than 1/32 inch. 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. - AC PLANT. - Refer to the illustration, Governor Adjustment. Connect the voltmeter across the output of the generator. With no electrical load connected, start the plant and adjust the speed adjusting nut to give a voltmeter reading of approximately 126 volts maximum for a 115 volt plant. Apply a full rated electrical load and again observe the voltage reading, which should be approximately 108 volts minimum. For 230 volt plants, 252 V. at n.l. is max. and 216 V. f.l. is minimum. The correct sensitivity adjustment gives the closest regulation without causing a hunting condition. If the voltage spread between no load and full load conditions is too great, move the end of the speed spring closer to the governor shaft. Test the governor action at various load conditions. If voltage regulation is good, but there is a tendency toward hunting at times, the sensitivity adjustment is too close or sharp and the sensitivity stud must be turned outward 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 rpm for a 4 pole generator, or 3600 rpm for a 2 pole generator, with a spread of not more than 100 rpm between no load and full load.

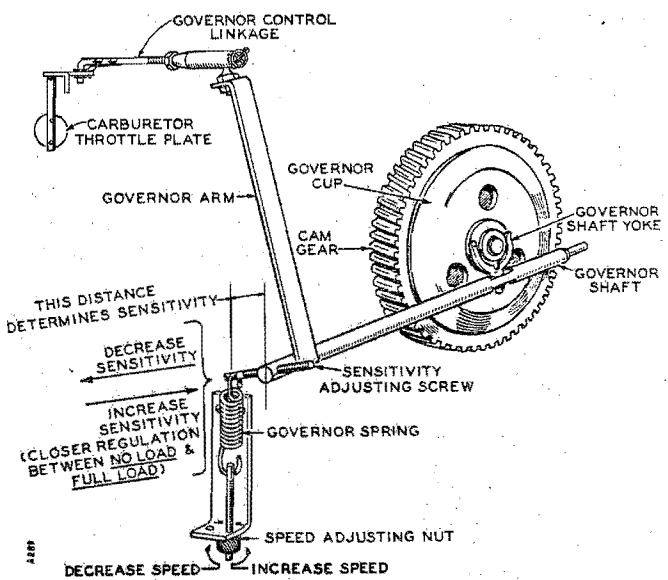


FIG. 22 - GOVERNOR ADJUSTMENT

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. 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 outward 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. Increasing sensitivity results in a slight decrease in engine speed. The desired adjustment is a setting which gives the closest regulation without hunting. Maximum speed at full load operation of battery charging plants is approximately 2400 rpm, as specified on the nameplate.

ANTI-FLICKER MECHANISM. - The anti-flicker mechanism, also called flicker resistance mechanism, is provided to help eliminate flicker of lights in the a. c. load. Breaker points and a field resistor are used on all 115 or 230 volt plants with 4 pole generators, 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 is mounted on the brush rig or support. 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, check to see if a new resistor is required.

If an adjustable resistor is used, 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.

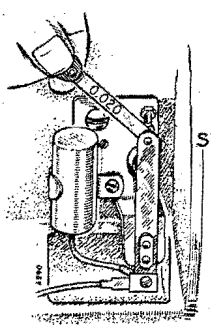


FIG. 23 - ANTI-FLICKER

CARBURETOR. - Refer to MAINTENANCE AND REPAIR-CARBURETOR if it becomes necessary 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. Before tampering with jet settings, mark the existing adjustment or count the number of turns the needle was backed out from its seat.

The carburetor is a side (horizontal) draft type and has two adjusting needles. The "idle" needle is located nearer the cylinder head. The "main" needle is located on the top nearer the air cleaner. Turning the needle inward gives a leaner fuel mixture for either jet.

The correct setting for the main jet needle gives the best stability at full rated load operation. The correct setting for the idle needle gives the best stability at no load operation.

Full load (f.l.) and no load (n.l.) operating conditions are necessary when making carburetor adjustments.

On alternating current plants, to obtain a full rated load condition, connect an a.c. load equal to the watts or amperes shown on the nameplate. To obtain a no load condition, disconnect all a.c. load, leaving starting batteries (where used) connected and with governor properly adjusted.

On battery charging (d.c.) plants, to obtain a full rated load condition, leave batteries connected, and increase engine speed to the point where ammeter reading compares with rated amperes shown on the nameplate. To obtain a no load condition, leave batteries connected, decrease engine speed to the point where ammeter reading is zero or as low as possible.

To adjust the carburetor, turn the adjusting needles in gently (finger tight) to their seats. Do not force them in, as they may be damaged by seating too tightly. Back the main needle out about 2-1/2 full turns. Back the idle needle out about 3/4 of a turn. Start the plant and allow it to thoroughly warm up under a full load condition.

Slowly turn the main adjusting needle inward (clockwise) for leaner mixture, until the plant begins to lose speed, or the voltage drops. Turn the needle outward (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 for richer fuel mixture, until the hunt is corrected, but do not turn the adjusting needle out more than 1/2 turn beyond the point where maximum generator output is obtained. Adjust the idle needle with the plant warm, with batteries connected, and with no a.c. electrical load connected or while at lowest possible charge rate as the case may be, depending upon the type of plant in question. Slowly

turn the idle adjusting needle inward (clockwise) until the plant loses speed from lack of fuel. Then turn the needle slowly outward until the plant runs smoothly.

The throttle idle stop screw should be adjusted to clear the throttle shaft stop by 1/32" when the plant is operating at desired speed and no load condition. This setting helps prevent hunting during changes in load.

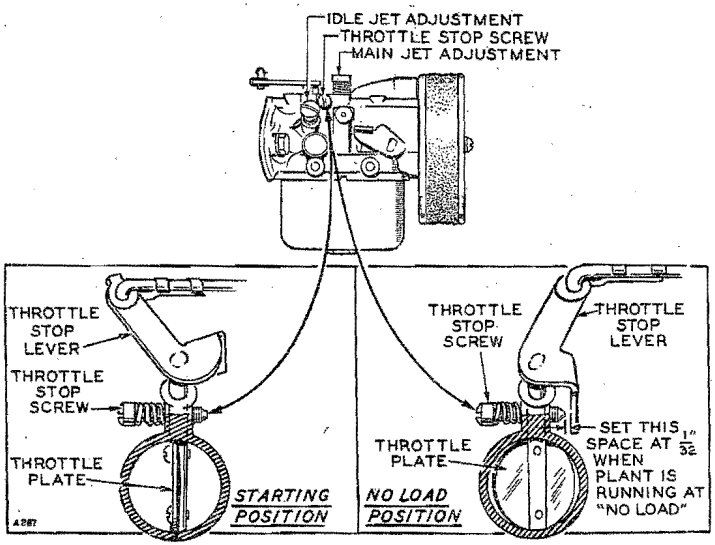


FIG. 24 - GASOLINE CARBURETOR ADJUSTMENTS

CARBURETOR FOR GAS FUEL ONLY. - To adjust the gas fuel carburetor, set the main adjusting screw approximately 1-1/2 turns open, and set the idle adjusting screw approximately 1-1/4 turns open, to permit starting the engine. Further adjust the screws as necessary for best operation while allowing the engine to thoroughly warm up under an average load condition. Make the final adjustment of the main adjusting screw while operating with a full load connected. Turn the screw in until the plant voltage (or speed) begins to drop, then turn the screw slowly outward until the voltage (or speed) returns to normal, and operation is steady. If it is necessary to turn the screw out more than 1/2 turn after normal voltage is attained, in order to prevent surging, it may be necessary to adjust the governor for slightly less sensitivity. Make the final adjustment of the "idle" screw for best operation after the load is disconnected.

Check the operation of the carburetor choke. The weighted choke should just close, but must be free to open with the air stream which enters the carburetor during operation.

On the initial start, press the priming button on the gas pressure regulator for just a moment to prime the system.

