


# INSTRUCTION MANUAL AND PARTS LIST



(Price 75 cents)

READ THIS BOOK CAREFULLY AND  
PRESERVE FOR FUTURE REFERENCE



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

## GENERAL INFORMATION

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

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

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

### MANUFACTURER'S WARRANTY

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

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

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

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

**IMPORTANT--RETURN WARRANTY CARD ATTACHED TO PLANT.**

# 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 35 miles.

100 running hours time on a generating plant engine is equivalent in total RPM's to approximately 3500 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 (200 to 300 miles) and changed every 50 to 100 operating hours (1750 to 3500 miles) depending on operating conditions.

About every 5,000 to 10,000 miles (140 to 285 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 285 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 35 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			GENERATING PLANT RUNNING HOURS			AUTOMOBILE RUNNING MILES		
DAILY AVERAGE	1 Hr.	=	35 Miles	MONTHLY AVERAGE		30 Hrs.	=	1050 Miles			
	4 Hrs.	=	140 Miles			120 "	=	4200 "			
	6 "	=	210 "			180 "	=	6300 "			
	8 "	=	280 "			240 "	=	8400 "			
WEEKLY AVERAGE	7 "	=	245 "	YEARLY AVERAGE		365 "	=	12,775 "			
	28 "	=	980 "			1460 "	=	51,100 "			
	42 "	=	1470 "			2190 "	=	76,650 "			
	56 "	=	1960 "			2920 "	=	102,200 "			

NOTE: Electric refrigerators and automatic heating units will add from 4 to 8 operating hours per day in addition to the regular lighting load.

# TABLE OF CONTENTS

SUBJECT	PAGE NO.
Description	
General Data .....	1
Engine .....	2
Generator .....	2
Controls - Accessories .....	2
Installation	
Location .....	3
Ventilation .....	3
Fuel Supply - Gasoline .....	3
Natural Gas or Vapor Fuel .....	3
Batteries .....	4
Wiring .....	4
Preparation	
Lubrication .....	6
Fuel, Gasoline .....	7
Fuel, Natural Gas or Liquid Petroleum Gas .....	7
Radiator .....	7
Operation	
Preliminary .....	8
Starting the Plant Electrically .....	8
Starting the Plant Manually .....	8
Checking the Operation .....	9
Stopping the Plant .....	9
Abnormal Operating Conditions	
Low Temperatures .....	10
Crankcase Lubrication .....	10
Air Cleaner .....	10
Cooling System .....	10
Fuel, Gasoline .....	10
Batteries .....	11
High Temperatures .....	11
Dust and Dirt .....	11
Periodic Service	
General .....	12
Daily Service .....	12
Weekly Service .....	12
Monthly Service .....	13
Semi-Yearly Service .....	14
Adjustments	
Carburetor, Gasoline .....	15
Carburetor, Gas or Vapor .....	15
Automatic Choke .....	15
Governor .....	16
High Water Temperature Switch .....	17
Fan Belt Adjustment .....	17
Maintenance and Repairs	
Engine .....	19
Table of Clearances .....	22
Generator - Controls .....	23
Service Diagnosis .....	25
Instructions for Ordering Parts .....	31
Repair Parts List .....	42
Service Kits - Accessories .....	55

# LIST OF ILLUSTRATIONS

## SUBJECT

## PAGE NO.

Governor Adjustment .....	16
Tappet Adjustment .....	18
Timing Gears .....	18
Generator Assembly .....	24
Care of Commutator and Brushes .....	24

## Repair Parts Illustrations

Fig. 1 - Cylinder Block Group .....	32
Fig. 2 - Crankshaft and Camshaft Group .....	33
Fig. 3 - Piston and Connecting Rod Group .....	34
Fig. 4 - Valve Group .....	34
Fig. 5 - Oil Pump and Oil Filter Group .....	35
Fig. 6 - Water Pump and Fan Group .....	36
Fig. 7 - Ignition Group .....	37
Fig. 8 - Governor Group .....	37
Fig. 9 - Fuel System Group .....	38
Fig. 10 - Carburetor Group .....	39
Fig. 11 - Generator Group .....	40
Fig. 12 - Control Group .....	41



## DESCRIPTION

This manual is supplied with each electric generating plant, and is intended to assist the operator in the installation and operation of the plant and in maintaining it so that it will provide long and satisfactory service.

Each plant is test run and carefully checked under various electrical loads before leaving the factory to assure that it is in good condition and will produce its rated output. Before putting the plant into operation, carefully inspect for any damage which may have occurred during shipment. Damaged parts must be repaired or replaced. Read this manual thoroughly to become familiar with the details of installation and operation of this plant. A deviation from these instructions may lead to unnecessary trouble and expense.

This manual applies to complete electrical generating plants producing 60-cycle, alternating current. One copy of this manual is supplied with each plant of the basic models listed in the following table, and with special models which differ slightly from these basic models. Each plant consists of an internal combustion engine, a self excited electric generator, and such accessories and controls as apply to the particular model. Each plant is enclosed in a metal housing.

### GENERAL DATA

WATTS	VOLTS	CYCLES	PHASE	WIRES	* ENGINE RPM	† PARTS REFERENCE SYMBOL
25000	115/230	60	1	3	1800	A
25000	120/208	60	3	4	1800	B
25000	230	60	3	3	1800	C
15000	115/230	60	1	3	1800	D
15000	120/208	60	3	4	1800	E
15000	230	60	3	3	1800	F

\* 50 CYCLE PLANTS RUN AT 1500 R.P.M.

† The Parts Reference Symbol in this column indicated which column to use under the heading "Quantity Used" in the parts list at the back of this book. To determine which column to use, compare the characteristics of your plant and the data given on the plant nameplate with the data in the above table. For example if your plant is a 25000 watt, 115/230 volt, single phase, 3 wire plant, use column "A" in the parts list. Order only those parts which have a quantity shown in that column. If your plant is of a different type than any shown in the above table, order generator parts by description only. Always be sure to give the model, spec. number and serial number of the plant, as shown on the plant nameplate.

## DESCRIPTION

### ENGINE

The engine is a 6 cylinder, L head, 4 stroke cycle, water cooled, internal combustion engine. For the 25,000 watt 60 cycle and 20,000 watt 50 cycle plants, the bore is 3-5/16", the stroke is 4-3/8", compression ratio 6 to 1, and the maximum horsepower rating is 54.2 at 1800 r.p.m. For the 15,000 watt 60 cycle and 14,000 watt 50 cycle plants, the bore is 3", the stroke is 4-3/8", compression ratio 6.4 to 1, and the maximum horsepower rating is 45.4 at 1800 r.p.m. 12 volt starting and ignition current is supplied by two 6 volt batteries connected in series. Charging current for the batteries is furnished by a separate automotive type generator. The engine speed is controlled by a flyweight type, gear driven governor. Full length water jackets surround the cylinders and valve seats. Circulation of the engine coolant is maintained by a belt driven pump, and the engine temperature is thermostat controlled. A pusher type fan forces cooling air out through the front of the radiator. A gear type oil pump supplies pressure lubrication to main, camshaft and connecting rod bearings, and to the tappets. The fuel tank capacity is 20 gallons, the cooling system capacity 16 quarts, and the crankcase oil capacity 5 quarts, plus 1 quart for the oil filter. All measures are United States standards.

Main, camshaft, and connecting rod bearings are replaceable. Exhaust valves are the "Roto" type, and have replaceable seats. Valve tappets are adjustable.

### GENERATOR

The air cooled generator has two main components; the alternator, and the exciter. The alternator is a 4 pole, revolving field type alternating current generator. The exciter generates direct current for exciting the alternator field. The alternator field and the exciter armature are assembled into a single rotor which is directly connected to the engine flywheel. The rotor is supported at the engine end by the engine rear main bearing and at the exciter end by a large ball bearing. The larger frame contains the stationary armature windings of the alternator, and the smaller frame contains the stationary exciter field.

Due to the inherent design of the generator, voltage regulation between no load and full load is very close. The frequency of the current is determined by the engine speed, and is regulated by the engine governor. The speed is approximately 1800 r.p.m. for the 60 cycle plant, and 1500 r.p.m. for the 50 cycle plant.

### CONTROLS

The plant is equipped with an instrument panel mounting the necessary meters, gauges, relays and switches for proper operation of the plant. Remote control switches, or automatic line transfer equipment may be connected to the plant.

### ACCESSORIES

Standard accessories supplied with each plant include batteries, a battery hydrometer, a tube of ball bearing grease, a remote start-stop switch, instruction books, and a hand crank.



# INSTALLATION

**IMPORTANCE OF PROPER INSTALLATION.**— Proper installation is essential to satisfactory and dependable performance. Location and ventilation are important factors to consider in installation.

**LOCATION.**— The plant should be centrally located in relation to the electrical load. If practicable, install the plant in a building or covered vehicle for protection from extremes in weather conditions.

## CAUTION

Exhaust gases are poisonous and must be piped outdoors if the plant is installed indoors. Connect a pipe as large as the muffler outlet to the muffler by means of a short length of flexible tubing. If the exhaust line must be pitched upward, install a condensation trap at the lowest point in the line. If the line passes through a wall, shield the wall by passing the line through a suitable metal flange.

The site should be dry, clean, and well ventilated. Either a damp or a dusty condition will require more frequent inspection and servicing of the plant. Allow at least 24" space on all sides for ease in servicing.

If the plant is mounted aboard a truck or trailer, see that it is fastened securely when in transit, and that it sets in a level position when operating.

**VENTILATION.**— Proper cooling depends upon correct ventilation to dissipate the heat generated by the engine and generator. Separate air inlet and outlet openings must be provided if the plant is mounted in a small room or compartment.

**FUEL SUPPLY, GASOLINE.**— A 20-gallon fuel tank is mounted over the generator of each plant. For permanent installations, a 55 gallon or 110 gallon tank suitable for underground installation is available. The total lift of the fuel from the tank to the plant should not exceed 8 feet, nor the total distance exceed 50 feet. Observe local codes when installing any auxiliary fuel tank.

**NATURAL GAS OR VAPOR FUEL.**— Observe any applicable codes when connecting to a source of gas. Some types of Liquid Petroleum Gas will not vaporize readily at extremely low temperatures, and heat exchanger equipment may have to be installed. Consult the fuel supplier for recommendations. The regulator inlet is threaded for 1" pipe.

## NOTE

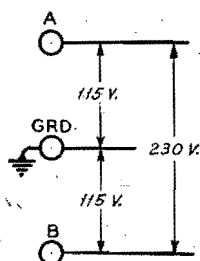
If the line pressure exceeds 5 pounds, it will be necessary to connect a primary regulator in the line to reduce the pressure before it enters the regulator mounted on the plant.

## INSTALLATION

**BATTERIES.**— The two 6-volt batteries are connected in series by a short jumper cable. Connect the long cable which is attached to the start solenoid switch to the remaining positive (+) post of the two batteries. Connect the cable which is grounded on the battery support to the remaining negative (—) post. If the plant was boxed for export shipment, service the batteries as directed on the tags attached to the batteries.

**WIRING.**— Connect the a-c load wires to the terminals marked AC OUTPUT, mounted on the side of the chassis. Remove the right side grille for access to the terminals. Solderless type connectors are provided, inclosed in a small cloth bag, for connecting the load wires to the output terminals. Run the load wires through the grille openings, making sure that all connections are made secure. If conduit is used, the conduit connector may be installed to the plugged hole in the chassis side plate. Be sure to use the proper size insulated wire, taking into consideration the distance between the plant and the load, and the type of load. Refer to the plant wiring diagram, the topmost terminal on the plant corresponding to the left hand terminal on the wiring diagram. Follow the directions for connecting the load lines as given below for the type of plant you have.

### 115/230 VOLT, SINGLE PHASE, 3 WIRE PLANT

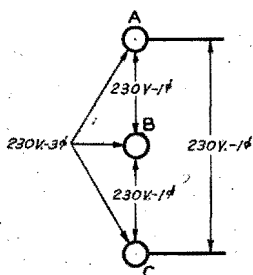


The center terminal is grounded. For 115 volt current, connect the grounded load wire to the center terminal, and the other load wire to either of the two outside terminals, A or B. Two 115 volt circuits are thus obtainable, with not more than 1/2 the plant rating available on each circuit. Balance the load as closely as possible between the two circuits.

For 230 volt current, connect the load wires to the upper and lower terminals, A and B, leaving the center terminal unused.

A load not to exceed 15 amps., 115 volts may be connected to each outlet of the receptacle mounted on the control panel. Any load connected to this receptacle will not register on the meters.

### 230 VOLT, THREE PHASE, 3 WIRE PLANT



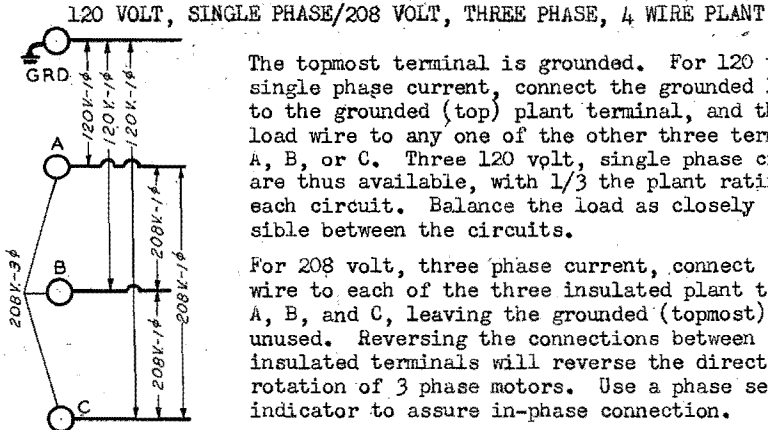
No terminal is grounded. For three phase current, connect a separate load wire to each plant terminal, A, B, and C, one wire to each terminal. Reversing the connections between any two terminals will reverse the direction of rotation of 3 phase motors. Use a phase sequence indicator to assure in-phase connection.

To obtain 230 volt, single phase current, connect separate load wires to each of any two plant terminals, one wire to each terminal. Three 230 volt, single phase circuits are thus available, with 1/3 the plant rating to each circuit. Balance the load as closely as possible between the circuits.

If both single and 3 phase current is to be used at the same time, use care not to overload any one circuit. Subtract the amount of the 3 phase load from the plant capacity. Divide the remainder by 3, and this

## INSTALLATION

is the load that may be taken from any one circuit for single phase current. For example, a 3 phase 10,000 watt load is used. This leaves 15,000 watts available for single phase, if the plant capacity is 25,000 watts. One third of this 15,000 watts is 5,000 watts, which is the amount that may be taken from each of the 3 single phase circuits. Do not attempt to take all 15,000 in this example off one circuit, as overloading of generator will result.



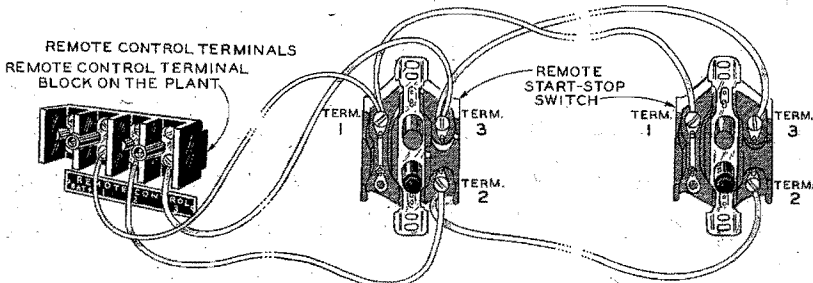
The topmost terminal is grounded. For 120 volt, single phase current, connect the grounded load wire to the grounded (top) plant terminal, and the other load wire to any one of the other three terminals A, B, or C. Three 120 volt, single phase circuits are thus available, with 1/3 the plant rating to each circuit. Balance the load as closely as possible between the circuits.

For 208 volt, three phase current, connect a load wire to each of the three insulated plant terminals, A, B, and C, leaving the grounded (topmost) terminal unused. Reversing the connections between any two insulated terminals will reverse the direction of rotation of 3 phase motors. Use a phase sequence indicator to assure in-phase connection.

For 208 volt, single phase current, connect separate load wires to each of any two insulated (three lower) terminals, one wire to each terminal. Three circuits are thus available, with 1/3 the plant rating to each circuit. Balance the load as closely as possible between the circuits. If both single and three phase current is used at the same time, see the directions for the three phase, three wire plant.

### ALL MODELS

A small, four place terminal block is mounted above and to the left of the a-c output terminals. This is the block marked "DC OUTPUT-REMOTE" on the wiring diagram. One or more remote control switches may be connected to this block for remote starting and stopping. Connect the switch terminals Nos. 1, 2, and 3 to the corresponding terminals on the terminal block. Leave the B+ terminal unused. Remote control switches may be connected at any desired point within 250 feet of the plant. Number 19 wire for this purpose is listed in the parts list. If automatic line transfer equipment is to be connected, follow the directions supplied with the equipment.



