INSTRUCTION MANUAL *and* PARTS CATALOG

FOR

ONAN ELECTRIC GENERATING PLANTS

Series

CW

MOBILE APPLICATIONS

Onan®

DIVISION OF STUDEBAKER CORPORATION

MINNEAPOLIS 14, MINNESOTA

920-1010

Printed in U.S.A.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

GENERAL INFORMATION

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

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

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

MANUFACTURER'S WARRANTY

The Manufacturer warrants each product of its manufacture to be free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to the Manufacturer's instructions.

Manufacturer's obligation under this warranty is limited to correcting without charge at its factory any part or parts thereof which shall be returned to its factory or one of its Authorized Service Stations, transportation charges prepaid, within ninety (90) days after being put into service by the original user, and which upon examination shall disclose to the Manufacturer's satisfaction to have been originally defective. Correction of such defects by repair to, or supplying of replacements for defective parts, shall constitute fulfillment of all obligations to original user.

This warranty shall not apply to any of the Manufacturer's products which must be replaced because of normal wear, which have been subject to misuse, negligence or accident or which shall have been repaired or altered outside of the Manufacturer's factory unless authorized by the Manufacturer.

Manufacturer shall not be liable for loss, damage or expense directly or indirectly from the use of its product or from any other cause. The Manufacturer makes no warranty whatsoever with respect to component parts which are warranted separately by their respective manufacturers.

The above warranty supersedes and is in lieu of all other warranties, expressed or implied, and no person, agent or dealer is authorized to give any warranties on behalf of the Manufacturer nor to assume for the Manufacturer any other liability in connection with any of its products unless made in writing and signed by an officer of the Manufacturer.

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT

LIST OF ILLUSTRATIONS

INTRODUCTION

This instruction manual is supplied to assist in the proper installation, operation, and servicing of certain CW series electric generating plants.

The plants covered by this book are all 115/230 volt or 120/240 volt, single phase, 3 wire, 60 cycle alternating current output rating. Basic model 10CW-3R/ is remote starting type and can be started either at the plant or from remote control switches. Basic model 10CW-3E/ is electric starting while at the plant only.

Other differences between plants are identified by the model specification number and letter which follow the diagonal (/) in the plant model which appears on the nameplate. ALWAYS FURNISH THE NAMEPLATE INFORMATION WITH EACH INQUIRY.

These plants are adaptable for permanent installation in motor vehicles. The particular application or unusual operating conditions may require the operator of this generating plant to modify these instructions. However, by using the instructions and recommendations given in this manual as a general guide, it will be possible to make a good installation, and to properly operate and maintain the plant.

General production changes, which resulted in model Spec Letter advances, are as follows:

SPEC "E" - Earliest model covered herein.

SPEC "F" - Sisson automatic choke (plus heater and relay) displaced Onan electric choke. Oil slinger feature added to washer.

SPEC "G" - Cartridge (folded paper) type air cleaner displaced mesh (metal fabric) "dry" type air cleaner.

SPEC "H" - Single resistor displaced 3 resistors in charge circuit.

SPEC "J" - "Bronze" faced main bearings and thrust washers displaced flanged aluminum main bearings.

Each CW generating plant is a complete electric power plant, consisting of an internal combustion engine, and a self excited electric generator directly connected to the engine. Controls and accessories suitable for a normal installation and according to the particular model are supplied. The plant is designed for electric cranking and requires a 12 volt battery. The plant has a built-in charging circuit.

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

ENGINE

The Onan engine is a horizontally opposed 2 cylinder, air cooled, 4 stroke cycle, L head, internal combustion type. Standard models burn gasoline fuel. The cylinder bore is 4"; the stroke is 3-1/2"; cylinders are removable; connecting rod bearings are replaceable; main bearings are replaceable precision sleeve type; oil capacity is 6 U.S. quarts; impulse coupled magneto ignition is used; cylinders fire alternately; the governor is an internal centrifugal flyball type, with external adjustments, and an auxiliary vacuum operated speed booster; Vacu-Flo type air cooling permits a single discharged air duct; mounting dimensions are 16-1/2" x 16-1/2".

AC GENERATOR

The alternating current generator is a revolving armature, self excited, inherently regulated type. A special series winding in the field permits the generator to be used as a starting motor. The armature, connected directly to the engine flywheel, is supported at the engine end by the engine rear main bearing, and at the outer end by a large ball bearing. 60 cycle generators operate at approximately 1800 rpm.

CONTROLS

The ELECTRIC starting models are equipped with a manual carburetor choke (with some exceptions). The REMOTE starting models are equipped with an electric type automatic choke. The Remote starting models are designed so that auxiliary automatic control equipment may be connected.

GENERAL. - Proper installation is very important. Points to consider include, adequate cooling air, clean induction air, sturdy and flat floor, discharge of cooling air and exhaust, electrical connections, fuel connection, and accessible for operation and servicing.

MOUNTING. - Space the 3/8 inch diameter mounting bolts 16-1/2" x 16-1/2" through the floor. Carefully assemble the mounting cushions, washers, and spacer bushing, see Mounting Detail illustration. The spacer bushing prevents excessive compression of the upper rubber cushion.

The plant is approximately 28" wide by 40" long by 28" high. Provide access room for servicing or install slide-out rails if compartment is small.

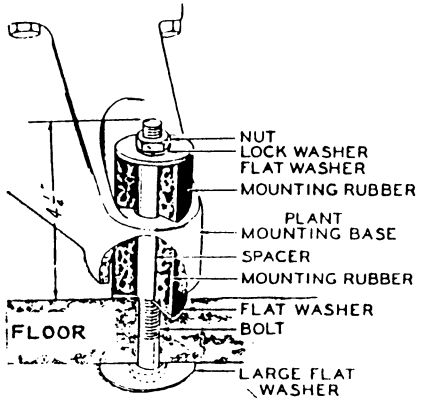


FIG. 1 - MOUNTING DETAIL

VENTILATION. - Provide at least 320 square inches of free air inlet area to the compartment or room. Make adequate allowance for the air flow restriction of a louver or screen. To prevent recirculation of heated air, install a duct between the plant air discharge opening and the room or compartment outlet opening. An 8"x 12" air outlet adapter is supplied with each plant, for use with a duct. Limit bends and use radius type elbows where needed. Use a short canvas section to connect the duct to the plant, to absorb vibration.

OIL DRAIN. - The oil drain may be extended to suit the installation. The oil base has a 3/4" pipe threaded hole.

FUEL CONNECTION. - Make the fuel connection according to the type of fuel to be used.

For plants equipped to burn only gasoline fuel, connect the fuel line to the fuel pump inlet. The pump inlet is threaded 1/8-27 Dryseal (American Standard Internal Straight Pipe Thread).

For plants equipped with a combination gas-gasoline carburetor, connect the gasoline fuel line to the fuel pump inlet and connect the gas fuel hose to the carburetor adapter tube while installing the secondary gas pressure regulator.

For plants equipped with a Zenith LP (liquid petroleum) Gas Pressure-Carburetor, and a separate vaporizer (heat exchanger)(mounted on the blower housing front panel) connect the LPG liquid withdrawal line to the vaporizer inlet. Set the line pressure at 10 pounds per square inch.

EXHAUST. - The engine exhaust gases must be piped outside any room or compartment, as the exhaust gases are deadly poisonous. The engine exhaust connection is located at the cooling air discharge opening, and is threaded for standard 1-1/4 inch pipe. Use flexible tubing to connect between the plant exhaust outlet and any rigid pipe extension or the muffler. Never use pipe smaller than 1-1/4 inch size.

Insulate or shield the exhaust pipe if there is danger or any one touching it, or if it must be run close to any wall or other material that is not completely fire proof. If the exhaust line must pass through a combustible wall or partition. provide shield collars for the line, with the openings for the line at least 2 inches larger on all sides than the exhaust line.

If turns in the exhaust line are necessary, avoid 90° pipe elbow turns. If the line must be run upward at any point, construct a condensation trap of suitable pipe fittings and install the trap at the low point in the line. The trap must be drained periodically.

BATTERY CONNECTION. - Two 6-volt batteries (or one 12-volt battery) are required to supply starting current. When two 6-volt batteries are used, use the short jumper battery cable to connect the positive (+) post of one battery to the negative (–) post of the second battery, connecting them in series for 12 volts. Connect the remaining battery terminal post to the proper terminals in the terminal box on the generator, as illustrated. Do not reverse the connections, taking care to observe correct polarity.

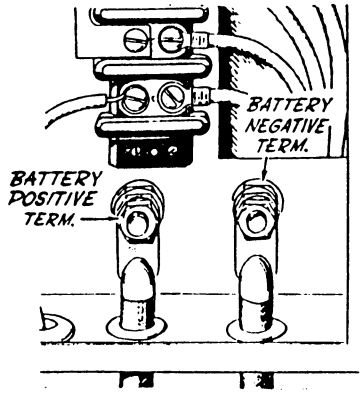


FIG. 2 - BATTERY CONNECTION

LOAD WIRE CONNECTIONS. - In making load wire connections to the plant output terminals, comply with requirements of the local electrical code. Install a fused main switch or circuit breaker between the generating plant and the load.

SINGLE PHASE PLANT

Be sure the jumper connections are properly made, as explained under VOLTAGE SELECTION, SINGLE PHASE PLANT. Connect the load wires to the proper terminals as shown, according to the jumper connections made, Fig. 3.

VOLTAGE SELECTION, SINGLE PHASE PLANT. - Models 10CW-3R/ and 10CW-3E/ are single phase plants. The plant is reconnectible for use as either a 120/240 volt 3 wire, 120 volt 2 wire, or 240 volt 2 wire unit.

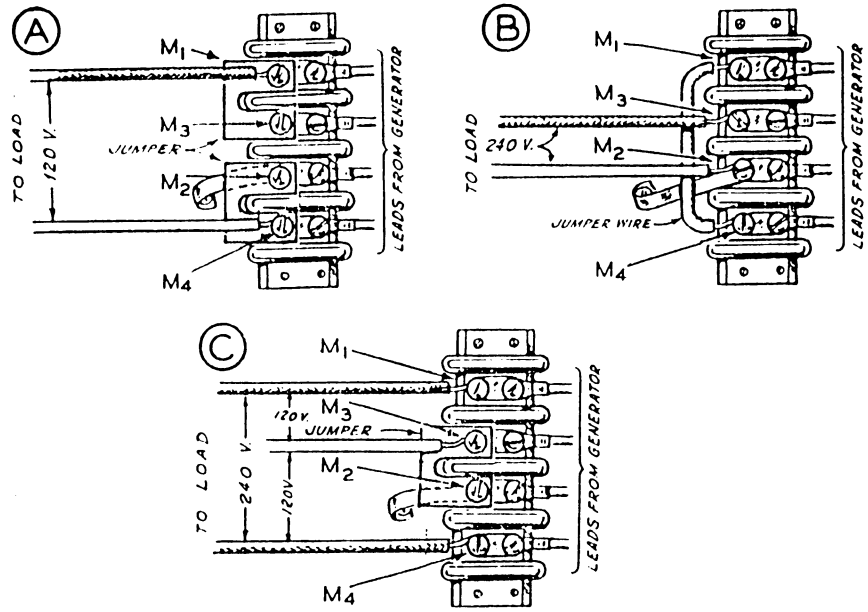


FIG. 3 - VOLTAGE SELECTION

120/240 VOLT, 3 WIRE SERVICE

Load connections are to be made to terminals inside the terminal box on the side of the generator. These load terminals are marked M1, M3, M2, and M4 from top to bottom. When the plant is shipped, two heavy jumper bars are connected across terminals M3 and M2. This jumper connection provides for two 120 volt circuits (with 1/2 the plant capacity available on each separate circuit), or one 240 volt circuit. Refer to C, Fig. 3. For 120 volt service, connect the black (hot) load wires to the M1 and M4 terminals, and the white (ground) wire to the M2 or M3 terminal. Remember that ONLY ONE HALF the rated capacity of the plant will be available on either of the two separate 120 volt circuits. The two black wires will give 240 volt [illegible] rated service.

120 VOLT, 2 WIRE SERVICE

If the full rated capacity of the plant at 120 volts ON ONE CIRCUIT ONLY, is desired, remove the two jumper bars from across terminals M3 and M2. Reconnect the jumper bars, one across terminals M1 and M3, and the other jumper across terminals M2 and M4. Connect the

black (hot) load wire to the M1 terminal, and the white (ground) wire to the M4 terminal. Refer to A, Fig. 3.

240 VOLT SERVICE

If 240 volt current only is to be used, and NEITHER load wire is white (grounded), leave the jumpers connected across terminals M3 and M2. Connect load wires to terminals M1 and M4. Refer to C, Fig. 3.

NOTE

Consult the local electrical code to determine if a grounded 240 volt load wire is necessary.

If a grounded 240 volt circuit is to be used remove (and save for possible future use) the two jumper bars connecting terminals M3 and M2. Using a short length of #10 or larger wire, connect terminals M1 and M4 together. Connect the black (hot) load wire to the M3 terminal, and the white (grounded) load wire to the M2 terminal. Refer to B, Fig. 3.

CRANKCASE LUBRICATION. - The capacity of the engine oil base is 6 quarts, U.S. Measure. Use detergent oils classified by the American Petroleum Institute as Service "DG" or, as marketed by most manufacturers, "MS/DG". The use of Service "DS" is satisfactory, but its higher cost does not justify its use. Select the viscosity of oil according to the temperature * of the unit at the time of starting as given below. Be sure oil will flow, before cranking the unit.

* COMPARTMENT TEMPERATURE	SAE NUMBER (Oil Viscosity)
Above 90°F (32°c.) (Continuous Duty)	50
30°F to 90°F (-1°C to 32°C)	30
0°F to 30°F (-18°C to -1°C)	10
Below 0°F (-18°C)	5W

Multi-viscosity oils such as 5W-20 or 10W-30 are not recommended, as the oil consumption is greater. At low temperatures where cold starting may be difficult and higher oil consumption is not a factor, the use of multi-viscosity oil may be justified. Do not use a non-detergent oil. When adding oil, add the same brand.

Always TIGHTEN the OIL FILL CAP securely. A slight vacuum is normally maintained in the engine crankcase. If the oil fill cap is loose, or if the gasket is damaged, an air leak at this point will destroy the vacuum. Loss of the vacuum may result in excessive oil consumption or in an oil leak past the crankshaft oil seals.

AIR CLEANER. - Perform the preparation according to the type used.

A. Dry Mesh Type (metal fabric) - To be effective the element must be moist with oil. Remove the element (it should be clean), dip it in clean oil of the same SAE number as used in the crankcase, drain it, and reinstall the pack element and the air cleaner cover.

B. Cartridge Type (folded paper) - No preparation is required. Service as instructed under Periodic Service Section.

GASOLINE FUEL. - Fill the fuel tank nearly full with a good grade of fresh, clean, "regular" automotive type of gasoline. Do not use a highly leaded "premium" type of gasoline. The use of any gasoline which has a high lead content will require more frequent carbon or lead removal, spark plug, and "valve grind" servicing. Observe the usual safety precautions when handling gasoline.

GAS FUEL (Downdraft Carburetor). - If gas fuel is to be used, be sure that all connections are leak proof. See that the line pressure at the regulator inlet is 3 to 8 ounces (for Garretson Mfr. regulator). In some localities, presence of foreign

matter in the fuel may require installation of a trap or filter. If LPG (bottled) fuel is used, be sure a proper pressure regulator is installed to reduce the gas pressure, as it enters the regulator supplied with the plant, to not more than 8 ounces. Do not connect the air preheater hose. The regulator's atmosphere vent must be kept clean to avoid difficult starting. Some installations require an electric solenoid fuel shut-off valve. This valve must be installed in the fuel line and connected as shown on the wiring diagram. Open the fuel line valve.

LPG FUEL (Horizontal Draft, Zenith Pressure-Carburetor). - This carburetor has a valve designed for a line pressure of 10 pounds per square inch. The primary regulator in the fuel system should never be set above 12 pounds per square inch, which has been approved by Underwriters' Laboratories Inc. To permit liquid withdrawal from the LPG tank (tank turned so that outlet is on bottom) a vaporizer (heat exchanger) is mounted on the blower housing front panel. Connect the liquid fuel line to the vaporizer inlet. Be sure the fuel line does not leak. Open the tank valve.

AIR PREHEATER HOSE. - An air preheater hose, plus fittings, is supplied with certain plants, for use in temperatures below 50°F. (10°C.). If a gasoline fueled plant is to be operated in temperatures below 50°F., particularly if high humidity prevails, install the preheater hose. See Air Preheater Hose illustration. Remove the sheet metal plug from the upper left corner of the engine blower housing. Assemble the hose to the air tube and insert the tube into the blower housing opening. Attach the other end of the air hose as shown.

NOTE

For best operation, disconnect the air heater hose when the surrounding air temperature is 60°F. or higher. No harm will result from leaving the hose connected at higher temperatures, but a slight drop in power and lowered efficiency may occur.

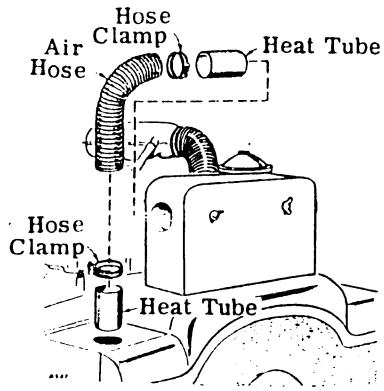


FIG. 4 - AIR PREHEATER HOSE

PRELIMINARY. - Before starting the plant, be sure that it has been properly installed, and that all requirements under PREPARATION have been met. Starting batteries MUST BE CONNECTED to a plant designed for electric starting unless special precautions are taken as explained below under OPERATING WITH BATTERIES DISCONNECTED.

CAUTION

ALWAYS BE SURE THAT ALL AIR HOUSING PARTS (cylinder air covers, blower housing) ARE PROPERLY INSTALLED BEFORE STARTING THE PLANT. The air housings direct the air flow to properly cool the engine and generator. UNLESS EACH AIR HOUSING PART IS CORRECTLY FASTENED IN PLACE, SERIOUS DAMAGE FROM OVER HEATING WILL RESULT.

STARTING THE PLANT ELECTRICALLY. - On remote models see that the small toggle switch is at the "ELECT. START" position. Adjust the choke on electric start models with manual choke. Push the "START-STOP" switch to the "START" position. THE PLANT MAY HESITATE FOR SEVERAL SECONDS BEFORE CRANKING PAST COMPRESSION ON THE FIRST REVOLUTION. HOLD THE STARTING SWITCH CLOSED FOR THIS HESITATION PERIOD. THE ENGINE WILL CRANK OVER COMPRESSION AND THEN GAIN NORMAL CRANKING SPEED. A sharp, distinct clicking sound will be heard as the engine is cranking, indicating that the magneto impulse coupling is operating. The sound will disappear as soon as the engine starts and picks up running speed.

On the initial start, or if the plant has run out of fuel, the engine must turn over enough times to pump fuel to the carburetor and fill it, before the plant will start.

Oil was sprayed into the cylinders before the plant was shipped, and it may be necessary to remove the spark plugs and clean them with gasoline before the plant will start the first time. Dry the plugs thoroughly before reinstalling them. The plant will smoke as this oil burns out.

If the plant starting batteries do not have sufficient cranking power, or if the plant can not be cranked electrically for other reasons, the plant can be started manually. Disregard manual choking instructions when hand cranking a plant designed for remote starting. However, do not disconnect the starting batteries unless a wire in the control box is first disconnected, as explained below.

OPERATING WITH BATTERIES DISCONNECTED. - If operation with batteries discon-

nected becomes necessary on a plant designed for electric starting, the generator dc output must be disconnected from the charging circuit. Beginning with Spec H models, disconnect the center wire (connected to fixed terminal) from the charge resistor, figure 5 (A). On Spec A through G models, disconnect the single wire at the end of the 3 charge resistors, figure 5 (B). Beginning with Spec F remote starting models, the Sisson choke is used and the carburetor must be manually choked while hand cranking.

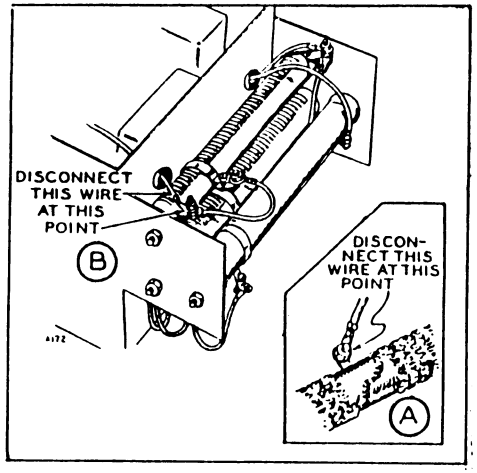


FIG. 5 - DC OUTPUT DISCONNECT POINT

CAUTION!
BURNED OUT RELAYS IN THE BATTERY CHARGING CIRCUIT WILL RESULT IF THE PLANT IS RUN WITHOUT BATTERIES UNLESS THIS WIRE IS DISCONNECTED.

Tape up the ends of the disconnected wires, to prevent a short circuit. After the dc output wire is disconnected, the plant can be started and safely operated without batteries. Be sure to reconnect the wires when batteries are again connected to the plant. On remote models throw the small toggle switch to the "HAND CRANK" position, and on models with a low-oil-pressure cutoff switch, open the normally closed momentary contact switch, to permit starting and running.

STARTING THE PLANT MANUALLY. - Select the instructions for the type of plant. Adjust the manual choke control (when used on electric starting models) to choke the carburetor according to temperature conditions. When starting an engine which has been standing idle in cold weather, full choking may be necessary. Little or no choking will be necessary in extremely hot weather, or if the engine is still warm from recent running.

On the remote type plants it may be necessary to overide the automatic choke and turn the carburetor choke shaft by hand while hand cranking.

If the plant is the remote starting type, throw the small toggle switch on the control box to the "HAND CRANK" position. Return the switch to the "ELECT. START" position as soon as the plant starts, unless "operating with batteries disconnected".

When the plant is equipped with an optional low oil pressure cutoff switch a momentary contact switch is mounted on oil filter bracket and must be held open to remove the ignition ground during hand cranking.

Engage the starting crank. Crank the engine with a quick upward pull on the crank handle. A sharp clicking sound will be heard, indicating that the magneto impulse coupling is functioning. This sound disappears as soon as the engine starts. Do not "spin" the engine nor push downward on the crank. Repeat the cranking as necessary, using only upward pulls on the crank handle. Remove the crank as soon as the plant starts.

WARM UP PERIOD. - On plants with manual choke control, adjust the manual choke control to the point of smoothest operation. As the plant warms up, gradually push the choke control inward. Be sure the choke is all the way in when the plant is fully warmed up.

Check the oil pressure as indicated on the oil pressure gauge. The oil pressure should be between 20 and 30 pounds, but may be somewhat higher until normal running temperature is reached.