AUTOMATIC CHOKE. - The a. c. remote control type plant is equipped with a thermal action electric choke. A thermostatic coil (bi-metal) 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 wind tighter and 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 1/8" from the fully opened position. The thermal coil (bi-metal) is installed in the choke body in a clockwise direction as viewed starting from the inside turn. The thermal coil tends to coil tighter when heated rather than unwind.

Extreme temperature may require a slight readjustment of the choke setting. To adjust the choke, loosen the two screws which retain the choke cover to the choke body. For less choking action, turn the cover assembly slightly in a counterclockwise direction, looking at the thermal unit end. For more choking action, turn the cover 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 lever and weight, 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 lever to horizontal position to open the choke. The choke would re-

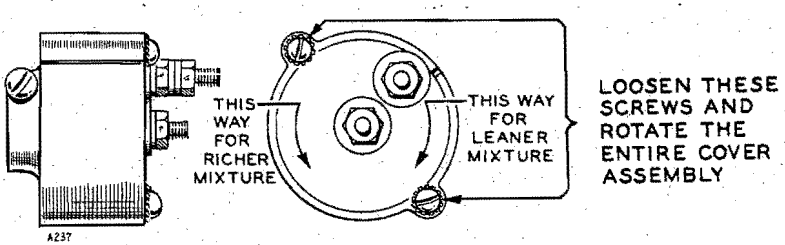


FIG. 25 - ELECTRIC CHOKE ADJUSTMENT

main at closed position if electric choke failure occured.

Note that the direction marking "CHOKE ⟶" as appears cast on the body of some carburetors is correct for manually choked plants, but is wrong for electric choked plants due to the choke valve arrangement. Choking position of the weight lever is vertical, on the shaft of electrically choked plants. Choking position of the lever is horizontal on manually choked plants.

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, replacing worn parts when necessary. Avoid accidental shorts by disconnecting the battery when servicing control parts.

TABLE OF CLEARANCES

	MINIMUM	MAXIMUM
Valve - Intake - Cast Iron Block	.010"	.012"
Valve - Exhaust - Cast Iron Block	.010"	.012"
Valve Face, Angle	44°	
Valve Seat, Angle	45°	
Valve Interference Angle	1°	
Valve Stem in Guide - Intake	.0010"	.0025"
Valve Stem in Guide - Exhaust	.0025"	.0040"
Crankshaft End Play	.008 "	.012"
Crankshaft Main Bearing	.0030"	.0040"
Crankshaft Main Bearing Journal - Standard Size	1.6860"	1.6865"
Crankshaft Rod Bearing Journal - Standard Size	1.3745"	1.3750"
Valve Seat Interference Width	2/64"	3/64"
Camshaft Bearing	.0015"	.0030"
Connecting Rod Bearing	.0015"	.0025"
Piston Pin in Rod - 72°F.	Thumb Push Fit	
Piston Pin in Piston - 72°F.	Hand Push Fit	
Piston to Cylinder - Cast Iron Block	.0025"	.0045"
Cylinder Bore - Standard Size - Cast Iron Block	2.7505"	2.7515"
Piston Ring Gap - Compression - Cast Iron Block	.007"	.017"
Piston Ring Gap - Oil - Cast Iron Block.	.007"	.017"
Magneto Breaker Point Gap (full separation)	.022"	
Anti-Flicker Breaker Point Gap (full sep.)	.020"	
Magneto Pole Shoe Air Gap	.010"	.015"
Spark Plug Gap - Gasoline Fuel	.025"	
Spark Plug Gap - Gas Fuel	.018"	
Ignition Timing Advance - Above 1800 rpm.	25° B.T.C.	
- 1800 rpm Plants.	19° B.T.C.	
Cylinder Head Screw, Torque	25-30 lb. ft.	
Connecting Rod Screw, Torque	10-12 lb. ft.	

ENGINE

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. A fine soft wire may be used to clean jets.

Carburetor adjustments appear in the adjustment section herein. See that the float is not damaged. Be sure the throttle assembly works freely. When reinstalling adjusting needles, do not force them into their seats.

The carburetor for the 3600 rpm plant has a larger venturi than other models.

MAGNETO. - The high tension magneto 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 at full separation as given in the Table of Clearances. A defective condenser must be replaced with a new one of proper capacity. A flywheel magnet which has lost its magnetism can be remagnetized. If the magneto backplate has been loosened or removed, see that the gap between the coil poleshoes and the flywheel is .010 to .015". Too wide an air gap would produce a weak spark.

TIMING THE IGNITION. - Proper timing of the spark is important for good engine operation. Refer to the Table of Clearances for the correct degree of spark advance 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. Install the flywheel loosely, with its key in place, and turn the flywheel with rotation direction to the position where the mark on the edge of the flywheel is in alignment with the proper degree 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.

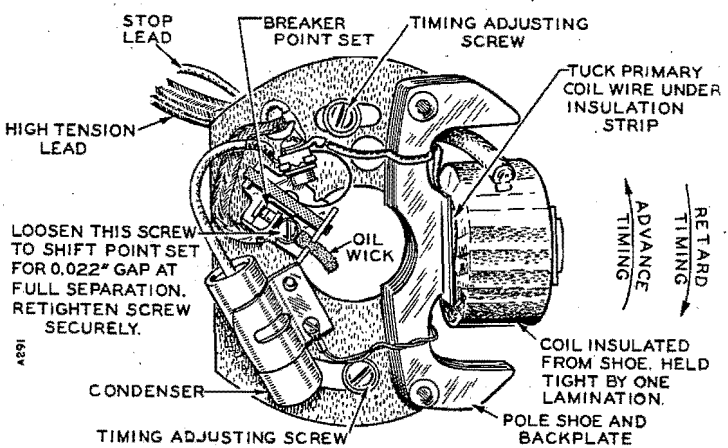


FIG. 26 - MAGNETO BACKPLATE ASSEMBLY

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.

The valve FACE angle is 44°. The valve SEAT angle is 45°. This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life.

The valves should not be hand lapped, if at all avoidable, since the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44°. Valve seats should be ground with a 45° stone, and the width of the seat band should be 2/64 to 3/64 of an inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat, using an air pressure type testing tool. If such a tool is not available, make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

Lightly oil the valve stems and reassemble all parts removed. Adjust the valve clearance.

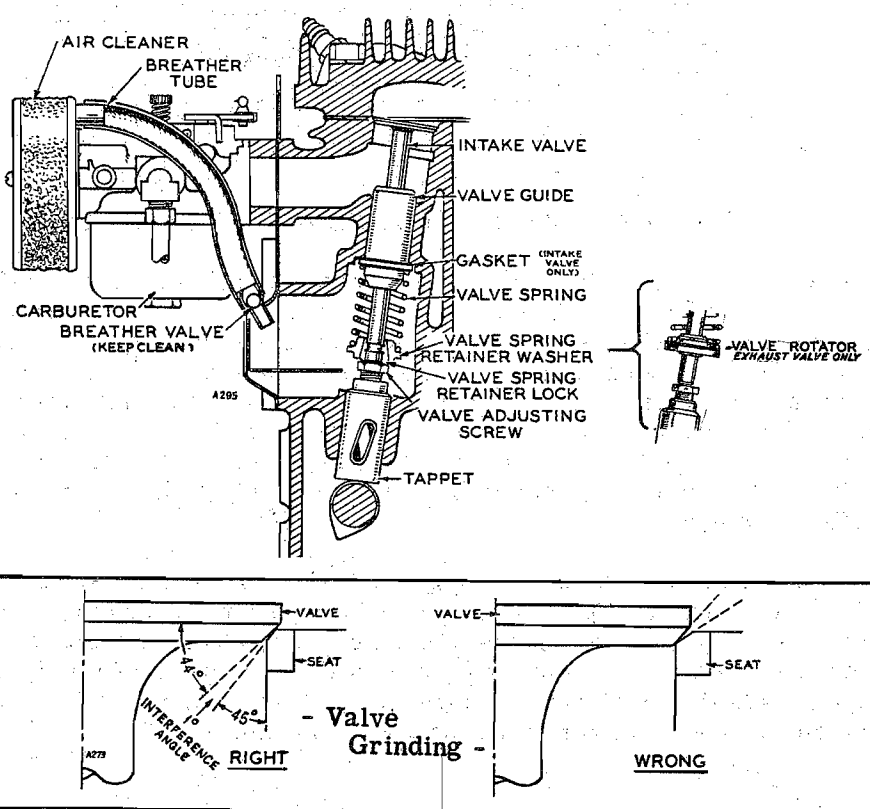


FIG. 27 - VALVE SERVICE

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 mark on the flywheel is in alignment with the TC mark on the gear cover. The correct tappet clearance for both the intake and exhaust valves appear in the Table of Clearance. 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.