### PROPER CONNECTIONS FOR REMOTE START-STOP SWITCHES

## PREPARATION

**PREPARATION FOR OPERATION.**— Before putting the plant in operation, supply it with fuel, oil and water (or antifreeze liquid). Comply with the following instructions.

**LUBRICATION.**— Fill the crankcase with 5 quarts of oil. Approximately 1 quart of oil remained in the oil filter when the crankcase was drained at the factory. Use a heavy duty (detergent) type oil. Do not use an oil heavier than SAE number 20 in a plant being put into service the first time. Following the initial filling, use an oil of the proper SAE number, according to the lowest temperature to which the plant will be exposed, as indicated in the following table.

LOWEST TEMPERATURE	SAE NUMBER OF OIL
Above 100°F. (37°C.)	40
Above 32°F. (0°C.)	30
0°F. (-18°C.)	20
Below 0°F. (-18°C.)	10W

When temperatures are so low as to cause SAE number 10W oil to be too heavy for satisfactory starting, follow the directions given under **ABNORMAL OPERATING CONDITIONS - LOW TEMPERATURES.**

The capacity of the crankcase is 5 quarts, plus approximately 1 quart used in the operation of the oil filter. Drain the oil filter on alternate oil changes. This will necessitate using approximately 6 quarts when refilling the crankcase.

The use of a heavy duty (detergent) type oil will greatly increase the life of pistons and rings. If a change to a heavy duty type oil is made after using non-detergent oil in this plant, allow not more than one-third the usual operating hours between the next two oil changes. Thereafter, change the crankcase oil at the regular periods, as recommended under **PERIODIC SERVICE.**

Keep the crankcase oil level at or near the "FULL" mark on the oil level gauge, but never above it. If the crankcase is overfilled, the connecting rods may strike the oil, causing improper lubrication and excessive oil consumption. Never allow the oil level to fall below the 3/4 mark on the oil level gauge.

Fill the air cleaner cup to the indicated level with oil of the same SAE number as that used in the crankcase, except as instructed under **ABNORMAL OPERATING CONDITIONS.**

Pour a drop or two of lubricating oil into the distributor oil cup.

Place a drop of lubricating oil on each of the governor to carburetor link ball joints.

## PREPARATION

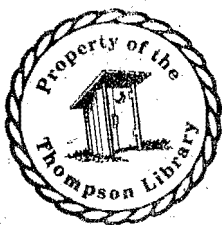
**FUEL, GASOLINE.**— The gasoline tank capacity is 20 gallons. Fill the tank nearly full with clean, fresh, unleaded gasoline. Do not fill the tank completely full in cold weather. Expansion of the fuel, as the plant warms up, may cause the gasoline to overflow and result in a fire. Observe the usual precautions when handling gasoline. Never fill the tank while the plant is running.

The fuel gauge on the control panel registers the amount of fuel in the tank only when the plant is running, or when the ignition switch is thrown to the HAND START position.

**FUEL, NATURAL GAS OR LIQUID PETROLEUM GAS.**— Make sure that fuel supply lines and tanks (if used) have been properly installed and connected as instructed under INSTALLATION.

**RADIATOR.**— The capacity of the cooling system is 16 quarts. Use clean, alkali-free water. Clean rain water may be used. The use of a rust and scale inhibitor is recommended. If the plant will be exposed to freezing temperatures, use a standard antifreeze in the proper proportion. To avoid loss of antifreeze through the overflow pipe, fill only to between 1 inch and 2 inches below the bottom of the filler neck.

After the foregoing instructions have been carefully complied with, the plant is ready for operation. However, before starting the plant, carefully study the paragraphs under the headings OPERATION and ABNORMAL OPERATING CONDITIONS immediately following.



## OPERATION

**PRELIMINARY.**— Be sure that the plant has been properly installed and prepared for operation before starting it. Turn on the fuel supply and check for leaks, correcting any that may be found. See that the circuit breaker handle is in the OFF position, so that no load is connected.

### CAUTION

If the preparation has been made for extremely cold weather, the initial filling of the crankcase with diluted oil should have been left to be done immediately before starting the plant. Be sure the crankcase is filled with the proper oil to the high level mark on the bayonet gauge.

Oil was sprayed into the cylinders before the plant was shipped, and it may be necessary to remove and clean the spark plugs in gasoline before the engine will start the first time. Dry the plugs before re-installing them.

**STARTING THE PLANT ELECTRICALLY.**— See that the ignition switch is set at the ELECT. START position. If the plant is to be operated on gasoline fuel, press the START button firmly for several seconds to allow the fuel pump to become full and to pump gasoline into the carburetor. The carburetor is automatically choked, and the engine should start after a few seconds of cranking. If it does not start, do not press the START button continuously, but for periods of not more than five seconds at a time, with equivalent stops between. If the plant fails to start after a few attempts, check the fuel and ignition systems and repeat the procedure after correcting the trouble.

If the plant is equipped for natural or Liquid Petroleum Gas operation, see that the arm of the choke control mounted upon the exhaust manifold is locked so as to make the choke inoperative. No choking is necessary when operating on gas, and the carburetor choke valve should be wide open. See that the gasoline supply is turned off, and that there is no gasoline in the carburetor bowl. Turn on the fuel supply and press the START button. The regulator primer button, at the center of the regulator, may have to be pushed to start the engine the first time. Unless the fuel to be used is of approximately the same BTU rating as that used by the manufacturer (800 BTU) it will be necessary to readjust the carburetor gas adjustment valve to insure smooth and economical operation. See the section headed ADJUSTMENTS.

**STARTING THE PLANT MANUALLY.**— If gasoline fuel is used, use the hand crank to turn the engine over enough times to fill the fuel pump and carburetor. Throw the ignition switch to the HAND START position. Crank the engine with a quick upward pull. Do not spin the crank or press down on it. If gas fuel is being used, it may be necessary to press the regulator priming button, at the center of the regulator, to start the engine the first time. After the carburetor gas adjustment valve has been properly adjusted, it should be unnecessary to use the priming button. After the plant starts, be sure to return the ignition switch to the ELECT. START position.

## OPERATION

### CAUTION

KEEP THE IGNITION SWITCH AT THE ELECT. START POSITION AT ALL TIMES EXCEPT WHEN ACTUALLY STARTING THE PLANT MANUALLY. THROW THE SWITCH TO THE HAND START POSITION WHILE CRANKING THE PLANT MANUALLY, BUT RETURN IT TO THE ELECT. START POSITION AS SOON AS THE PLANT STARTS. WHILE THIS SWITCH IS AT THE HAND START POSITION THE HIGH WATER TEMPERATURE CUT-OFF SWITCH (AND LOW OIL PRESSURE SWITCH, IF THE PLANT IS SO EQUIPPED) IS CUT OUT OF THE CIRCUIT AND THE PLANT IS NOT PROTECTED AGAINST OVER-HEATING. IF THE SWITCH IS LEFT AT THE HAND START POSITION WHEN THE PLANT IS NOT RUNNING, THE BATTERY MAY BECOME DISCHARGED AND THE IGNITION COIL DAMAGED.

CHECKING THE OPERATION.- After the plant starts, allow the engine to reach operating temperature. The oil pressure should be between 20 and 40 pounds, the coolant temperature approximately 150° to 180°F. (65° to 82°C.), and the battery charge rate between 2 and 12 amperes, depending upon the charge condition of the batteries.

If it is desired to check the coolant temperature or the fuel supply when the plant is not running, throw the ignition switch to the HAND START position while making the observation. Be sure to return the ignition switch to the ELECT. START position after the observation is completed. While the plant is running, the various gauges are automatically in operation when the switch is at the ELECT. START position.

If the plant will start but does not continue to run, start the plant manually with the ignition switch in the HAND START position. If the plant continues to run with the ignition switch at the HAND START position, but stops when the switch is thrown to the ELECT. START position, trouble is indicated in one of the relays, the high water temperature switch, or a loose connection. Failure of the battery charging generator to deliver current to the stop relay will also prevent the plant from running with the ignition switch at the ELECT. START position.

DO NOT LEAVE THE IGNITION SWITCH AT THE HAND START POSITION LONGER THAN NECESSARY TO MAKE TESTS.

Connect a load to the plant by throwing the circuit breaker handle to the ON position. The electrical meters indicate the output voltage and the amount of load connected to the output terminals. At no load, the voltage should be slightly above the nameplate rating, and with a full load the voltage should be slightly below the nameplate rating. A voltmeter-ammeter selector switch is provided for checking the individual phases of the circuit on the three phase plants. Plants equipped with an output receptacle on the control panel will not register any load which may be connected to the receptacle.

If the voltmeter reading fluctuates, investigate for possible fluctuating load conditions before attempting any adjustments on the plant carburetor or governor.

The circuit breaker will open automatically and disconnect the load if the plant is severely overloaded. Correct the cause of overloading before again throwing the circuit breaker handle to the ON position. To disconnect the load, throw the circuit breaker handle to the OFF position.

STOPPING THE PLANT.- Throw the circuit breaker handle to the OFF position. Press the STOP button firmly. The ignition switch must be at the ELECT. START position, as pressing the STOP button will have no effect if the switch is at the HAND START position.

## ABNORMAL OPERATING CONDITIONS

**LOW TEMPERATURES.**— Lubrication, fuel, and the cooling system require special attention at temperatures below 32°F. (0°C.).

**CRANKCASE LUBRICATION.**— When operating the plant in temperatures between 32°F. (0°C.) and 0°F. (-18°C.) use a good quality oil of SAE number 20 in the crankcase. For temperatures below 0°F. (-18°C.) use SAE number 10W. If the plant will be exposed to extremely low temperature when stopped, so that the oil will become congealed, drain the crankcase immediately upon stopping the plant. Keep the oil in a warm place until ready to start the plant again, at which time the crankcase should be refilled with the warm oil.

In temperatures below -20°F. (-29°C.), if it is impracticable to drain the oil and keep it warm, it will be necessary to dilute the oil with kerosene in the following manner. Run the engine until it is warm, then drain the crankcase and the oil filter. Thoroughly mix 1 part of kerosene with 4 parts of SAE number 10W oil and fill the crankcase to the FULL mark on the oil level gauge. Run the engine for approximately 10 minutes to thoroughly circulate the mixture, and check the oil level, adding enough to compensate for that used in the oil filter. Always use a mixture of the same proportions when adding oil between changes. When using diluted oil, change the oil every 25 operating hours and check the oil level frequently. Use undiluted oil again as soon as temperature conditions permit.

### CAUTION

Do not put diluted oil into the engine until ready to start it. Mix well just before pouring it into the engine.

**AIR CLEANER.**— If congealed oil or frost formation within the air cleaner restricts the air flow, remove and clean the air cleaner. Reassemble and use the air cleaner without oil until conditions permit the use of oil in the normal manner. Do not use diluted oil in the air cleaner.

**COOLING SYSTEM.**— The coolant must be protected if there is any possibility of its freezing. Use any good antifreeze, in the proportion recommended by the manufacturer for the lowest temperature to which the plant will be exposed. The capacity of the cooling system is 16 quarts.

If the water temperature gauge shows the engine to be operating too coolly, a portion of the radiator surface may be covered to raise the coolant temperature to normal. Avoid overheating. Set the high water temperature cut-off switch to operate at a temperature several degrees below the boiling point of the coolant, taking into consideration the altitude at which the plant is operating. Check the antifreeze solution frequently.

If the cooling system is drained to prevent freezing, be sure to remove the radiator cap in order to prevent formation of a vacuum in the cooling system, which would prevent complete draining. Open both the radiator and cylinder block drain cocks.



## ABNORMAL OPERATING CONDITIONS

**FUEL, GASOLINE.**— Use fresh, clean, high test gasoline for easy starting in cold weather. Moisture condensation can cause considerable trouble from ice formation in the fuel system. Do not fill the fuel tank entirely full of gasoline, as expansion may cause it to overflow.

**BATTERIES.**— Check the charge condition of the batteries frequently, to be sure that they are kept in a fully charged condition. A discharged battery will freeze at approximately 20°F. (-7°C.) and be permanently damaged. A fully charged battery will not freeze at -90°F. (-67°C.).

**HIGH TEMPERATURES.**— If the plant is to be operated in abnormally high temperatures (above 100°F., or 38°C.), provide sufficient air circulation for proper cooling. Keep the cooling system clean and free of rust and scale. See that the high water temperature cut-off switch is correctly set. Keep the radiator well filled, the fan belt tension properly adjusted, and the crankcase oil level at, but not above, the FULL mark on the oil level gauge.

### CAUTION

For best cooling effects, keep the door panels in place on the plant when it is in operation.

Use SAE number 30 oil for temperatures up to 100°F. (38°C.) and SAE number 40 for higher temperatures. Check the oil level frequently, and change the crankcase oil at least every 50 hours. Keep the electrolyte level in the batteries up to normal.

**DUST AND DIRT.**— Keep the plant as clean as practicable. Service the air cleaner as frequently as conditions require. Keep the radiator fins clean and free of obstructions. Keep the generator commutator and slip rings and brushes clean. See that all brushes ride freely in their holders. Keep oil and gasoline supplies in air tight containers. Install a new oil filter element as often as necessary to keep the oil clean. Change the crankcase oil more frequently if it becomes discolored before the normal time has elapsed between changes.

## PERIODIC SERVICE

**GENERAL.**-- Follow a definite schedule of inspection and servicing to assure better performance and longer life of the plant at minimum expense. Service periods outlined below are for normal service and average operating conditions. For extreme load conditions, or abnormal operating conditions, service more frequently. Keep a record of the hours of operation each day to assure servicing at the proper periods.

### DAILY SERVICE

If the plant is operated more than 8 hours daily, perform the DAILY SERVICE operations every 8 hours.

**FUEL.**-- If the plant is operated on gasoline fuel, check the fuel gauge often enough to assure a continuous fuel supply. Do not fill the tank while the plant is running.

**RADIATOR.**-- Check the level of the coolant and, if necessary, add sufficient liquid to bring the level up to within 1 inch of the bottom of the filler neck. In freezing weather, if a non-permanent type antifreeze is used, check the protective strength of the coolant.

**AIR CLEANER.**-- Check the oil level in the air cleaner cup and add sufficient oil to bring it to the indicated level. Clean out and refill the oil cup if dusty conditions prevail.

**CRANKCASE OIL LEVEL.**-- Check the oil level as indicated on the bayonet type oil level gauge. Do not allow the engine to operate with the oil level below the  $\frac{3}{4}$  mark on the gauge. Add sufficient oil of the proper SAE number to bring the level to the FULL mark, but do not overfill the crankcase.

**CLEANING.**-- Keep the plant as clean as possible. A clean plant will give longer and more satisfactory service.

### WEEKLY SERVICE

If the plant is operated more than 50 hours a week, perform the WEEKLY SERVICE operations every 50 hours.

**CRANKCASE OIL.**-- Add crankcase oil, or change the oil after 50 operating hours. If the plant has been operating with diluted oil, change the oil after 25 hours operation.

**GENERAL LUBRICATION.**-- Put a drop of light lubricating oil on each of the governor to carburetor link ball joints, and a few drops in the distributor oil cup. Put several drops of oil in the oil holes at each end of the battery charging generator, and in the oil hole at the forward end of the starting motor.

**AIR CLEANER.**-- Clean the air cleaner filter element and cup thoroughly in gasoline or other suitable solvent. Allow to dry, or use compressed air to dry. Refill the cup to the indicated level with clean oil of the same SAE number as that used in the crankcase, except as noted under ABNORMAL OPERATING CONDITIONS.

## PERIODIC SERVICE

**FAN BELT.**— Check the fan belt tension. Adjust to permit about 3/4" play when pressure is applied midway between the fan and crankshaft pulleys. Install a new belt if the old one is badly worn.

**BATTERIES.**— See that battery connections are clean and tight. Keep the electrolyte level at the proper level above the plates by adding only clean water which has been approved for use in batteries. In freezing weather, run the plant at least 20 minutes after adding water, to mix the water with the electrolyte.

**SPARK PLUGS.**— Clean the spark plugs and check the electrodes gap. Keep the gap adjusted to 0.025". More frequent spark plug service may be necessary if leaded gasoline is used.

**WATER PUMP.**— Lubricate the water pump with a good grade of water pump grease. Do not overlubricate, as grease may be forced into the coolant.

**DISTRIBUTOR.**— Check the distributor contact points. If they are only slightly burned or pitted, resurface them on a fine stone. Install new contact points if the old ones are badly burned. Keep the gap adjusted to 0.020". Excessive burning or pitting of the points indicates a faulty condenser, which should be replaced with a new one.

## MONTHLY SERVICE

If the plant is operated more than 200 hours a month, perform the MONTHLY SERVICE operations every 200 hours.

**GASOLINE SUPPLY.**— Close the gasoline shutoff valve and remove and clean the sediment bowl and screen. Be sure the bowl gasket is in good condition when reassembling.

Remove the pipe plug at the bottom of the carburetor and drain the bowl of any sediment which may have accumulated. Drain the fuel pump to remove sediment.