If conditions permit, allow the plant to warm up before connecting the electrical load. If the plant tends to alternately speed up and slow down it is usually an indication that more warm up time is needed before connecting a heavy electrical load.

DURING OPERATION. - The generator is designed so that a temporary heavy over load, such as exists while starting an electric motor, will not injure the generator. However, continuous heavy over loading of the generator will cause the generator temperature to rise to a dangerous point, and may lead to failure of the windings. The generator is designed to produce its rated capacity continuously, or a 25% over load for a period of less than 2 hours, under normal temperature conditions.

Balance the load on the available generator circuits as given in INSTALLATION Section, VOLTAGE SELECTION Paragraph.

OPERATION BELOW 50°F (10°C). - Under conditions where the air temperature is 50°F. or lower, and the humidity is quite high, ice formation inside the carburetor may occur. Such icing consists of actual building up of ice around the carburetor throttle plate and is due to the refrigerating action of the carburetor causing moisture in the air to freeze and collect on the throttle plate and surrounding parts. Icing may result in a gradual drop in

engine speed (and generator voltage) and binding of the throttle. Under such conditions, connect the air preheater hose to direct hot air to the air cleaner. Refer to PREPARATION (AIR PREHEATER HOSE).

STOPPING THE PLANT. - If conditions permit, disconnect the electrical load before stopping the plant. To stop the plant, press the START-STOP switch to the STOP position holding contact until the engine comes to a complete stop. If the STOP switch is released too soon, the engine may pick up speed again and continue to run.

If a remote starting model is being operated with the starting batteries disconnected, throw the small toggle switch to the ELECT. START position. to stop the plant. The STOP switch (and all other control box equipment) is by-passed when the toggle switch is at the HAND CRANK position.

EXERCISING. - If generating plant is out of service for short periods up to thirty days it should be exercised regularly. Once a week start the plant and allow it to run long enough to thoroughly warm up (about 30 minutes).

If the plant stands idle without such an exercising period, gasoline has a tendency to evaporate out of the carburetor making starting more difficult.

Frequent exercising also contributes toward better lubrication, keeps moisture condensation to a minimum, and helps to keep the starting batteries in a well charged condition.

If generating plant is to be out of service for extended periods refer to storage instructions.

GAS FUEL OPERATION (Downdraft Carburetor). - This applies to the combination gas-gasoline carburetor. For gas fuel operation see that the float lock screw (see B, Fig. 9) is turned up tightly to prevent the float from vibrating inside the carburetor. If an emergency source of gasoline fuel is also connected, see that the gasoline shut off valve is closed. See that the choke is properly locked in its wide open position (Fig. 10). Plants equipped with a Garretson regulator require no choking or priming when starting.

To change from gas fuel to gasoline fuel operation, with the combination

carburetor, a few preliminary change-over steps are necessary.

1. Be sure the gas fuel supply is turned off. If the gas supply line is disconnected, install a plug in the regulator inlet. If the gas connection hose is disconnected, close the carburetor gas adjusting screws to prevent any entry of air through the gas inlet opening.

2. Release the automatic choke lock to permit normal choke operation. Check to be sure the choke operates properly.

3. Back off the float lock screw (B, Fig. 9) until it seats firmly in the down position. Turn the gasoline shut off valve to its open position.

LPG (LIQUID PETROLEUM GAS) OPERATION (Zenith Pressure-Carburetor). - No choking is required for starting. The fuel supply valve is a part of the carburetor and opens only when a pressure drop as created by cranking the engine, causes the regulating diaphragms to move. However, the carburetor has a poppet valve type choke plate which is held open by a spring but can be used if the need arises.

ONAN GASOLINE ENGINE SERVICE CHART

The following recommended Servicing Chart may be used as a guide to estimating servicing requirements of Onan Electric Generating Plants and Engines. It is based on the average of records kept by the factory.

The chart is based on the Units operating under favorable conditions, such as: satisfactory installation, use of recommended fuel and oils, etc.

SERVICE & PARTS REQUIRED	HOURS OF OPERATION																	
	100	200	300	400	500	600	700	800	900	1000	1500	2000	2500	3000	3500	4000	4500	5000
Oil Change (Check Level Daily)	x	x	x	x	x	x	x	x	x	x								COMPLETE RECONDITIONING
Clean and Adjust Spark Plugs	x	x	x	x	x	x	x	x	x	x								
Clean Crankcase Breather	x	x	x	x	x	x	x	x	x	x								
Replace Oil Filter Element		x		x		x		x		x								
Check Ignition Points		x		x		x		x		x								
Inspect Commutator		x		x		x		x		x								
Inspect Brushes		x		x		x		x		x								
Clean Carbon					x					x	x	x	x	x	x	x	x	
Check Tappets					x					x	x	x	x	x	x	x	x	
Clean Carburetor										x		x		x		x		
Grind Valves										x		x		x		x		
Remove and Clean Oil Base										x		x		x		x		
Clean Generating Plant (*)										x		x		x		x		
Service Air Cleaner	SEE PERIODIC SERVICE																	
Replace Spark Plugs	AS REQUIRED																	
Replace Valves	AS REQUIRED																	
Replace Points	AS REQUIRED																	
Replace Generator Brushes	AS REQUIRED																	
Replace Piston Rings	AS REQUIRED																	

*Blow carbon dust from generator, using clean compressed air.

If it is necessary to remove parts for inspection and gaskets are disturbed they should be replaced with new ones. Keep spare cylinder head, cylinder base, oil base and other gaskets on hand.

When brushes are replaced be sure the commutator and slip rings are in good condition. If necessary, seat(sand) new brushes for full contact.

Periodic Inspection ... Loose or Poor Connections, Fittings, etc.

Recommended Fuel: Use a regular grade of automotive type gasoline. If a high lead content fuel is used, it will be necessary to remove the lead deposits more frequently.

GENERAL. - Follow a definite schedule of inspection and servicing to help in keeping the plant in good running condition, and to keep operating expenses to a minimum. Service periods outlined in this section are for normal service and operating conditions. For extreme conditions, such as continuous heavy duty, extremely high or low temperature, etc., service more frequently. For periods of little use, service periods can be lengthened accordingly. Keep a record of the operating hours 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. - Check the fuel supply often enough to avoid running the tank dry.

CRANKCASE OIL. - Check the oil level, on the level indicator. Do not allow the oil level to fall below the lower level "L" mark on the indicator. Add oil of the proper SAE number as necessary to bring the level to the upper level "F" mark. Do not overfill the crankcase. Tighten the oil fill cap securely.

AIR CLEANER. - Service the air cleaner as often as required by the operating conditions. Under extremely dusty conditions, it may be necessary to service the air cleaner several times a day. Under dust-free conditions, every 100 hours or even less frequent servicing may be sufficient. See also WEEKLY SERVICE.

CLEANING. - Keep the plant clean. A clean plant will give better service, and it is easier to service a clean plant. Wipe off spilled oil, dust, dirt, etc.

WEEKLY SERVICE

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

CRANKCASE OIL. - If the plant has been operating under LOW TEMPERATURE conditions or for short operating periods, oil dilution or sludge formation may occur. Under such conditions, change the engine oil each 50 operating hours. Under normal temperature and operating conditions change the oil each 100 operating

hours. Always drain the oil, when changing it, only when the plant is warm from running.

AIR CLEANER. - Service the air cleaner as often as required by the operating conditions.

To service the dry "mesh" type air cleaner remove the filter packing element. Clean the element in solvent, dry, and dip in engine oil (same SAE number as used in the oil base). After allowing the excess oil to drain off the element, reassemble the air cleaner.

To service the dry "cartridge" type air cleaner, remove the cartridge every 50 hours and shake out accumulated dirt. Install a new cartridge every 500 hours, or more often under extreme dust conditions. DO NOT WASH CARTRIDGE. When cartridge has a foam wrapper, remove wrapper and wash in soapy water, gasoline or solvents. Squeeze dry and reinstall.

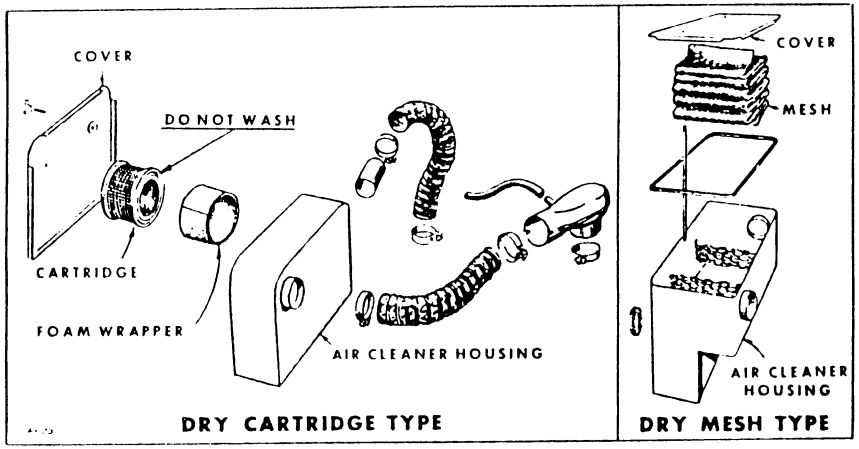


FIG. 6 - AIR CLEANER SERVICE

GOVERNOR LINKAGE. - Inspect the governor link ball joint and the point where the link engages the carburetor throttle arm. Keep these points free of dust. Lubricate with a "dry" type of lubricant, such as powdered graphite, if there is any binding. If a "dry" lubricant is not obtainable, use only a light machine oil of non-gumming quality.

SPARK PLUGS. - Remove the spark plugs, clean them, and adjust the gap according to the type of fuel used. Refer to the Table of Clearances in the MAINTENANCE section. Replace with a new one any plug which will not pass a standard compression firing test. Be sure the wire terminal faces upward, when connecting to the plug. If the terminal faces downward, the spark may jump to the shield clamping screw, causing the plug to misfire.

BATTERIES. - If starting batteries are used, see that the connections are clean and tight. Corrosion at the terminals can be removed by flushing with a weak baking soda and water solution. Flush clean with clear water and dry thoroughly. A light coating of grease or asphalt paint will retard such corrosion. Keep the electrolyte at the proper level above the plate separators by adding clean water which has been approved for use in batteries. In freezing weather, run the plant for at least 20 minutes after adding water, to mix the water with the electrolyte and prevent its freezing.

MONTHLY SERVICE

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

FUEL SYSTEM. - If the 5 gallon fuel tank is used, drain and clean to remove any sediment or water condensation. "Breathing" of the fuel tank may draw dust into the tank, or condensation may collect, particularly under cold or damp conditions. Such a contaminated fuel system may cause hard starting or uneven operation. Remove the drain plug at the bottom of the carburetor to drain off any sediment. After servicing is completed, inspect carefully against leaks.

EXHAUST SYSTEM. - If an exhaust extension is used, inspect all connections carefully for leaks. Tighten or make any necessary repairs.

OIL FILTER. - Remove the oil filter element for inspection. If it appears to be filling with sludge, install a new element. Do not attempt to clean and re-use an element. Differences in operating conditions may lengthen or shorten the time intervals between necessary oil filter replacements. Always clean out old oil and sludge from inside the oil filter body before installing the element. A new element will absorb a pint or more of oil when the plant is started. After a few minutes of running, stop the plant and add enough oil to bring the level up to the "F" mark on the indicator.

COOLING FINS. - Remove the cylinder air covers. Clean the cooling fins of the cylinders and cylinder heads. Dirty or obstructed cooling fins will cause over heating and may lead to serious damage. BE SURE AIR HOUSINGS ARE PROPERLY REPLACED.

MAGNETO. - Remove the end cap from the magneto and inspect the breaker contact points. Slight burning or pitting can sometimes be corrected by resurfacing smooth on a fine stone, removing for such servicing. If the points are badly burned or pitted replace with a new set. Severe or frequent burning or pitting is usually

an indication of a defective magneto condenser, which should be replaced with a new one.

Keep the contact points clean and free of oil. Adjust the gap, with the rubbing arm on the "high" side of its cam, to 0.020 inch. Put a drop of light oil on the cam oil wick. Do not over lubricate.

When installing the end cap, be sure its gasket is undamaged and properly in place.

VALVE TAPPETS. - Remove the valve compartment covers and check the tappet clearances. Adjust as necessary to a clearance of 0.012 inch for both intake and exhaust valves, at room temperature (cold setting).

CRANKCASE BREATHER VALVE. - The crankcase breather valve helps to maintain a slight vacuum inside the engine crankcase while the engine is running. If the flapper type valve becomes gummed up or otherwise inoperative, the crankcase vacuum will be destroyed and excessive oil consumption or oil seal leakage may result. After removing the valve, Fig. 7, clean thoroughly in gasoline or other solvent. Replace the valve with a new one if the flapper diaphragm is worn or otherwise damaged so as to prevent proper seating to the perforated disc.

When installing the breather valve, be sure the perforated disc faces downward, with the diaphragm upward. See that the cap is properly installed, so that there can be no air leak at this point.

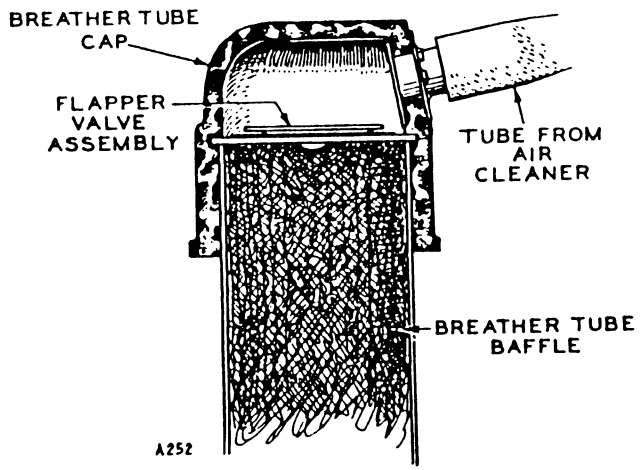


FIG. 7 - CRANKCASE BREATHER VALVE

CARBON REMOVAL. - The frequency of necessary carbon or lead deposits removal will vary with operating conditions. If the plant is operated at light load consistently, under cool operating temperatures, or if highly leaded gasoline is used, the combustion chambers must be cleaned frequently. Remove carbon or lead deposits as experience indicates the necessity. After removing the cylinder air covers, remove the cylinder heads and gaskets. Scrape all carbon and lead deposits from the cylinder heads and ends of the pistons, valves, etc. If a cylinder head gasket is damaged, install a new one. Install the cylinder heads, tightening the nuts evenly to 35-40 lb. ft. torque. Be sure air covers are properly replaced.

GENERATOR. - Remove the inspection plates from the generator end bell and inspect the commutator, collector rings, and brushes. In service, the commutator and collector rings acquire a brown finish, which is a normal condition. Do not attempt to maintain a bright newly machined appearance. Wipe clean with a dry, lint free cloth. Slight roughness or heavy coating may be remedied by lightly sanding with #00 sandpaper. Do not use emery or carborundum cloth or paper. If scratches or grooves are present, refinishing will be

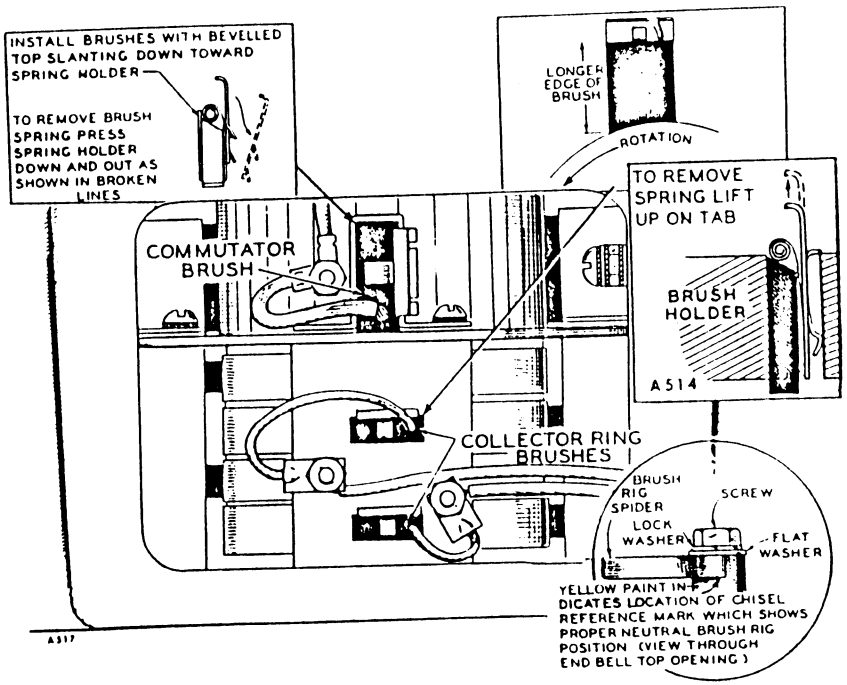


FIG. 8 - BRUSH RIG

necessary. Refer to MAINTENANCE.

Brushes eventually wear too short to perform their function. Brush wear will be more rapid under dusty operating conditions. Replace brushes with new ones only when worn to 1/2 inch in length. The brush springs provide equal pressure as the brushes wear shorter in use. Each spring is permanently attached to a metal plate which snaps into place. To replace a commutator brush, first remove the spring by pushing the spring plate inward and away from the brush guide, Fig. 8. To replace a collector ring brush, first remove the spring by pulling straight outward on the spring plate. When inserting a new brush in its guide, be sure that the shorter length of the brush is installed against generator rotation, to conform to its off-set position for correct seating. Be sure that each brush is free in its guide, and that its spring is correctly installed. Keep the brush rig and end bell clean of carbon dust, etc.

MAGNETO GREASING. - The magneto is lubricated at the factory. Renewing the grease in the field is inadvisable, unless the magneto is disassembled for another reason. If magneto overhaul becomes necessary, consult a Fairbanks Morse Authorized Magneto Service Station.

GENERATOR BEARING. - No lubrication is required. Use only a double shielded ball bearing when installing a new bearing.

GENERAL INSPECTION. - Thoroughly inspect the entire plant for oil leaks, loose electrical connections, worn parts, or loose bolts or nuts. Make any necessary repairs.

SEMI-YEARLY SERVICE

If the plant is operated more than 1000 hours semi-yearly, perform the SEMI-YEARLY SERVICE operations every 1000 hours.

GENERATOR. - Remove the inspection plates from the generator end bell and blow out with compressed air or clean the carbon dust out of the generator. If this is not done, a flash over of the higher AC voltage may occur and badly burn the brush rig.

CARBURETOR. - Carburetors used, differ according to the fuel to be used. However, the adjustment is basically the same. The location of the adjustments differ.

The carburetor has a fuel main adjustment and fuel idle adjustment. The main adjustment affects the operation at the heavier load conditions. The idle adjustment affects the operation at light or no load conditions. Under normal circumstances, the factory carburetor adjustments should not be disturbed. If the adjustments have been disturbed, open them off their seats, 1 to 1-1/2 turns to permit starting, then, readjust them for smoothest operation. Refer to the Carburetor Adjustments illustration.

Before final adjustment allow the engine to thoroughly warm up. Adjust the idle adjustment with no load connected to the generator. If available, connect a voltmeter of the proper range to the generator output. Slowly turn the idle adjustment out until the engine speed (or generator voltage) drops slightly below normal. Then turn the needle in until the speed (or voltage) returns to normal.

To adjust the fuel main adjustment, apply a full electrical load to the generator output. Turn the main adjustment in until the engine speed (or generator voltage) drops slightly below normal. Then turn the needle out until the speed (or voltage) returns to normal. Proper carburetor adjustment can not be assured unless the governor is properly adjusted.

The gasoline type carburetor float setting, from the bottom of the float to the air intake body, is 1-1/4" (plus 1/8", minus zero).

With electrical load removed, adjust the throttle lever stop screw to prevent a voltage output drop below 75 per cent of rated voltage(or so that there is 1/32 inch clearance at the end of the stop screw while running at rated speed under no load).

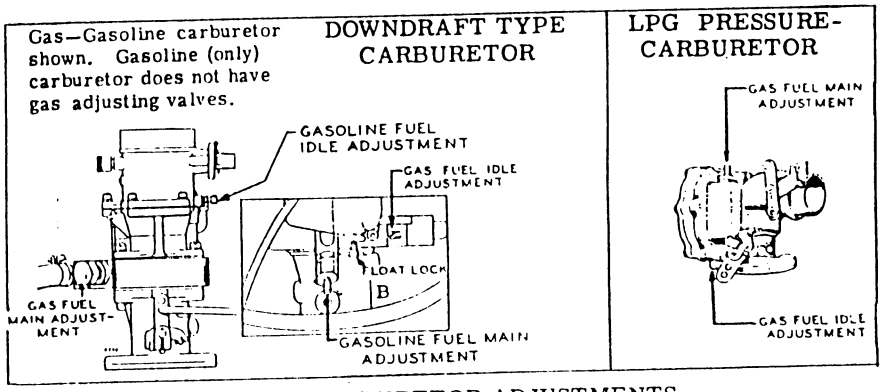


FIG. 9 - CARBURETOR ADJUSTMENTS

AUTOMATIC CHOKE. - Two types of automatic chokes have been used. Select the proper instructions for type of choke.

A. ELECTRIC CHOKE

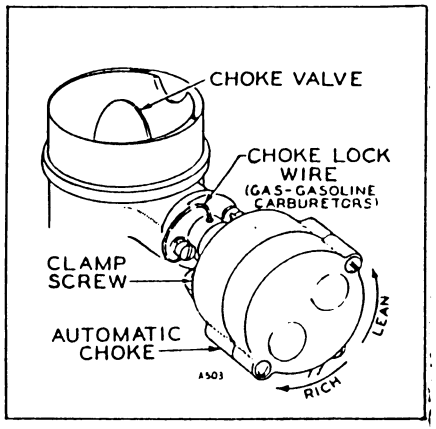


FIG. 10 - ELECTRIC CHOKE ADJUSTMENTS

If the electric choke does not open as the engine warms up, check the electric heating element to be sure it is operating. Extremes in local temperatures may require readjustment of the choke. In extremely cold temperatures, the choke may close so tightly as to cause overchoking. Loosen the choke housing clamp screw and turn the housing slightly to the left (counterclockwise). Do not turn too far - a few degrees are usually sufficient. In extremely high temperatures, the choke may remain open, causing under choking. To increase the choking action, turn the choke housing slightly clockwise. Be sure to retighten the clamp screw.

B. AUTOMATIC CHOKE (SISSON MFR.)

The Sisson choke should require no readjustment for wide temperature variations. However if the original setting has been disturbed, proper setting must be restored.

If the choke does not open as the plant warms up, check the heating element under the mounting bracket to be sure it is operating.