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 in the gear cover engages any one of the three holes in the governor cup. Turn the governor cup so that a hole is in upward position where it corresponds to the 12 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. Be careful not to damage the gear cover oil seal.

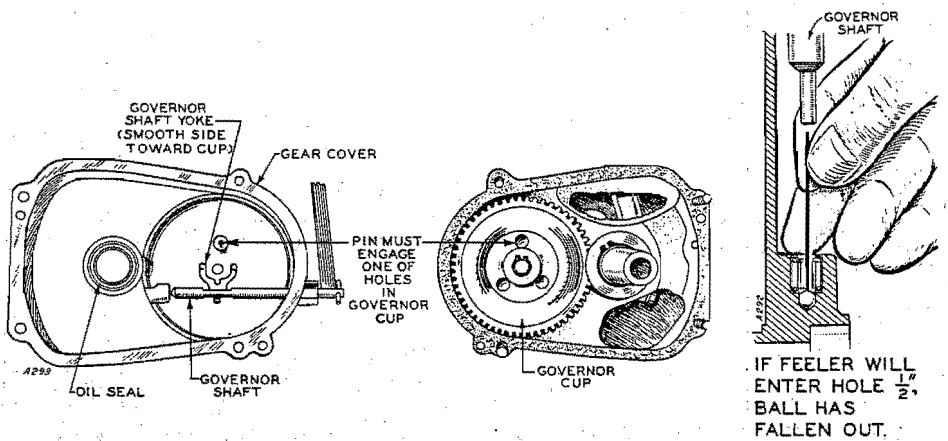


FIG. 28 - INSTALLING THE GEAR COVER

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. 3600 rpm units use only 5 flyballs while other models use 10 flyballs in the governor cup.

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 must be exactly 7/32" when the cup is pressed back against the flyballs as far as

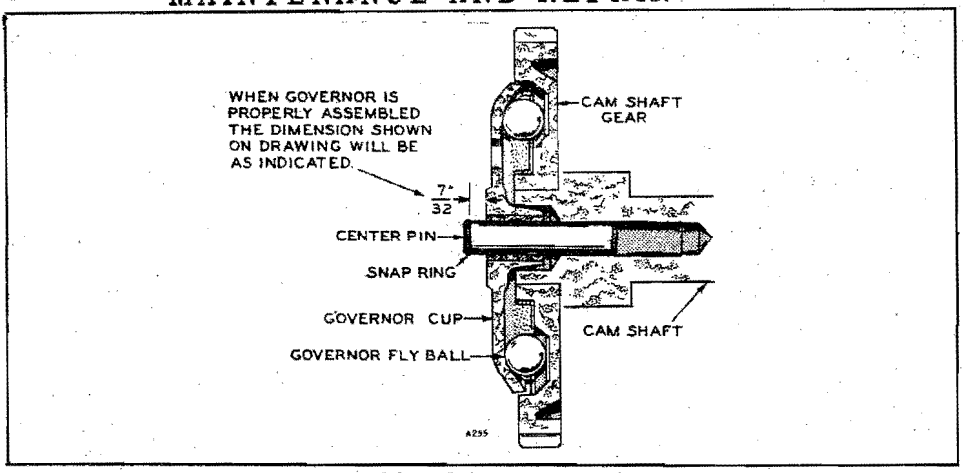


FIG. 29 - GOVERNOR CUP

possible. If the distance is too small, carefully dress the face of the cup as required, being sure to remove any burr from the inside of the cup bore. 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 difficult 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 flyballs are replaced and evenly spaced.

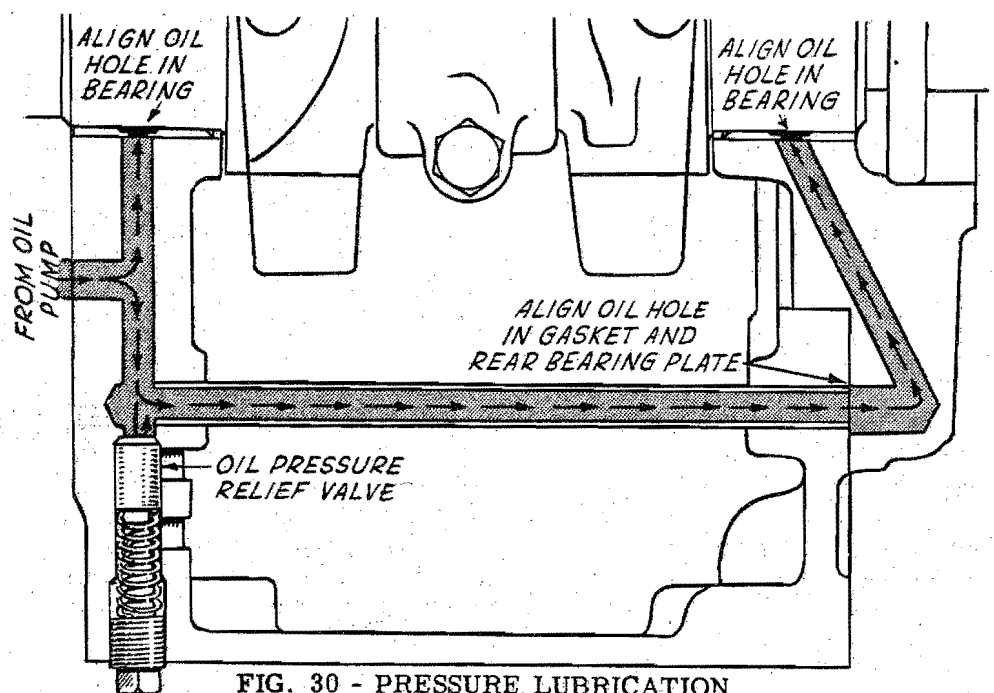


FIG. 30 - PRESSURE LUBRICATION

PRESSURE LUBRICATION. - Pressure lubrication does not apply to all models. Pressure lubricated plants have a gear type oil pump, an oil intake cup, a non-adjustable relief valve and necessary machining. If the oil pump is to be removed, it must be turned off the intake pipe. If the oil pump fails, install a complete new pump. The relief valve may be removed for cleaning.

Be sure to properly install a good pump mounting gasket. Install the intake pipe tightly and at the correct angle to have the cup parallel to the oil base. BE SURE THE OIL PUMP IS PRIMED WITH OIL.

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.