Turn on the gasoline supply and inspect for leaks, correcting any found.

**DISTRIBUTOR.**— Place one drop of light oil on the distributor breaker arm pivot pin, several drops on the felt pad under the rotor, and three or four drops on the flyweight mechanism, distributed where it will reach friction points. Place a light coating of grease on each cam lobe.

**EXHAUST SYSTEM.**— Inspect all exhaust connections carefully. Make any necessary repairs.

**ENGINE COMPRESSION.**— Check the compression of each cylinder, using a compression gauge. A difference of more than 10 pounds pressure between cylinders indicates a compression loss which should be corrected.

## PERIODIC SERVICE

---

**GENERATOR.**— Check the condition of the commutator, collector rings, and brushes. In service, the commutator and collector rings acquire a glossy brown color, which is a normal condition. Do not attempt to maintain a bright, metallic, newly machined finish. If the commutator or collector rings become heavily coated, clean with a good cleaning solvent and a lint free cloth.

Replace with new ones any brushes worn so that the top of the brush is below a point midway between the top and bottom of the brush holder. Brushes must ride freely in their holders, and spring tension should be uniform.

Check the brush rig for proper alignment of the witness marks on the brush rig and its support.

**GENERAL.**— Thoroughly inspect the plant for oil or water leaks, loose electrical connections, and loose bolts or nuts. Make any necessary repairs.

## SEMI-YEARLY SERVICE

Every 6 months or 1200 operating hours, whichever occurs first, service the generator ball bearing.

Remove the plate from the housing rear end. Thoroughly clean all dirt from around the bearing cover and remove the cover and gasket. Remove the old lubricant from the bearing with a clean finger. Work about one tablespoon of new ball bearing lubricant into the bearing and again remove the lubricant. Refill the bearing housing about one-half full of bearing lubricant, packing it well into the lower half of the bearing. Be sure that no dirt gets into the bearing. Reinstall the bearing cover, using a new gasket if necessary.

## ADJUSTMENTS

**CARBURETOR, GASOLINE.**— The carburetor should require no servicing other than keeping it clean and free of sediment. When cleaning jets and passages, use compressed air or a fine, soft copper wire. Be sure that all gaskets are in their proper places when reassembling.

Changes in the type of gasoline used, or in operating conditions may necessitate a readjustment of the carburetor. Before readjusting the carburetor, make sure that the ignition system, valves, and other parts of the fuel system are operating properly. The main jet adjustment is at the bottom of the carburetor and should be adjusted with a full load on the plant, and with the plant at operating temperature.

Turn the adjusting needle in (clockwise) until the voltage, as shown on the AC VOLTMETER, drops noticeably. Turn the screw slowly out (counterclockwise) until the voltage rises to normal, and the engine runs smoothly. If it is necessary to open the adjustment more than one half turn beyond the point where normal voltage is attained in order to obtain smooth operation, a readjustment of the governor may be necessary. Check the operation at various loads.

After the plant has been adjusted for load operation, disconnect the load and adjust the idle adjustment screw in the same manner. This adjustment is usually not as critical as the main jet adjustment. The throttle lever idling stop screw should be adjusted so that there is  $1/32$ " space between the screw end and the throttle stop when the plant is operating at no load.

**CARBURETOR, GAS OR VAPOR.**— A change in the BTU rating of the fuel used will probably necessitate readjusting the knurled head gas adjustment valve at the bottom of the carburetor. With a full load on the plant, turn the adjusting valve in (clockwise) until the voltage as shown on the AC voltmeter drops noticeably. Turn the screw slowly out (counterclockwise) until the voltage rises to normal and the engine runs smoothly. If it is necessary to open the adjustment much beyond the point where normal voltage is attained in order to obtain smooth operation, a readjustment of the governor may be necessary. Check the operation at various loads. There is no idle adjustment necessary for gas or Butane-Propane vapor operation except to see that the throttle lever stop screw is adjusted to  $1/32$ " clearance between the screw end and the throttle stop with the plant operating at no load.

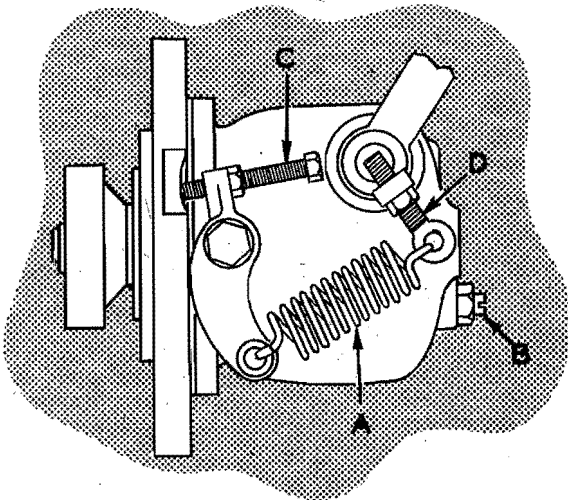
**AUTOMATIC CHOKE.**— The choke control should not need seasonal adjustments, but may be adjusted in the following manner. Turn the shaft of the control to the position where a  $3/32$ " diameter rod may be passed down through the hole in the end of the shaft opposite the lever. Engage the rod in the notch in the edge of the mounting flange. Loosen the lever clamp screw just enough to allow the lever to be turned slightly. To adjust the choke for a richer mixture, pull the lever upward. To adjust for a leaner mixture, push the lever downward. Retighten the lever clamp screw and remove the rod from the hole in the shaft. Check to see that when the lever is lifted up to the limit of its travel, the carburetor choke valve is completely closed, and when the lever is pushed down, the carburetor choke valve is wide open. For gas or vapor operation, the choke arm should be locked in the wide open position.

## ADJUSTMENTS

**GOVERNOR.**— The governor controls the speed of the engine, and therefore the frequency of the current. If the governor or carburetor has been removed, resetting of the governor may be necessary. Proceed as follows, referring to the illustration, Governor Adjustment.

1. With tension on the governor spring A, adjust the connecting linkage length so that the carburetor throttle lever clears the wide open stop by approximately  $1/64$ ".
2. Screw the bumper screw "B" out far enough so that it does not function.
3. Adjust to the desired speed by turning the screw "C" in (clockwise) to increase the speed, or out (counterclockwise) to decrease the speed.
4. If there is a tendency of the plant to hunt (alternately increase and decrease speed) under load conditions, turn the screw eye "D" out a turn or two until the hunting condition is corrected. For closest regulation, keep the screw "D" in as close as possible, without hunting.
5. If hunting occurs at no load, screw the bumper screw "B" in until the hunt is stopped, but not far enough to increase the engine speed. Be sure that lock nuts on all adjusting screws are securely tightened after adjustment is completed.

The governor cannot operate properly if there is any binding or sticking action in the connecting linkage or carburetor throttle assembly.



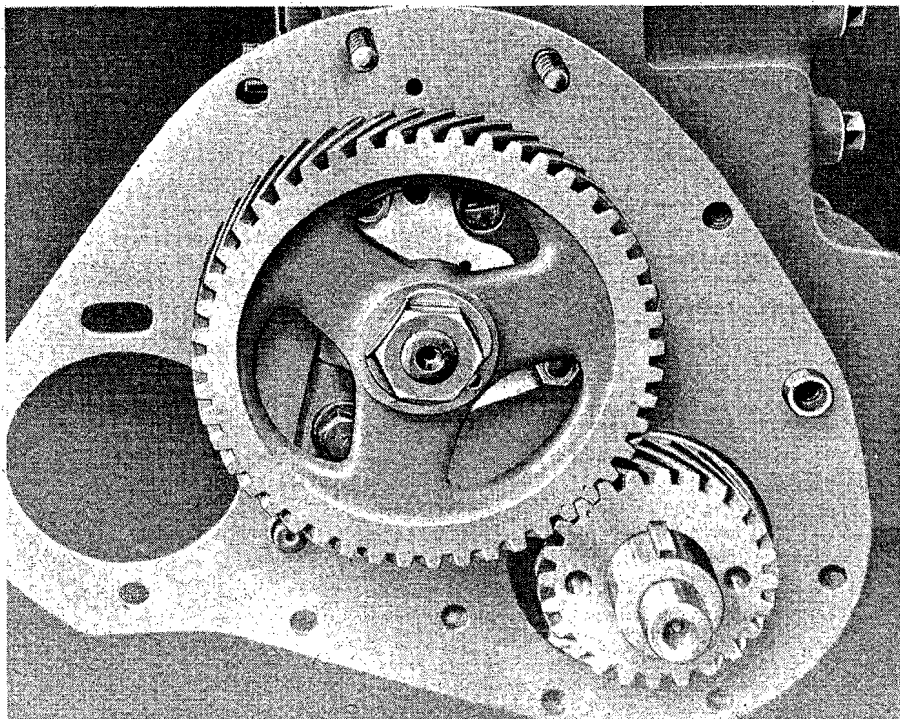
GOVERNOR ADJUSTMENT

## ADJUSTMENTS

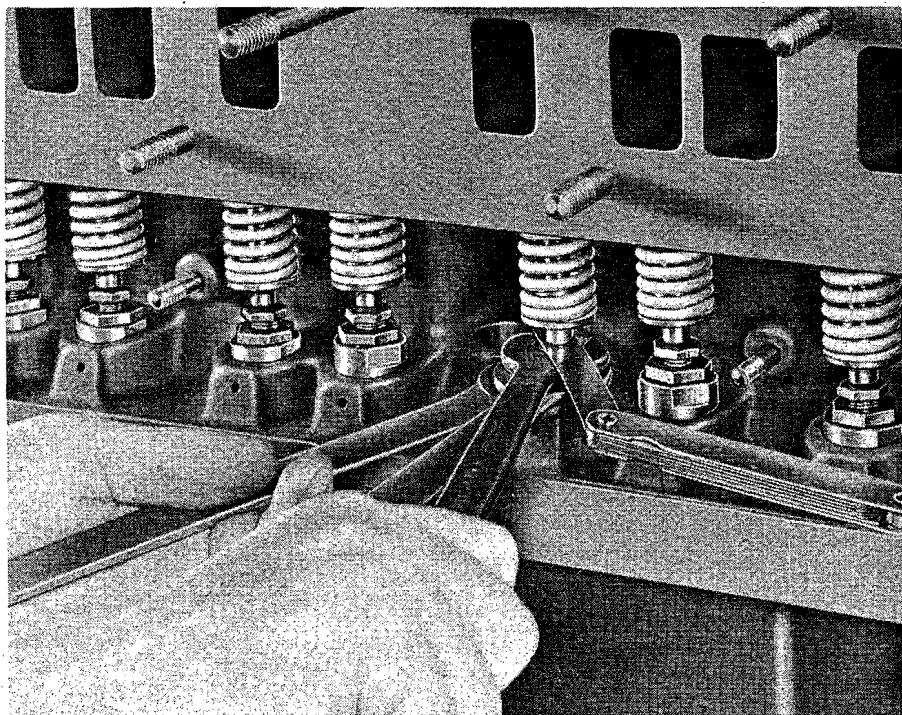
**HIGH WATER TEMPERATURE SWITCH.**— The high water temperature switch operates to stop the engine if the coolant temperature rises too high. This prevents overheating, which could cause serious damage to engine parts. The engine may be started again when the coolant temperature drops approximately 10°F. The dial adjustment should be set to operate at a temperature several degrees below the boiling point of the coolant, taking into consideration the altitude at which the plant is operating. Lower the setting 3°F. for each 1000 feet above sea level. The dial was set at 205°F. at the factory. Do not set the switch to operate at too low a temperature or the engine may be stopped before it reaches operating temperature.

**FAN BELT ADJUSTMENT.**— The fan belt tension is regulated by the position of the battery charging generator. To readjust the tension, loosen the adjusting arm bolt and nut slightly and move the generator toward the engine to lessen the belt tension, or move the generator away from the engine to increase the tension. Be sure to tighten the bolt and nut after the adjustment is completed. There should be approximately 3/4" play when pressure is applied on the belt midway between the fan and crankshaft pulleys. Too tight a belt will have a short life and will cause excessive strain and wear on the water pump and generator bearings. A belt too loose will slip, wear out rapidly, and cause inefficient cooling.

**MANIFOLD HEAT ADJUSTMENT.**— Under certain atmospheric conditions, such as cold and damp weather, it may be necessary to change the setting of the manifold heat control valve. To increase the heat deflected to the intake manifold and carburetor venturi, loosen the heat control valve sector lock nut and turn the sector counterclockwise to the desired position. In very cold weather it may be necessary to turn the valve counterclockwise to the limit of its travel. Under extreme conditions it may be necessary to install an auxiliary air heater around the manifold to deflect more heat to the carburetor air intake. This air heater is available as an accessory kit.



TIMING GEARS



TAPPET ADJUSTMENT



## MAINTENANCE AND REPAIRS

**GENERAL.**— Refer to the SERVICE DIAGNOSIS section for assistance in locating and correcting troubles which may occur. Should a major overhaul become necessary, the plant should be carefully checked and all necessary repairs made by a competent mechanic who is thoroughly familiar with modern internal combustion engines and revolving field generators.

### ENGINE

**TAPPET ADJUSTMENT.**— The tappet adjustments may be reached by removing the valve chamber cover. The tappets are the adjustable screw type, requiring three wrenches to adjust. See the illustration, TAPPET ADJUSTMENT.

The tappets should be adjusted with the engine warm. Adjust each tappet in turn to a clearance of 0.014" for both the intake and exhaust valves. A final check should be made with the engine running at a slow idle. Be sure the lock nut on the adjusting screw is securely tightened after the adjustment is completed.

**VALVE SERVICE.**— The proper seating of the valves is essential to good engine performance. The "Roto" exhaust valve assembly used in this engine decreases considerably the frequency of necessary valve service. Tappet barrels may be removed and replaced from above, without removing the camshaft, by first removing the adjusting screw and lock after the valve assemblies are removed.

If any one valve is leaking, service all.— The intake valve seat angle is 30° and the exhaust valve seat angle is 45°. Each valve, its guide, and the cylinder head and block should be cleaned of all carbon deposits. Grind and assemble each valve to its original seat.

Be very careful to properly reassemble the exhaust Roto valve assembly, installing the cap on the end of the valve stem before installing the spring retainer locks. It should be possible to spin the exhaust valves in their guides when they are in the open position. Set the tappet adjustments after the valves are reassembled. When tightening the cylinder head, start at the center and work outward and towards the ends. Check the tappet adjustments after the engine warms up, and again after 50 hours operation.

**TIMING GEARS.**— The crankshaft and camshaft timing gears are keyed to their respective shafts. The camshaft gear is fastened with a large hexagon nut and locking washer. The gears may be removed with a gear puller. Always install both gears new when either needs replacing, never one only. The crankshaft gear has one tooth punch-marked, which must mesh with the two teeth punch-marked on the camshaft gear. See the illustration, TIMING GEARS.

**IGNITION TIMING.**— The correct ignition timing is at a point where the engine develops the maximum power without "pinging". Before attempting to set the timing, see that the distributor contact points are adjusted to 0.020" gap. There are stamped markings on the rim of the flywheel which can be seen through the small inspection hole on the right side of

## MAINTENANCE AND REPAIRS

the generator adapter, above the starter. Turn the engine over, with the hand crank, until the No. 1 piston is coming up on the compression stroke. Continue to slowly crank the engine until the flywheel mark IGN is in the center of the inspection hole. At this point the distributor contact points should just separate, and the rotor should point to a position corresponding to the distributor cap tower for the No. 1 cylinder. The correct firing order is 1-5-3-6-2-4 in a counterclockwise direction. The timing may be retarded by turning the distributor slightly in a counterclockwise direction or advanced by turning in a clockwise direction.

**PISTON RING REPLACEMENT.**— The piston and connecting rod assemblies are removed from the top of the cylinder. Three compression rings and one oil control ring are used on each piston. Check the cylinders for an out of round or tapered condition, reboring for oversize pistons if necessary. Any ridge worn at the top of the bore should be removed, even if not reboring. Fit each ring to its individual cylinder, being sure that the gap between the ends of the ring, when in the cylinder, is between 0.008" and 0.013". Fit the proper ring in each ring groove on the piston, with the ring gaps spaced an equal distance around the piston. Be sure the ring grooves are clean and free of carbon deposits, and that oil holes are open before installing the rings on the piston. The rings should have between 0.0015" and 0.002" clearance in their grooves. Replacement rings of the tapered type will be marked "TOP", or identified in some other unmistakable manner, and this mark must be installed toward the top of the piston.

**PISTON PINS.**— The hardened piston pins are selected in production to obtain a 0.0003" loose fit in connecting rod pin bushing, and 0.0003" tight in piston boss. By heating the piston in hot water, the piston pin can be pushed in by hand. Maintain these clearances if necessary to fit oversize piston pins. When reinstalling old pistons, be sure that they are installed in their original cylinder, and in the same position relative to the numbered side of the connecting rod. When reassembling, make sure that the snap ring at either end of the pin is tightly in place.