1. Loosen the carburetor choke arm on its shaft.

2. Slip the choke assembly cover upward to remove it.

3. Insert an 8 penny nail or similar 1/8 inch diameter rod through the [illegible] of the choke solenoid armature and core as shown.

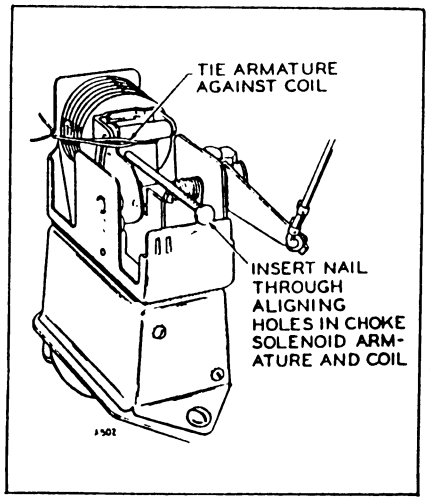


FIG. 11 - SISSON CHOKE ADJUSTMENTS

4. Tie the armature firmly against the core. This simulates the choke position while the engine is actually cranking.

5. Set the carburetor choke valve-plate at its fully closed position and tighten the carburetor choke arm on its shaft.

6. Remove the alignment nail and untie the armature. The carburetor choke valve-plate will be open slightly. Replace the cover.

GOVERNOR. - The governor controls the engine speed, and therefore the voltage and frequency of the generator output. 60 cycle plants are adjusted at the factory to a maximum no load speed of 1890 rpm. These are maximum figures, and may sometimes be as low as 1800 rpm for 60 cycle plants. A voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor.

A. Preliminary Steps:

1. With the plant stopped, check the clearance of the carburetor throttle stop lever. The clearance between the lever and stop pin should be approximately 1/32". Fig. 12. This clearance can be adjusted by loosening the linkage ball joint and turning the ball joint on the linkage threads as necessary to lengthen or shorten the over-all length of the linkage. Be sure that the lever to which the link connects is securely clamped on the carburetor throttle shaft.

Pull the governor arm gently toward the front of the engine several times. Any binding, sticking, or excessive looseness in the travel will cause erratic governor action. The action must be smooth, subject only to the tension of the governor spring.

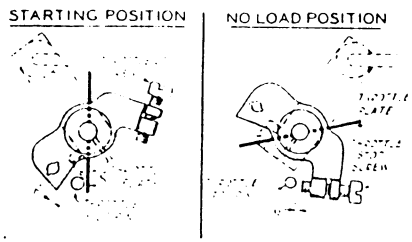


FIG. 12 - THROTTLE LEVER AND STOP PIN

2. Start the plant and run at a light electrical load for long enough to thoroughly warm up. If the governor is completely out of adjustment, make a preliminary adjustment at no load to first attain a safe voltage operating range, as directed below under ADJUSTMENT. The plant must be thoroughly warmed up before a satisfactory final governor adjustment can be made.

B. Adjustment Procedure:

1. The plant is equipped with an auxiliary speed booster device, operating by intake manifold vacuum. The speed booster is adjusted to increase governor action as the load on the generator is increased. The booster serves to maintain or increase the speed at heavier loads, thus resulting in more nearly constant voltage.

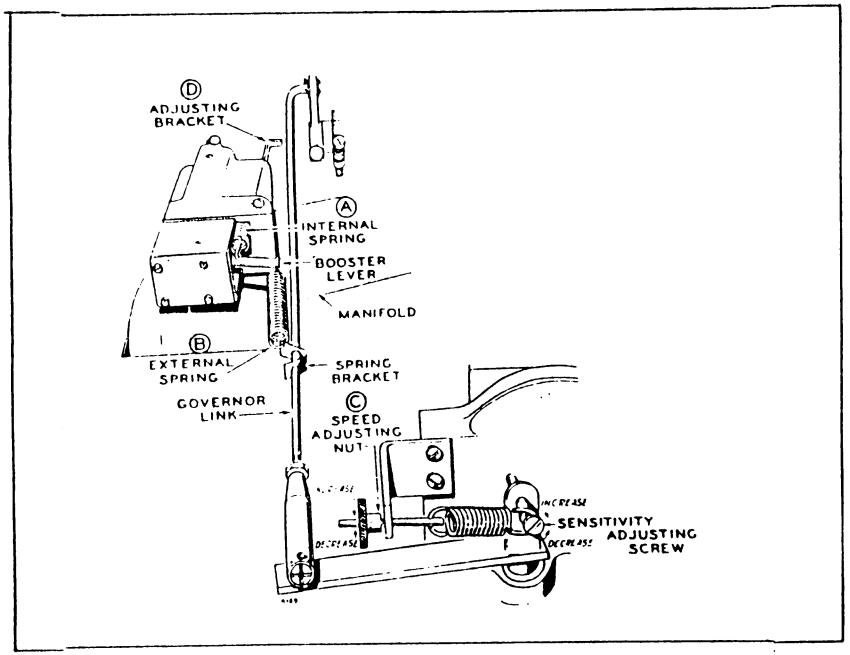


FIG. 13 - GOVERNOR AND BOOSTER

The booster is mounted on the intake manifold and is operated by engine vacuum through a small passage in the manifold. See Fig. 13. When the plant is operating at about half load or less, the engine vacuum is sufficient to cause the diaphragm to overcome the tension of the internal booster spring (A). Under these conditions, there is no tension on the booster external spring (B) and the booster does not affect the governor operation.

As the load on the plant is increased, the engine vacuum becomes less, the booster internal spring tension overcomes the pull of the diaphragm, and tension is put on the booster external spring. The tension on the external spring "helps" the regular governor spring in its function, thus causing a slight increase in engine speed as the load is increased.

2. With the plant operating at no load, disconnect the booster external spring (B), Fig. 13. Turn the speed adjusting nut (C) to obtain a frequency reading of 60 to 61 cycles for a 60 cycle plant. The voltage should be within the limits shown in the table, according to the rated plant voltage shown on the plant nameplate.

TABLE OF GOVERNOR ADJUSTING LIMITS

PLANT RATED VOLTAGE	NO LOAD VOLTS (MAXIMUM)	MINIMUM FULL LOAD VOLTS WITHOUT BOOSTER	MAXIMUM NO LOAD TO FULL LOAD VOLT. DROP WITH BOOSTER
120/240	124 or 248	112 or 224	7 or 14

3. Connect a full electrical load to the generator. As the electrical load is connected, the governor should act smoothly and quickly to keep the voltage within the limits in the table. However, there should be not more than a spread of 3 cycles between the no load frequency and the full load frequency. For example, if the frequency was 60 cycles at no load, then the full load frequency should be not less than 57 cycles. If the cycle spread is more than 3 cycles, turn the sensitivity screw, Fig. 13, in (clockwise) a half turn. This will, in turn, necessitate a slight compensating speed nut adjustment. Repeat the process until the cycle spread is within 3 cycles and voltage is within the limits shown in the table.

4. Check the performance under various loads. The governor should react to each load change quickly and smoothly. It is normal for the frequency (and voltage) to drop below the lower limit for a few seconds when a sudden heavy load is connected, but then should stabilize within the limit. It is also normal for the frequency (and voltage) to rise temporarily above the upper limit upon removing a heavy load.

5. If the frequency fluctuates or refuses to stabilize when under a constant load condition, the governor is perhaps too sensitive. Turn the sensitivity screw out (counterclockwise) a partial turn at a time until the governor stabilizes. It will then be necessary to again adjust the speed nut to bring the frequency within the proper limits.

6. After long service, the governor mechanism parts may become worn enough to prevent correct governor adjustments. If the engine and generator are otherwise in good condition and all other ad-

justments are properly made, but governor action is still erratic, inspect for worn parts. Remove the gear cover to inspect the fly balls, shaft-and-yoke assembly, and other internal parts.

7. If governor adjustment will not correct and excessive drop in cycles at full load, engine power may be low. Check the compression, etc., making repairs as necessary. If governor adjustment will not correct a fluctuating speed condition, the carburetor adjustment may be too lean. Refer to ADJUSTMENTS; CARBURETOR.

8. Af ter satisfactory performance has been attained under various loads, the booster can be connected. With the plant operating at no load, connect the booster external spring, Fig. 13. Adjust the bracket on the governor link just to the position where there is no tension on the spring.

9. Now connect the full electrical load to the generator. The frequency should stabilize at a point 1 to 2 cycles HIGHER than the no load frequency. For example, if the no load frequency is 60 cycles, the frequency under full load should be 61 to 62 cycles. If the rise in frequency is more than 2 cycles, lessen the internal spring tension. If there is a drop in the frequency, increase the internal spring tension. Adjust the tension of the internal spring by pulling out on the spring bracket (D), and moving the pin to a different hole.

10. With the booster disconnected, a maximum drop of 3 cycles from no load to full load is normal. With the booster in operation, a maximum INCREASE of 2 cycles from no load to full load is normal. A drop of 1 cycle at 1/4 load is permissible, giving an over all spread of 3 cycles.

11. The effect of the booster is limited by the general condition of the engine. The booster can not compensate for a loss in engine vacuum caused by leaky valves, worn piston rings, etc.

12. The booster requires little maintenance other than using a fine wire to clean the small hole in the short vacuum tube which fits into the hole in the top of the engine intake manifold. Do not enlarge this hole. If there is tension on the external spring, Fig. 13, when the plant is operating at no load or light load, it may be due to improper adjustment, restricted hole in the small vacuum tube, or a leak in the booster diaphragm.

ENGINE

GENERAL. - Refer to the SERVICE DIAGNOSIS section for assistance in locating and correcting servicing situations which may occur. The information in this MAINTENANCE AND REPAIR section is intended to assist in properly maintaining the generating plant. If major repairs should become necessary, it is recommended that such services be performed by a competent mechanic who is thoroughly familiar with modern internal combustion engines and revolving armature type generators.

GASKETS. - It is always good practice to use a new gasket when installing a part which requires a gasket. Be sure to thoroughly clean the surfaces that the gasket contacts before installation.

BLOWER HOUSING, REMOVAL. - To remove the blower housing, remove the flat head screws mounting the front cover casting and pull the cover off straight forward. Remove the blower wheel from its hub. Remove the nuts and lock washers mounting the dual exhaust pipe to the cylinders, and 3 screws which mount the blower housing to the front of the engine. The blower housing, with the exhaust pipe loose inside it, can then be removed.

BLOWER HUB. - Remove the screw and washer from the center of the blower wheel hub. Remove the crank pilot by pulling it straight forward. If the blower hub proves to be too tight for easy removal, tap lightly in a forward direction to loosen it.

CYLINDER HEAD. - Models using gaseous fuel have a high compression cylinder head. Beginning in 1959 this head has a 1/8" radius boss on the top edge to identify it from standard compression. Look near the spark plug. Both heads must be high compression.

VALVES. - The valve FACE angle is 44°. The valve SEAT angle is 45°. This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life. Valve faces should be finished in a machine to 44°. Valve seats should be ground with a 45°stone, and the width of the seat band should be 3/64 to 5/64 of an inch wide. Clean, oil, then assemble the valves. Valve rotocaps, as furnished as optional equipment on gasoline fueled plants only, serve to prolong valve life, by rotating the valve a fraction of a turn each time it opens. While at open position the valve can be rotated freely but in only one direction. Try it. If faulty, replace it.

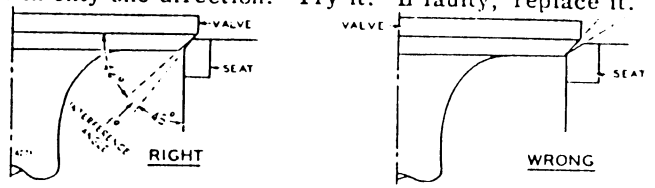


FIG. 14 - VALVE SEATING

VALVE TAPPETS. - The valve tappets are adjustable, having self locking adjusting screws. Set the tappets for clearance of .012" for intake and exhaust valves, at room temperature (cold setting). Tappets set too close may cause burned or warped valves or seats, or scored tappets or camshaft lobes.

Be sure when checking the tappets, that the tappet being checked is riding on the low point of its cam lobe. Watch the valve to be checked as the engine is slowly hand cranked. As the valve closes, turn the crankshaft one complete turn beyond the valve closing point. This will assure that the tappet is then on the low point of its cam lobe.

IGNITION TIMING. - Correct ignition timing is important to good engine performance. The ignition timing should be checked after servicing or replacing the magneto contact points. Refer to Fig. 15.

Remove the end cap from the magneto. Adjust the magneto breaker points to a gap of .020 inch at full separation. Remove the air cover from the engine right hand cylinder, to expose the timing hole in the flywheel housing.

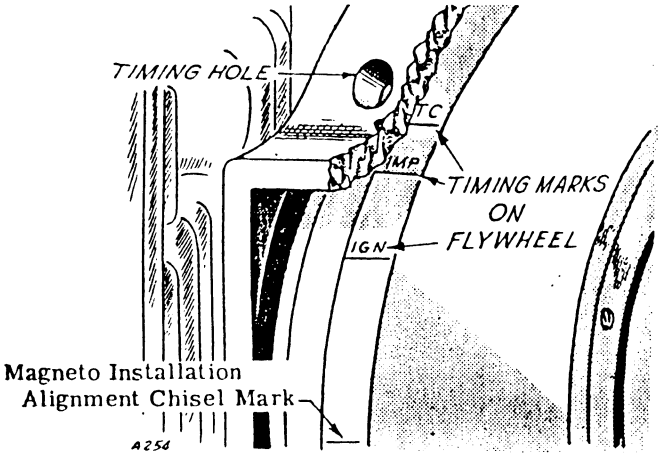


FIG. 15 - IGNITION TIMING MARKS

With the hand crank, slowly turn the engine, until the IMP timing mark on the outside edge of the flywheel can be seen through the timing hole. As the timing mark centers in the timing hole, a sharp click should be heard from the magneto. This click is caused by the magneto impulse as it trips, and is the instant the spark occurs. If this click occurs before the IMP mark is visible through the timing hole, the ignition timing will be "fast". If the click occurs after the IMP mark passes the center of the timing hole, the ignition timing will be "slow". Loosen the two magneto mounting screws a few turns each and turn the magneto slightly, to advance or retard the spark timing as necessary. Repeat the checking operation until proper timing is attained.

When the plant is running, the impulse coupling is no longer in operation and the spark is automatically advanced. If a neon timing light is used to check the timing, the spark should occur as the IGN. mark on the flywheel aligns in the timing hole.

MAGNETO INSTALLATION. - If the magneto has been removed from the engine, turn the flywheel to the point where the chisel mark, located 8-1/2 inches before TC mark, is visible through the timing hole. Holding the magneto in the hands, turn its drive gear in a clockwise direction until the gear locks (starts to wind impulse spring). Without changing this setting, carefully install the magneto to the engine, making sure the setting does not change as the gears mesh together. Check the timing as previously described.

GEAR COVER INSTALLATION. - Before installing the gear cover, see that the metal-lined (smoothest) hole of the governor cup is properly aligned to engage the pin inside the gear cover. Install the gear cover, leaving the mounting screws a turn or two loose. Carefully center the gear cover so as to avoid any off-center effect between the oil seal and the crankshaft. Hold in the centered position while tightening the mounting screws securely.

CYLINDERS. - The cylinders are removable from the crankcase. If cylinders become worn more than 0.005" out of round or tapered, or are scored, they can be refinished to fit oversize pistons. If cooling fins are broken, or other damage occurs, replace the damaged cylinder with a new one. New engine cylinder bore is 4.000"-4.001", unless oversize cylinders and pistons are used, in which case the bore is 4.005 - 4.006".

PISTONS AND RINGS. - The pistons and connecting rods may be removed outward through the cylinders, or the cylinders can be removed over the pistons without loosening the connecting rods. Full Floating type piston pins are used.

The compression rings have one edge beveled on the inside and this bevel must be installed toward the closed end of the piston. Proper ring gap, when fitting rings, is 0.013 inch to 0.025 inch. Space the ring gaps equally around the piston, with no gap directly in line with

the piston pin. Use standard size rings if 0.005 oversize pistons are installed, and oversize rings for larger oversize pistons.

CONNECTING RODS. - The forged steel connecting rods have precision type bearing inserts easily replaceable. Do not dress the rod cap to compensate for any bearing wear; replace with new bearings. Correct bearing clearance to the crankshaft journal is 0.001 inch to 0.003 inch, and should be measured at a point in line with the length of the rod, Fig. 18. If new piston pin bushings are installed in the upper end of the rod, the bushings must be pressed in only flush with the sides of the rod, to permit a 1/16 inch oil groove at the center. Finish ream to 1.1879/1.1882 inch for a new piston pin, or to give a clearance of 0.0002" to 0.0007" if a used pin is continued in service.

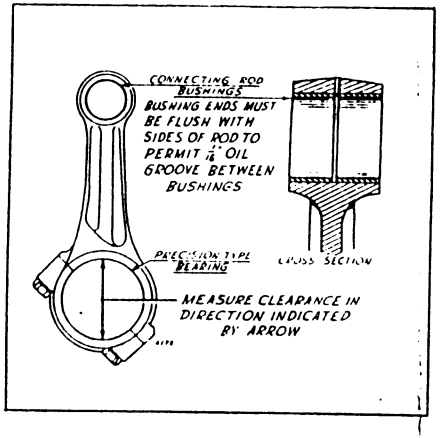


FIG. 16 - CONNECTING ROD BEARINGS

MAIN BEARINGS. - The crankshaft main bearings are of the sleeve type. The "bronze" faced main bearing and separate thrust washer is original equipment, beginning on Spec J models. When used to replace the flanged aluminum bearing as used on models prior to Spec J, you must drill one additional hole and install a second

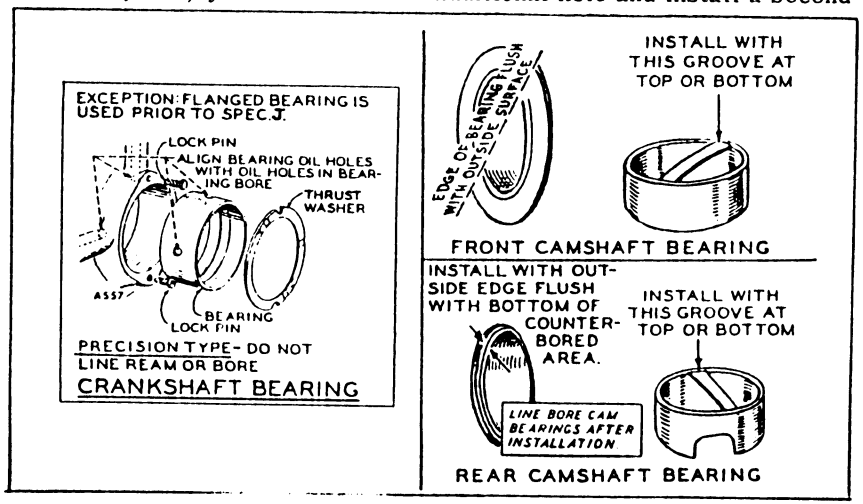


FIG. 17 - MAIN AND CAMSHAFT BEARINGS

lock pin to prevent each thrust washer from riding on the crankshaft. Main bearings are available in std. or .002", 010", .020", .030" undersize, and do not require finishing to size after installation. When driving or pressing the bearing in, align the oil passages in the bearing and bore. Oil the bearings. When installing the crankshaft, install a thrust washer at each end and engaged with lock pins(coat with oil to hold while assembling). Measure the crankshaft endplay.

CAMSHAFT BEARINGS. - The camshaft bearings are babbitt lined sleeves, pressed into the crankcase. Press new bearings in from the outside of the crankcase, forcing the old bearing from the bore in the same operation. Oil grooves can be positioned toward either the top or bottom of the crankcase. Press the front bearing in flush with the front surface of the crankcase, and the rear bearing in flush with the bottom of the plug recess. Camshaft bearings must be finished to size after installation, for a clearance of 0.001" to 0.003". Install a new plug, using sealing compound and expanding into place with sharp blows at its center.

CRANKSHAFT. - See that the oil passages of the crankshaft are clean and free of obstructions. These oil passages conduct oil from the main bearing journals to the connecting rod journals. If the bearing journals become worn out of round or scored, refinish to use undersize bearings. If either oil seal contact surface becomes grooved or scored, refinish and polish smooth.

When installing the rear bearing plate, use sufficient gaskets to provide crankshaft end play of 0.008 to 0.020". Use care not to damage the oil seal during the bearing plate installation.

CAMSHAFT. - If a lobe of the camshaft has become slightly scored (too close tappet adjustment sometimes causes this), dress smooth with a fine stone. A badly worn or scored camshaft must be replaced with a new one.

The camshaft center pin can not be pulled outward nor removed without damage. The center pin is a very tight fit, and the 3/4 inch distance it extends beyond the end of the camshaft is quite critical. For this reason, never press or tap on the center pin, except as directed in the GOVERNOR CUP paragraph.

GOVERNOR CUP. - The governor cup can be removed from the camshaft and gear after first removing the small snap ring from the camshaft center pin. Slide the governor cup forward over the center pin, catching the governor fly balls in the hand.

Replace with a new part any fly ball which is grooved or has a flat spot, if the ball spacer arms are worn or otherwise damaged, or if the fly ball contact surface of the cup is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but without any excessive looseness or wobble.

When assembling the governor cup to the camshaft and gear, be sure all twelve fly balls are installed in the spacer openings After installing the snap ring to the center pin, hold the governor cup in toward the gear. The distance from the snap ring to the front surface of the governor cup must be 7/32", Fig. 18. If the distance is more than 7/32 inch, use an arbor press to carefully press the center pin in the required amount. If the distance is less than 7/32", it will be necessary to remove the center pin and install a new one, pressing in only the required amount. The metal-lined hole of the governor cup must engage with the gear cover roll pin.

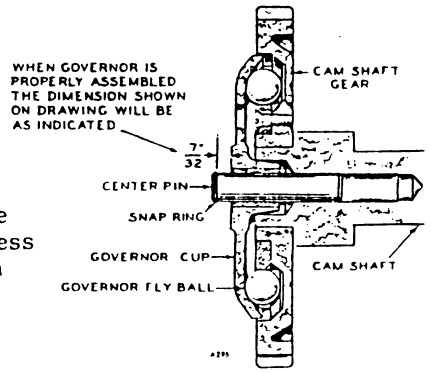


FIG. 18 - GOVERNOR CUP

CAMSHAFT GEAR. - The camshaft gear is keyed and pressed on to the camshaft. If replacement becomes necessary, the gear can be pressed off the camshaft. After removing the governor cup, fly balls, spacer, etc., use a hollow tool or pipe of the proper diameter to fit inside the gear bore and over the camshaft center pin. Press the camshaft out of the gear bore, taking extreme care not to press on the camshaft center pin.

When installing a camshaft gear to the camshaft, be sure the key is properly in place, and press on up to the camshaft shoulder. Assemble the governor ball spacer, balls, cup, etc. before installing to the engine.