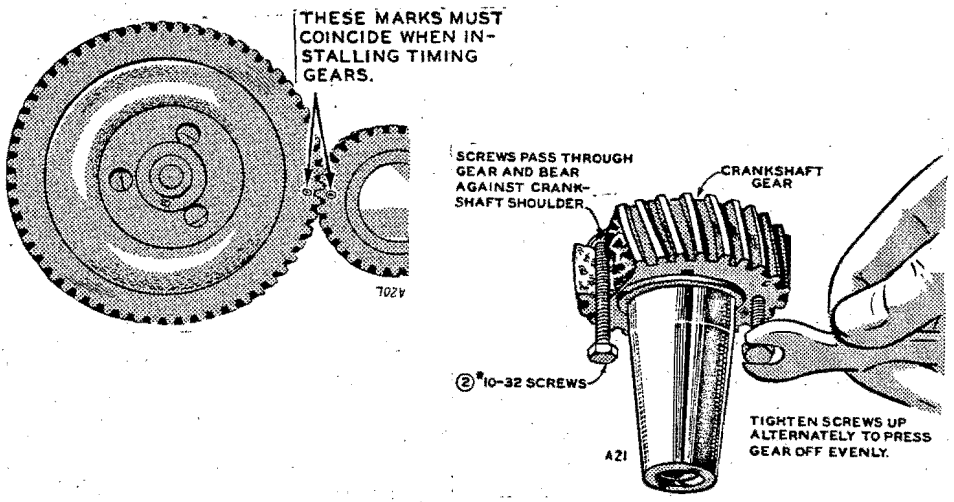


FIG. 31 - TIMING GEARS

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. Remove the anti-flicker breaker plunger (where used). Remove the fuel pump and 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 "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", .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 side of the crankcase near the fuel filter, 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 as given in the Table of Clearances. 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 size, 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.

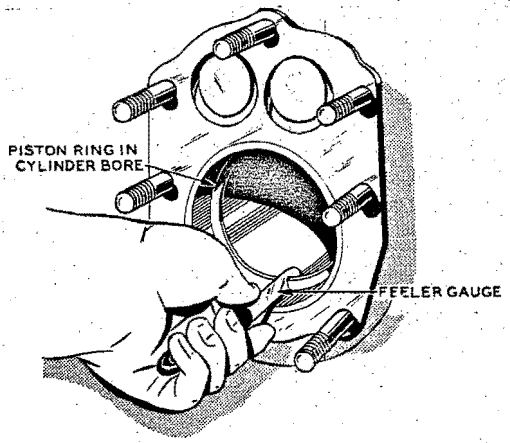


FIG. 32 - FITTING PISTON RINGS TO THE CYLINDER

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 appears in the Table of Clearance.

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 (#320 grit or finer) 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.

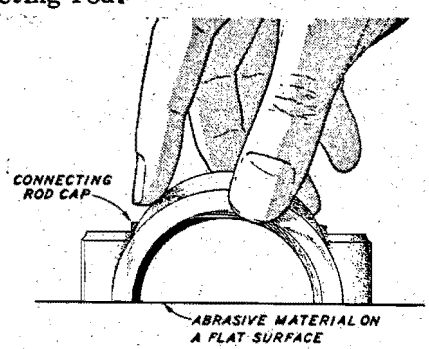


FIG. 33 - REDUCING CONNECTING ROD CLEARANCE

MAIN BEARINGS. - The main bearings are the sleeve type babbitt faced, steel backed and are not flanged. Align the oil hole in the bearing with the oil hole in the block bore which receives the bearing. On splash, lubricated units the hole will be upward. On pressure lubricated units the hole will be opposite from the camshaft. When replacing main bearings, they must be pressed in toward the inside, the rear bearing plate assembled to the cylinder block, 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.

Support the cylinder block to avoid damage while removing or installing the bearings. The inside end of the main bearings must be 1/16" to 3/32" back from the inside end of the bore in the cylinder block to allow clearance for the machined radius of the crankshaft.

Adjust the crankshaft end play as shown in the Table of Clearance by using the correct thickness of gaskets between the rear bearing plate and the cylinder block. On models with pressure lubrication, align the hole in the bearing plate gasket with the oil hole in the bearing plate.

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

Press the front camshaft bearing in flush with the outside surface of the cylinder block. Press the rear camshaft bearing in flush with the bottom of the counterbore which receives the welch plug.

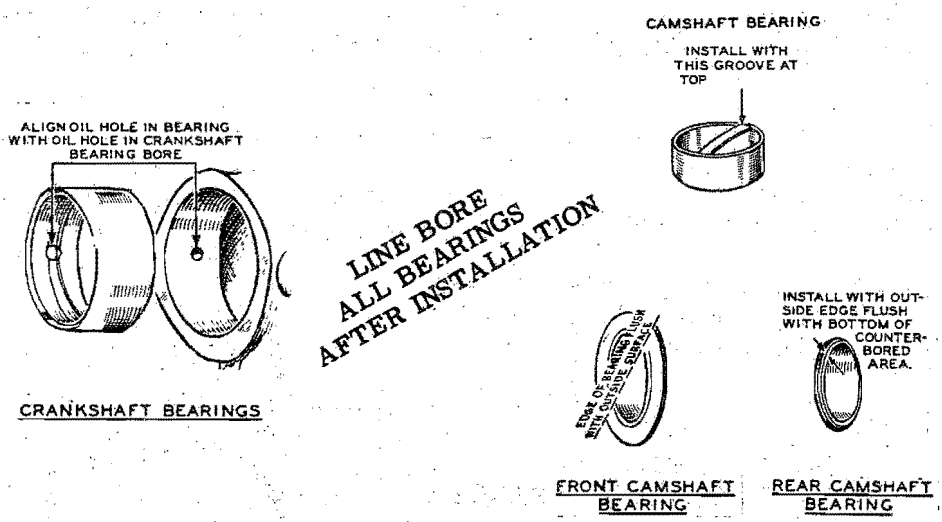


FIG. 34 - CRANKSHAFT AND CAMSHAFT BEARINGS

VALVE COMPARTMENT OIL DRAIN. - A drain hole from the valve compartment enters the crankcase. This hole 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 edge of the oil seal or damage it in any way. The rear bearing plate must be removed to replace the rear oil seal. Remove the gear cover to replace the front oil seal. Seal expanding and driving tools are available through the dealer.

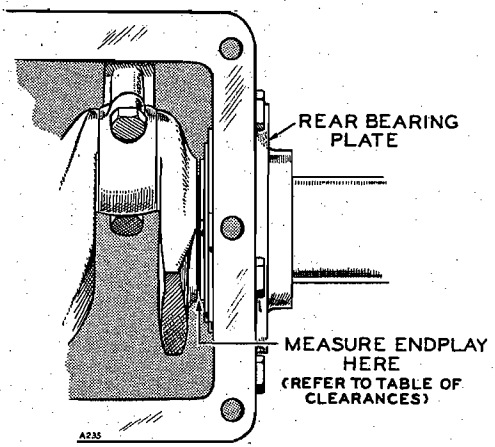


FIG. 35 - CRANKSHAFT END-PLAY

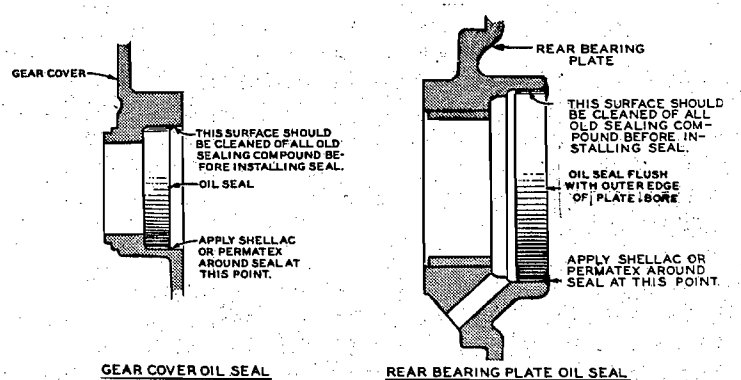


FIG. 36 - OIL SEALS

GENERATOR

Two types of generator construction are used in this series of plants. The 3600 rpm plants have a 2 pole generator. All other plants have a 4 pole generator and differ according to the model

BRUSH REPLACEMENT. - Install new commutator brushes and other rectangular brushes when the old ones are worn to 5/8" or less in length. The cylindrical type or nearly square (1/4 x 3/8) type collector ring brush which is spring loaded may be used until worn to 5/16" in length. It is not necessary to remove the brush rig to install new brushes. Remove the end cover to expose the brush rig. 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. The correct setting results in the least sparking at the commutator brushes at average load operation.