**CONNECTING RODS.**— The steel backed connecting rod lower end bearings are readily replaceable. When removing the connecting rods, note the markings on the camshaft side of the rods and caps, so as to reassemble in the original manner. Connecting rods 1, 3, and 5 are not interchangeable with rods 2, 4, and 6, nor are the bearing shells. Notches machined in the connecting rod halves receive matching projections stamped into the steel backs of the bearing shells. If a shell becomes worn, discard both shells for that rod and install new ones. The shells are designed to provide a clearance of 0.0015" to 0.002". Never attempt fitting a bearing by scraping or filing of either the cap or upper half of the rod. Be sure that rods and caps, as well as bearing shells are perfectly clean and free of oil when inserting the shells. Oil on the back of the shell will prevent proper seating of the shell in the rod or cap. Oil the crankshaft journal after the bearing has been firmly seated.

## MAINTENANCE AND REPAIRS

The sides of the connecting rod crank ends are not babbitt lined. It is of vital importance that the side play clearance of 0.008" to 0.012" be maintained. Be sure that piston and connecting rod assemblies are properly aligned before installation.

**MAIN BEARINGS.**— The crankshaft main bearings are of the same type as the connecting rod bearings. Front, intermediate, and rear bearing shells are not interchangeable, although the two intermediate pair are. Bearing caps are numbered on the camshaft side and are doweled to assure proper reassembly. The same general directions given for fitting the connecting rod bearings should be observed in fitting the main bearings. The clearance, when installed, should be 0.0015" to 0.002". The rear face of the front main bearing takes the end thrust of the crankshaft.

The crankshaft end play should be 0.004" to 0.006" and is regulated by a shim pack to the rear of a removable thrust collar behind the crankshaft gear. When servicing the crankshaft or related parts, always make sure that all oil holes in the shaft are open and clean.

**CAMSHAFT.**— Provided that proper lubrication is supplied, the forged alloy steel camshaft and its bearings should never require servicing. If the cams are cut by too close adjustment of the tappets, they can be reconditioned by careful honing if not too badly scored.

The camshaft bearings are bronze bushings which are line reamed after installation in the crankcase to a clearance of 0.0015" to 0.002". The installation of new camshaft bearings is not practicable without the proper line reaming equipment.

**WATER PUMP.**— The water pump on this engine is a centrifugal, ball bearing, self sealing type. To dismantle the pump proceed as follows:

1. Remove the nut and lockwasher from the front of the water pump shaft and, using a suitable puller, pull the pulley off the shaft.
2. Remove the three nuts mounting the shaft support to the body and remove the support assembly.
3. To remove the impeller, remove the set screw and pull or press the impeller from the shaft. Note that if the set screw is loosened only a few turns it will not be free from the hole in the shaft.
4. To remove the shaft and bearings from the support, remove the set screw from the top of the support and press the assembly out through the front.
5. The seal will be found assembled in the impeller hub. Care must be taken in removing this assembly, as the carbon seal is fragile and easily broken. The holes in the brass cup holding

## MAINTENANCE AND REPAIRS

the seal should be lined up with the slots in the impeller hub. These are provided to prevent dirt from forming behind the seal ears and preventing efficient sealing. To reassemble, reverse the procedure used in disassembly. When reassembling the pump make sure that the set screw projects far enough to line up the impeller on the shaft. Press the impeller on flush with the end of the shaft. Pack the space between bearings with a good grade of sodium soap type grease such as Mobile grease No. 5.

**LUBRICATION SYSTEM.**— A gear type oil pump supplies oil under pressure through drilled passageways to the crankshaft main, lower connecting rod bearings, camshaft bearings, timing gears, and valve tappets. Whenever the engine is disassembled for service, make sure that all oil passages are clean and unobstructed. Thoroughly clean the engine oil pan and the oil pump strainer screen. An oil pressure relief valve is adjusted at the factory to give a pressure of 20 to 40 pounds at the governed speed, with the engine oil hot. The oil pressure relief adjustment is reached by removing a large hexagon shaped plug in the side of the crankcase close to the fuel pump. Too high or too low pressure may be caused by a sticking plunger. Remove the assembly and clean thoroughly. Continued low oil pressure usually indicates excessively worn bearings.

### TABLE OF CLEARANCES

	MINIMUM	MAXIMUM
Valve Tappets - Intake and Exhaust .....	0.014"	
Valve Seat Angle - Intake .....	30°	
Valve Seat Angle - Exhaust .....	45°	
Crankshaft Main Bearings .....	0.0015"	0.002"
Crankshaft End Play .....	0.004"	0.006"
Connecting Rod Bearing .....	0.0015"	0.002"
Connecting Rod End Play .....	0.008"	0.012"
Piston in Cylinder .....	0.002" - 10-15 lb. pull with 1/2" wide feeler	
Piston Pin in Piston .....	0.0003"	Tight
Piston Pin in Rod .....	0.0003"	Loose
Camshaft Bearings .....	0.0015"	0.002"
Piston Ring Gap .....	0.008"	0.013"
Piston Ring in Groove .....	0.0015"	0.002"
Distributor Breaker Points Gap .....	0.020"	
Spark Plug Electrode Gap .....	0.025"	

## GENERATOR

GENERAL.- The generator normally requires little servicing other than PERIODIC SERVICE. If a generator fails to deliver current, check to see that the trouble does not lie in the circuit outside the generator.

COMMUTATOR AND COLLECTOR RINGS.- After a long period of service, the surface of the commutator may become worn to such an extent as to cause the brushes to ride the mica insulation between the commutator bars. Remove the end bell and undercut the mica to a depth equal to the distance between bars. See that no burrs are left along the edges of the bars and that spaces between the bars are free of any metallic particles. Should the commutator or collector rings become grooved, out of round, or the surface become pitted or rough so that good brush contact cannot be maintained, it will be necessary to remove the rotor and turn the commutator or collector rings down in a lathe. It will be necessary to remove the generator frame before the rotor can be removed. Remove the ball bearing before turning, to prevent any foreign material getting into it. After turning down the commutator, the mica must be undercut as described above. When the rotor is reinstalled, be sure the run-out at the bearing end does not exceed 0.010".

BRUSHES.- Install new brushes when the old ones are worn so that the top of the brush is below a point midway between the top and bottom of the brush holder. Sand new brushes to a good seating contact. See the illustration on sanding of brushes. See that brushes ride freely in their holders and spring tension is uniform. The correct tension is 30 oz. for the commutator brush springs and 16 oz. to 18 oz. for the collector ring brush springs, measured with the contact point of the spring level with the top of the holder.

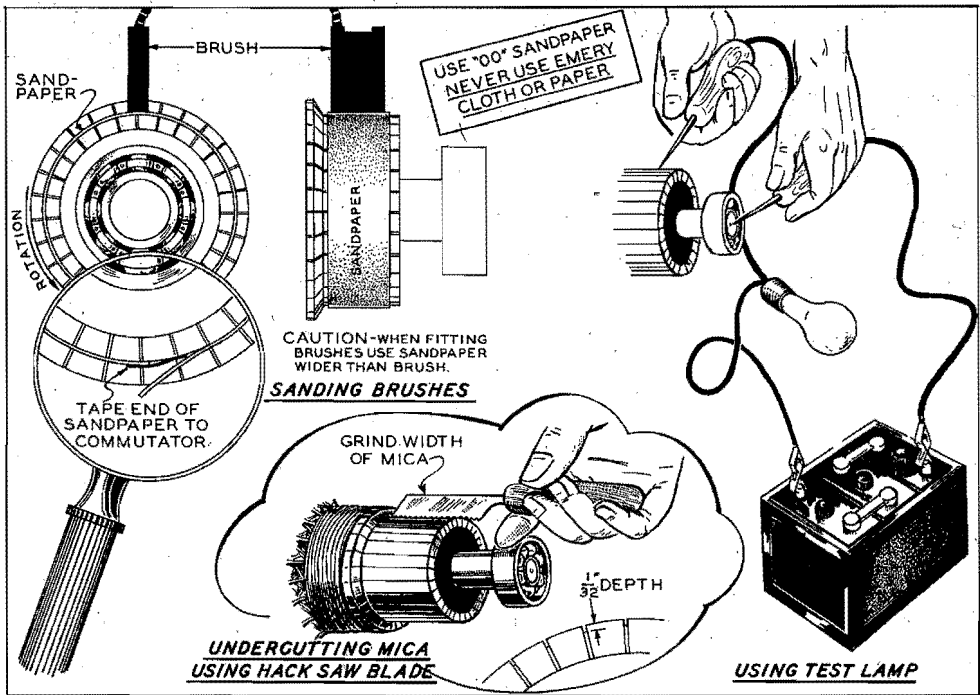
GENERATOR WINDINGS.- Use a test lamp set to test for grounded or open circuits in the windings. Be sure that all brushes are lifted away from contact with the commutator and collector rings, and that leads are disconnected. When disconnecting leads, tag them to facilitate correct replacement. If a rotor winding tests open circuited, short circuited, or grounded install a new rotor. Use an armature growler to test the exciter armature for an internal short circuit.

The exciter field coil windings may be tested for an internal short by comparative ohmmeter readings. If one exciter field coil tests defective, install a new set of field coils. If a stator winding tests defective, install a new stator assembly. If the trouble is in any lead outside a winding, repair the lead as necessary.

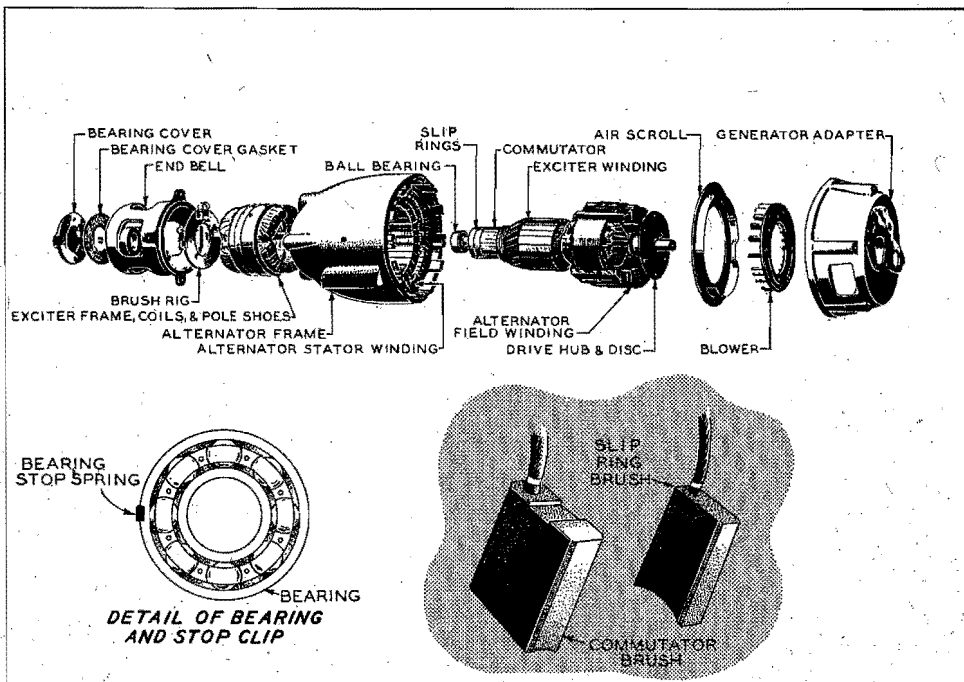
BRUSH RIG.- It is unnecessary to remove the brush rig when servicing the generator. If it has been removed, accidentally, line up the mark on the rig with the mark on the end bell when reinstalling it. Improper positioning of the brush rig will lead to excessive arcing of the brushes, heating of the windings and general low performance. Any defective condenser should be replaced with a new one of the same capacity.

## CONTROLS

CONTROL PANEL EQUIPMENT.- If any of the control panel equipment fails to function properly, it should be replaced with a corresponding new unit rather than to attempt repairs on the old one. Disconnect the battery whenever servicing the control panel equipment. Keep all connections tight and clean.



## CARE OF COMMUTATOR AND BRUSHES



## GENERATOR ASSEMBLY

## REMEDY

**Overloaded.**                      **Reduce load.**

Reduce load.

Engine lacks power.	See remedies for engine missing under heavy load.
Poor compression.	Tighten cylinder head and spark plugs. If still not corrected, grind the valves. Replace piston rings, if necessary.
Faulty carburetion.	Check the fuel system. Clean, adjust or replace parts necessary.
Restricted air cleaner.	Clean and refill.
Excessive choking.	See that choke opens properly.
Carbon in cylinders.	Remove carbon.
Restricted exhaust line.	Clean or increase the size.

Carburetor idle adjustment set wrong or clogged.	Adjust, clean if needed.
Spark plug gaps too narrow.	Adjust to correct gap.
Intake air leak.	Tighten or replace gaskets.
Faulty ignition.	Clean, adjust, or replace breaker points, plugs, condenser, coils, etc., or retime ignition.
Uneven compression.	Tighten cylinder head and spark plugs. If still not corrected, grind valves. Replace piston rings, if necessary.
Worn intake valve stems.	Replace valves.

Spark plugs defective.	Replace.
Faulty ignition.	Clean, adjust, or replace breaker points, plugs, condenser, coil, etc., or retime ignition.

## SERVICE DIAGNOSIS

### POSSIBLE CAUSE

### REMEDY

#### ENGINE MISFIRES AT HEAVY LOAD - CONT'D.

Clogged carburetor.	Clean jets.
Clogged fuel screen.	Clean.
Defective spark plug cables.	Replace.

#### ENGINE MISFIRES AT ALL SPEEDS

Fouled spark plug.	Clean and adjust.
Defective or wrong spark plug.	Replace.
Sticking valves.	Clean stems and guides.
Broken valve spring.	Replace.
Defective ignition wires.	Replace.
Defective or improperly adjusted points.	Adjust or replace breaker points.

#### LOW OIL PRESSURE

Oil too light.	Drain, refill with proper oil.
Oil badly diluted.	Drain, refill with proper oil.
Oil too low.	Add oil.
Oil relief valve not seating.	Remove and clean, or replace.
Badly worn bearings.	Replace.
Sludge on oil screen.	Remove and clean.
Badly worn oil pump.	Replace.
Defective oil pressure gauge.	Replace.

#### HIGH OIL PRESSURE

Oil too heavy.	Drain, refill with proper oil.
Clogged oil passage.	Clean all lines and passages.
Oil relief valve stuck.	Remove and clean.
Defective oil pressure gauge.	Replace.



## SERVICE DIAGNOSIS

### POSSIBLE CAUSE

### REMEDY

#### ENGINE BACKFIRES AT CARBURETOR

Lean fuel mixture.	Clean carburetor.
Clogged fuel screen.	Clean screen.
Intake air leak.	Replace flange gaskets, tighten carburetor.
Poor fuel.	Refill with good, fresh fuel.
Spark too late.	Retime ignition.
Spark plug wires crossed.	Install wires correctly.
Intake valves leaking.	Grind or replace.

#### EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST

Poor compression, usually due to leaking valves.	Tighten cylinder head and plugs. If still not corrected, grind or replace valves.
Oil leaks from engine or connections. This does not cause smoky exhaust.	Replace gaskets or leaking tubing. Tighten screws and connections.
Oil too light or diluted.	Drain, refill with correct oil.
Too large bearing clearance.	Replace.
Oil pressure too high.	Refer to symptoms of high oil pressure for remedies.
Engine misfires.	Refer to symptoms of engine misfires.
Faulty ignition.	Clean, adjust, or replace breaker points, plugs, condenser, coil, etc., or retime ignition.
Unit operated at light or no load for long periods.	No remedy needed.
Too much oil.	Drain excess oil.

#### BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUGS WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD

Fuel mixture too rich.	Adjust choke. Install needed carburetor parts, adjust float level.
Choke not open.	See that choke opens properly.
Dirty air cleaner.	Clean, refill to proper level.

## SERVICE DIAGNOSIS

### POSSIBLE CAUSE

### REMEDY

#### LIGHT POUNDING KNOCK

Loose connecting rod bearing.	Replace.
Low oil supply.	Add oil.
Low oil pressure.	Refer to symptom of low oil pressure for remedies.
Oil badly diluted.	Change oil.

#### ENGINE STOPS UNEXPECTEDLY

Fuel tank empty.	Refill.
High water temperature.	See symptoms for engine overheating.
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.	Replace bearings, unless one of the next three remedies permanently corrects the trouble.
-------------------	---

#### SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE FIRST STARTED

Low oil supply.	Add oil.
Low oil pressure.	Refer to symptom of low pressure for remedies.
Oil badly diluted.	Change oil.

#### PINGING SOUND WHEN ENGINE IS RAPIDLY ACCELERATED OR HEAVILY LOADED

Carbon in cylinders.	Remove carbon.
Spark too early.	Retime ignition.
Wrong spark plugs.	Install Champion M-6 plugs.
Spark plugs burned or carboned.	Install new plugs.
Valves hot.	Adjust tappet clearance.
Fuel stale or low octane.	Use good fresh fuel.
Lean fuel mixture.	Clean carburetor.