When installing to the engine, be sure the marked tooth meshes with the marked tooth of the crankshaft gear, Fig. 19. Do not omit the thrust washer behind the camshaft gear.

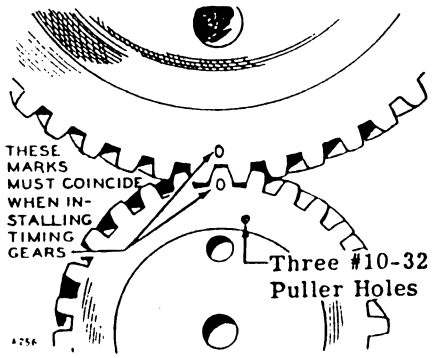


FIG. 19 - GEAR TIMING MARKS

CRANKSHAFT GEAR. - The crankshaft gear is keyed and a drive fit to the crankshaft and is fastened with a lock ring. To remove the slotted gear (earlier type), use a claw type puller To remove the gear which has three #10-32 tapped holes on a 2-1/2" diameter (later type), use a screw-attaching type gear puller.

When installing a crankshaft gear, see that its key is in place, face with the "0" timing mark outward, and drive the gear on up to the crankshaft shoulder. Be sure the marked tooth ("0" timing mark) meshes with the marked camshaft gear tooth.

OIL PUMP. - If the oil pump is to be removed, it must be turned off the oil intake pipe. If the oil pump fails to function properly, install a complete new pump. Except for the intake assembly, component parts of the oil pump are not available separately.

When installing the oil pump, be sure its mounting gasket is in good condition, and properly in place. Turn the intake pipe and cup in tightly and at the correct angle to have the intake cup parallel to the bottom of the crankcase.

NOTE

Be sure the oil pump is primed with oil.

OIL PRESSURE RELIEF VALVE. - The oil pressure relief valve is not adjustable. If the valve should become stuck open or closed, remove and clean. Remove the hex head screw and copper washer, Fig. 20. Lift out the pressure spring. The valve can be removed with a long 3/8"-16 screw.

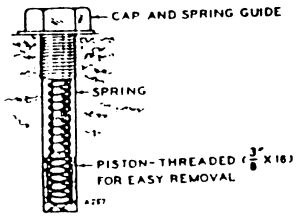


FIG. 20 - OIL PRESSURE RELIEF VALVE

FLYWHEEL. - The flywheel is keyed and a taper fit to the crankshaft. After removing the flywheel attaching screw, if the flywheel proves difficult to remove, reinstall the flywheel screw and leave it a few turns loose. Hit the screw sharply to jar the flywheel loose.

When installing the flywheel, be sure the key is in good condition and is properly fitted in place. See that the taper surfaces of the crankshaft and of the flywheel are clean and free of nicks. The flywheel must run true. Any unbalance will set up harmful vibration.

Tighten the mounting screw securely, to a torque wrench reading of 50-55 lb. ft.

OIL SEALS. - Install the rear bearing plate oil seal flush with the outer surface of the plate. Install the gear cover oil seal flush with the outer edge of the oil seal opening. Both seals must be installed with the open side of the seal facing inward. Double lipped type oil seals must be lubricated between the lips with "Mobilplex EP" (or equal) grease.

TABLE OF CLEARANCES. - The clearances given in table V are the factory standards. A comparison between the standard clearances shown, and clearances as determined during repair operations will usually indicate which parts should be replaced with new ones. As a general rule, when the clearance exceeds by 50% the maximum factory limit (or nearly so), the worn parts should be replaced with new ones. For example, if connecting rod bearing clearance is .0045" or more (factory maximum clearance 0.003"), new connecting rod bearings should be installed. For those clearances which are adjustable, keep the clearances within the factory tolerance.

TABLE OF CLEARANCES (IN INCHES)

	MINIMUM	MAXIMUM
Valve tappet (Cold)	.012	.012
Valve stem in guide - Intake	.0015	.003
Valve stem in guide - Exhaust	.003	.0045
Valve seat width	3/64	5/64
Crankshaft main bearing - Aluminum	.0035	.0045
Crankshaft main bearing - "Bronze" faced	.0019	.0054
Crankshaft endplay - Aluminum bearing	.008	.020
Crankshaft endplay - "Bronze" bearing	.008	.012
Camshaft bearing	.001	.003
Connecting rod bearing	.001	.003
Connecting rod endplay	.002	.011
Timing gear backlash	.001	.006
Oil pump gear backlash	.003	.005
Piston to cylinder (90^{o} to pin)	.0045	.0065
Piston pin in piston (tap- in fit)	.0000	.0003
Piston pin in connecting rod	.0002	.0007
Compression ring gap, Top	.013	.025
Compression ring, 2nd	.013	.025
Oil ring gap	.013	.025
Magneto breaker points gap	.020	
Spark Plug Gap		
Models with Gasoline Only Carburetor	.025"	
Models with Gas-Gasoline Carburetor	.018"	
Models with Gas Only Carburetor	.015"	
Models with LP G... sure-Carburetor	.015"	
Crankshaft main bearing journal - Std size	2.7495	2.7500
Crankshaft rod bearing journal - Std size	2.3745	2.3750
Cylinder Bore - Standard size	4.000	4.001

ASSEMBLY TORQUES. - As a general rule, tighten bolts or nuts securely, using reasonable force only, and using a wrench of normal length. The assembly torques shown will assure proper tightness without danger of stripping threads.

ASSEMBLY TORQUES (POUND FEET)

Rear Bearing Plate -		Intake Manifold Screws	36-38
Place Bolts (No Locks)	40-45	Exhaust Manifold Screws	25-30
Nuts (Earlier Models)	18-20	Generator Adapter Screws	25-30
Connecting Rod -		Oil Base Screws	25-30
Place Bolts (No Locks)	40-45	Fuel Pump Mounting Screws	15-20
Screws (With Locks)	27-30	Timing Gear Cover Screws	15-20
Cylinder Head Screws	40-45	Armature Mounting Screws	10-12
Crank Pilot Screw	43-48	Oil Pump Mounting Screws	7-9
Cylinder Base Nuts	58-60	Spark Plugs	25-30
Flywheel Mounting Screw	35-40		

GENERATOR

GENERAL. - The generator normally requires little maintenance other than the regular PERIODIC SERVICE operations, which should never be neglected. Some generator tests are simple to perform, do not require major disassembly, and require only a continuity type test lamp set. Other tests require special equipment and extensive disassembly of the generator. Partial disassembly, and removal of the generator is necessary in order to make certain engine repairs.

GENERATOR REMOVAL. - To disassemble the generator for removal, first remove the brush springs and brushes. Disconnect field coil and other lead wires which connect to the brush rig, to permit removal of the end bell and brush rig as an assembly. Be sure to tag each wire and its connection point as it is disconnected, to assure correct reconnection.

After removing the end bell mounting screws, carefully tap the end bell straight backward until it becomes free of the armature bearing. Place blocking under the rear of the engine, remove the screws which attach the generator frame to the engine rear, and carefully pull the frame assembly straight back over the armature. Use care not to allow the frame to drag or catch on the armature laminations.

To remove the armature, carefully block up the armature and remove the screws mounting its drive disc to the engine flywheel. Slide the armature away from the engine.

COMMUTATOR AND COLLECTOR RINGS. - The mica insulation between the commutator bars, or segments, was originally undercut to a depth of 1/32 inch below the commutator surface. After a long period of service, the surface of the commutator may become worn down level with the mica. This condition would cause noisy brushes, sparking of the brushes, and pitting of the commutator. The mica should again be undercut to 1/32 inch depth. Remove the brush springs and pull all the brushes out of their guides. After tagging any leads disconnected (to assure correct reconnection) remove the end bell. With a mica undercutting tool, or an improvised tool fashioned from a hack saw blade (Fig. 21), carefully cut the mica between all of the commutator bars down to the 1/32 inch depth. Use care to avoid scratching the surface. Remove any burrs which may be formed along the edges of the bars, and clean all spaces between bars completely free of any metallic particles, Fig. 22.

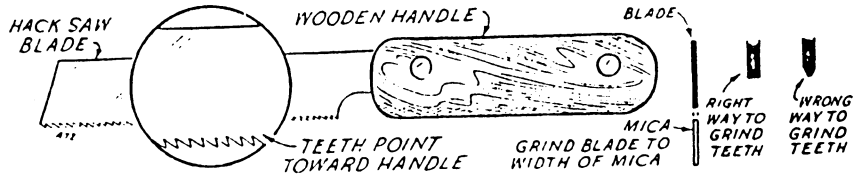


FIG. 21 - MICA UNDERCUTTING TOOL

If some unusual operating condition should cause the surface of the commutator or collector rings to become grooved, out of round, pitted, or rough, it will be necessary to remove the armature and turn the damaged commutator or collector rings in a lathe, to "true" the surface. Before centering the armature in the lathe, remove the ball bearing to prevent getting any dirt into it. After turning smooth, be sure to undercut the commutator mica as previously described. When the armature is reinstalled, reduce the run-out at the bearing end as much as possible before installing the end bell.

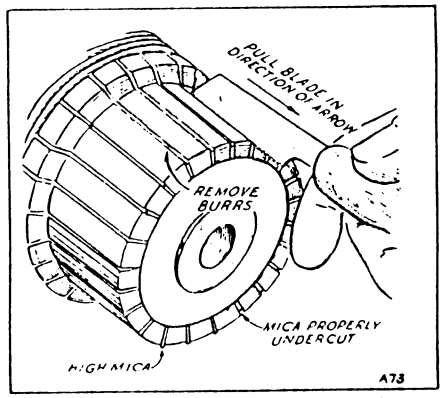


FIG. 22 - UNDERCUTTING MICA

BRUSH RIG. - It is unnecessary to loosen or remove the brush rig from the end bell for average generator servicing. However, if the brush rig has been loosened or removed for any reason, the brush rig must be returned to its exact original position. This original position was marked at the factory in the test run and must be maintained as long as the original brush rig and armature are continued in service. The position can be identified by a mark across the outer edge of the brush rig supporting ring, which mark must align with the marked support in the end bell (Fig. 8). Improper positioning of the brush rig will cause excessive arcing of the brushes, burning of the commutator, low generator output, and possible serious damage to the generator windings from over-heating.

GENERATOR WINDINGS TEST PROCEDURE

Some generator tests do not require complete disassembly of the generator, and can be performed with the use of a continuity type test lamp set. Other tests require extensive generator disassembly and the use of an armature growler or other equipment usually found only in an electrical repair shop.

NOTE:

Individual coils of the field coil set can be installed. Full instructions for installation are included with replacement coils, and must be carefully followed. Proper installation of individual coils can best be done by a qualified service shop.

It is seldom practicable to make internal repairs of generator windings. However, an external lead wire can be repaired as necessary.

FIELD COIL TESTS

To test the field coils for an open circuit or a grounded circuit, use a test lamp set. As each lead wire is disconnected, tag it and its connection point, to assure correct reconnection.

If the plant is an electric cranking model which uses the generator as a cranking motor, the field coils are wound with two separate windings to each coil. The series (cranking) winding is of very heavy wire and its leads, marked S1 and F+, are easily identified. The shunt field leads are marked F- and F+. Temporarily connect the two F+ leads together, for test purposes. Manual cranking models have only the F- and F+ shunt field leads.

OPEN CIRCUIT TEST. - To test for an open circuit, connect one test lamp lead to the F+ coil terminals, and the other test lamp lead to the F - coil lead. If the test lamp fails to light, an open circuit in the shunt winding is indicated. Repeat the test, between the S1 and F+ terminals. If the test lamp fails to light an open circuit in the cranking winding is indicated.

If an indicated open circuit can not be isolated in an external lead, or in a loose terminal, a more thorough test of individual coils will be necessary. Consult a qualified service shop.

GROUNDED CIRCUIT TEST. - To test the field windings for a grounded circuit, connect one test lamp lead to a bare metal part of the generator frame. Connect the other test lead to the coil terminals F+. If the test lamp lights, a grounded circuit is indicated. If inspection locates the ground in an external lead, repair as necessary. To locate a grounded coil, remove the screws mounting one of the pole shoes to the generator frame. Push the pole shoe and coil away from contact with the frame. If the ground is thus eliminated (test light goes out), the ground has been isolated at the loosened coil. Repeat as necessary until the grounded coil is located. Usually, the grounded point of the coil can be easily identified and the insulation repaired at the point of damage.

SHORT CIRCUIT TEST. - A short circuit test requires the use of special equipment and testing of individual coils. A sensitive ohmmeter can be used to test the resistance of each coil winding. If one coil winding shows an ohmmeter reading of more than 10% LESS than the average reading of the other three coils, that coil is short circuited. On electric cranking models, care must be taken not to confuse the cranking winding with the shunt winding.

ARMATURE TESTS

The armature is wound with two separate windings, dc and ac. The dc winding produces direct current for exciting the field, and for charging the starting batteries on the electric cranking models. The ac winding produces the alternating current output of the generator. Replace a defective armature with a new one.

GROUNDED CIRCUIT TEST. - Use a test lamp set to test both armature windings for a grounded circuit. Connect one test lamp lead to a bare metal point on the armature shaft. Contact the other test lead to the commutator surface. If the test lamp glows, the dc portion of the armature is grounded. Repeat the test, contacting the collector rings. If the test lamp glows, the ac portion of the armature is grounded. Replace a grounded armature with a new one.

AC WINDING, OPEN CIRCUIT TEST. - Use a test lamp set to test the ac winding for an open circuit. If the generator is the 120/240 volt, single phase model there are TWO ac windings. Contact the test lamp leads to the two collector rings nearest the ball bearing. If the test lamp fails to light, an open circuit in that winding is indicated. Repeat the test in the same manner, contacting the two collector rings nearest the commutator. If the test is made between the two middle collector rings, the test lamp should not glow - if it does, a short circuit between the two windings is indicated.

AC WINDING, SHORT CIRCUIT TEST. - An armature growler is required for making an ac winding short circuit test. Follow the test procedure recommended by the growler manufacturer.

DC WINDING, OPEN OR SHORT CIRCUIT TEST. - An armature growler is required to make a satisfactory test. Follow the test procedure recommended by the growler manufacturer.

SHORT BETWEEN AC AND DC WINDINGS. - Place one test prod on the commutator, and the second test prod on one of the slip rings. If the test light glows, a short circuit between the ac and dc windings is indicated.

CONTROL BOX EQUIPMENT

The control box equipment requires no maintenance other than keeping it dry, free of dust, and all connections electrically tight. If any of the control box equipment fails to function properly, replace the defective part with a corresponding new part. Repairs or adjustments on such parts are seldom practicable.

Always disconnect the starting battery before working on any control box equipment. Tag or otherwise mark each lead and its connection point before disconnecting it, to assure correct reconnection. Check carefully for loose or broken connections, or for damaged insulation.

SYMPTOM POSSIBLE CAUSE	REMEDY
ENGINE CRANKS TOO STIFFLY	
Too heavy oil in crankcase.	Drain. Refill with light oil. See PREPARATION.
Engine stuck.	Disassemble and repair.
ENGINE CRANKS TOO SLOWLY WHEN CRANKED ELECTRICALLY	
Discharged or defective battery.	Recharge or replace.
Loose connections.	Tighten loose connections.
Corroded battery terminals.	Clean corroded terminals. Replace cable if necessary.
Brushes worn excessively or making poor contact.	Replace brushes or clean commutator.
Short circuit in generator load circuit.	Repair or replace parts necessary. Disconnect load.
Dirty or corroded points in start solenoid switch.	Replace switch.
ENGINE WILL NOT START WHEN CRANKED	
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condenser, etc., or retime ignition.
Lack of fuel or faulty carburetion.	Refill the tank. Check the fuel system. Clean, adjust, or replace parts necessary.
Cylinders flooded.	Ground spark plug cables. crank engine with spark plugs removed.
Poor fuel.	Drain. Refill with good fuel.
Poor compression.	Tighten cylinder heads and spark plugs. If still not corrected, grind the valves. Replace piston rings if necessary.
Stop circuit closed.	Check switch.

SYMPTOM

POSSIBLE CAUSE	REMEDY
ENGINE WILL NOT START WHEN CRANKED (Cont.)	
Wrong ignition timing.	Reset breaker points or retime ignition. See IGNITION TIMING.
ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP	
Poor brush contact.	See that brushes seat well on commutator and collector rings, are free in holders, are not worn shorter than 1/2 inch, and have good spring tension.
Open circuit, short circuit, or ground in generator.	Refer to the GENERATOR section of Maintenance.
VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING	
Speed too low.	Adjust governor to correct speed.
Poor commutation or brush contact.	Refinish commutator or undercut mica if necessary. See that brushes seat well on commutator and collector rings, are free in holders, are not worn shorter than 1/2 inch, and have good spring tension.
Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load condition causing trouble.
GENERATOR OVERHEATING	
Short in load circuit.	Correct short circuit.
Generator overloaded.	Reduce the load.
Improper brush rig position.	Refer to the GENERATOR section of MAINTENANCE - See Brush Rig.

SYMPTOM

POSSIBLE CAUSE	REMEDY
ENGINE OVERHEATING	
Improper lubrication.	See Low Oil Pressure.
Poor ventilation.	Provide ample ventilation at all times.
Dirty or oily cooling surfaces.	Keep the engine clean.
Retarded ignition timing.	Retime ignition.
Generator overloaded.	Reduce load.
VOLTAGE DROPS UNDER HEAVY LOAD	
Engine lacks power.	See remedies under "Engine Misfires at Heavy Load".
Poor compression.	Tighten cylinder heads and spark plugs. If still not corrected, grind the valves. Replace piston rings if necessary.
Faulty carburetion.	Check the fuel system. Clean, adjust or repair as needed.
Dirty carburetor air cleaner.	Clean and Service.
Choke partially closed.	Choke plate must be wide open at operating temperature.
Carbon in cylinders or in carburetor venturi.	Remove carbon.
Restricted exhaust line.	Clean or increase the size.
Improper governor adjustment.	Refer to ADJUSTMENTS.
ENGINE MISFIRES AT LIGHT LOAD	
Carburetor idle jet clogged or improperly adjusted.	Clean or adjust.
Spark plug gaps too narrow.	Adjust to correct gap.

SYMPTOM

POSSIBLE CAUSE	REMEDY
ENGINE MISFIRES AT LIGHT LOAD (Cont.)	
Intake air leak.	Tighten manifold and carburetor mounting screws. Replace gaskets if necessary.
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condenser, etc.
ENGINE MISFIRES AT HEAVY LOAD	
Defective spark plug.	Replace.
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condensers, etc. or retime ignition.
Clogged carburetor.	Clean carburetor.
Clogged fuel screen.	Clean.
Defective spark plug cable.	Replace.
ENGINE MISFIRES AT ALL LOADS	
Fouled spark plug.	Clean and adjust.
Defective or wrong spark plug.	Replace.
Leaking valves.	See VALVE SERVICE.
Broken valve spring.	Replace.
Defective or improperly adjusted breaker points.	Adjust or replace breaker points.
LOW OIL PRESSURE	
Oil too light or badly diluted.	Drain, refill with proper oil.
Leaking fuel pump dilutes oil.	Repair or replace fuel pump.
Oil too low.	Add oil.
Oil relief valve not seating.	Remove and clean, or replace.

SYMPTOM

POSSIBLE CAUSE	REMEDY
LOW OIL PRESSURE (Cont.)	
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.
ENGINE BACKFIRES	
Lean fuel mixture.	Clean carburetor. Adjust jets.
Clogged fuel filter.	Clean.
Air leak at intake manifold or carburetor flange.	Tighten mounting screws. Replace gaskets if necessary.
Poor fuel.	Refill with good, fresh fuel. See PREPARATION.
Spark advanced too far.	Reset breaker points or retime ignition.
Intake valve leaking.	Reseat or replace.
EXCESSIVE OIL CONSUMPTION, LIGH BLUE EXHAUST	
Poor compression. Usually due to worn piston, rings, or cylinders.	Refinish cylinders. Install oversize pistons and rings.
Oil too light or diluted.	Drain. Refill with proper oil.
Too large bearing clearance.	Replace bearings necessary.
Oil seal leaks.	Replace. Put grease between lips of double lip type.

SYMPTOM

POSSIBLE CAUSE	REMEDY
EXCESSIVE OIL CONSUMPTION, LIGHT BLUE EXHAUST (Cont.)	
Engine misfires.	Refer to "Engine Misfires At All Loads".
Faulty ignition.	Clean, adjust, or replace breaker points, spark plugs, condenser, etc., or retime the ignition.
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.	See that choke opens properly. Adjust jets properly. Adjust the float level.
Choke not fully open.	See that choke opens properly.
Dirty air cleaner.	Clean and service.
LIGHT POUNDING KNOCK	
Loose connecting rod.	Replace rod bearings.
Low oil supply.	Add oil. Change if necessary.
Oil badly diluted.	Drain. Refill with proper oil.
Low oil pressure.	See Low Oil Pressure for remedies.
ENGINE STOPS UNEXPECTEDLY	
Empty fuel tank.	Refill.
Defective ignition system.	Check the ignition system. Repair or replace as needed. See that the STOP button lead is not grounded.
Fuel pump failure.	Repair or replace.

SYMPTOM

POSSIBLE CAUSE	REMEDY
DULL METALLIC THUD, IF NOT BAD, MAY DISAPPEAR AFTER FEW MINUTES OF OPERATION. IF BAD, INCREASES WITH LOAD.	
Loose crankshaft bearing.	Replace, unless one of the next two remedies permanently corrects the trouble.
SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE FIRST STARTED.	
Low oil supply.	Add oil. Change if necessary.
Oil badly diluted.	Drain. Refill with proper oil.
PINGING SOUND WHEN ENGINE IS SUDDENLY OR HEAVILY LOADED.	
Carbon in cylinders.	Remove the carbon.
Spark advanced too far.	Reset breaker points or retime ignition.
Wrong spark plugs.	Install correct spark plugs.
Spark plugs burned or carboned.	Clean. Install new plugs if necessary.
Valves hot.	Adjust tappet clearance. See VALVE SERVICE.
Fuel stale or low octane.	Use good, fresh fuel. See PREPARATION.
Lean fuel mixture.	Clean fuel system. Adjust carburetor jets properly.
TAPPING SOUND	
Valve clearance too great.	Adjust to proper clearance. See VALVE TAPPETS.
Broken valve spring.	

POSSIBLE CAUSE	REMEDY
SYMPTOM	
HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD	
Loose piston.	If noise is only slight and disappears when engine warms up, no immediate attention needed. Otherwise replace parts necessary.
SHARP CLICK WHEN CRANKING ENGINE	
Magneto impulse coupling.	Normal condition - should stop as soon as engine starts.
VOLTAGE LOW AT FAR END OF LINE BUT NORMAL NEAR PLANT	
Too small line wire used 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 THE PLANT	
Too small line wire used 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 or reduce load until worn in.
Open circuit in armature.	Install a new armature.
Brush rig out of position.	Line up properly.