On standard models, the neutral brush rig position is determined and permanently fixed at the factory. It can not shift from neutral position.

Special models may have a brush rig of the adjustable design, and neutral position is identified by a "witness" mark at the point of mounting. 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.

GENERATOR DISASSEMBLY. - To disassemble the generator, first remove the end cover. Lift each brush high in its guide, so that the brush is held by spring pressure against its side. It is not necessary to remove the brush rig from its support. Tag leads which are disconnected, to assure correct replacement. Mark the position of other parts by scratching them to aid correct reassembling. After removing the two frame stud nuts, the brush rig and frame may be removed as a unit, the armature bearing remaining on the armature.

To remove the armature, loosen the armature center nut just enough to avoid damaging the threads. While pulling outward on the armature, strike the 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.

GENERATOR REASSEMBLY. - 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. Remove any foreign material, install the armature, then correct excessive run-out by striking the high side of the shaft near the ball bearing. Never strike the commutator.

On armatures not having a ball bearing, strike against a board held flat to the high side of the lamination, to correct excessive run-out.

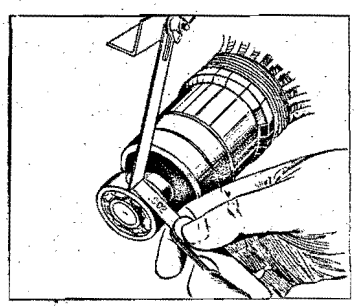


FIG. 37 - CHECKING ARMATURE RUN-OUT

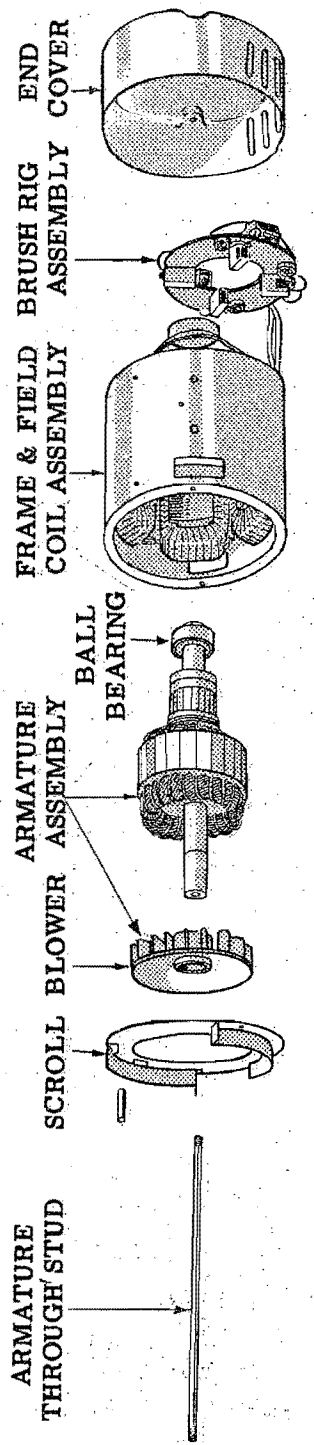


FIG. 38 - GENERATOR ASSEMBLY

The frame will mount only in the correct side upward. If the brush rig has been removed it must be installed in its original position. Avoid accidentally damaging brushes during assembly. Check for good brush contact and for good spring tension.

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 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 of a continuity type test lamp on the center shaft and the other test prod f rst 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 a.c. winding is open circuited. The use of an armature growler is required to test the d.c. winding for an open circuit, and to test for a short circuit. Follow the directions of the growler manufacturer.

CONTROLS

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. It 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.

STARTER INSTALLATION. - Follow each step in proper sequence. Refer to the illustrations for part reference numbers.

1. Remove the existing rope sheave from the engine flywheel. The sheave is not used with the recoil starter. The flat washer and lock washer are reused.

2. Secure cup #2 by placing lock washer #26 and flat washer #24 between cup and cap screw #23. See Figure 39b.

3. Assemble the mounting ring #3 (sometimes called bracket) to the starter (if not already so attached) using the four screws #4, and selecting the correct one of four possible positions to give the desired direction of rope pull.

4. Place three "U" shaped speed nuts #22 on the engine housing, with the longer end of the "U" nut toward the inside.

5. Failure to center the starter properly will damage the starter ! ! Incorrect alignment may be caused by distortion of, or shifting of, the blower housing on the engine.

   Place the starter against the engine blower housing and check to see that the centering pin #19 engages the center hole of the cup-and-flywheel-mounting capscrew while the starter mounting holes align. (NOTE: If the centering pin does not extend a sufficient length to engage the center hole of the capscrew, a pair of pliers can be used to pull the pin out farther.) Use the three sheet metal screws #21 to mount the starter securely to the blower housing.

6. Operate the starter to see that the installation is satisfactory. After the starter is mounted on the engine, there should be clearance of approximately 1/8 inch between cup #2 and rotor face #17. A minimum clearance of 3/32 inch between capscrew #23 and starter shaft must also be maintained.

7. During operation the starter friction shoe plates will roughen the cup. This condition is normal.

8. When operating the starter, slowly pull out at least six inches of cord, then give a fast steady pull. By this method, cord breakage is less apt to occur due to a false start and engine backfiring.

STARTER DISASSEMBLY. - CAUTION: Improper disassembly may allow rewind spring to release wildly and cause personal injury.

1. Loss of spring #8 can be avoided by holding washer #7 in position with hand while removing truarc retainer ring #6 with a screw driver. See Figure 39c.