## SERVICE DIAGNOSIS

### POSSIBLE CAUSE

### REMEDY

#### 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, plugs, condenser, coil, etc., or retime ignition.
Lack of fuel or faulty carburetion.	Refill the tank. Check the fuel system. Clean, adjust, or replace parts necessary.
Clogged fuel screen.	Clean.
Cylinders flooded.	Crank few times with spark plugs removed.
Poor fuel.	Drain, refill with good fuel.
Poor compression.	Tighten cylinder head and spark plugs. If still not corrected, grind the valves. Replace piston rings, if necessary.
Wrong timing.	Retime ignition.

#### ENGINE RUNS BUT CURRENT DOES NOT BUILD UP

Poor brush contact.	See that brushes seat well, are free in holders, are not worn too short, and have good spring tension.
Open circuit, short circuit, or ground in generator.	See GENERATOR, replace part necessary.

#### CURRENT 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, and collector rings, are free in holders, are not worn too short, and have good spring tension.
Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load condition causing trouble.

## SERVICE DIAGNOSIS

### POSSIBLE CAUSE

### REMEDY

#### 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 pistons.	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 UNIT

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

#### MOTORS RUN TOO SLOWLY AND OVERHEAT AT FAR END OF LINE BUT OK NEAR POWER UNIT

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

#### NOISY BRUSHES

High mica between bars of commutator.	Undercut mica.
---------------------------------------	----------------

#### EXCESSIVE ARCING OF BRUSHES

Rough commutator or rings.	Turn down.
Dirty commutator or rings.	Clean.
Brushes not seating properly.	Sand to a good seat.
Brush rig out of position.	Line up marks on brush rig and support.

#### ENGINE OVERHEATING

Low water in radiator.	Refill radiator.
Overloaded.	Remove part of load.
Improper lubrication.	See Low Oil Pressure
Radiator obstructed.	Clean radiator.
Ignition timing late.	Adjust ignition timing.

# INSTRUCTIONS FOR ORDERING REPAIR PARTS

FOR SERVICE OR PARTS, CONTACT THE DEALER FROM WHOM YOU PURCHASED THIS EQUIPMENT, OR REFER TO THE COMPANY LISTED ON THE NAME-PLATE.

The Parts Reference Symbols in the right hand column of the General Data table on page 1 correspond with the same symbols at the tops of the Quantity Used column in the Parts List. They indicate which Quantity Used column to use when ordering parts for one of the plants listed in the General Data table. Compare the characteristics of the plant with the data in the General Data table to determine which Parts Reference Symbol applies. Order only parts which have a quantity listed in the applicable Quantity Used column in the Parts List.

Be sure to state on your order the Model Number, Serial Number, and Generator Number of the plant for which the parts are required. Obtain these numbers directly from the nameplates on the plant.

Order parts by part numbers and complete descriptions as listed herein. State the quantity of each part desired. Do not order parts as "sets" unless they are listed as "sets" in the parts list. If unable to identify the part required, return the old part to the address shown on the nameplate. Be sure to print your name and address plainly on the package. Regardless of any previous correspondence, write a letter to the same address describing the part and stating the reason for returning it.

Please do not order parts in a letter in which some other subject is treated. State definite shipping instructions when ordering parts.

All shipments are complete unless the packing list indicates items are back ordered. Shipments are properly packed and in good order when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.