POSSIBLE CAUSE	REMEDY
SYMPTOM	
SPARK PLUGS FOUL UP RAPIDLY	
Engine running "cold".	Restrict air flow. Install preheater hose.
Wrong plugs.	Replace with correct plugs.
Carburetor too "rich".	Adjust.
OIL DILUTION	
One spark plug fouled.	Clean plugs.
Leaky carburetor valve.	Clean.
OIL SEAL LEAK	
Worn oil seals.	Replace.
Fouled breather valve.	Clean or replace.
Loose oil fill cap.	Tighten - replace if gasket is damaged.

PREPARING UNITS FOR STORAGE CR EXTENDED OUT-CF-SERVICE PERIODS.

Engines taken out of service for extended periods of time, in many cases are left to stand idle without being protected against possible damage from rust and corrosion or the elements. The factory recommends that any unit to be removed from service for 30 days or more be protected as follows:

1. Shut off the fuel supply at the tank and allow the unit to run until it stops from lack of fuel. The fuel system will then be free of gasoline except for the tank.

If the fuel tank will be subjected to temperature changes, fill the tank nearly full to lessen chances of condensation forming within the fuel tank.

2. Drain the oil from the oil base while the engine is warm. Replace the drain plug. See that the oil fill cap or plug is in place.

3. Remove each spark plug and pour two tablespoonfuls of rust inhibitor oil (Use SAE-50 motor oil as a substitute) into each cylinder. Crank the engine over slowly by hand to lubricate the cylinders. Stop the engine with the TC (top center) mark on the flywheel indicating at least one piston is at top center position. Replace the spark plugs.

4. Remove, clean and replace the air cleaner per instructions under Periodic Service.

5. Wipe all exposed parts clean and coat with a film of grease all such parts liable to rust.

6. Oil the governor to carburetor linkage with SAE 50 oil.

7. Plug the exhaust outlet with a wood plug to prevent entrance of moisture or foreign matter.

8. Clean the generator brushes, brush holders, commutator and collector rings by wiping with a clean cloth. Do not coat with lubricant or other preservatives.

9. Where batteries are likely to be exposed to freezing temperatures, they must be removed and stored where there is no danger of freezing. A fully charged battery can withstand very low temperatures but an idle battery gradually loses its charge and may become discharged to the point where it will freeze. An idle battery should be given a freshening charge about every 40 days.

If battery is not to be removed, disconnect the cables from the unit.

Arrange the cables so that the lugs cannot come in contact with each other or with metal parts.

10. Provide a suitable cover for the entire unit, particularly if it will be exposed to the elements.

RETURNING THE UNIT TO SERVICE

1. Remove all protective coatings of grease from external parts. Wipe the entire unit clean of accumulated dust or other foreign matter.

2. Inspect the unit carefully for damage and for other conditions requiring attention. Service as needed.

3. Remove the plug from the exhaust outlet.

4. Remove, clean and adjust spark plugs. While the plugs are out, crank the engine over several times by hand to distribute oil over the cylinder walls. If the cylinders are dry, put a tablespoonful of oil into each cylinder and crank the engine several turns by hand to distribute the oil. Replace the spark plugs and gaskets.

5. Examine all fuel and oil connections. Service as needed.

6. Refill the crankcase with the correct amount and grade of oil.

7. Lubricate governor linkage ball joint with powdered graphite.

8. Check carefully for leaks of fuel or oil after servicing the unit. Correct any leaks before starting the unit.

9. Connect the battery cables to unit. Carefully recheck to make sure the unit is ready for operation. Then start the unit in the regular manner as described under OPERATION.

PARTS CATALOG

The CW series generating plant models covered by this parts catalog have their SPEC NO. listed in the first column of the following chart.

The nameplate attached to the plant identifies the plant. Always furnish the MODEL and SPEC NO. and the SERIAL NUMBER with each inquiry.

Unless otherwise stated in the parts Description, parts are interchangeable between models. Optional parts shown apply only to special models.

To select parts which apply: (1) Determine the plant model as given on the nameplate; (2) Select part desired from the typical parts illustrations; (3) Refer to the list for that group and reference number; (4) Compare the description with the part you desire; (5) If you are not familiar with the optional equipment on your model, refer to the chart below for help.

Use this Chart as a guide in choosing applicable part numbers. OPTIONAL Equipment Applied, is checked (x) opposite the plant model SPEC NO. in the first column.

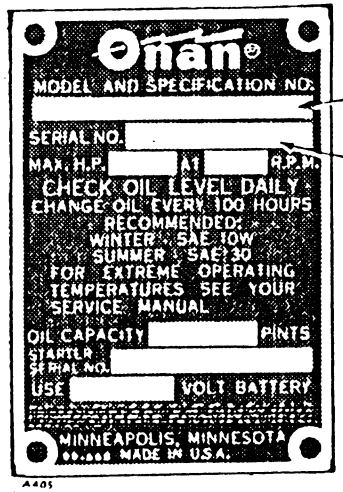
MODEL SPEC NO.	Stellite Intake Valve & Seat	Low Oil Pressure Cutoff Switch	Valve Rotators	Vertical Down Exhaust Outlet	Not Radio Noise Suppressed	Control Mounted on Left (#1 cyl) Side	Manual Choke (on electric start plant)	Zenith Mtr. Pressure-Carburetor & Vaporizer (for LPG fuel)	Comb. Gas-Gasoline Carburetor (downdraft)	Gas Only Carburetor (downdraft)	Garretson Gas Pressure Regulator
1	Specification number "1" is basic standard and has none of these options.										
96		X									
665						X					
980		X									
1329		X			X	X					
1338						X			X		X
1511		X		X	X	X	X				
1597		X		X	X	X				X	X
1615				X		X					
1689		X		X	X		X				
1725				X		X					
1775	X	X		X	X	X		X			
1776	X	X	X	X	X	X	X				
1813		X		X		X	X				
1819		X			X		X				
1824		X		X	X	X		X			
1837	X	X	X		X		X				
1841				X	X	X	X				
1850	X	X			X	X		X			
1970		X		X		X					
1991	X	X	X			X	X				
2148	X	X	X	X		X	X				
2203	X	X	X		X	X	X				
2206				X	X	X	X				
2217	Same as Spec 1776 except painted blue color.										
2428	X	X	X		X	X	X				
2537	X	X	X	X	X	X	X				

INSTRUCTIONS FOR ORDERING REPAIR PARTS

FOR PARTS OR SERVICE, CONTACT THE DEALER FROM WHOM YOU PURCHASED THIS EQUIPMENT OR REFER TO YOUR NEAREST AUTHORIZED SERVICE STATION.

TO AVOID ERRORS OR DELAY IN FILLING YOUR PARTS ORDER, PLEASE FURNISH ALL INFORMATION REQUESTED.

REFER TO THE ENGINE NAMEPLATE.



1. Always give the
   - MODEL AND
   - SPECIFICATION NO.
   - SERIAL NO.
2. State definite shipping instructions.
3. Give the part number, description and quantity needed of each item. Do not order by reference number or group number! If an old part cannot be identified, return the part prepaid to your dealer or nearest AUTHORIZED SERVICE STATION. Print your name and address plainly on the package. Write a letter to the same address stating the reason for returning the part.

Any claim for loss or damage to your unit in transit should be filed promptly against the transportation company making the delivery. Shipments are complete unless the packing list indicates items are backordered.

"Prices are purposely omitted from this Parts Catalog due to the confusion resulting from fluctuating costs, import duties, sales taxes, exchange rates, etc.

For Current parts prices, consult your ONAN Dealer, Distributor or Parts and Service Center."

"En esta lista de partes los precios se omiten de proposito, ya que bastante confusion resulto de fluctuaciones de los precios, derechos aduanales, impuestos de venta, cambios extranjeros etc.

Consiga los precios vigentes de su distribuidor de productos "ONAN".