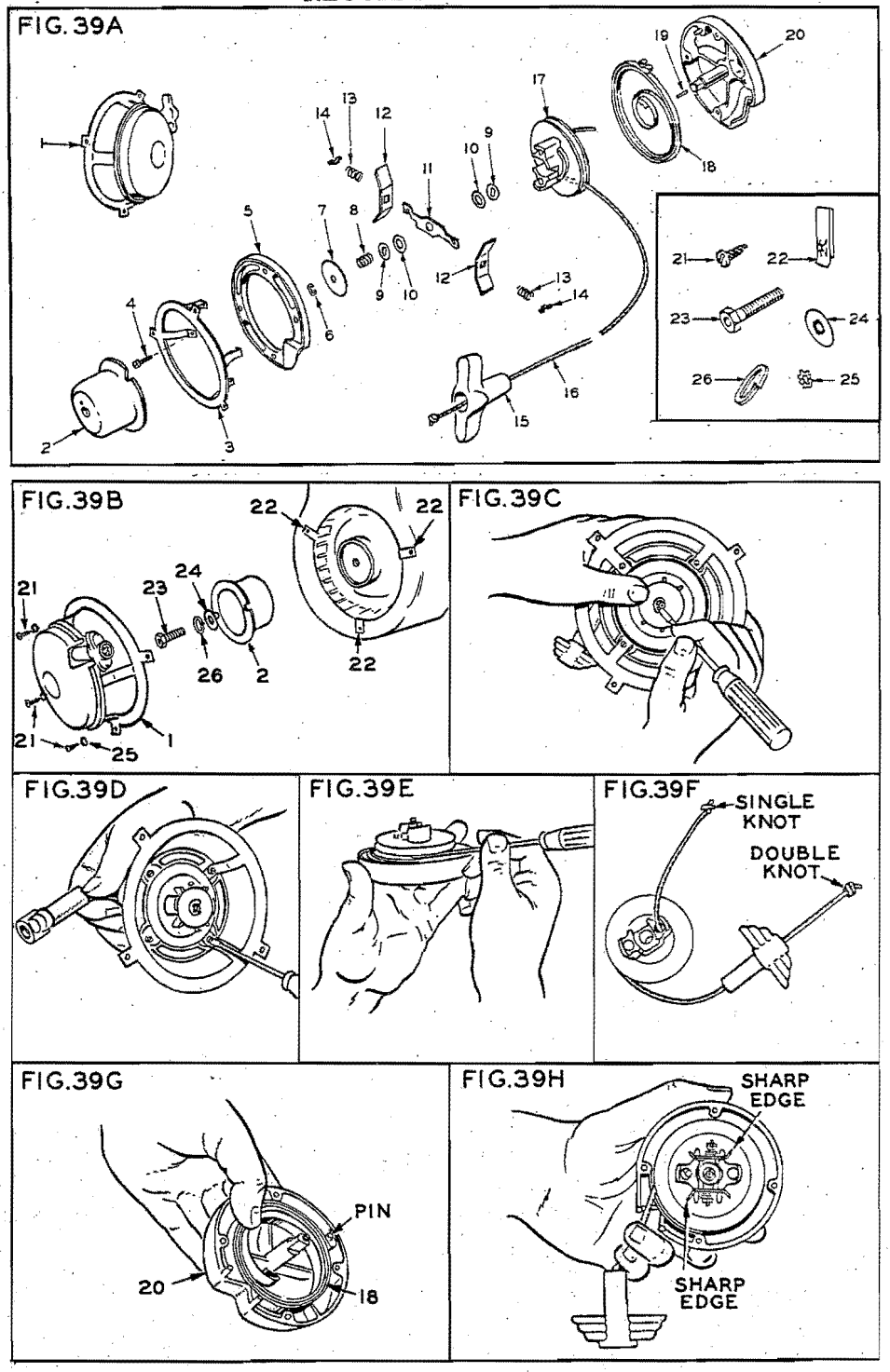


FIG. 39 - ROPE-RECOIL STARTER

2. Remove the following parts and assembly:
Large washer #7; Brake Spring #8; Washers #9 and 10; Friction Shoe Assembly - (Including parts #11, 12, 13, and 14); Washers #10 and 9.

3. To prevent spring rotation of rotor (rope sheave) #17, cord can be held as shown in Figure 39d, while removing four screws. Continue to hold rotor and cover as shown and remove mounting ring #3 and middle flange #5. Now the tension of the re-wind spring can be relieved by slowly releasing hold, and allowing spring to unwind.

4. Prevent re-wind spring #18 from escaping from cover (and causing personal injury) by carefully lifting rotor #17 only 1/4 inch away from the cover and detach inside spring loop from rotor as shown in Figure 39e. (NOTE: If spring should escape, it can be replaced in cover easily by coiling in turns.)

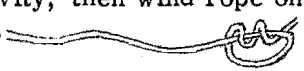
5. Clean the starter parts. Gummy grease and dirt may cause sluggish performance.

CORD REPLACEMENT.

1. First perform procedure given for starter disassembly.

2. Tie single knot in end of new cord. See Figure 39f.

3. Thread cord through rotor hole and out through rotor cord groove, pulling knot into cavity, then wind rope on rotor. Replace handle tying a double knot.



4. Perform procedure given for starter assembly.

RE-WIND SPRING REPLACEMENT.

1. First perform procedure given for starter disassembly.

2. Starting with the inside loop, remove re-wind spring #18 carefully from cover #20 by pulling out one loop at a time; holding back rest of turns. NOTE: that starting from the outermost coil of the spring, the spring must be wound in crankshaft rotation direction.

3. Spring holders furnished with replacement springs simplify the assembly procedure. Place spring in proper position as shown in Figure 39g, with the outside loop engaged around the pin. Then press spring into cover cavity thus releasing the spring holder.

4. Lubricate the shaft with a film of light grease. Lubricate the re-wind spring with a few drops of SAE 20 or SAE 30 oil. Under extremely dusty operating conditions, if performance indicates a dirty condition, then use only powdered lubricating graphite on the spring or do not lubricate it at all. Avoid lubrication of the brake washers.

5. Perform procedure given for starter assembly.

STARTER ASSEMBLY.

1. First complete installation of re-wind spring and cord.

2. Place rotor #17 (complete with handle and cord wound in proper direction) into cover #20 and hook the inside loop of spring #18 to rotor with the aid of a screw driver or other slender tool. Prevent the unhooking of the rewind spring from the rotor by keeping a slight tension on the spring until later when the middle flange is installed.

3. Install the following parts and assembly:
Washers #9 and 10; Friction shoe assembly (See Figure 39h. for positions) (Including parts #11, 12, 13 and 14); Washers #10 and 9; Spring #8; Large Washer #7; and Truarc retainer ring #6.

4. Wind the cord in the proper direction onto the rotor, then add two additional turns of the rotor and cord for pre-tension. A fatigued spring condition may require more additional turns to attain desired pre-tension of the re-wind spring.

5. With tension held on the cord, place middle flange #5 against cover #20, then install mounting ring #3 in position for desired direction of pull and continue as instructed under starter installation.

TROUBLE SHOOTING. - If friction shoe fails to function and engage with the cup, check for failure of brake spring #8, check for lubrication getting onto brake washers #10, and check for proper position of friction shoe sharp edge and friction shoe lever.

Periodically observe if starter assembly has shifted away from centering with crankshaft.

A broken re-wind spring should be replaced with a new one.

The life of a fatigued re-wind spring can be extended by adding turns of the rotor to increase pre-tension and then reinstalling the middle flange. Or, try forming new loops and coiling spring inside-out.

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.

POSSIBLE CAUSE	REMEDY
ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP	
Poor commutation.	See that brushes seat well on commutator, are free in their holders, are not worn too short, and have good spring tension.
Open circuit, short circuit, or ground in generator.	See GENERATOR, Replace part necessary.
Residual magnetism lost.	Consult your dealer.
EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST	
Poor compression, usually due to worn piston, rings, or cylinder.	Refinish cylinder. Replace piston and rings.
Oil leaks from oil base or connections. This does not cause smoky exhaust.	Replace gaskets. Tighten screws and connections. Check breather valve.
Oil too light or d iluted.	Drain, refill with correct oil.
Worn engine.	Repair as necessary.
Worn intake valve guide or valve stem.	Replace.
Engine misfiring.	Refer to smyptoms 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.

POSSIBLE CAUSE	REMEDY
BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUG WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD (CONT.)	
Dirty air cleaner.	Clean.
Excessive crankcase pressure, causing excessive fuel pump pressure.	Clean breather valve.
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 emptly.	Refill.
Defective ignition.	Check the ignition system. Repair or replace parts necessary.
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.

PINGING SOUND WHEN ENGINE IS SUDDENLY OR HEAVILY LOADED (CONT.)

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.