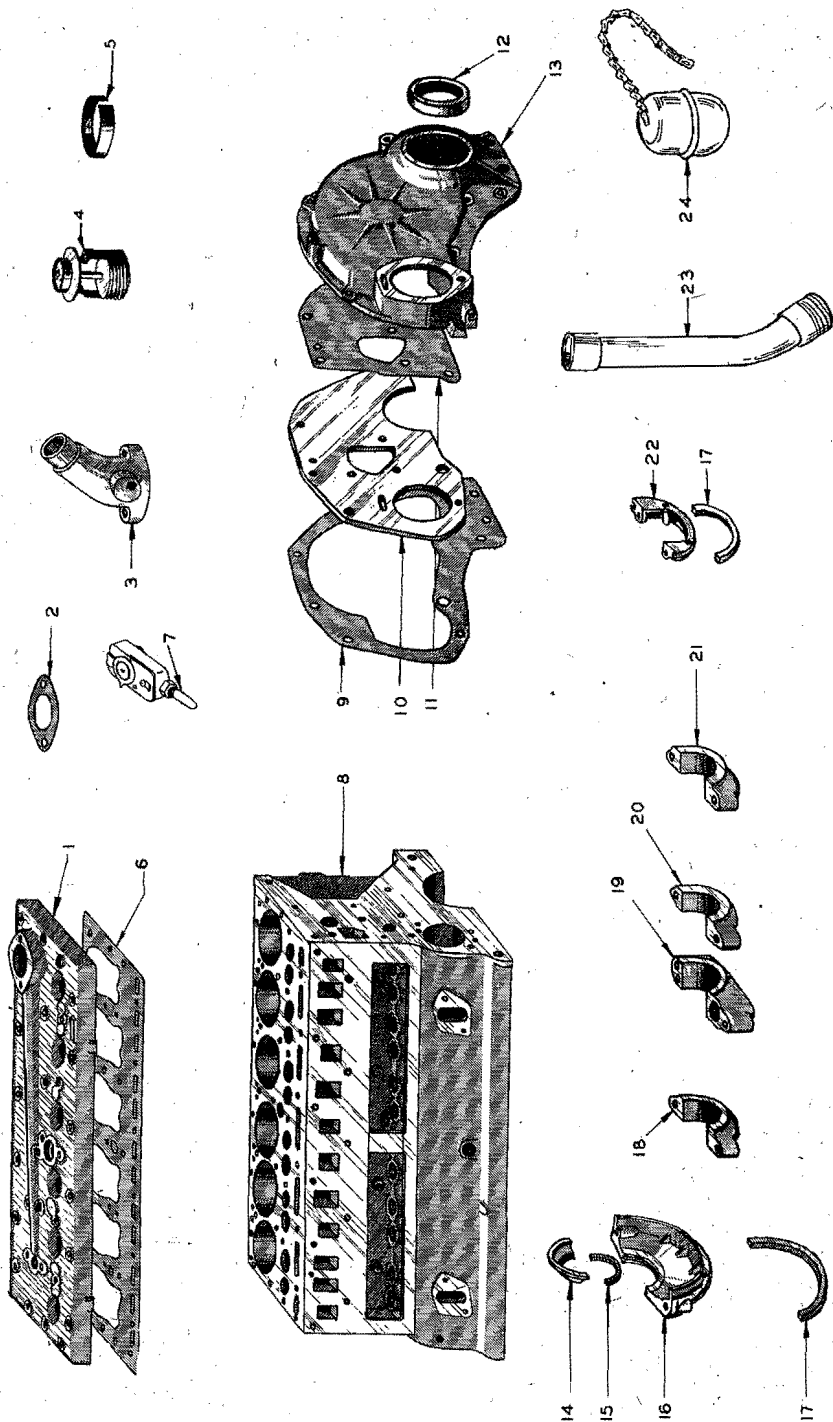


Fig. 1-CYLINDER BLOCK GROUP

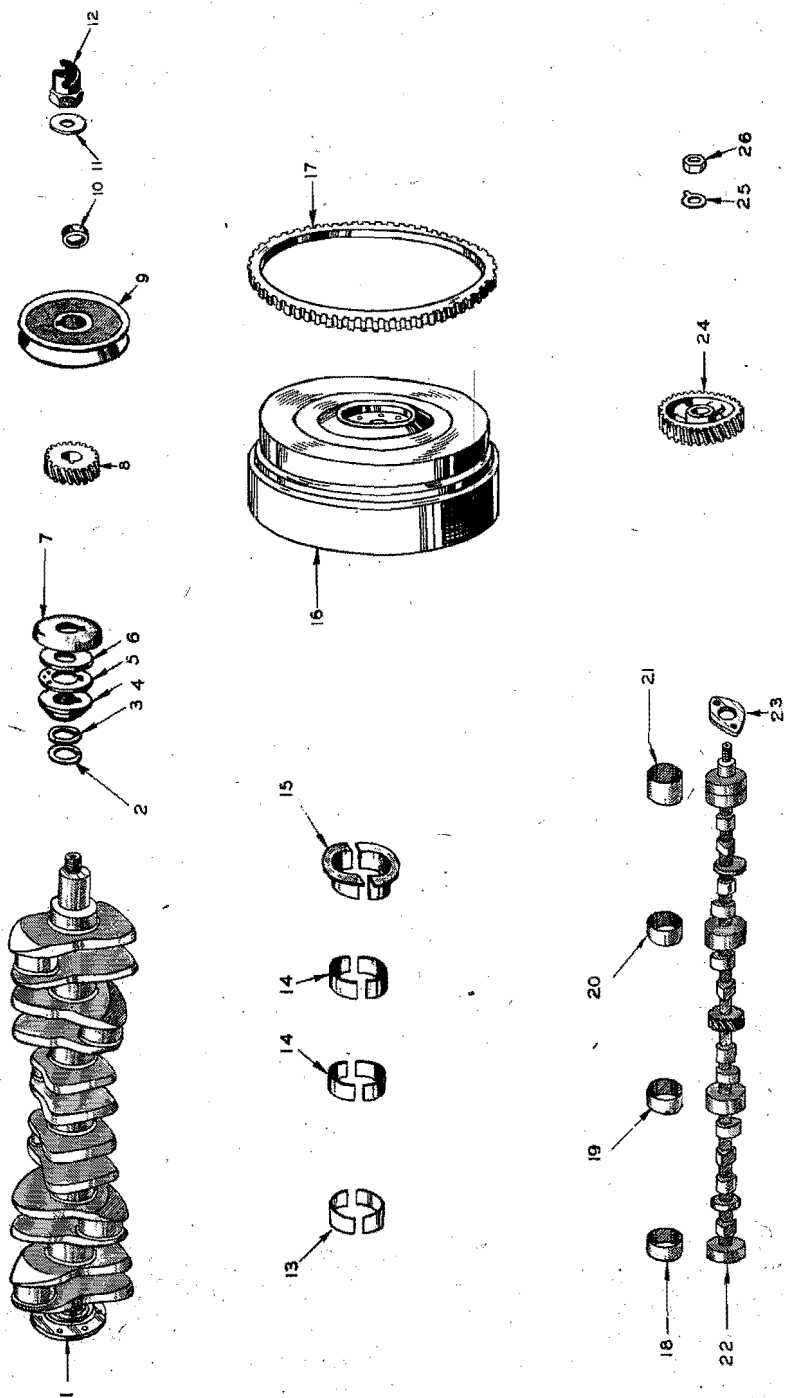


Fig. 2-CRANKSHAFT AND CAMSHAFT GROUP

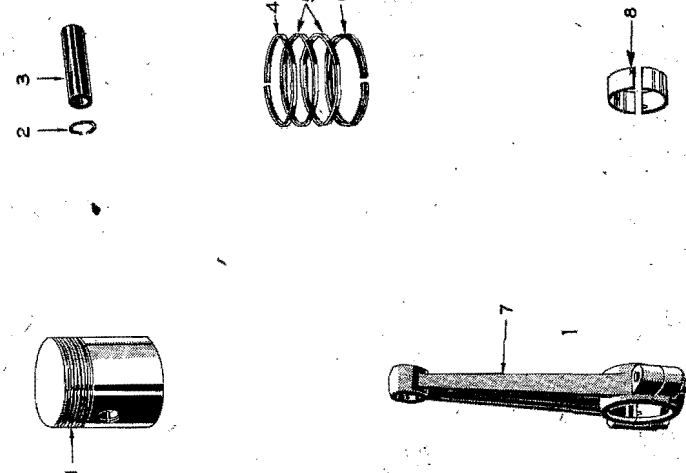


Fig. 3-PISTON AND CONNECTING ROD GROUP

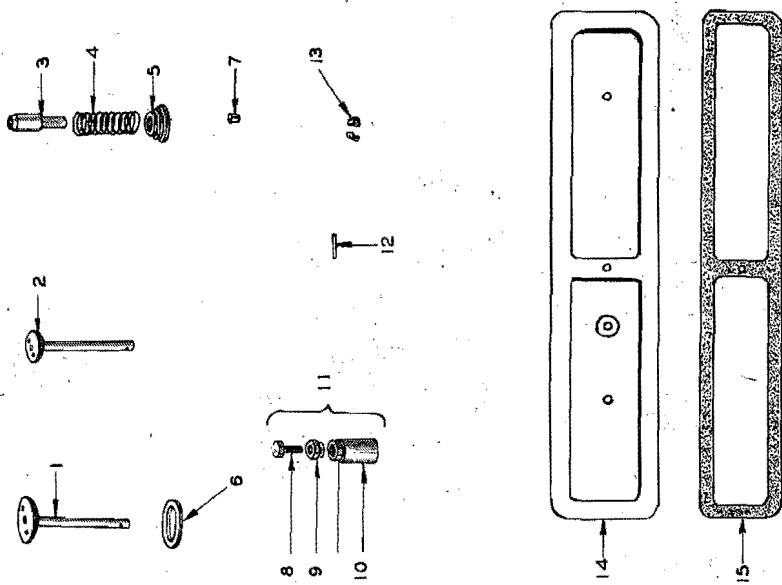


Fig. 4-VALVE GROUP



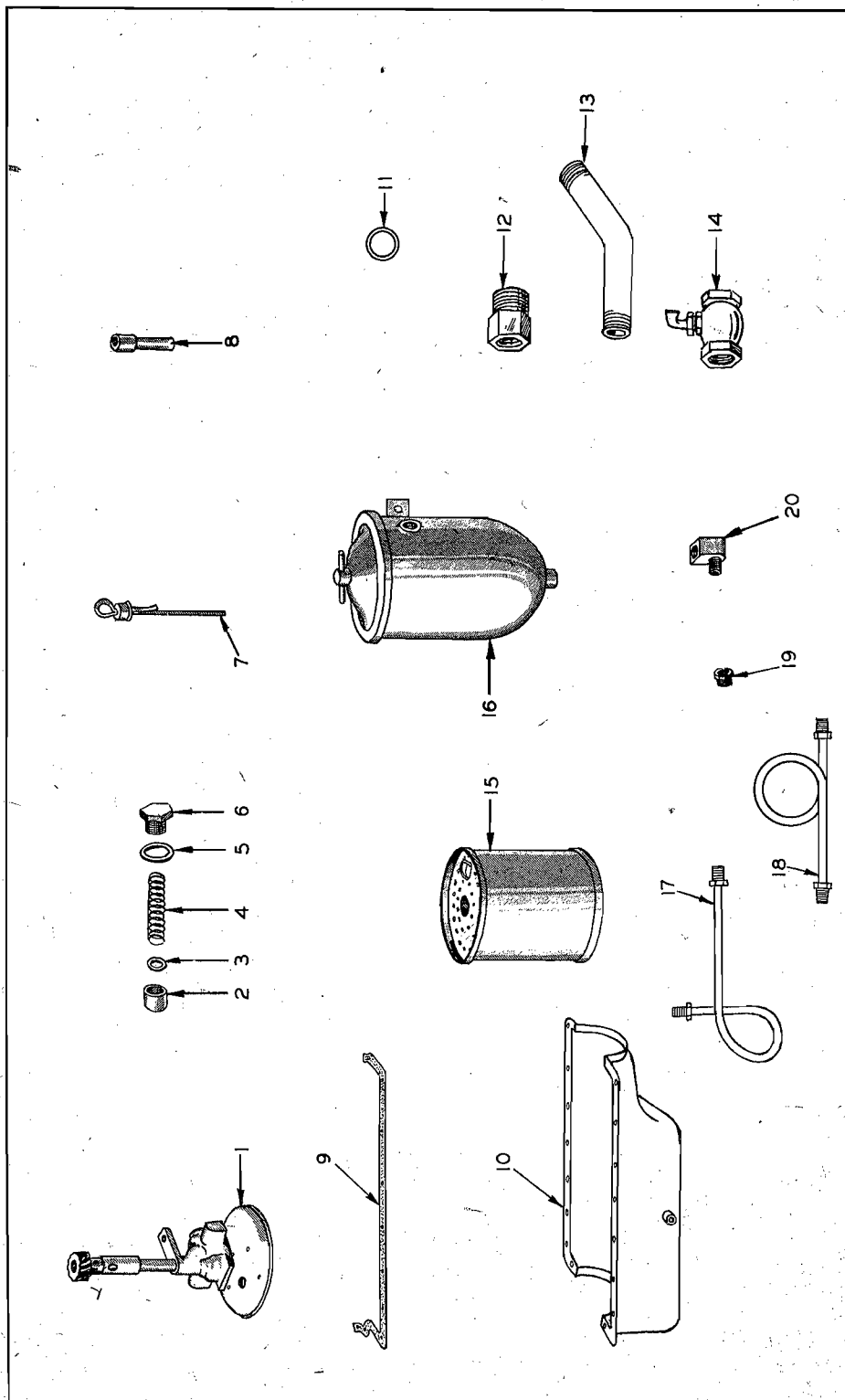


Fig. 5 - OIL PUMP AND OIL FILTER GROUP

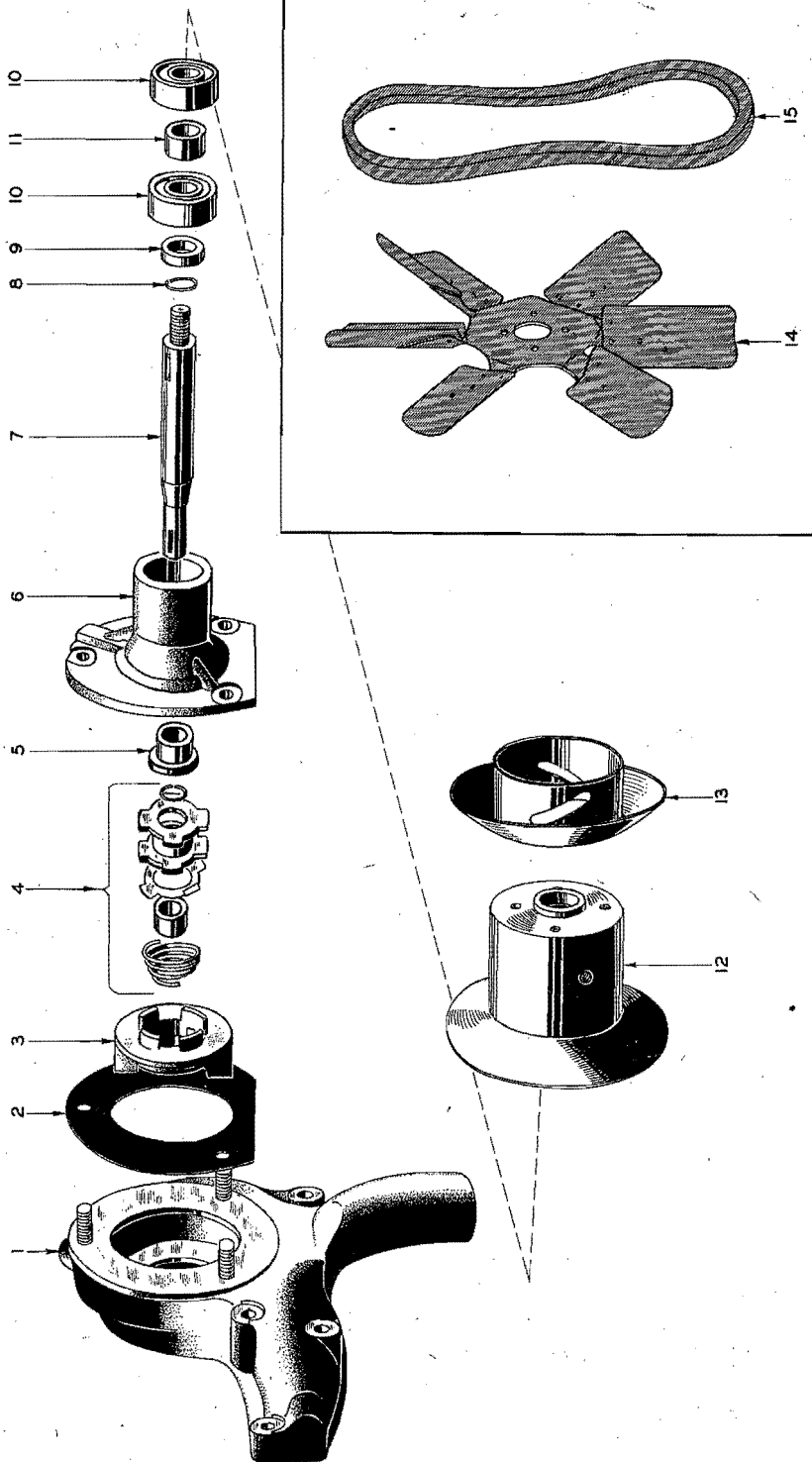


Fig. 6—WATER PUMP AND FAN GROUP

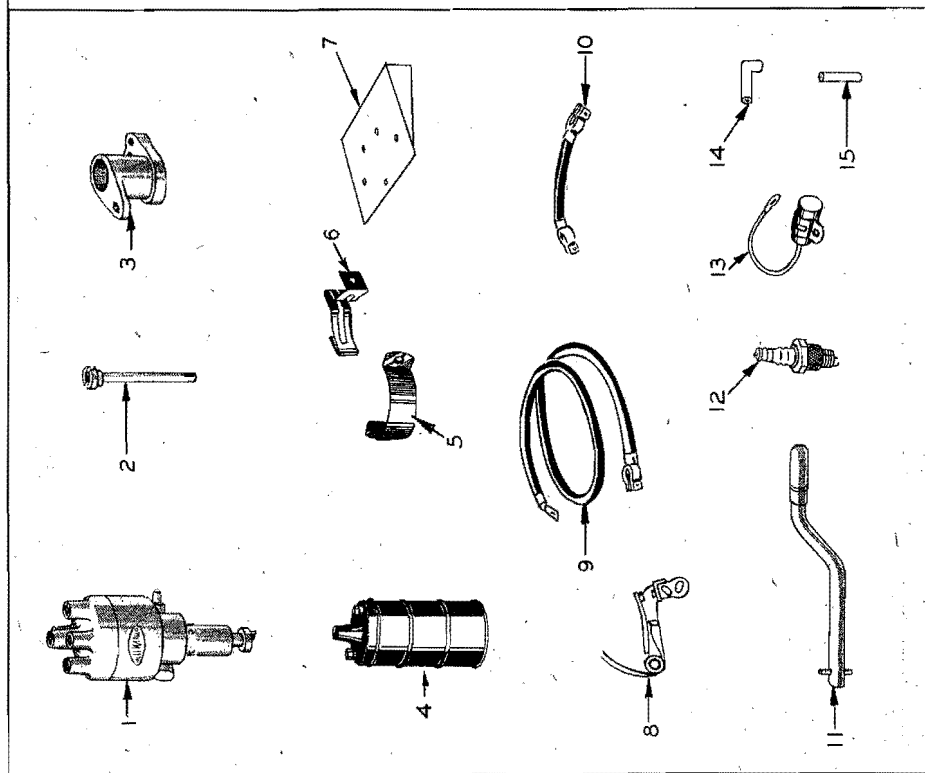


Fig. 7- IGNITION GROUP

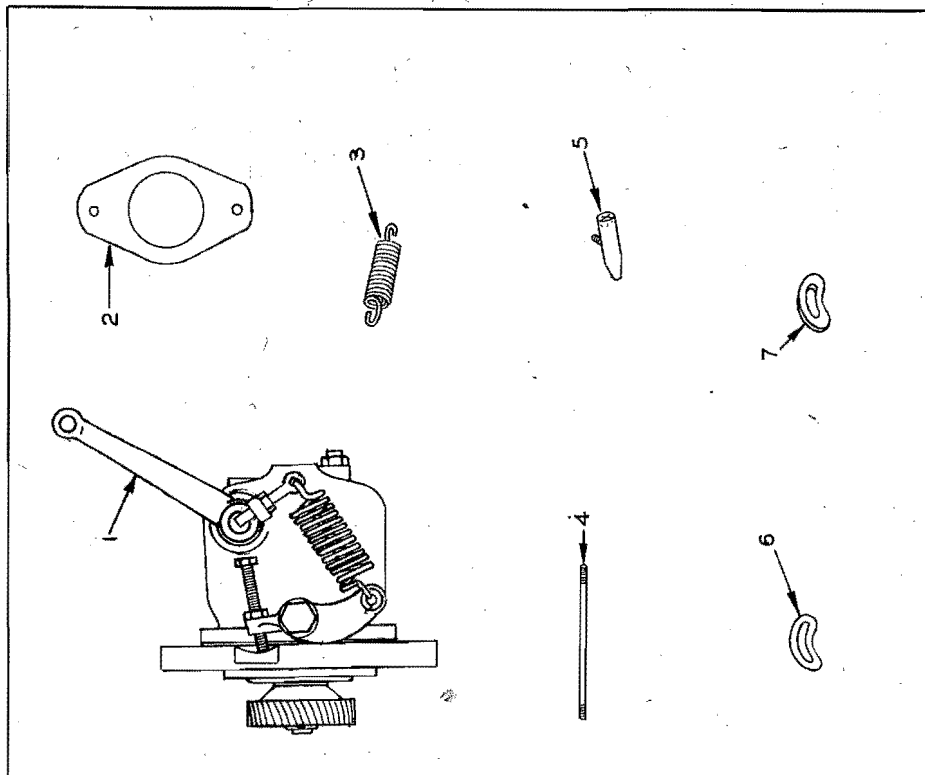


Fig. 8-GOVERNOR GROUP



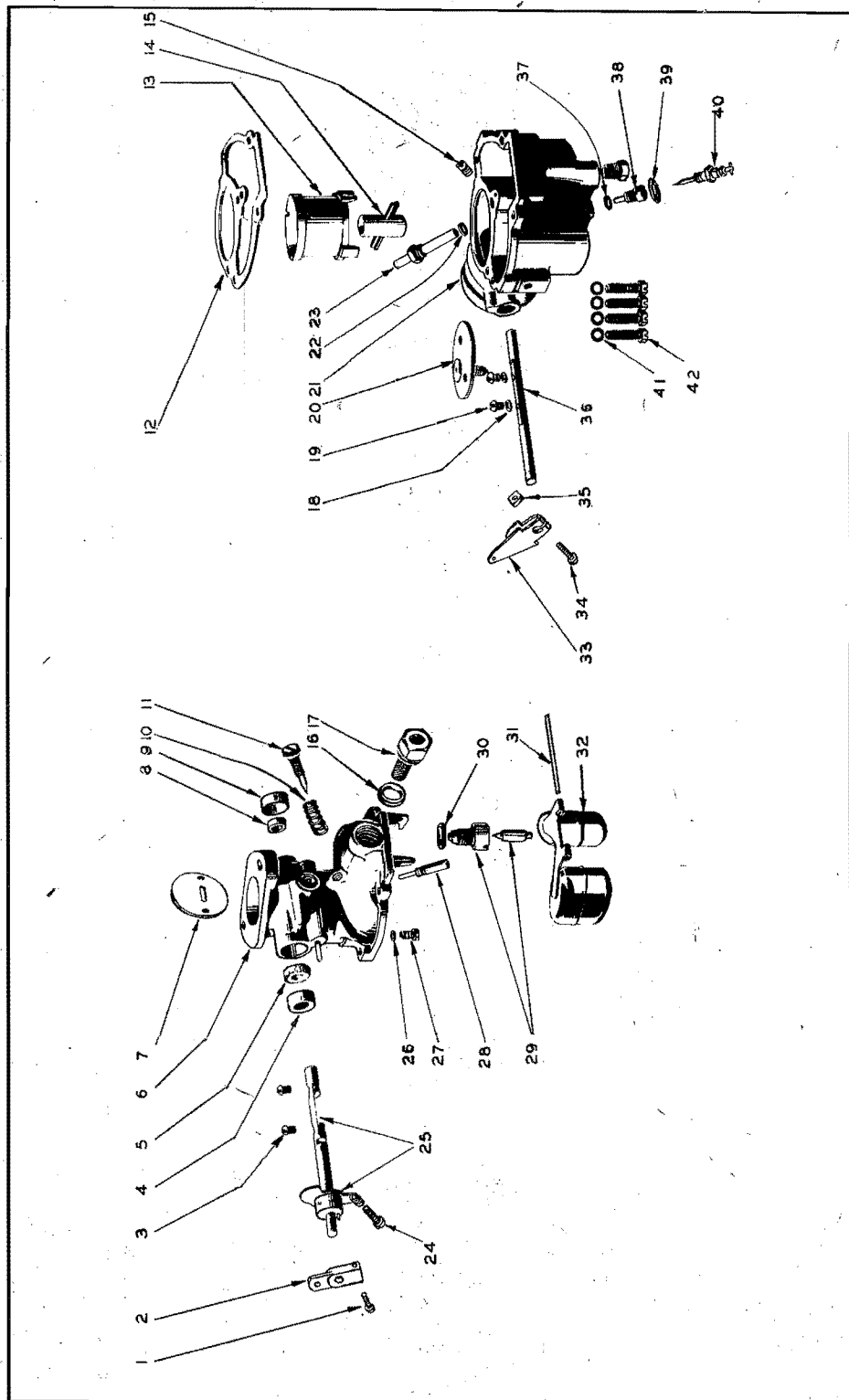


Fig. 10-CARBURETOR GROUP

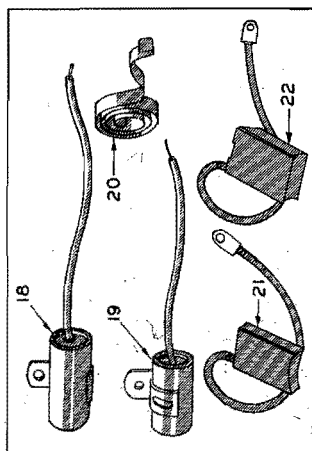
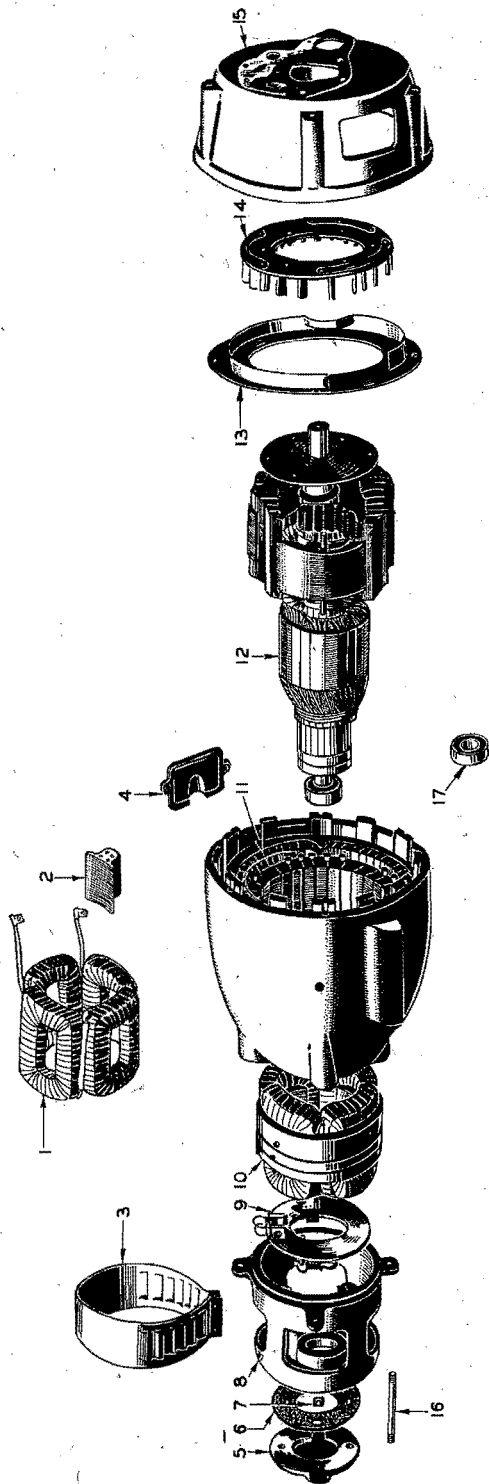