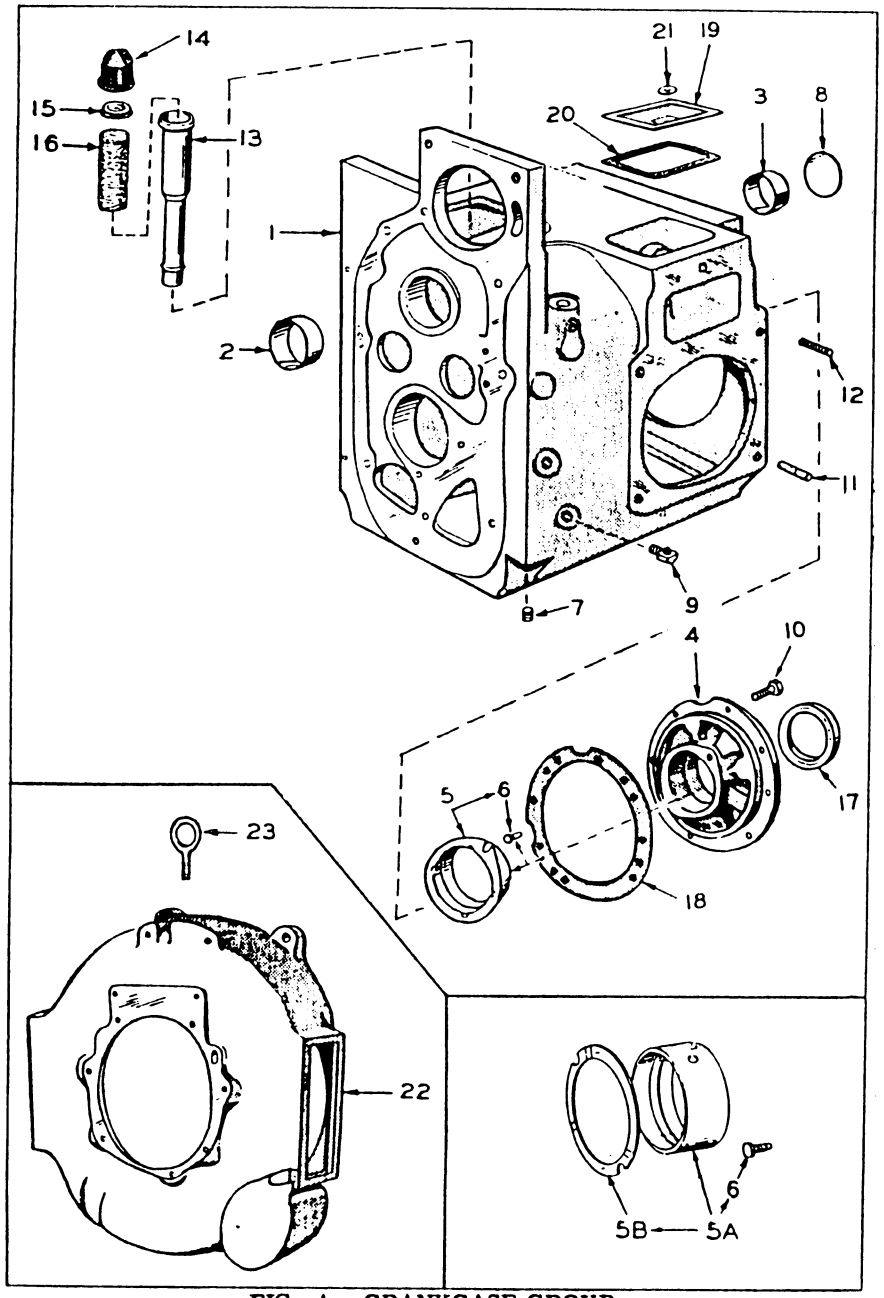


FIG. A - CRANKCASE GROUP

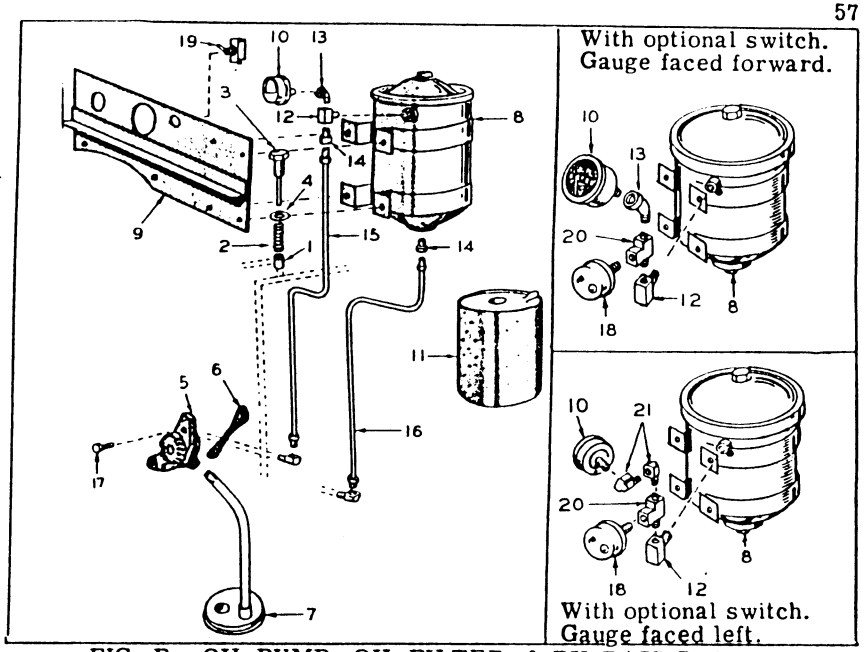


FIG. B - OIL PUMP, OIL FILTER, & BY-PASS GROUP

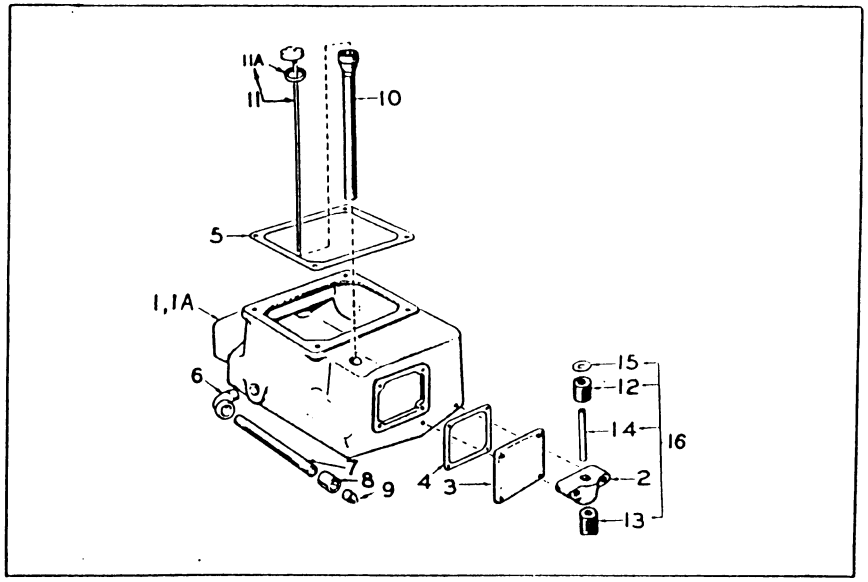


FIG. C - OIL BASE GROUP

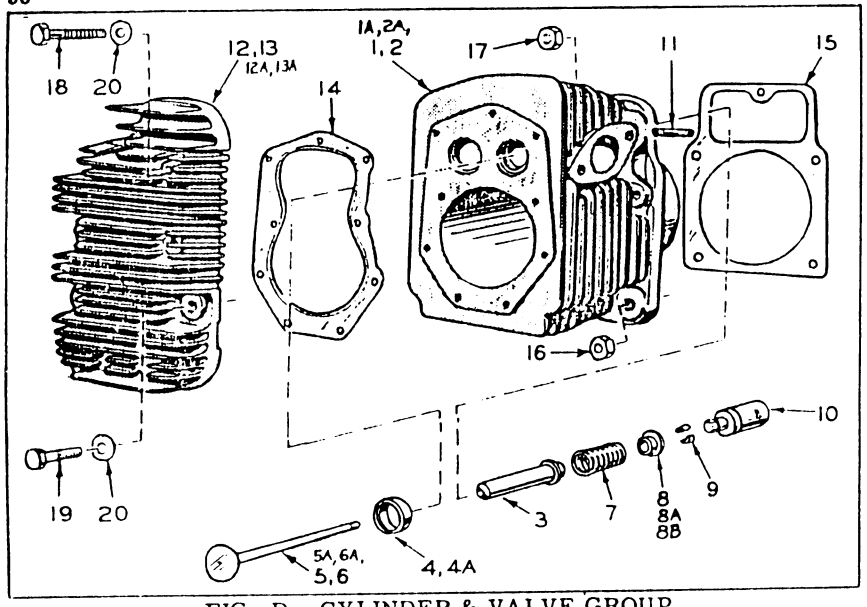


FIG. D - CYLINDER & VALVE GROUP

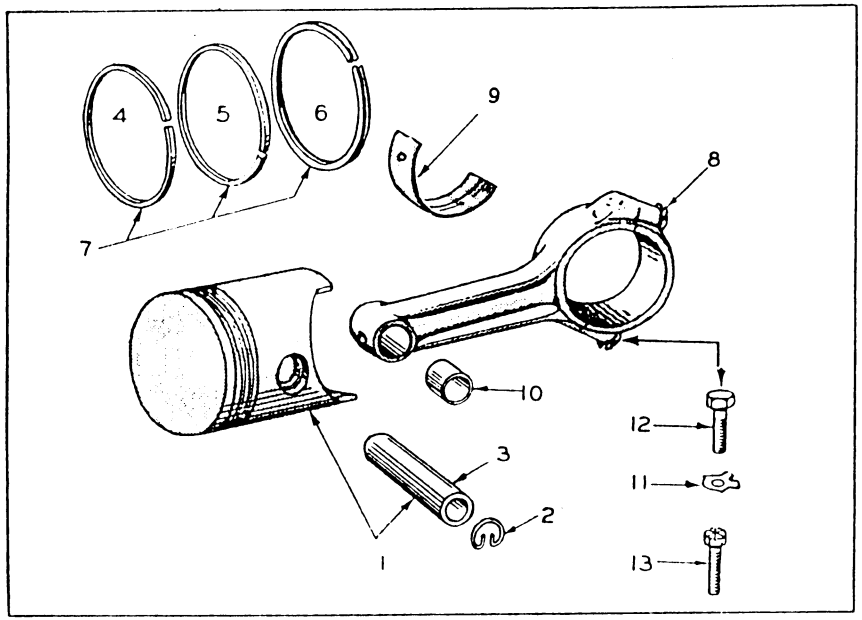


FIG. E - CONNECTING ROD & PISTON GROUP

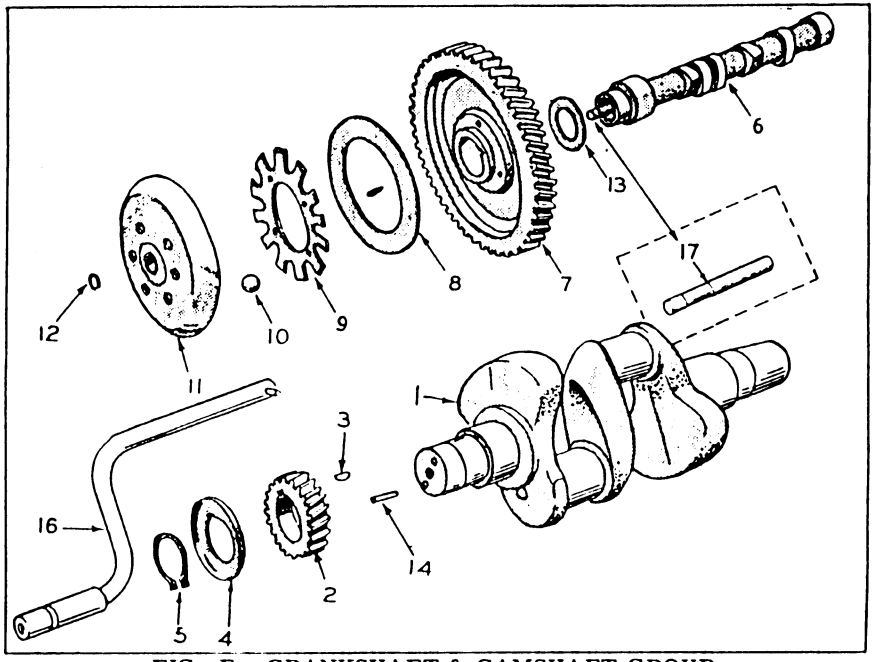


FIG. F - CRANKSHAFT & CAMSHAFT GROUP

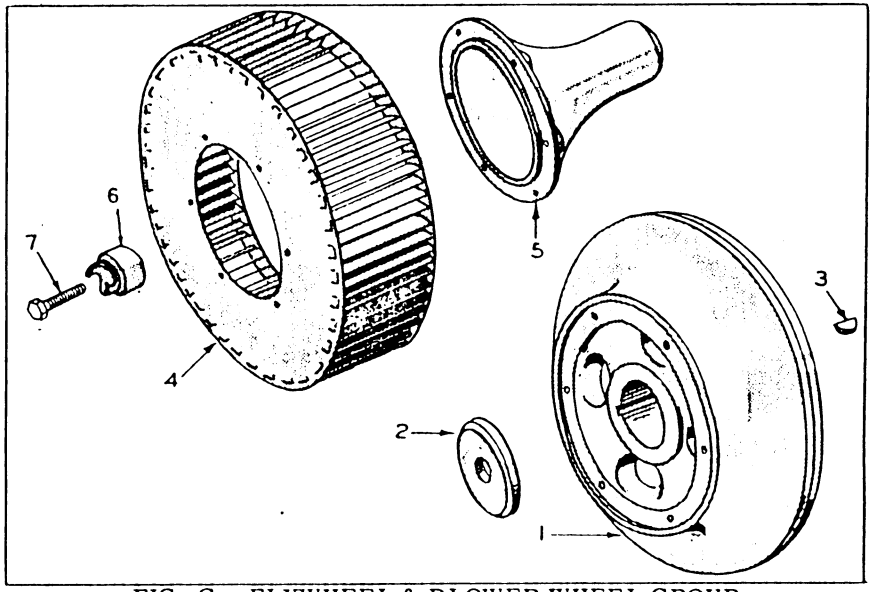


FIG. G - FLYWHEEL & BLOWER WHEEL GROUP

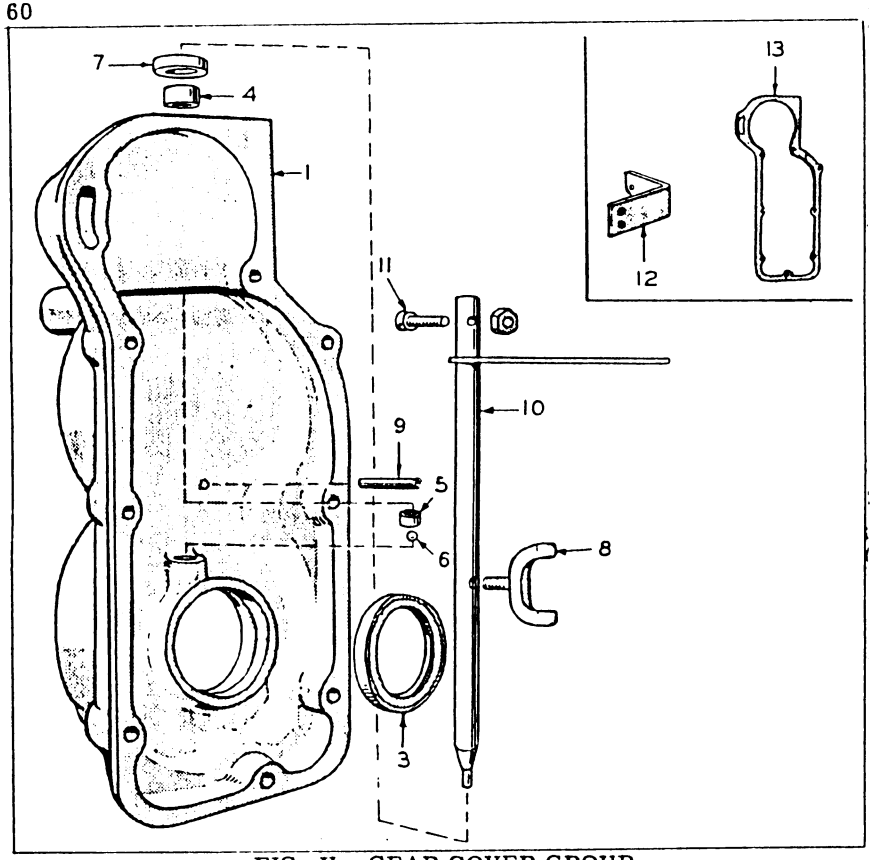


FIG. H - GEAR COVER GROUP

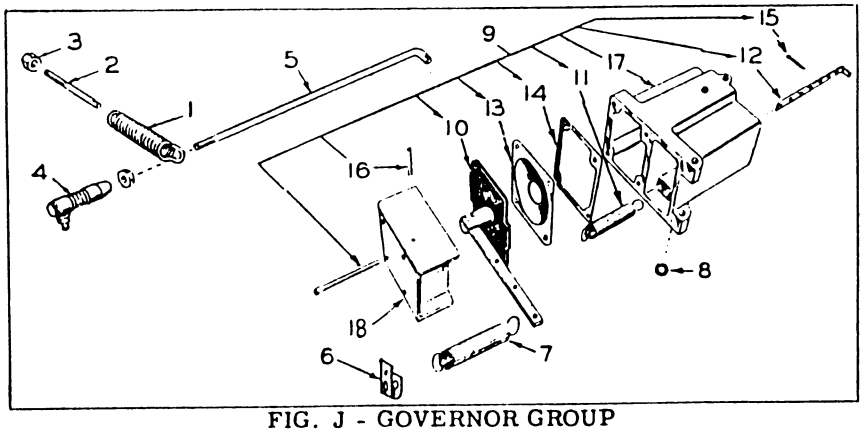


FIG. J - GOVERNOR GROUP

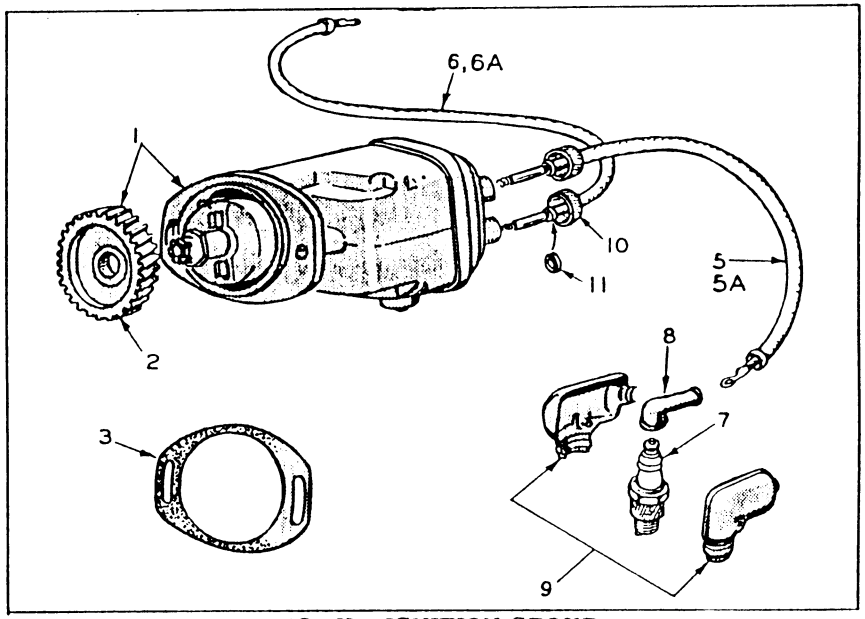


FIG. K - IGNITION GROUP

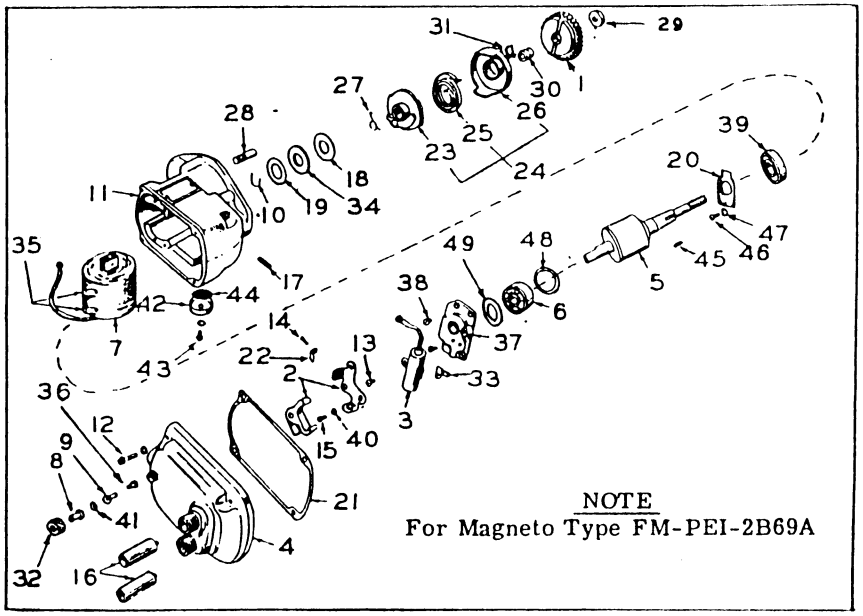


FIG. L - MAGNETO PARTS GROUP

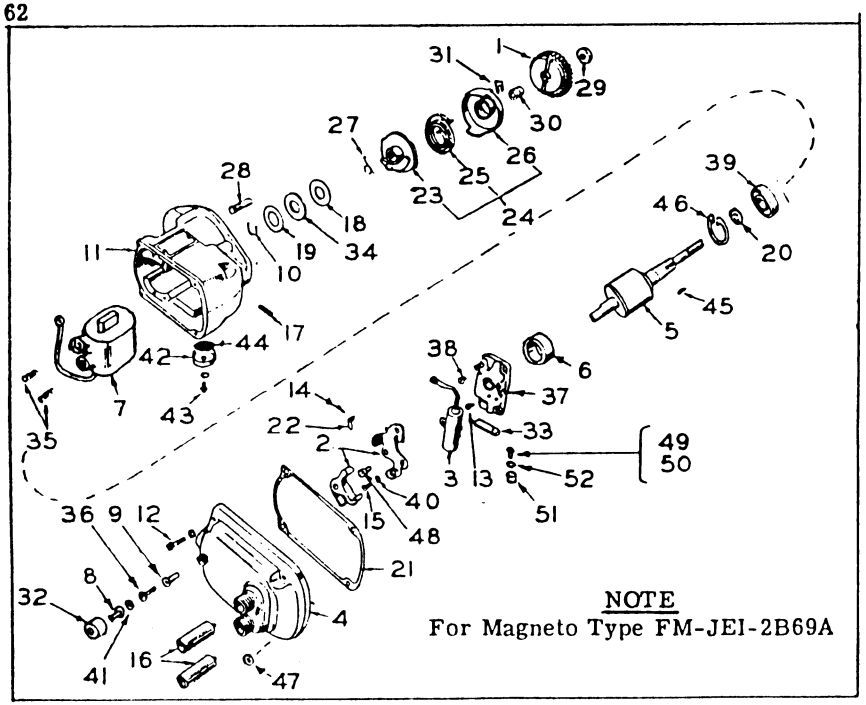


FIG. M - MAGNETO PARTS GROUP

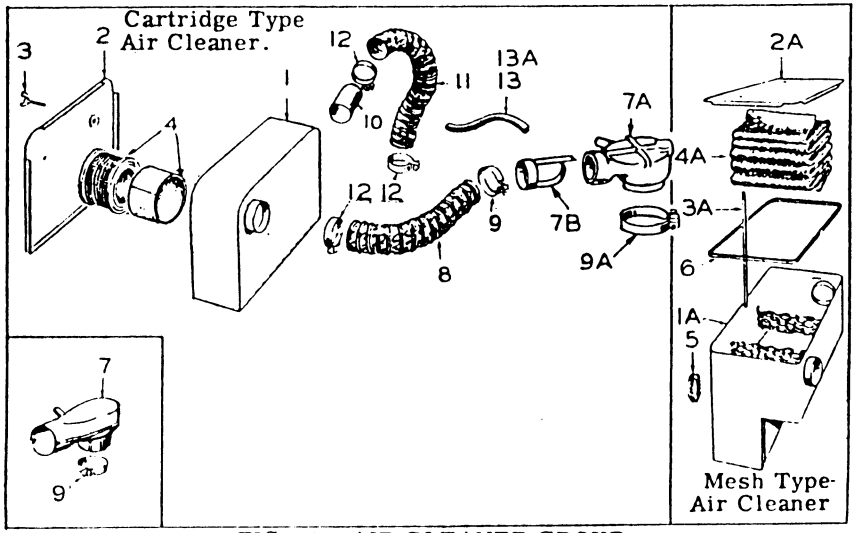


FIG. N - AIR CLEANER GROUP

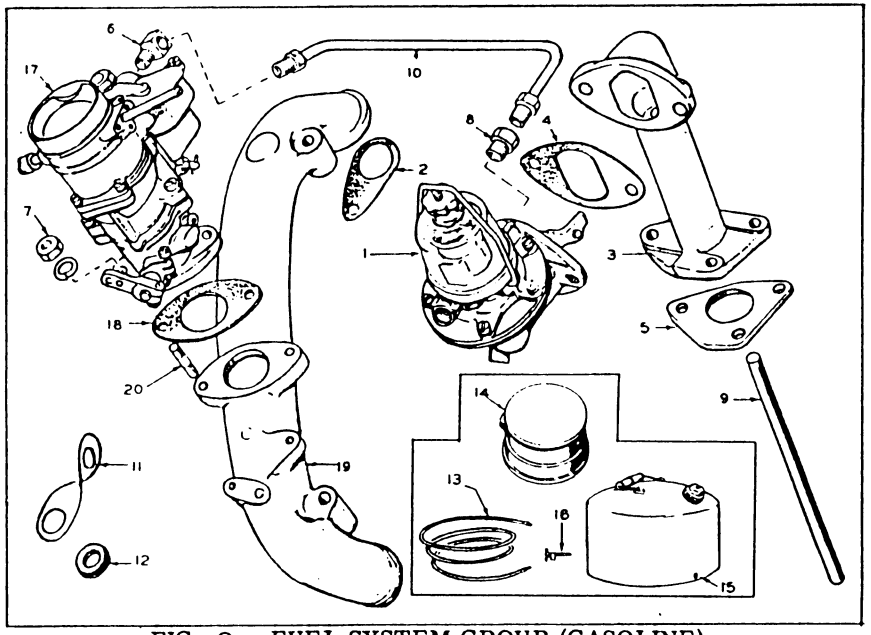


FIG. O - FUEL SYSTEM GROUP (GASOLINE)

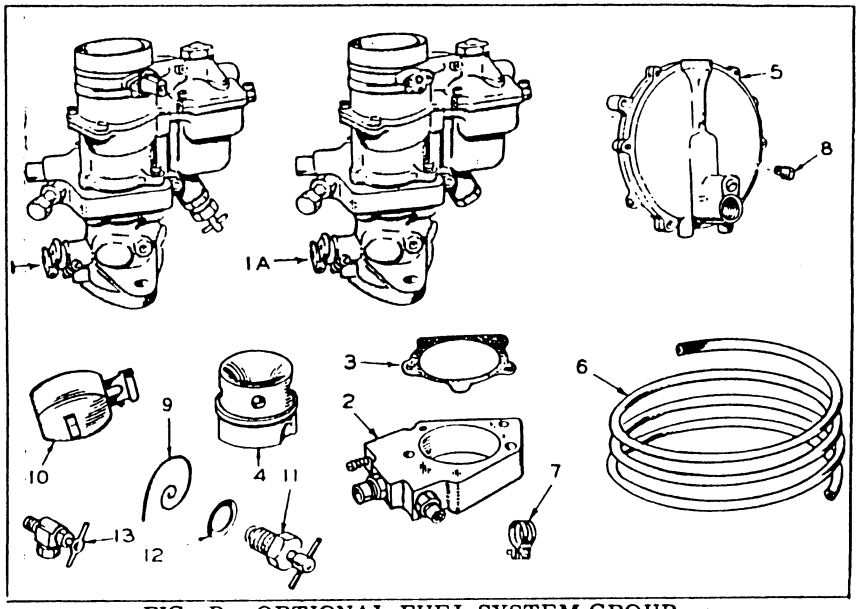


FIG. P - OPTIONAL FUEL SYSTEM GROUP -
(Combination GAS-GASOLINE or GAS Only, Downdraft Carburetor)

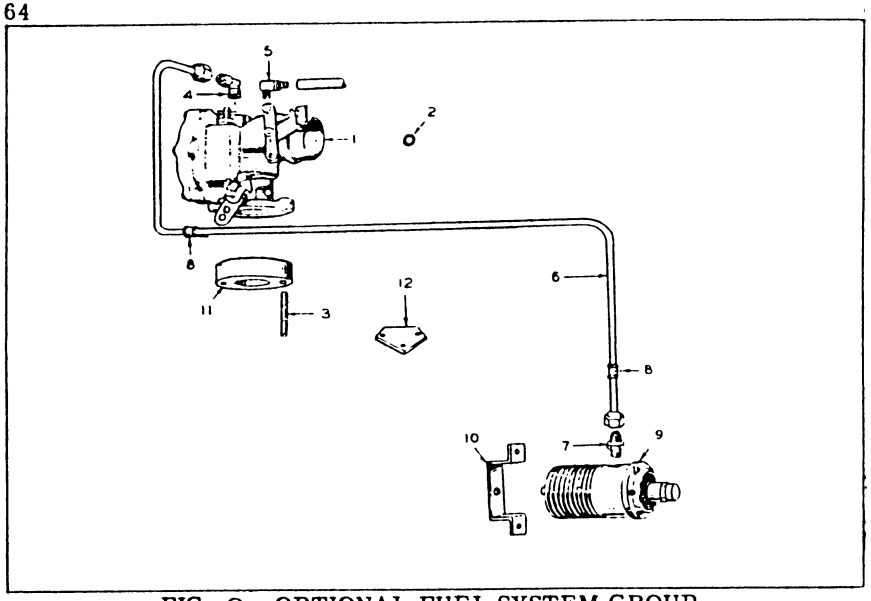


FIG. Q - OPTIONAL FUEL SYSTEM GROUP -
(Zenith Mfr. LPG Pressure-Carburetor)

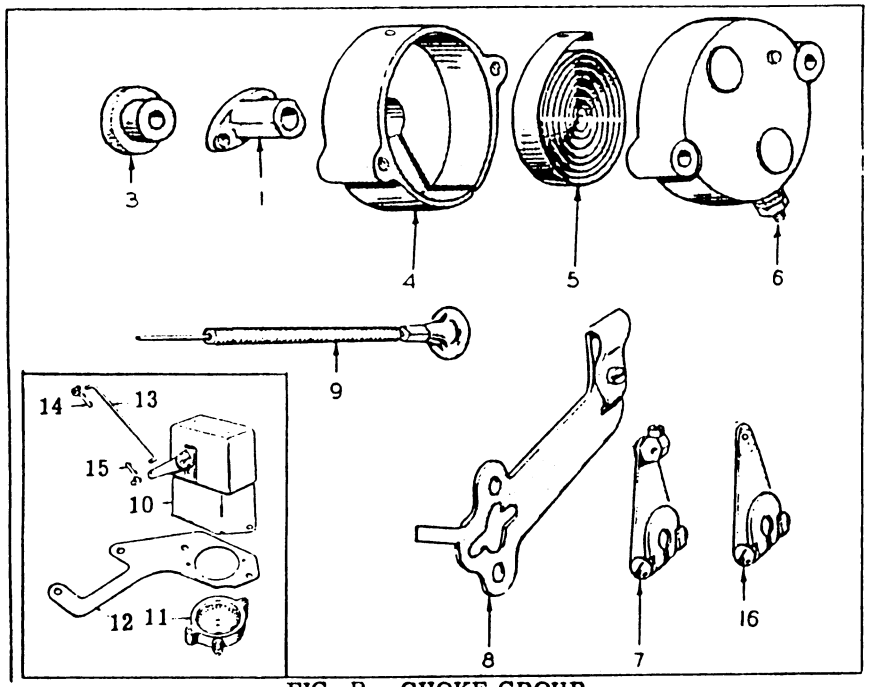


FIG. R - CHOKE GROUP

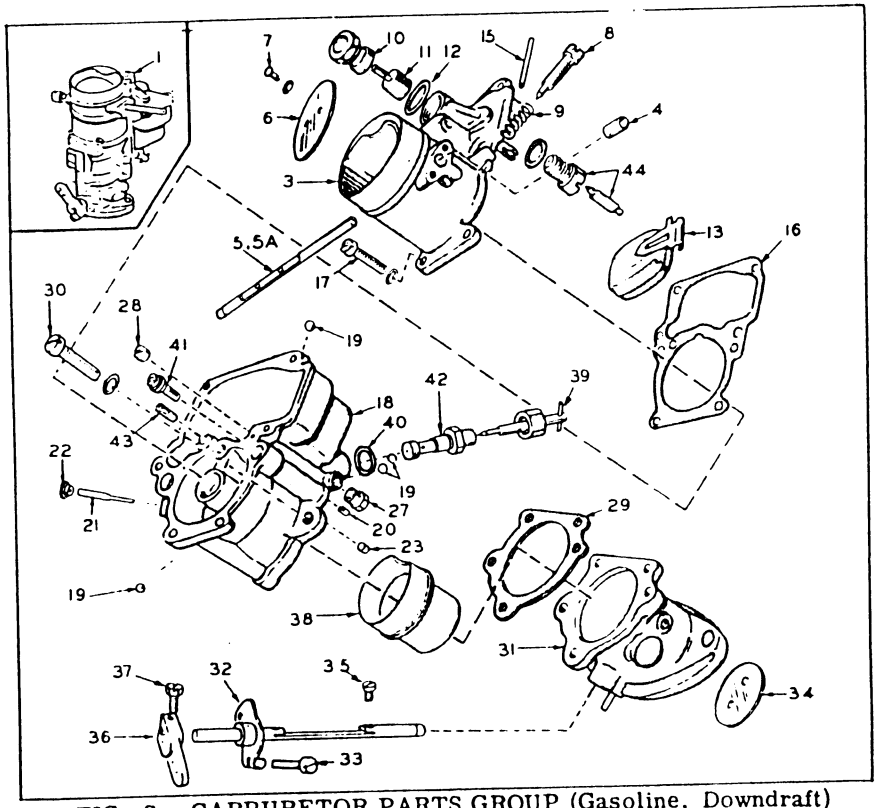


FIG. S - CARBURETOR PARTS GROUP (Gasoline, Downdraft)