ELECTRIC MOTOR RUNS TOO SLOWLY AND OVERHEATS AT FAR END OF LINE BUT OK IF USED NEAR POWER UNIT

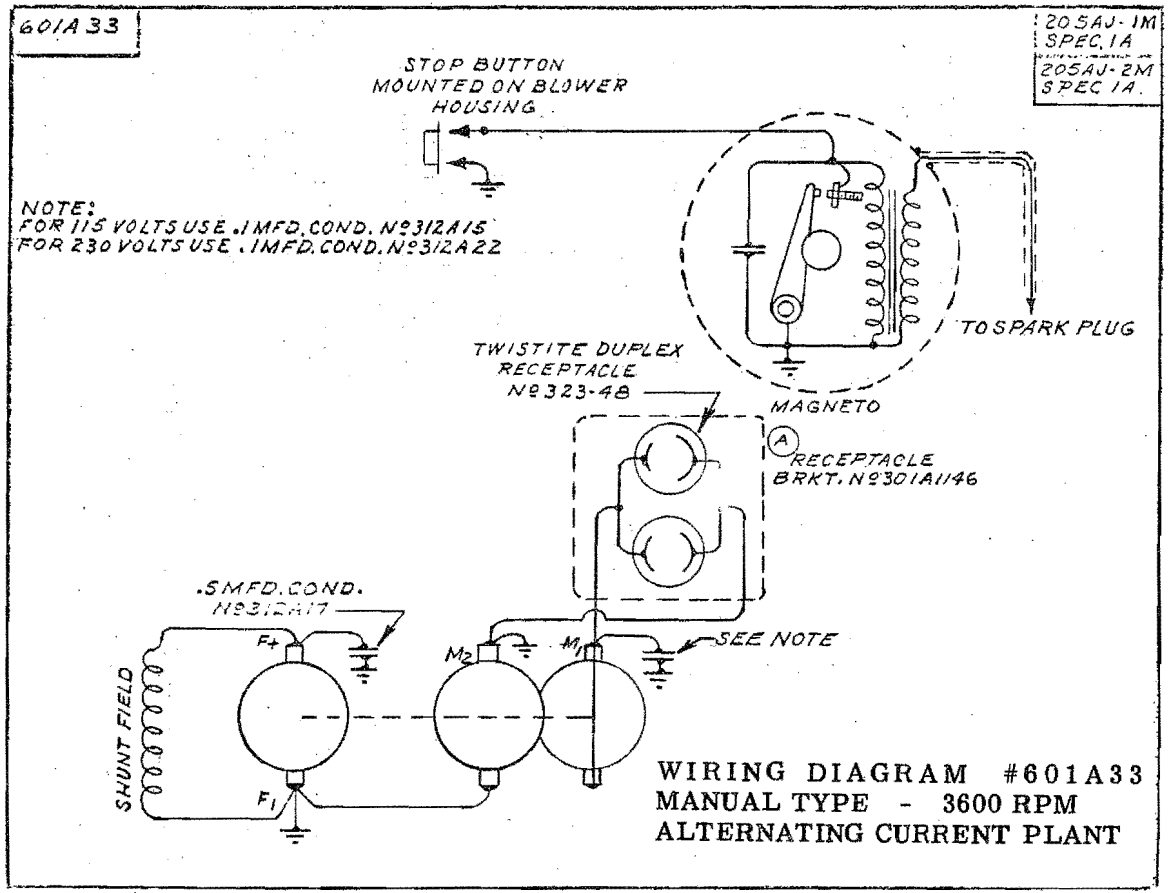
Too small line wire for load and distance.	Install larger or extra wires or reduce load.

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 too short, and have good spring tension.

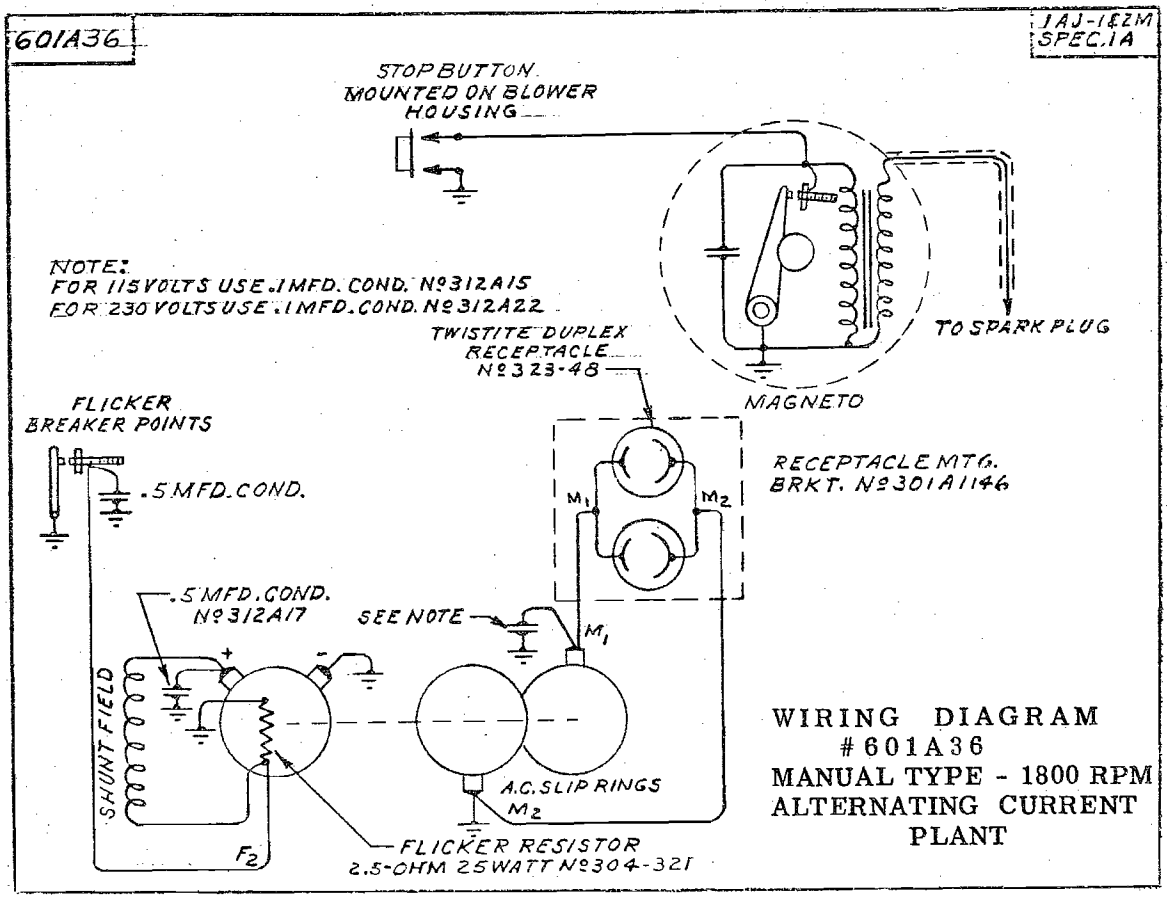
POSSIBLE CAUSE	REMEDY
VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING (CONT.)	
Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load condition causing trouble.
ENGINE BACKFIRES AT CARBURETOR	
Lean fuel mixture.	Clean or adjust carburetor.
Clogged fuel screen.	Clean screen.
Poor 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.
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.

POSSIBLE CAUSE	REMEDY
VOLTAGE DROPS UNDER HEAVY LOAD (CONT.)	
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.