Fig. 11—GENERATOR GROUP

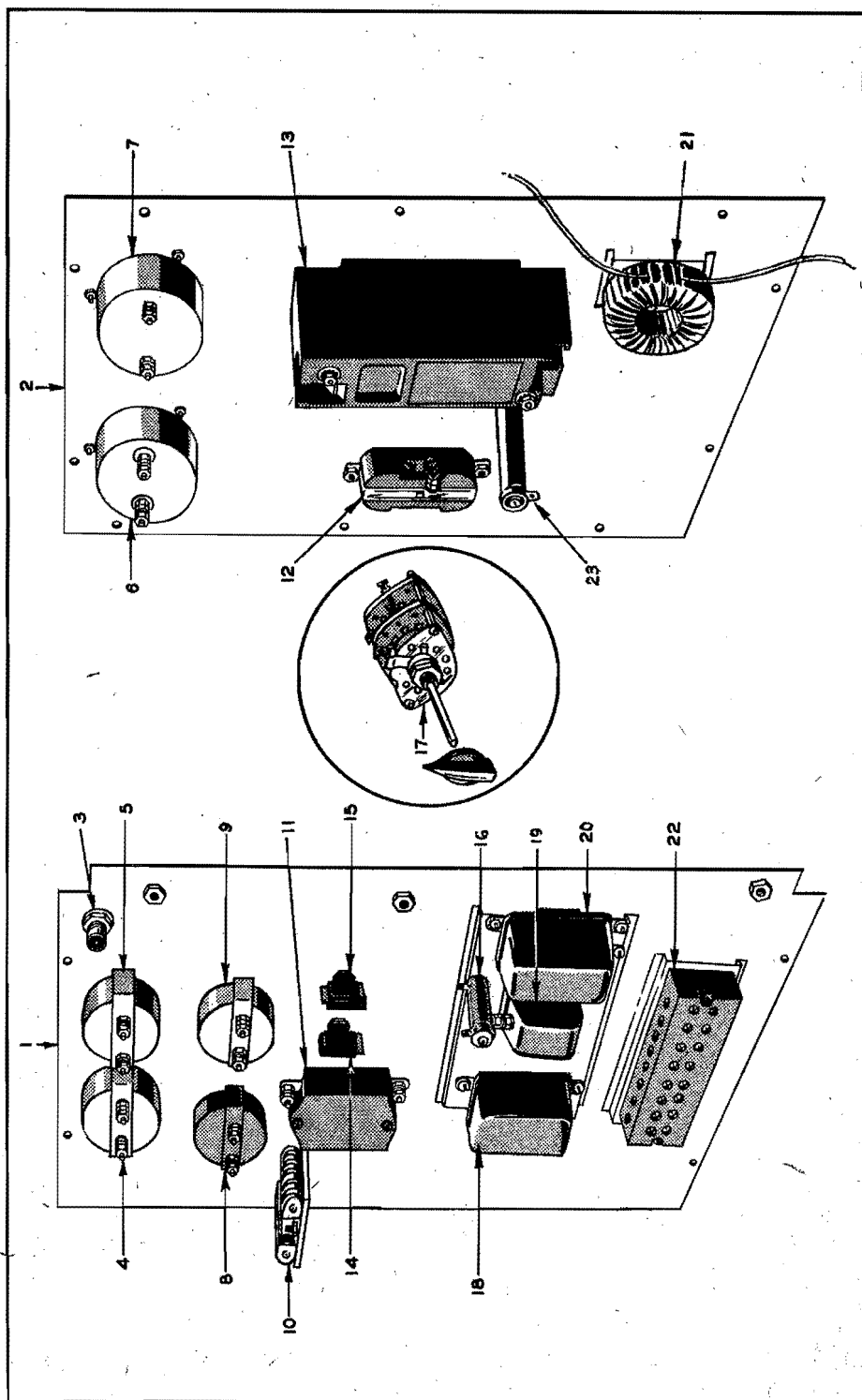


Fig. 12—CONTROL GROUP

# PARTS LIST

REF. PART NO.	DESCRIPTION	QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
CYLINDER BLOCK GROUP (Fig. 1)								
1	F226A-2005 Head, Cylinder .....	1	1					29.60
1	F600A-3632 Head, Cylinder .....			1	1	1	1	33.45
2	C400K-215 Gasket, Water Outlet Elbow .....	1	1	1	1	1	1	.10
3	F140K-323 Elbow, Water Outlet .....	1	1	1	1	1	1	3.55
4	F218K-304 Thermostat, Water Temperature .....	1	1	1	1	1	1	1.60
5	F218K-202 Ring, Thermostat Retainer .....	1	1	1	1	1	1	.30
6	F600A-266 Gasket, Cylinder Head .....	1	1	1	1	1	1	1.55
7	309-1 Switch, Cut-Off - High Water Temperature .....	1	1	1	1	1	1	13.00
8	F600A-6201A Block, Cylinder - Incl. Valve Guides, Brgs., Plugs, Studs .....	1	1	1				205.10
8	F600A-4481A Block, Cylinder - Incl. Valve Guides, Brgs., Plugs, Studs .....							
9	F600B-357 Gasket, Gear Cover to End Plate .....	1	1	1	1	1	1	209.50
10	F226B-205 Plate, Front End .....	1	1	1	1	1	1	.30
11	D600B-339 Gasket, End-Plate to Crankcase .....	1	1	1	1	1	1	
12	A600L-202 Seal, Oil - Gear Cover .....	1	1	1	1	1	1	1.25
13	F600B-4163 Cover, Gear - Includes A600L-202 .....	1	1	1	1	1	1	18.00
14	D600B-305 Guard, Oil - Rear Crankshaft Bearing .....	1	1	1	1	1	1	.40
15	D600B-217 Cork, Crankshaft Rear .....	2	2	2	2	2	2	.10
16	D600B-406 Block, Filler - Rear .....	1	1	1	1	1	1	2.40
17	D600B-214 Cork, Filler Block - Front and Rear .....	2	2	2	2	2	2	.25
18	F600B-339 Cap, Bearing - Crankshaft Rear .....	1	1	1	1	1	1	2.60
18	F600B-344 Cap, Bearing - Crankshaft Rear .....	1	1	1	1	1	1	2.00
19	F600B-336 Cap, Bearing - Crankshaft Intermediate Rear .....	1	1	1	1	1	1	3.15
19	F600B-346 Cap, Bearing - Crankshaft Intermediate Rear .....							
20	F600B-338 Cap, Bearing - Crankshaft Intermediate Front .....							
20	F600B-345 Cap, Bearing - Crankshaft Intermediate Front .....							
21	F600B-355 Cap, Bearing - Crankshaft Front .....	1	1	1	1	1	1	2.05
21	F600B-347 Cap, Bearing - Crankshaft Front .....	1	1	1	1	1	1	1.95
22	D600B-340 Block, Filler - Front .....	1	1	1	1	1	1	1.80
23	123896 Tube, Oil Fill .....	1	1	1	1	1	1	1.30
24	123420 Cap, Oil Fill Tube - Breather .....	1	1	1	1	1	1	1.35

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT



## PARTS LIST

Part No.	Description	QTY	UNIT	PRICE	TOTAL
PF140-412	Support, Front Engine	1	EA	1.30	1.30
PF140-218	Bushing, Mounting - Upper Front Engine Support	1	EA	2.70	2.70
PF140-220	Bushing, Mounting - Lower Front Engine Support	1	EA	.90	.90
PF140-219	Cup, Retainer - Mounting Bushing	1	EA	.75	.75
X-1005	Cock, Drain - Cylinder Water	1	EA	.10	.10
X-2236	Plug, Expansion - 1-1/2" - Camshaft Head	1	EA	.10	.10
X-2207	Plug, Expansion - 1-1/8" - Core Hole	5	EA	.10	.50
X-2202	Plug, Expansion - 1-3/8" - Core Hole	3	EA	.20	.60
X-137A	Plug, Pipe - 1/4" - Oil Passages	1	EA	.30	.30
8TC-200	Dowel, Ring - Gear Cover to Crankcase	33	EA	.10	3.30
X-19889	Stud, Cylinder Head	2	EA	.10	.20
X-4106	Stud, Water Outlet Elbow	2	EA	.10	.20
X-4200	Stud, Gear Cover	2	EA	.10	.20
X-4584	Stud, Engine Support	2	EA	.10	.20
X-3511	Screw, Hex. Head - 1/2"-13 x 3-1/4" - Bearing Cap	6	EA	.10	.60
X-3555	Screw, Hex. Head - 1/2"-13 x 2-1/2" - Bearing Cap	6	EA	.10	.60
X-3368	Screw, Hex. Head - 7/16"-14 x 1-1/2" - Gear Cover	3	EA	.10	.30
X-3299	Screw, Hex. Head - 3/8"-16 x 2" - Gear Cover	1	EA	.10	.10
X-3295	Screw, Hex. Head - 3/8"-16 x 1-1/8" - Gear Cover	1	EA	.10	.10
6FK-131	Screw, Hex. Head - 3/8"-16 x 7/8" - End Plate to Gear Cover	2	EA	.10	.20
NL-194	Screw, Hex. Head - 3/8"-16 x 3/4" - End Plate to Crankcase	1	EA	.10	.10
6RB-105	Screw, Fill. Head - 2-5/8" - Filler Block	2	EA	.15	.30
X-3164	Screw, Fill. Head - 7/8" - Filler Block	2	EA	.15	.30
193-23	Gauge, Water Temperature - Motor Unit	1	EA	2.00	2.00
193-25	Gauge, Oil Pressure - Motor Unit	1	EA	2.00	2.00
232-235	Cover, Timing Hole	1	EA	.10	.10
FF400C-208	Felt, Timing Hole Cover	1	EA	.10	.10
<b>CRANKSHAFT AND CAMSHAFT GROUP (Fig. 2)</b>					
F600C-5043	Crankshaft	1	EA	1.10	1.10
F209C-3091	Crankshaft	4	EA	1.10	4.40
10BC-204	Shim, Crankshaft Thrust - .002"	7	EA	1.10	7.70
10BC-205	Shim, Crankshaft Thrust - .008"	1	EA	1.10	1.10
F600C-214	Plate, Crankshaft Thrust	1	EA	1.10	1.10
F600C-205	Plate, Crankshaft Thrust	1	EA	1.10	1.10

Refer to page 1 regarding the use of PARTS REF. SYMBOLS A, B, C, D, E and F.

# PARTS LIST

REF. PART NO.	DESCRIPTION	QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
CRANKSHAFT AND CAMSHAFT GROUP - CONT'D.								
5 F600C-216	Washer, Crankshaft Thrust .....	1	1	1		1		1.40
5 D600C-204	Washer, Crankshaft Thrust .....				1	1		.75
6 D600C-206	Spacer, Crankshaft Thrust Plate .....	1	1	1	1	1		.15
7 A600C-204	Thrower, Oil .....	1	1	1	1	1		.15
8 D600H-300	Gear, Crankshaft Timing .....	1	1	1	1	1		4.50
9 F110K-302	Pulley, Fan Drive .....	1	1	1	1	1		6.10
10 D600K-232	Seal, Fan Drive Pulley .....	1	1	1	1	1		.40
11 830-202	Washer, Starting Jaw .....	1	1	1	1	1		.50
12 D600C-201	Jaw, Crankshaft Starting .....	1	1	1	1	1		2.85
13 F600G-3171	Bearing, Rear Main - Upper and Lower .....	1	1	1		1		2.25
13 D600G-2131	Bearing, Rear Main - Upper and Lower .....				1	1		2.05
14 F600G-3151	Bearing, Intermediate Rear or Front - Upper and Lower ..	2	2	2		2		1.90
14 D600G-3101	Bearing, Intermediate Rear or Front - Upper and Lower ..	1	1	1		1		1.60
15 F600G-3131	Bearing, Front Main - Upper and Lower .....				1	1		3.70
15 D600G-3081	Bearing, Front Main - Upper and Lower .....	1	1	1		1		3.00
16 F226C-3120	Flywheel Assembly - Includes King Gear .....	1	1	1	1	1		3.20
17 8FC-304	Gear, Flywheel Ring .....	1	1	1	1	1		.30
18 F600G-208	Bushing, Camshaft - Rear .....	1	1	1	1	1		.75
19 D600G-217	Bushing, Camshaft - Intermediate Rear .....	1	1	1	1	1		.35
20 F600G-207	Bushing, Camshaft - Intermediate Front .....	1	1	1	1	1		.45
21 F600G-206	Bushing, Camshaft - Front .....	1	1	1	1	1		28.10
22 F2181-200	Camshaft .....	1	1	1	1	1		1.45
23 D600I-259	Plate, Camshaft Thrust .....	1	1	1	1	1		5.25
24 F600H-310	Gear, Camshaft Timing .....	1	1	1	1	1		.10
25 8FC-202	Lock, Camshaft Nut .....	1	1	1	1	1		.15
26 X-18156	Nut, Camshaft Gear .....	1	1	1	1	1		.10
F600L-203	Plate, Oilier - Timing Gear .....	1	1	1	1	1		.10
X-506	Key, Camshaft Gear - Woodruff #6 .....	1	1	1	1	1		.10
X-511	Key, Crankshaft Gear - Woodruff #15 .....	1	1	1	1	1		.10
C600K-218	Key, Fan Drive Pulley .....	1	1	1	1	1		.10
G600C-206	Bolt, Flywheel to Crankshaft .....	6	6	6	6	6		.15

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT

# PARTS LIST

## PISTON AND CONNECTING ROD GROUP

(Fig. 3)

1	F600A-4671E	Piston Assembly - Incl. Pin and Retaining Rings .....	6	6	6	6	5.15
1	F124A-4011E	Piston Assembly - Incl. Pin and Retaining Rings .....	12	12	12	12	4.85
2	6SA-101	Ring, Pin Retainer .....	6	6	6	6	.10
3	W5A-202	Pin, Piston .....	6	6	6	6	.85
3	158A-200	Pin, Piston .....	6	6	6	6	.65
4,5,6	113-19	Ring Set, Piston - For 1 Piston Only .....	6	6	6	6	1.10
4,5,6	113-18	Ring Set, Piston - For 1 Piston Only .....	6	6	6	6	1.20
7	F600D-4022	Rod Assembly, Connecting - Incl. Bearings - Nos. 1-3-5 ..	3	3	3	3	11.90
7	F600D-3102	Rod Assembly, Connecting - Incl. Bearings - Nos. 2-4-6 ..	3	3	3	3	
7	F400D-5001	Rod Assembly, Connecting - Incl. Bearings - Nos. 1-3-5 ..	3	3	3	3	
7	F400D-5001	Rod Assembly, Connecting - Incl. Bearings - Nos. 2-4-6 ..	3	3	3	3	
8	F600G-320	Bearing, Connecting Rod - Nos. 1-3-5 - Upper or Lower ..	6	6	6	6	.90
8	F600G-319	Bearing, Connecting Rod - Nos. 2-4-6 - Upper or Lower ..	6	6	6	6	.95
8	D600G-315	Bearing, Connecting Rod - Nos. 1-3-5 - Upper or Lower ..	6	6	6	6	.70
8	D600G-314	Bearing, Connecting Rod - Nos. 2-4-6 - Upper or Lower ..	6	6	6	6	.60
8	C600D-206	Bolt, Connecting Rod .....	12	12	12	12	.30

## VALVE GROUP

(Fig. 4)

1	F600I-229	Valve, Intake .....	6	6	6	6	.75
2	F600I-334	Valve, Exhaust (Boto) .....	6	6	6	6	2.30
3	F600I-235	Guide, Valve Stem - Intake .....	6	6	6	6	.35
3	F600I-241	Guide, Valve Stem - Exhaust .....	6	6	6	6	.35
4	F600I-232	Spring, Valve .....	12	12	12	12	.35
5	F600I-234	Retainer, Valve Spring - Intake .....	6	6	6	6	.15
5	F600I-200	Retainer, Valve Spring - Exhaust .....	6	6	6	6	
6	F600A-263-L	Insert, Valve Seat - Exhaust - .010" Oversize .....	6	6	6	6	1.60
7	D600I-347	Cap, Exhaust Valve Stem .....	6	6	6	6	.65
8	Y400I-213	Screw, Tappet Adjusting .....	12	12	12	12	.10
9	Y400I-212	Nut, Tappet Adjusting Lock .....	12	12	12	12	.10
10	Y400I-211	Tappet, Valve .....	12	12	12	12	.85
11	Y400I-2110	Tappet Assembly, Valve .....	12	12	12	12	1.15
12	12S1-207	Lock, Valve Spring Retainer - Intake .....	6	6	6	6	.10
13	D600I-348	Lock, Valve Spring Retainer - Exhaust .....	12	12	12	12	.20
14	110B229	Cover, Valve Chamber .....	1	1	1	1	

Refer to page 1 regarding the use of PARTS REF. SYMBOLS A, B, C, D, E, and F.