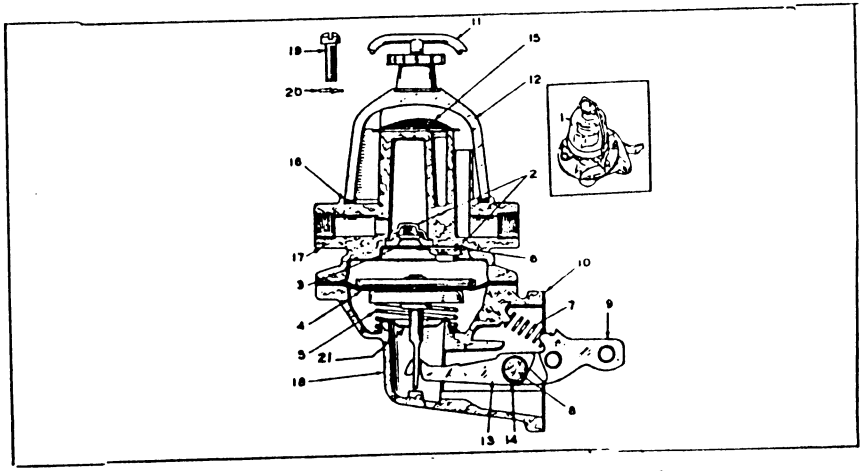


FIG. T - FUEL PUMP PARTS GROUP

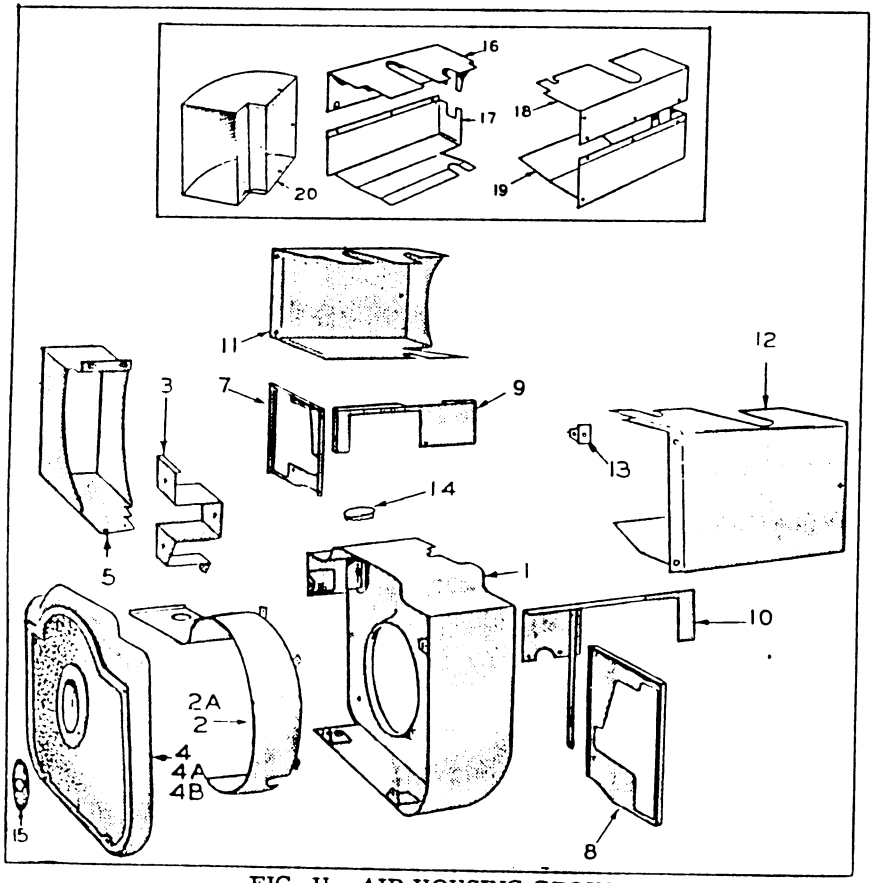


FIG. U - AIR HOUSING GROUP

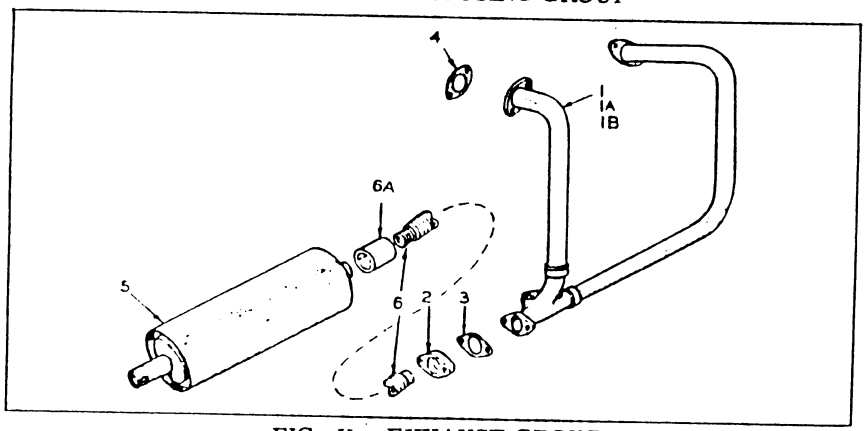


FIG. V - EXHAUST GROUP

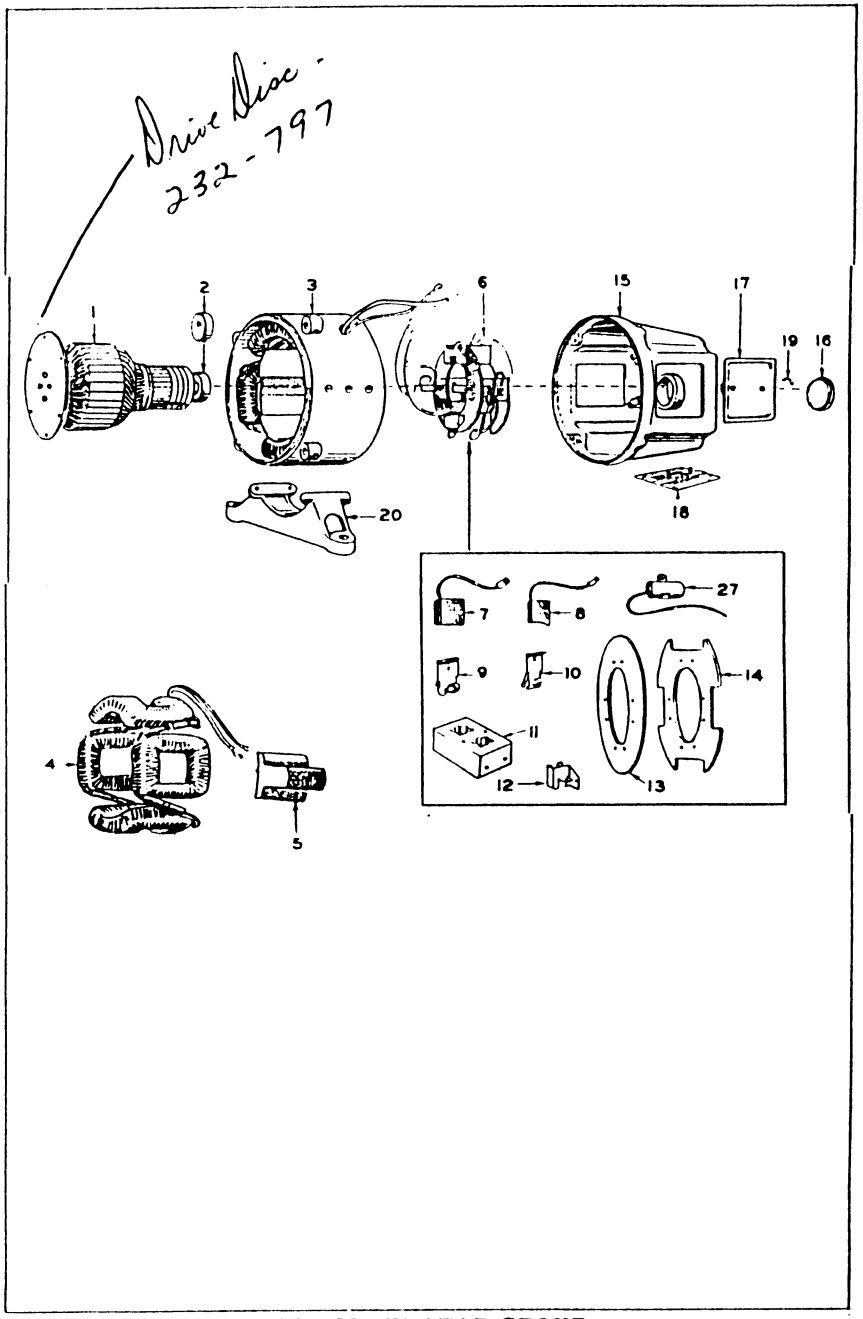
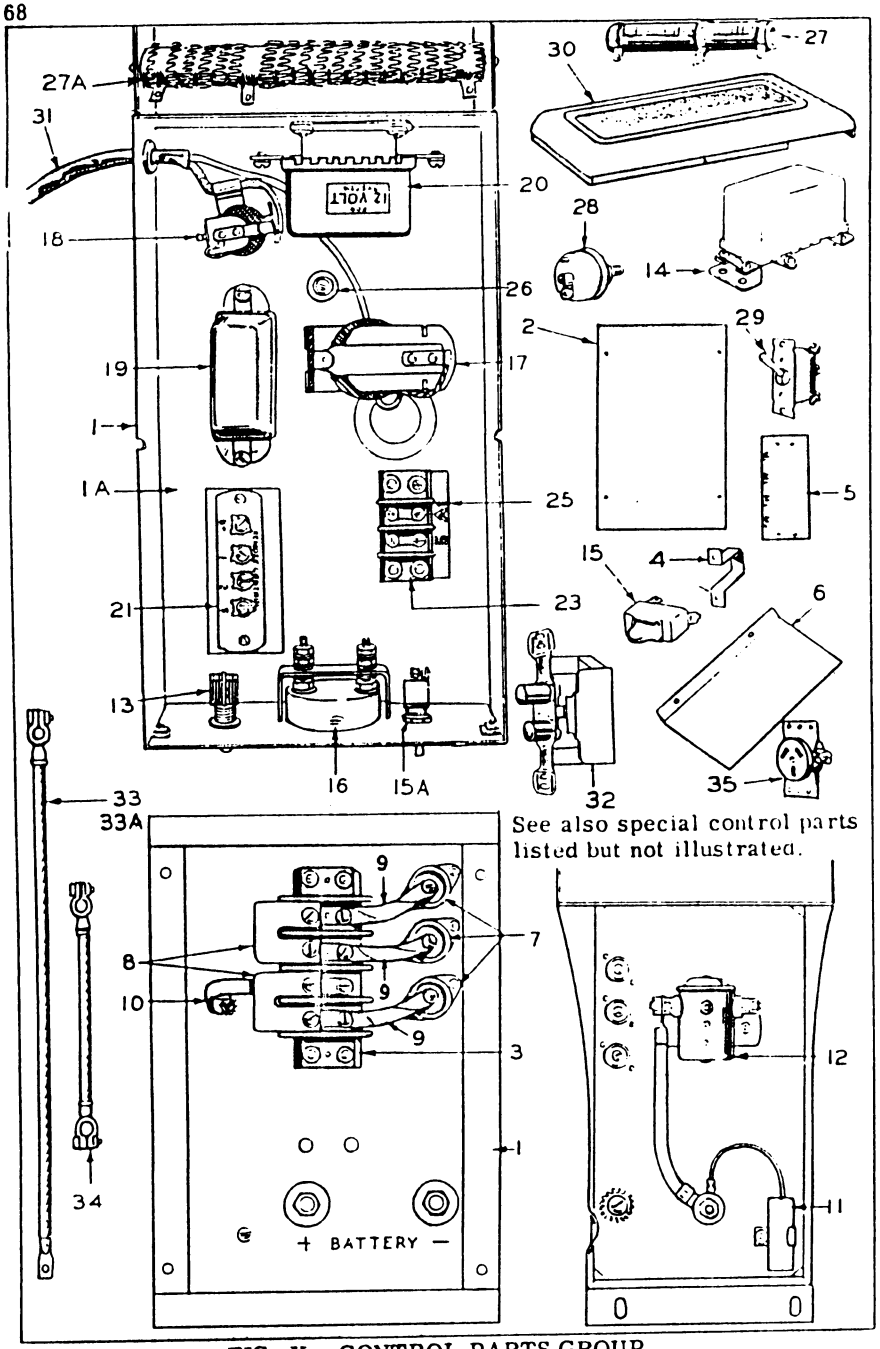


FIG. W - GENERATOR GROUP



See also special control parts listed but not illustrated.

FIG. X - CONTROL PARTS GROUP

Ref. No.	Part No.	Quant.	Description
			FIG. A - CRANKCASE GROUP
1	101A236	1	Crankcase, Replacement - Includes Camshaft Bearings, Main Bearings, Rear Bearing Plate - Less Studs, Oil Seal.
2	101A70	1	Bearing, Camshaft - Front.
3	101A50	1	Bearing, Camshaft - Rear.
4	101C268	1	Plate, Rear Main Bearing - Less Bearing and Lock Pin.
5		2	Bearing Kit, Main - Front or Rear - Used Prior to Spec J - See Ref. No. 5A.
5A	101K341	2	Bearing Kit, Main - Front or Rear - Includes Thrust Washer and Lock Pins - Precision Type - "Bronze Faced" - Specify: Std. or .002", .010", .020" .030" Undersize - original equpment beginning with Spec J models. Replaces Aluminum Flanged Bearing Kit 101K220 used on earlier models.
5B	104B432	2	Washer, Crankshaft Thrust - Part of Bearing Kit 101K341 - Begin Spec J.
6	516A72	As Req.	Pin, Lock - 2 used with Flanged Main Bearing or 4 used with Separate Thrust Washers.
7	505-274	4	Plug, Pipe - Countersunk Head.
8	517-48	1	Plug, Fxpansion - Rear Camshaft Bearing Opening.
9	502-2	2	Elbow, Inverted Flare - Oil Filter Lines.
10	805-18	8	Bolt, Place - Rear Bearing Plate - 3/8" x 1".
11	520A431	8	Stud, Cylinder Base - 1/2" x 2-5/16".
12	520A434	2	Stud, Cylinder Base - 3/8" x 1-13/16".
13	123A445	1	Tube, Breather.
14	123A458	1	Cap, Breather Tube.
15	123A315	1	Valve, Breather.
16	123-452	1	Filter, Breather Tube.
17	509P64	1	Seal, Oil - Crankshaft Rear.
18	101K116	1	Gasket Kit - Rear Bearing Plate - Assorted Thickness.
19	110B640	2	Cover, Valve Box.
20	110A647	2	Gasket, Valve Cover.
21	526-63	2	Washer - Copper - 1/4" - Valve Cover Screw.
22	101E222	1	Housing, Flywheel.
23	403A95	1	Bolt, Eye - Lifting.

Ref. No.	Part No.	Quant.	Description
			FIG. B - OIL PUMP, OIL FILTER & BY-PASS GROUP
1	120A222	1	Piston, Valve - Oil By-Pass.
2	120A221	1	Spring, Oil By-Pass.
3	120A224	1	Screw, Oil By-Pass.
4	526-153	1	Washer, Copper - Oil By-Pass.
5	120A279	1	Pump, Oil.
6	120K161	1	Gasket Kit, Oil Pump.
7	120B275	1	Cup, Intake - Oil Pump.
8	122C56	1	Filter, Oil - Includes Cartridge.
9	122C122	1	Bracket, Oil Filter - (Replaces 122C120).
10	193P6	1	Gauge, Oil Pressure.
11	122-37	1	Cartridge, Oil Filter.
12	502-57	1	Tee, Oil Filter Inlet.
13	505-52	1	Elbow, Oil Pressure Gauge - 1/8 iron pipe x 45°.
14	502-3	2	Connector, Inverted Flare - Oil Line to Filter.
15	122B94	1	Line, Oil - Filter Inlet.
16	122B95	1	Line, Oil - Filter Outlet.
17	120A182	1	Screw, Shoulder - Oil Pump Mounting.
18	309B10	1	Switch, Cutoff - Low Oil Pressure - (Optional) - Listed also in Control Group.
19	308-97	1	Switch, Momentary Contact - Used with Optional Cutoff Switch - Replaces 308P37 - Listed also in Control Group.
20	502-58	1	Tee, Special Brass Pipe - Used with Optional Cutoff Switch.
21	502-20	2	Elbow, Street - Brass - 1/8 x 90° - Two used to mount Oil Gauge optionally facing left.
			FIG. C - OIL BASE GROUP
1	102E262	1	Base, Oil
1A	102E465	1	Base, Oil - Spec 2428 only.
2	102B271	2	Foot, Oil Base.
3	102A221	1	Cover, Oil Base Opening.
4	102A222	1	Gasket, Oil Base Opening Cover.
5	102B215	1	Gasket, Oil Base to Crankcase.
6	505-51	1	Elbow, Street - Oil Base Drain - 3/4 x 90°.
7	505-268	1	Pipe, Oil Drain - 3/4 x 9" - (Accessory).
8	505-29	1	Coupling, Drain Pipe - 3/4" - (Accessory).
9	505-130	As Req.	Plug, Oil Drain.
10	123A437	1	Tube, Oil Fill.

Ref. No.	Part No.	Quant.	Description
			FIG. C - OIL BASE GROUP (Cont.)
11	123A439	1	Indicator, Oil Level.
11A	123A191	1	Gasket, Oil Level Indicator.
12	402A36	4	Cushion, Mounting - Upper.
13	402A38	4	Cushion, Mounting - Lower.
14	402A46	4	Bushing, Cushion Spacer.
15	526A124	8	Washer, Mounting Cushion.
16			Mounting Assembly - Includes Ref. Nos. 12, 13, 14, 15 Plus Hardware.
	402A103	4	- With 6" long Bolt.
	402A219	4	- With 8" long Bolt - (Optional).
			FIG. D - CYLINDER & VALVE GROUP
			NOTE: The letter "S" appears on the Stellite Valve Head.
1,1A,2,2A		1	Block, Cylinder - Includes Valve Guides and Exhaust Valve Seat Insert - Less Valves etc.
1	110C757	1	Left Hand (When facing blower end).
1A	110C1201	1	Left Hand (When facing blower end) - Includes also Intake Valve Seat Insert - Used with Stellite Intake Valve - (Optional).
2	110C756	1	Right Hand (When facing blower end).
2A	110C1200	1	Right Hand (When facing blower end) - Includes also Intake Valve Seat Insert - Used with Stellite Intake Valve - (Optional).
3	110B644	4	Guide, Valve.
4	110A646	2	Insert, Exhaust Valve Seat - Stellite - Specify: Std. or .002", .005", .010" or 025" Oversize.
4A	110A1191	2	Insert, Intake Valve Seat - Stellite - Used with Stellite Intake Valve - (Optional).
5	110B642	2	Valve, Exhaust - Stellite - Groove is 0.355 to 0.365 inch from end of stem.
5A	110B1195	2	*Valve, Exhaust - Stellite - Rotator Type - (Optional)
6	110B643	2	Valve, Intake - Groove is 0.355 to 0.365 inch from end of stem.
6A	110B1193	2	*Valve, Intake - Stellite - Used in Cylinder Block with optional Intake Valve Seat Insert - (Optional).
7	110A738	4	Spring, Valve.

* - The optional Stellite Valve has its groove located 1/4 inch from end of stem to accommodate optional Rotocap valve rotators and not change spring tension. If the Rotocap is not used on this valve, the optional 110A1204 Spring Retainer (13/64" thick at O.D.) is required for proper spring tension.

ef. No.	Part No.	Quant.	Description
			FIG. D - CYLINDER & VALVE GROUP (Cont.)
	110A648	4	Retainer, Valve Spring - Used with Valves 110B642 and 110B643.
A	110A1204	4	*Retainer, Valve Spring - Used with Valves 110B1193 or 110B1195 - (Optional).
B	110A620	4	*Rotocap, Valve - Used with Valves 110B1193 or 110B1195 - (Optional).
	110A639	8	Lock, Valve Spring Retainer.
0	115A34	4	Tappet, Valve - Includes Adjusting Nut.
1	520A11	4	Stud, Exhaust Manifold.
2	110D638	1	Head, Cylinder - Left Hand (When facing blower end) - Standard compression - Used with Gasoline Fuel.
2A	110D749	1	Head, Cylinder - Left Hand (When facing blower end) - High Compression - Used only with Gas Fuel - (Optional).
13	110D637	1	Head, Cylinder - Right Hand (When facing blower end) - Standard Compression - Used with Gasoline Fuel.
13A	110D748	1	Head, Cylinder - Right Hand (When facing blower end) - High Compression - Used only with Gas Fuel - (Optional).
14	110B641	2	Gasket, Cylinder Head - Right or Left.
15	110B645	2	Gasket, Cylinder Base - Right or Left.
16	110A707	8	Nut, Cylinder Base Mounting - 1/2"-20 - Hardened.
17	104A91	2	Nut, Cylinder Base Mounting - 3/8"-24 - Hardened.
18	110A815	10	Screw, Hex Head - 3/8"-24 x 2" - Hardened - Cylinder Head Mounting.
19	110A814	8	Screw, Hex Head - 3/8"-24 x 1-1/2 - Hardened - Cylinder Head Mounting.
20	526A127	18	Washer, Cylinder Head Mounting.

* - The optional Stellite Valve has its groove located 1/4 inch from end of stem to accommodate optional Rotocap valve rotators and not change spring tension. If the Rotocap is not used on this valve, the optional 110A1204 Spring Retainer (13/64" thick at O.D.) is required for proper spring tension.

Ref. No.	Part No.	Quant.	Description
			FIG. E - CONNECTING ROD & PISTON GROUP
1	112-90	2	Piston & Pin - Specify: Standard or, .010", .020", .030", .040" Oversize (Replaces #112-55).
2	112A19	4	Ring, Lock - Piston Pin.
3	112A54	2	Pin, Piston - Specify: Standard or .002" Oversize.
4, 5		4	Ring, Piston - Compression - Sold only as part of Ring Set #113-105.
6		2	Ring, Oil Control - Sold only as part of Ring Set #113-105.
7	113-105	2	Ring, Set - For 1 Piston - Specify: Standard or .010", .020", .030", .040" O/S (Replaces #113-59)
8	114B65	2	Rod, Connecting - Includes Bearing - Specify: Standard or .002", .010", .020", .030" O/S.
9	114B53	4	Bearing Half, Connecting Rod - Specify: Standard or .002", .010", .020", .030" Oversize
10	114B54	4	Bushing, Piston Pin - Semi Finished.
11	114A20	4	Washer, Lock - Connecting Rod Screw - (See Ref. 13).
12	114A57	4	Screw, Connecting Rod - (See Ref. 13)
13	805-20	4	Bolt, Place - (Replaces 114A20 and 114A57).
			FIG. F - CRANKSHAFT & CAMSHAFT GROUP
1	104D172	1	Crankshaft.
2	104B1	1	Gear, Crankshaft.
3	515-1	2	Key, Crankshaft or Camshaft Gear.
4	104A365	1	Washer & Slinger, Crankshaft Gear.
5	518-16	1	Ring, Lock - Crankshaft Gear Washer.
6	105A112	1	Camshaft - Includes Center Pin.
7	105B107	1	Gear, Camshaft.
8	150A413	1	Plate, Back - Governor Ball.
9	150C417	1	Spacer, Governor Ball.
10	510-46	12	Ball, Fly - Governor.
11	150A440	1	Cup, Governor.
12	150P437	1	Ring, Snap - Center Pin.
13	105A42	1	Washer, Thrust - Camshaft Gear.
14	516A116	2	Pin, Roll - Crank Guide Pilot.
16	192C268	1	Crank, Hand.
17	150A435	1	Pin, Camshaft Center.

Ref. No.	Part No.	Quant.	Description
	FIG. G - FLYWHEEL & BLOWER WHEEL GROUP		
1	104D192	1	Flywheel.
2	104A160	1	Washer, Flywheel.
3	515-90	1	Key, Flywheel Mounting.
4	134C388	1	Wheel, Blower.
5	134C387	1	Hub, Blower Wheel.
6	104B252	1	Dog, Crank Engagement.
7	806-38	1	Screw, Crank Dog Mounting.
	FIG. H - GEAR COVER GROUP		
1	103C173	1	Cover, Gear - Assembly. Includes Ref. #3-12.
3	509-19	1	Seal, Oil - Crankshaft Front.
4	510-48	1	Bearing, Needle - Upper.
5	510-49	1	Bearing, Needle - Lower.
6	510-14	1	Ball, Bearing - Shaft Thrust.
7	509-46	1	Seal, Oil - Governor Shaft.
8	150A444	1	Yoke, Governor Shaft.
9	516-90	1	Pin, Stop - Governor Cup Engaging.
10	150B416	1	Arm and Shaft, Governor.
11	150A438	1	Screw, Adjusting - Governor Sensitivity.
12	150A411	1	Bracket, Governor Spring.
13	103C110	1	Gasket, Gear Cover.
	FIG. J - GOVERNOR GROUP		
1	150A115	1	Spring, Governor.
2	150A96	1	Stud, Governor Spring Tension (Speed).
3	150A398	1	Nut, Governor Speed Adjusting.
4	150A639	1	Joint, Ball - Governor Link.
5	150A410	1	Link, Governor Arm to Carburetor.
6	150A495	1	Bracket, Booster External Spring.
7	150A471	1	Spring, External - Booster.
8	150A425	1	Ring. Gasket - Booster to Manifold.
9	150K580	1	Kit, Booster Replacement.
10	150K582	1	Kit, Booster Diaphragm.
11	150A475	1	Spring, Internal - Booster.
12	150A376	1	Bracket, Booster Internal Spring.
13	150A666	1	Plate, Diaphragm - Booster.
14	150A668	1	Gasket, Diaphragm Plate.
15	516-39	1	Pin, Cotter - 3/32 x 5/8".
16	516-85	1	Pin, Roll - 3/32 x 3/4".
17		1	Housing, Vacuum Booster - Not Sold Separately.
18		1	Cover, Vacuum Booster - Not Sold Separately.