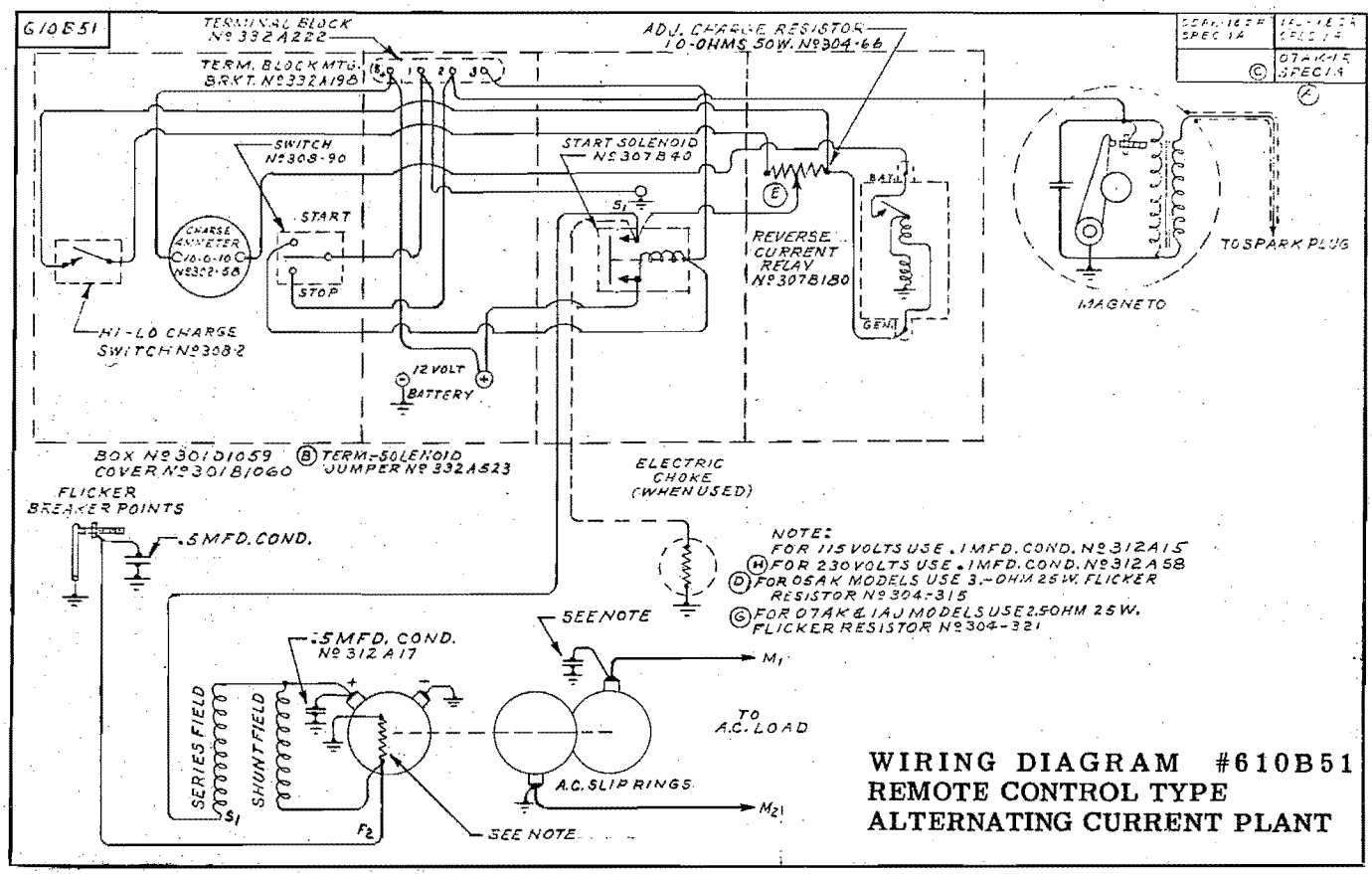

601A33
205AJ-1M SPEC. 1A
205AJ-2M SPEC 1A.
STOP BUTTON MOUNTED ON BLOWER HOUSING
NOTE:
FOR 115 VOLTS USE .1 MFD. COND. Nº312A15
FOR 230 VOLTS USE .1 MFD. COND. Nº312A22
TO SPARK PLUG
TWISTITE DUPLEX RECEPTACLE Nº323-48
MAGNETO
A
RECEPTACLE BRKT. Nº301A1146
.5 MFD. COND. Nº312A17
F+
F1
M2
M1
SEE NOTE
SHUNT FIELD
WIRING DIAGRAM #601A33
MANUAL TYPE - 3600 RPM
ALTERNATING CURRENT PLANT

601A36

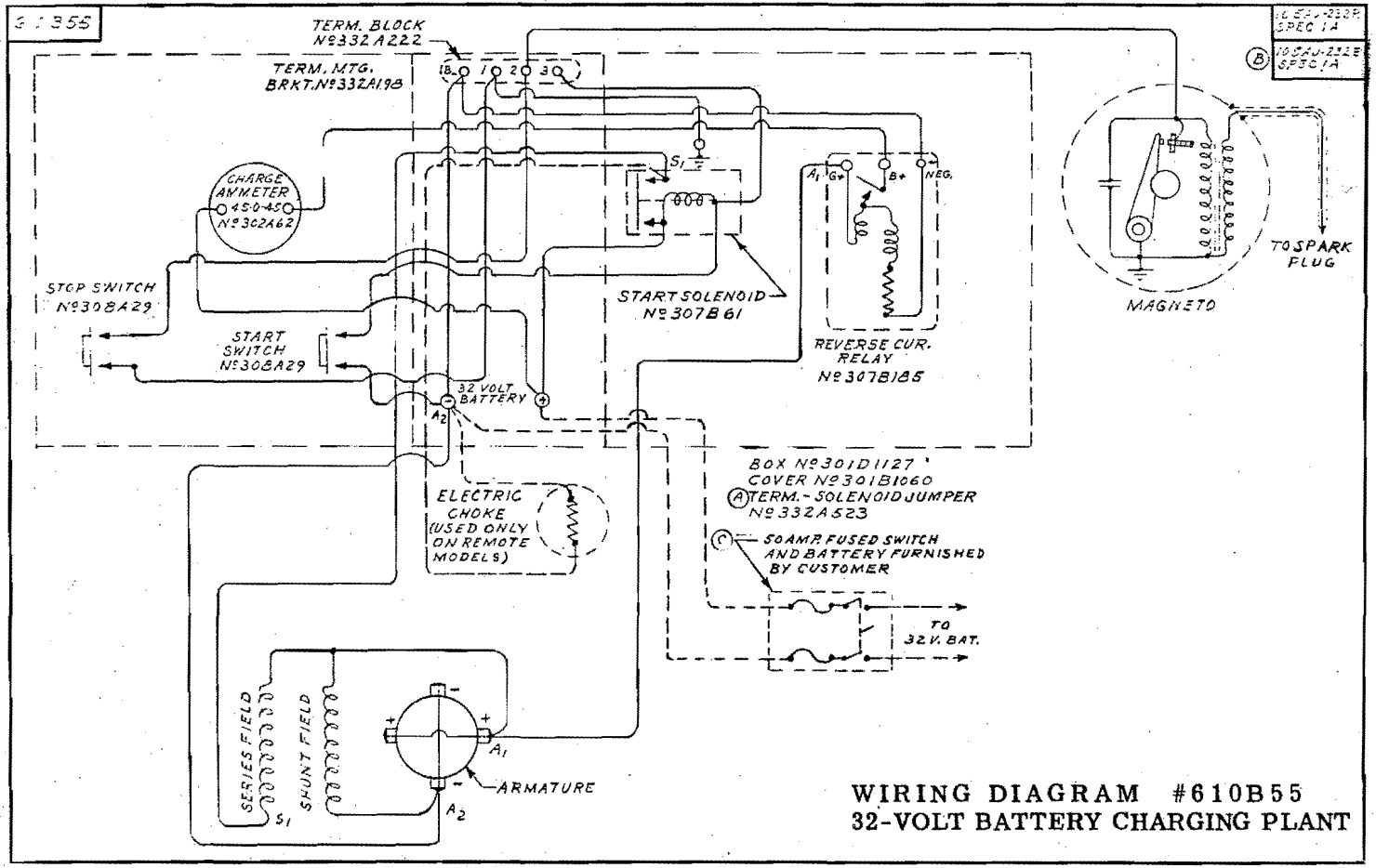
JAJ-1E2M
SPEC.1A



WIRING DIAGRAM
#601A36
MANUAL TYPE - 1800 RPM
ALTERNATING CURRENT
PLANT



WIRING DIAGRAM #610B51
REMOTE CONTROL TYPE
ALTERNATING CURRENT PLANT


G 1355
TERM. BLOCK
Nº332A222
TERM. MTG.
BRKT. Nº332A198
CHARGE AMMETER
45-0-45
Nº302A62
STOP SWITCH
Nº308A29
START SWITCH
Nº308A29
START SOLENOID
Nº307B61
REVERSE CUR. RELAY
Nº307B185
32 VOLT BATTERY
ELECTRIC CHOKE
(USED ONLY ON REMOTE MODELS)
BOX Nº301D1127
COVER Nº301B1060
(A) TERM.-SOLENOID JUMPER
Nº332A523
(C) 50 AMP. FUSED SWITCH AND BATTERY FURNISHED BY CUSTOMER
TO 32 V. BAT.
SERIES FIELD
SHUNT FIELD
ARMATURE
MAGNETO
TO SPARK PLUG
(B) 10CAU-2112 SPEC 1A
WIRING DIAGRAM #610B55
32-VOLT BATTERY CHARGING PLANT


Academy of the
Theatre Arts