## PARTS LIST

REF. PART NO.	DESCRIPTION	† QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
VALVE GROUP -CONT'D.								
15	F600A-369 123A101 78792B 502-42	1 1 1 2	1 1 1 2	1 1 1 2	1 1 1 2	1 1 1 2	1 1 1 2	.20
	Gasket, Valve Chamber Cover .....							
	Tube Assembly, Breather .....	1	1	1	1	1	1	
	Valve Assembly, Breather .....	1	1	1	1	1	1	
	Elbow, Inverted Male - Breather Valve .....	2	2	2	2	2	2	
OIL PUMP AND OIL FILTER GROUP (Fig. 5)								
1	D600L-4027	1	1	1	1	1	1	24.65
2	15SL-211	1	1	1	1	1	1	.35
3	W5L-213		As	Req.				.10
4	F400L-223	1	1	1	1	1	1	.10
5	X-365	1	1	1	1	1	1	.10
6	4LAL-200	1	1	1	1	1	1	.20
7	D600L-2170	1	1	1	1	1	1	1.00
8	10EL-227	1	1	1	1	1	1	.30
9	D600B-402	2	2	2	2	2	2	.15
10	D600B-4010	1	1	1	1	1	1	6.75
11	102A34	1	1	1	1	1	1	
12	102A33	1	1	1	1	1	1	
13	102A32	1	1	1	1	1	1	
14	504-11	1	1	1	1	1	1	1.50
15	122-24	1	1	1	1	1	1	
16	122C26	1	1	1	1	1	1	
17	122A31	1	1	1	1	1	1	
18	122B28	1	1	1	1	1	1	
19	505-7	1	1	1	1	1	1	
20	502-2	2	2	2	2	2	2	.20
	X-3896	18	18	18	18	18	18	.10
	Pump Assembly, Oil .....							
	Plunger, Oil Pressure Relief Valve .....							
	Washer, Valve Adjusting .....							
	Spring, Oil Pressure Relief Valve .....							
	Gasket, Relief Valve Plug .....							
	Plug, Relief Valve .....							
	Gauge, Oil Level Bayonet .....							
	Support, Oil Level Gauge .....							
	Gasket, Oil Pan .....							
	Pan, Oil .....							
	Gasket, Adapter - Oil Drain .....							
	Adapter, Oil Drain .....							
	Tube, Oil Drain .....							
	Cock, Oil Drain .....							
	Cartridge, Oil Filter .....							
	Filter Assembly, Oil .....							
	Line, Oil - Filter Inlet .....							
	Line, Oil - Filter Outlet .....							
	Bushing, Reducing - Oil Line - 1/4" to 1/8" Pipe .....							
	Elbow, Inverted Male - Oil Lines .....							
	Screw, Hex. Head - With Lockwasher - Oil Pan .....							

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT

## PARTS LIST

**WATER PUMP AND FAN GROUP**  
(Fig. 6)

[illegible]

Refer to page 1 regarding the use of PARTS REF. SYMBOLS A, B, C, D, E, and F.

# PARTS LIST

REF. PART NO.	DESCRIPTION	+ QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
MUFFLER AND MANIFOLD GROUP -CONT'D.								
168E-203	Crab, Manifold to Cylinder .....	6	6	6	6	6	6	.20
F600E-208	Valve, Heat Control .....	1	1	1	1	1	1	.40
F600E-213	Shaft, Heat Control Valve .....	1	1	1	1	1	1	1.10
F600G-200	Bushing, Valve Shaft .....	2	2	2	2	2	2	.15
F600E-210	Sector, Adjusting .....	1	1	1	1	1	1	.85
155A90	Gasket, Exhaust Tube to Manifold .....	1	1	1	1	1	1	.35
155C7	Tube, Exhaust .....	1	1	1	1	1	1	7.75
155A25	Muffler .....	1	1	1	1	1	1	
155A82	Bracket, Muffler Mounting .....	1	1	1	1	1	1	.10
X-4266	Stud, Manifold to Cylinder - 2-1/8" .....	8	8	8	8	8	8	.10
X-19006	Stud, Manifold to Cylinder - 1-3/4" .....	3	3	3	3	3	3	
RADIATOR GROUP								
(Not Illustrated)								
130-60	Radiator .....	1	1	1	1	1	1	
130C37	Guard, Fan - Left .....	1	1	1	1	1	1	
130C38	Guard, Fan - Right .....	1	1	1	1	1	1	
130B70	Tube, Lower Water .....	1	1	1	1	1	1	
503A2	Hose, Upper .....	1	1	1	1	1	1	
503-3	Hose, Lower .....	2	2	2	2	2	2	
503-4	Clamp, Hose .....	6	6	6	6	6	6	
103C71	Shroud, Fan .....	1	1	1	1	1	1	
504-3	Cock, Radiator Drain .....	1	1	1	1	1	1	
130-83	Adapter, Radiator Inlet .....	1	1	1	1	1	1	
141A281	Gasket, Radiator Inlet Adapter .....	1	1	1	1	1	1	.10
DISTRIBUTOR GROUP								
(Fig. 7)								
1 166-36	Distributor Assembly .....	1	1	1	1	1	1	2.90
2 F600M-2160	Shaft, Drive .....	1	1	1	1	1	1	1.65
3 C400M-230	Adapter, Distributor .....	1	1	1	1	1	1	5.90
4 166-5	Coil, Ignition - 12 Volt .....	1	1	1	1	1	1	

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT

## PARTS LIST

[illegible]

Refer to page 1 regarding the use of PARTS REF. SYMBOLS A, B, C, D, E, and F.

## PARTS LIST

REF. PART NO.	DESCRIPTION	+ QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
FUEL SYSTEM GROUP -CONT'D.								
7 7451	Choke Control, Automatic .....	1				1		5.00
8 193-10	Gasket, Fuel Gauge Tank Element .....	1	1		1	1		.20
9 159D69	Tank, Fuel .....	1	1		1	1		
10 153-26	Gasket, Insulating - Choke Control .....	1	1		1	1		.15
11 SAF-203	Gasket, Carburetor to Manifold .....	1	1		1	1		.10
12 141-278	Carburetor .....	1	1		1	1		22.50
	Trade-In Allowance .....							2.50
13 149A76	Line, Fuel - Fuel Pump to Carburetor .....	1	1		1	1		
14 149-61	Pump, Fuel .....	1	1		1	1		6.00
	Trade-In Allowance .....							.50
15 149A126	Gasket, Fuel Pump Mounting .....	1	1		1	1		.10
16 50A-4	Valve, Fuel Shut-Off .....	1	1		1	1		
17 149A12	Filter Assembly, Fuel .....	1	1		1	1		1.35
18 501A7	Line, Fuel - Flexible .....	1	1		1	1		1.25
19 1098A	Screen, Fuel Filter .....	1	1		1	1		.25
20 149-157	Gasket, Fuel Filter Bowl .....	1	1		1	1		.15
21 1098	Bowl, Fuel Filter .....	1	1		1	1		.20
22 502-2	Elbow, Inverted Male - Filter (1), Carburetor (1) .....	2	2		2	2		.15
23 502-3	Connector, Inverted Male - Fuel Line .....	1	1		1	1		
140C92	Tube, Air Cleaner .....	1	1		1	1		
503-42	Hose, Air Cleaner .....	1	1		1	1		
503-43	Clamp, Air Cleaner Hose .....	3	3		3	3		
140-78	Band, Air Cleaner .....	2	2		2	2		
CARBURETOR PARTS GROUP (Fig. 10)								
1 141-289	Screw, Throttle Lever Clamp .....	1	1		1	1		
2 141-288	Lever, Throttle .....	1	1		1	1		
3 141-252	Screw, Throttle Plate .....	2	2		2	2		
4 141-284	Retainer, Shaft Packing Washer .....	1	1		1	1		
5 141-283	Washer, Shaft Packing .....	1	1		1	1		
6 141-232	Body, Throttle .....	1	1		1	1		

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT



10. 10. 10. 10. 10.

[illegible]

51

## PARTS LIST

REF. PART NO. NO.	DESCRIPTION	+ QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
STARTING MOTOR AND BATTERY CHARGING GROUP (Not Illustrated)								
191-7	Motor Starter .....	1						
232A232	Adapter, Starter .....	1	1	1	1	1	1	1.95
191-22	Generator, Battery Charging .....	1	1	1	1	1	1	
F400M-301	Bracket, Generator Mounting .....	1	1	1	1	1	1	
232A230	Arm, Generator Belt Adjusting .....	1	1	1	1	1	1	
232A234	Spacer, Generator Mounting .....	1	1	1	1	1	1	
191-21	Regulator, Charge .....	1	1	1	1	1	1	
191-16	Brush Set, Charge Generator .....	1	1	1	1	1	1	
191-19	Spring, Generator Brush .....	2	2	2	2	2	2	
191-17	Brush Set, Starter .....	1	1	1	1	1	1	
GENERATOR GROUP (Fig. 11)								
1 22A1188	Coil Set, Exciter - Set of 4 Coils .....	1	1	1	1	1	1	
2 22LA3	Poleshoe, Exciter .....	4	4	4	4	4	4	
3 232B122	Band, End Bell .....	1	1	1	1	1	1	
4 232B84	Plate, Alternator Cover .....	1	1	1	1	1	1	
5 232B55	Cover, Bearing .....	1	1	1	1	1	1	
6 232A57	Gasket, Bearing Cover .....	1	1	1	1	1	1	
7 232A333	Spring, Bearing Retainer .....	1	1	1	1	1	1	
8 211C11	Bell, End .....	1	1	1	1	1	1	
9 212C100	Rig Assembly, Brush - Includes Brushes & Springs .....	1	1	1	1	1	1	
10 210A1218	Frame Assembly, Exciter .....	1	1	1	1	1	1	
11 220A45	Stator Assembly - Windings & Laminations .....	1	1	1	1	1	1	
11 220A37	Stator Assembly - Windings & Laminations .....	1	1	1	1	1	1	
11	Stator Assembly - Windings & Laminations .....	1	1	1	1	1	1	
12 201A156	Stator Assembly - Incl. Bearing .....	1	1	1	1	1	1	
13 232B165	Scroll, Air .....	1	1	1	1	1	1	
14 205C5	Blower .....	1	1	1	1	1	1	
15 231D11	Adapter, Generator to Engine .....	1	1	1	1	1	1	
16 520A152	Stud, Exciter to Alternator .....	6	6	6	6	6	6	
17 510A32	Bearing, Ball - Motor .....	1	1	1	1	1	1	

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT

# PARTS LIST

18	312A27	Condenser - .5 MFD. ....	1	1	2	1	2	2	.75
19	312A15	Condenser - .1 MFD. ....	1	1	2	1	2	2	.75
20	212A1011	Spring, Commutator Brush .....	2	2	4	4	4	4	.25
20	212A1004	Spring, Slip Ring Brush .....	4	4	4	4	4	4	.25
21	21L4A8	Brush, Slip Ring .....	4	4	2	2	2	2	.60
21	21L4A17	Brush, Commutator .....	2	2	2	2	2	2	1.25
22	420-82	Grease, Ball Bearing .....	1	1	1	1	1	1	.25
CONTROL PANEL GROUP									
(Fig. 12)									
1	301C926	Panel, Right Hand - Engine Control Half .....	1	1	1	1	1	1	4.00
2	301C931	Panel, Left Hand - Electrical Meter Half .....	1	1	1	1	1	1	6.50
2	301C930	Panel, Left Hand - Electrical Meter Half .....	1	1	1	1	1	1	1.75
3	322-5	Light, Pilot .....	1	1	1	1	1	1	2.25
4	193-24	Gauge, Engine Oil Pressure - Dash Unit .....	1	1	1	1	1	1	2.25
5	193-22	Gauge, Water Temperature - Dash Unit .....	1	1	1	1	1	1	14.00
6	302-41	Voltmeter, AC 0-300 Volts .....	2	2	2	2	2	2	10.00
7	302-12	Ammeter, AC - 0-150 Amps. ....	2	2	1	1	1	1	10.00
7	302-10	Ammeter, AC - 0-80 Amps. ....	1	1	1	1	1	1	10.00
7	302-116	Ammeter, AC - 0-50 Amps. ....	1	1	1	1	1	1	2.50
8	302-60	Ammeter, Charge - 20-0-20 Amps. ....	1	1	1	1	1	1	1.55
9	193-11	Gauge, Fuel - Dash Unit .....	1	1	1	1	1	1	1.25
10	193-30	Divider, Voltage .....	1	1	1	1	1	1	.70
11	308-9	Switch, Push - Start and Stop .....	1	1	1	1	1	1	25.00
12	323-48	Receptacle, Duplex Twistite .....	1	1	1	1	1	1	32.00
13	320-55	Breaker, Circuit - 2 Pole, 5 Amp .....	1	1	1	1	1	1	.75
13	320-54	Breaker, Circuit - 3 Pole, 5 Amp .....	1	1	1	1	1	1	.75
14	308-5	Switch, Toggle - Ignition .....	1	1	1	1	1	1	.50
15	308-2	Switch, Toggle - Panel Light .....	1	1	1	1	1	1	3.00
16	304-32	Resistor, Fixed - Charge Circuit .....	1	1	1	1	1	1	2.00
17	308-22	Switch, Meter Selector .....	1	1	1	1	1	1	11.00
18	307-81	Relay Assembly, Charge .....	1	1	1	1	1	1	
19	307-32	Relay Assembly, Low Voltage .....	1	1	1	1	1	1	
20	307-4	Relay Assembly, Start-Stop .....	1	1	1	1	1	1	
21	302-79	Transformer, Current .....	2	2	2	2	2	2	
21	302-77	Transformer, Current .....	3	3	3	3	3	3	
21	302-117	Transformer, Current .....	3	3	3	3	3	3	

Refer to page 1. regarding the use of PARTS REF. SYMBOLS A, B, C, D, E, and F.

## PARTS LIST

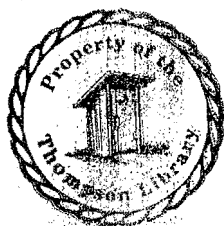
REF. PART NO.	DESCRIPTION	† QUANTITY USED						PRICE EACH
		A	B	C	D	E	F	
CONTROL PANEL GROUP - CONT'D.								
22	332-54	1	1	1	1	1	1	3.75
23	304-74	1	1	1	1	1	1	15.00
	302-68	1	1	1	1	1	1	.25
	322-4	1	1	1	1	1	1	.15
	332A21	2	3	3	2	3	3	.25
	332A23	2	3	3	2	3	3	.25
	332A22	2	3	3	2	3	3	.25
	332A19	2	3	3	2	3	3	.25
	332-56	1	1	1	1	1	1	.25
	332A20	1	1	1	1	1	1	1.75
	332A35	1	1	1	1	1	1	.75
	332-18	2	3	3	3	3	3	.60
	312A15	3	4	3	3	4	3	.20
	312-16							.75
	332-216							
	332-142							
	304-99							
HOUSING GROUP								
	405A216	1	1	1	1	1	1	.75
	403D92	1	1	1	1	1	1	
	405C228	1	1	1	1	1	1	
	405B321	3	3	3	3	3	3	
	405B337	2	2	2	2	2	2	
	405C227	1	1	1	1	1	1	
	405C224	1	1	1	1	1	1	15.00
	405C223	1	1	1	1	1	1	
	405C229	1	1	1	1	1	1	1.00
	405C211	2	2	2	2	2	2	
	405C139	2	2	2	2	2	2	5.00
	402-27	2	2	2	2	2	2	

WHEN ORDERING PARTS BE SURE TO INCLUDE MODEL AND SERIAL NUMBER OF UNIT

## PARTS LIST

Part Number	Part Description	Quantity	Unit Price	Total Price
416062	Tray, Battery .....	1	1.00	1.00
416861	Frame, Battery Hold Down .....	1	1.00	1.00
406A45	Latch, Cover Spring .....	1	1.00	1.00
155B72	Plate, Muffler Baffle .....	1	1.00	1.00
405D290	Panel, Left Hand Door .....	1	1.00	1.00
405P231	Panel, Right Hand Door .....	1	1.00	1.00
405A44	Clamp, Assembly, Starting Crank .....	1	1.00	1.00
406-2	Pull, Door .....	3	1.00	3.00
406A13	Plate, Pivot - Left Rear Slide Bars .....	1	1.00	1.00
406A14	Plate, Pivot - Right Rear Slide Bars .....	1	1.00	1.00
406A15	Plate, Pivot - Left Front Slide Bars .....	1	1.00	1.00
406A16	Plate, Pivot - Right Front Slide Bars .....	1	1.00	1.00
406A19	Bar, Slide - Horizontal .....	4	1.00	4.00
406A23	Bar, Slide - Vertical .....	4	1.00	4.00
406-9	Handle, Door .....	1	1.00	1.00
232C223	Duct, Air .....	1	1.00	1.00
405A353	Support, Engine .....	1	1.00	1.00
<b>SERVICE KITS</b>				
168-31	Kit, Gasket .....	1	1.00	1.00
168-32	Kit, Gasket .....	1	1.00	1.00
522-63	Kit, Overhaul - Includes Gasket Kit .....	1	1.00	1.00
522-62	Kit, Overhaul - Includes Gasket Kit .....	1	1.00	1.00
110-280	Kit, Valve Grind .....	1	1.00	1.00
149-75	Kit, Fuel Pump Repair .....	1	1.00	1.00
<b>ACCESSORIES</b>				
148-78	Kit, Gas - Gasoline Conversion .....	1	1.00	1.00
140-118	Kit, Air Heater .....	1	1.00	1.00
308-40	Switch, Remote Start and Stop .....	1	1.00	1.00
171A	Wire, Three Conductors - Remote Switch - Per Ft. ....	1	1.00	1.00
415B3	Tank, Fuel - Underground - 55 gal. ....	1	1.00	1.00
415B4	Tank, Fuel - Underground - 110 gal. ....	1	1.00	1.00
415-7	Line, Fuel - Underground - 25 Ft. ....	1	1.00	1.00
415-8	Line, Fuel - Underground - 50 Ft. ....	1	1.00	1.00

Refer to page 1 regarding the use of PARTS REF. SYMBOLS. A, B, C, D, E, and F.







UC 21-15-48  
SC 3-24-40

PRINTED IN U.S.A.