Ref. No.	Part No.	Quant.	Description
	FIG. K - IGNITION GROUP		
1	161C238	1	Magneto - Includes Drive Gear - Type FM-PE1-2B69A (Replaces Onan #161A148, FM-JE1-2B69A)
2	160B339	1	Gear, Magneto Drive.
3	160A124	1	Gasket, Magneto Mounting.
5, 5A			Cable, Spark Plug - Right Hand (Does not include Nut).
5	167A1213	1	Shielded (Radio Noise Suppressed).
5A	167A1277	1	Unshielded - Includes Seal - (Optional).
6, 6A			Cable, Spark Plug - Left Hand (Does not include Nut)
6	167A1214	1	Shielded (Radio Noise Suppressed).
6A	167A1278	1	Unshielded - Includes Seal - (Optional).
7	167-34	2	Plug, Spark.
8	166-105	2	Nipple, Spark Plug (Used with shielded Spark Plug Cable).
9	166A41	2	Shield, Spark Plug (Used with shielded Spark Plug Cable).
10	167A57	2	Nut, Coupling - Spark Plug Cable to Magneto.
11	167-19	2	Seal, Rubber - Spark Plug Cable to Magneto (Component of unshielded Spark Plug Cable).
	FIG. L - MAGNETO PARTS GROUP (Type FM-PE1)		
NOTE: These parts are for type FM-PE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering replacement parts.			
	161C238	1	Magneto Assembly - Includes Drive Gear
1	160B339	1	Gear, Magneto Drive
2	161-242	1	Point Set - Includes Arm and Stationary Bracket
3	161A178	1	Condenser, Magneto
4	161P210	1	Cap, End
5	161P212	1	Rotor Assembly, Magnetic
6	161P217	1	Bearing, Roller - Rotor Cam End
7	161P211	1	Coil, Magneto
8	161A11	1	Ferrule, Ground Terminal
9	161P118	1	Insulator, Ground Terminal
10	161-19	1	Ring. Drive Shaft Snap
11	161-236	1	Housing, Magneto
12	161-120	4	Screw, End Cap - #10-24 x 5/8"
13	161P224	1	Screw, Condenser Mounting - #8-32 x 1/4"
14	161P223	1	Screw and Lockwasher, Breaker Arm Terminal
15	161P231	1	Screw and Lockwasher, Contact Support Locking - #8-32 x 5/16"
16	161P123	2	Outlet, High Tension Cable
17	161P226	2	Setscrew, Coil Bridge

Ref. No.	Part No.	Quant.	Description
			FIG. L - MAGNETO PARTS GROUP (Type FM-PE1) (Cont.)
NOTE: These parts are for type FM-PE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering replacement parts.			
18	161-128	1	Washer, Rotor Drive End Seal Outer
19	161P213	1	Washer, Rotor Drive End Seal Inner
20	161P214	1	Washer, Rotor Drive End Bearing Retaining
21	161P215	1	Gasket, End Cap to Housing
22	161-136	1	Spring, Contact Support Ground
23	161-170	1	Hub, Coupling
24	161-243	1	Coupling Assembly, Impulse - Includes #23, 25 and 26
25	161-51	1	Spring, Impulse Coupling Drive
26	161-131	1	Shell, Impulse Coupling
27	161-96	1	Spring, Impulse Coupling Pawl
28	161-172	1	Pin, Impulse Coupling Pawl Stop - 3/8-16
29	161-53	1	Nut, Impulse Coupling
30	161-135	1	Bushing, Impulse Coupling
31	161-240	1	Washer, Coupling Plate
32	161P164	1	Nut, Ground Cable
33	161P230	1	Wick and Holder, Cam
34	161-62	1	Seal, Rotor Drive End
35	161-186	2	Spring, Coil Lead
36	161-119	1	Terminal, Ground Cable
37	161P216	1	Support, Bearing
38	814-77	4	Screw, Bearing Support - #8-32 x 3/8"
39	161P71	1	Bearing, Rotor Drive End
40	526-3	1	Washer, Contact Support Locking Screw Plate-#8
41	161A79	1	Washer, Ground Terminal
42	161P219	1	Cover, Vent
43	161P220	1	Screw, Vent Cover - #6-32 x 1/4"
44	161P221	1	Screen Vent
45	515-1	1	Key, Rotor Shaft to Impulse Coupling
46	161-244	1	Screw, Rotor Drive End Bearing Retaining Washer - #8-32 x 3/8"
47	850-25	1	Lockwasher, Bearing Retainer Screw
48	161P232	1	Washer, Bearing Support Grease Retaining-Outer
49	161P213	1	Washer, Bearing Support Grease Retaining - Inner
			FIG. M - MAGNETO PARTS GROUP (Type FM-JE1)
NOTE: These parts are for type FM-JE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering parts.			
	161A148	1	Magneto Assembly - Includes Drive Gear
1	160B339	1	Gear, Magneto Drive
2	161-86	1	Point Set, Contact

Ref. No.	Part No.	Quant.	Description
			FIG. M - MAGNETO PARTS GROUP (Type FM-JE1)
NOTE: These parts are for type FM-JE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering parts.			
3	161A178	1	Condenser, Magneto
4	161P210	1	Cap, End
5	161-169	1	Rotor Assembly, Magnetic
6	161-72	1	Bearing, Rotor Cam End
7	161-168	1	Coil, Magneto
8	161A11	1	Ferrule, Primary Ground
9	161P118	1	Insulator, Primary Ground Terminal
10	161-19	1	Ring, Rotor Shaft Snap
11	161-236	1	Housing, Magneto
12	161-120	4	Screw, End Cap - #10-24 x 5/8"
13	161P225	1	Screw, Condenser Mounting - #8-32 x 3/8"
14	161P225	1	Screw and Lockwasher, Breaker Arm Terminal - #8-32 x 3/8"
15	161P225	2	Screw and Lockwasher, Contact Support Locking - #8-32 x 3/8"
16	161P123	2	Outlet, High Tension Cable
17	161-239	2	Setscrew, Coil Bridge
18	161-128	1	Washer, Rotor Drive End Seal Outer
19	161P213	1	Washer, Rotor Drive End Seal Inner
20	161-56	As Req	Shim, Rotor Drive End Bearing
21	161A42	1	Gasket, End Cap to Housing
22	161-136	1	Spring, Ground Switch
23	161-170	1	Hub, Coupling
24	161-171	1	Coupling Assembly, Impulse - Includes 23, 25 & 26
25	161-51	1	Spring, Impulse Coupling Drive
26	161-175	1	Shell, Impulse Coupling
27	161-96	1	Spring, Impulse Coupling Pawl
28	161-172	1	Pin, Impulse Coupling Pawl Stop - 3/8-16
29	161-53	1	Nut, Impulse Coupling
30	161-135	1	Bushing, Impulse Coupling
31	161-240	1	Washer, Coupling Plate
32	161P164	1	Nut, Ground Cable
33	161-112	1	Wick and Holder, Cam
34	161-62	1	Seal, Rotor Drive End
35	161-186	2	Spring, Coil Lead
36	161-119	1	Terminal, Ground Cable
37	161-173	1	Support Bearing
38	814-77	4	Screw, Bearing Support - #8-32 x 3/8"
39	161P71	1	Bearing, Rotor Drive End
40	526-3	2	Washer, Contact Support Locking Screw Plate-#8
41	161A79	1	Washer, Ground Terminal
42	161P219	1	Cover, Vent
43	161P220	1	Screw, Vent Cover - #6-32 x 1/4"
44	161P221	1	Screen, Vent

Ref. No.	Part No.	Quant.	Description
	FIG. M - MAGNETO PARTS GROUP (Type FM-JE1) (Cont.)		
NOTE: These parts are for type FM-JE1-2B69A magneto. Be sure to check magneto nameplate for type before ordering parts.			
45	515-1	1	Key, Rotor Shaft to Impulse Coupling
46	161-18	1	Ring, Rotor Bearing Snap
47	161-241	1	Washer, End Cap Plate
48	161-35	1	Screw, Contact Support Adjusting
49	812-61	1	Screw, Cam Wick - #6-32 x 3/8"
50	161-116	1	Lockwasher, Cam Wick Screw
51	161-113	1	Spacer, Cam Wick
52	161-114	1	Washer, Cam Wick
	FIG. N - AIR CLEANER GROUP 140K539		
NOTE: Cartridge type Air Cleaner used on Spec G and later models, and also on some earlier models. Mesh type air cleaner used prior to Spec G.			
1	140D531	1	Housing, Air Cleaner - For Cartridge Type Air Cleaner.
1A	140C355	1	Housing, Air Cleaner - For Mesh Type Air Cleaner.
2	140B532	1	Cover, Air Cleaner Housing - For Cartridge Type Air Cleaner.
2A	140B356	1	Cover, Air Cleaner Housing - For Mesh Type Air Cleaner.
3	518-56	2	Screw, Cover Retaining - For Cartridge Type Air Cleaner.
3A	520A75	2	Stud, Air Cleaner Cover - For Mesh Type Air Cleaner.
4	140B495	1	Cartridge & Wrapper, Air Cleaner - For Cart. Type (NOTE: Wrapper not sold separately).
4A	140-359	1	Element, Air Cleaner - For Mesh Type Air Cleaner.
5	517-9	1	Plug, Button - 2 inch - For Mesh Type Cleaner.
6	140B467	1	Gasket, Air Cleaner Cover - For Mesh Type Air Cleaner.
7	140A357	1	Inlet, Carburetor Air - Metal - Order: Inlet 145A239, Bushing 145A246 & Clamp 503P368.
7A	145A239	1	Inlet, Carburetor Air (Air Horn) - Rubber.
7B	145A246	1	Bushing, Carburetor Air Inlet - Use with Rubber Inlet.
8	503B49	1	[illegible] Air Cleaner to Carburetor - 13" Long - works for 503A263 Hose 9-1/2" Long.
9	503-274	2	Clamp, Hose - (1) Air Cleaner Hose to Inlet (1) Metal Inlet to Carburetor.
9A	503P368	1	Clamp, Hose - Rubber Inlet to Carburetor.

Ref. No.	Part No.	Quant.	Description
	FIG. N - AIR CLEANER GROUP (Cont.)		
10	133A32	2	Tube, Air Pre-Heater - (Optional).
11	503-259	1	Hose, Air Pre-Heater - (Optional).
12	503-269	3	Clamp, Hose (2) Air Pre-Heater Hose (1) Air Cleaner Hose to Carburetor.
13	503A275	1	Hose, Breather Cap to Air Inlet - 3-1/8" - For all except models with LPG Pressure-Carburetor.
13A	503A366	1	Hose, Breather Cap to Air Inlet - 4-3/4" - For models with LPG Pressure-Carburetor.
	508-31	1	Grommet, Rubber - For 11/32" hole.
	FIG. O - FUEL SYSTEM GROUP (GASOLINE ONLY)		
1	149C567	1	Pump, Fuel.
2	154A252	2	Gasket, Intake Manifold Mounting.
3	149C528	1	Adapter, Fuel Pump.
4	149A277	1	Gasket, Fuel Pump to Adapter.
5	149A520	1	Spacer, Fuel Pump Adapter Mounting.
6	502-2	1	Elbow, Fuel Line Connection - Carburetor Inlet.
7	868-3	2	Nut, Carburetor Mounting Stud.
8	502-3	1	Connector, Fuel Line - Fuel Pump Outlet.
9	149A519	1	Rod, Push - Fuel Pump Adapter.
10	149A533	1	Line, Fuel - Pump to Carburetor.
11	159A477	1	Bracket, Fuel Line Support.
12	508-21	1	Grommet, Rubber - Fuel Line Support Bracket.
13	501A27	1	Line, Fuel - Flexible - 48 inch - Accessory.
14	415A124	1	Cap, Rain - Rubber - Accessory.
15	415B126	1	Tank, Fuel - 5 Gallon - Accessory.
16	504A13	1	Valve, Shut Off - Fuel Tank - Accessory.
17			Carburetor, Gasoline.
	141C564	1	With slotted choke shaft for engaging ONAN electric choke which mounts around choke shaft - For Models Prior to Spec F.
	141C621	1	With choke shaft suitable for use with Sisson Automatic Choke or Manual Choke - For Models Begin Spec F.
18	154A133	1	Gasket, Carburetor to Manifold.
19	154A315	1	Manifold, Intake.
20	520A311	2	Stud, Carburetor to Manifold.

Ref. No.	Part No.	Quant.	Description
			FIG. P - OPTIONAL FUEL SYSTEM GROUP (COMBINATION GAS-GASOLINE OR GAS ONLY CARBURETOR) (DOWN DRAFT TYPE)
			NOTE: Refer to this group first. For parts not found here, refer to the Gasoline Fuel System Group.
1	141C622	1	Carburetor, Combination Gas-Gasoline - With Float Lock.
1A	141C519	1	Carburetor, Gas Only - (Modified Gasoline Carburetor - Requires separate gas pressure Regulator).
2	148B197	1	Adapter. Gas Fuel - Carburetor Inlet.
3	148A198	1	Gasket, Gas Adapter to Carburetor Body.
4	148A196	1	Venturi, Carburetor.
5	148C311	1	Regulator, Gas Pressure - Secondary - Garretson Manufacture.
6	503-51	1	Hose, Gas Fuel - Regulator.
7	503-49	2	Clamp, Hose - Gas Fuel Hose.
8	148A107	1	Vent, Gas Regulator.
9	141A501	1	Spring, Choke Stop -(Used with Combination Gas-Gasoline Carburetor only).
10	141A493	1	Float, Carburetor - (Used with Combination Gas-Gasoline Carburetor only).
11	148A135	1	Lock, Float - (Used with Combination Gas-Gasoline Carburetor only).
12	148A17	1	Gasket, Float Lock Bushing - (Used with Combination Gas-Gasoline Carburetor only).
13	504-7	1	Valve, Gasoline Inlet Shut-Off - (Used with Combination Gas-Gasoline Carburetor only).
	149A555	1	Cover, Crankcase Fuel Pump Hole - (Used with Gas Only Carburetor only).
	148P390	1	Repair Kit, Gas Regulator (Garretson Manufacture).
			FIG. Q - OPTIONAL FUEL SYSTEM GROUP (LIQUID PETROLEUM GAS ONLY)
1	141B637	1	Carburetor, Pressure - LPG (Liquid Petroleum Gas) Fuel - Zenith modified by ONAN - Combination Carburetor and Pressure Regulator - Component parts are not available.
2	Describe	1	Seal, Throttle Shaft - Zenith Part No. 50-CT48-9 - Component of Carburetor 141B637.
3	520A429	2	Stud, Carburetor Mounting - 3/8 x 2-1/2".

Ref. No.	Part No.	Quant.	Description
			FIG. Q - OPTIONAL FUEL SYSTEM GROUP (LIQUID PETROLEUM GAS ONLY) Cont.
4	502-230	1	Elbow, Carburetor Fuel Inlet - 3/8" Male Pipe Thread by 3/8" Tube.
5	502-138	1	Elbow, Breather Hose to Carburetor.
6	148C429	1	Line, Fuel - Vaporizer to Carburetor.
7	502-231	1	Union, Half - Vaporizer Outlet - 1/4" Male Pipe Thread by 3/8" Tube.
8	332-50	2	Clip, Tinnerman - Secures Fuel Line to Engine.
9	148A418	1	Vaporizer Assembly - Zenith No. A963B-1 - Mounts on Blower Housing Front Panel.
10	148A423	1	Bracket, Vaporizer Mounting.
11	145A231	1	Spacer, Carburetor to Intake Manifold.
12	149A555	1	Cover, Crankcase Fuel Pump Hole.
			FIG. R - CHOKE GROUP
			NOTE: ONAN electric choke is standard on plants Prior to Spec F. - Sisson automatic choke is standard Begin Spec F. -Manual choke is optional.
1	153A155	1	Adapter, Choke - Electric - Prior to Spec F.
3	141A372	1	Knob, Choke Shaft - Electric - Prior to Spec F.
4, 5, 6	153A161	1	Choke, Assembly, 28 Volt - Prior to Spec F.
4	153A58	1	Housing, Choke Bimetal - Electric - Prior to Spec F.
5	153-57	1	Element, Choke Bimetal - Electric - Prior to Spec F.
6	153A162	1	Cover, Choke - 28 Volt - Includes Heating Element - Electric - Prior to Spec F.
7	141-172	1	Lever, Choke Shaft - For Plants with Manual Choke (Optional).
8	141A496	1	Bracket, Choke Control Rod - Manual - For Plants with Manual Choke (Optional).
9	153A18	1	Rod, Choke Control - Manual Push-Pull - (Optional).
10	153P213	1	Choke, Automatic - Sisson - For Remote starting Plants - Begin Spec F.
11	153A256	1	Cover, Choke - Includes Heating Element - Use with Sisson Choke - Begin Spec F.
12	153A252	1	Bracket, Automatic Choke - Use with Sisson Choke - Begin Spec F.
13	153A253	1	Linkage, Automatic Choke - Use with Sisson Choke - Begin Spec F.

Ref. No.	Part No.	Quant.	Description
			FIG. R - CHOKE GROUP (Cont.)
14	518-5	1	Clip, Choke Linkage - Carburetor End - Use with Sisson Choke - Begin Spec F.
15	518-47	1	Clip, Choke Linkage - Choke End - Use with Sisson Choke - Begin Spec F.
16	153A214	1	Arm, Choke Shaft - Use with Sisson Choke - Begin Spec F.
			FIG. S - CARBURETOR PARTS GROUP (GASOLINE)
1			Carburetor - Gasoline.
	141C564	1	For Plants with Onan Electric Choke - Prior to Spec F.
	141C621	1	For Plants with Manual Choke or Sisson Automatic Choke - Begin Spec F.
3	141-530	1	Body, Air Intake - Includes Choke Shaft Bushing.
4	141-531	1	Bushing, Choke Shaft.
5	141A478	1	Shaft, Choke - With Slotted End for Electric Choke - Prior to Spec F.
5A	141-624	1	Shaft, Choke - For Sisson Automatic or Manual Choke - Begin Spec F.
6	141-532	1	Plate, Choke.
7	141-471	2	Screw, Choke Plate.
8	141-8	1	Needle, Idle Adjusting.
9	141-9	1	Spring, Idle Needle.
10	141-533	1	Plug, Fuel Filter Head.
11	141-566	1	Filter, Fuel Inlet.
12	141-534	1	Washer, Gasket - Filter Plug.
13	141-535	1	Float - For Gasoline Carburetor only.
15	141-72	1	Axle, Float.
16	141-536	1	Gasket, Intake to Bowl.
17	141-537	6	Screw, Intake to Bowl.
18	141-538	1	Bowl, Fuel - Includes References 19 thru 23.
19	141-539	4	Plug, Lead - Bowl Passages.
20	141-540	1	Bushing, Idle Channel.
21	141-541	1	Jet, Blank - Accelerator.
22	141-542	1	Plug, Jet Channel - Accelerator.
23	141-543	1	Plug, Accelerator Pump Rod Channel.
27	141-70	1	Plug, Bowl Drain.
28	141-544	1	Plug, Power Jet Channel.
29	141-545	1	Gasket, Bowl to Throttle Body.
30	141-546	2	Screw, Bowl to Body.

Ref. No.	Part No.	Quant.	Description
			FIG. S - CARBURETOR PARTS GROUP (GASOLINE) Cont.
31	141-585	1	Body, Throttle - Includes Shaft, Plate and Needle Bearings.
32	141K586	1	Shaft and Lever Kit, Throttle - Includes Stop Screw.
33	815-133	1	Screw, Lever Stop.
34	141-551	1	Plate, Throttle.
35	141-257	2	Screw, Throttle Plate.
36	141-552	1	Lever, Clamp - Throttle.
37	141-2	1	Screw, Throttle Lever Clamp.
38	141P573	1	Venturi.
39	141-553	1	Jet and Adjusting Needle, Main.
40	141A77	2	Washer, Gasket - Main Adjusting Needle and Fuel Valve.
41	141-554	1	Jet, Idle.
42	141-555	1	Jet, Discharge.
43	141-556	1	Jet, Well Vent.
44	141-323	1	Valve, Fuel Inlet.
	141P590	1	Kit, Repair - Throttle Body Needle Bearing - Includes Seal & Washer.
	141-563	1	Kit, Repair - Carburetor.
	141-529	1	Kit, Gasket - Carburetor.
			FIG. T - FUEL PUMP PARTS GROUP
1	149C567	1	Pump, Fuel.
2	149A95	2	*Valve and Cage.
3	149A96	2	*Gasket, Valve.
4	149P276	1	*Diaphragm and Pull Rod.
5	149P576	1	Spring, Diaphragm.
6	149P575	1	Retainer, Valve.
7	149P580	1	Spring, Rocker Arm.
8	149P578	1	Pin, Rocker Arm.
9	149P581	1	Arm, Rocker.
10	149A277	1	*Gasket, Mounting.
11	149P573	1	Bail, Bowl Retainer.
12	149A481	1	Bowl, Strainer.
13	149P579	1	Link, Rocker Arm.
14	149P577	1	Bushing, Rocker Arm Pin.
15	149P483	1	Screen, Strainer.
16	149A275	1	*Gasket, Bowl.

* - Included in Fuel Pump Repair Kit 149K106.

Ref. No.	Part No.	Quant.	Description
			FIG. T - FUEL PUMP PARTS GROUP (Cont.)
17		1	Body, Upper } Not Sold Separately
18		1	Body, Lower } Order Complete Pump
19	815-135	6	Screw, Body
20	850-30	6	Lockwasher, Body Screw.
21	149P793	1	*Seal, Diaphragm Pull Rod.
	149K106	1	Repair Kit, Fuel Pump-Includes parts marked *.
			FIG. U - AIR HOUSING GROUP
1	134D462	1	Housing, Blower.
1A	134D1228	1	Housing, Blower - Spec 2537 Only.
2	134D396	1	Scroll, Blower Housing.
2A	134A1095	1	Scroll, Blower Housing - Spec 2203 Only.
3	134B397	1	Grille, Air Outlet.
4	134E999	1	Panel, Blower Housing (Replaces #134E408).
4A	134B1020	1	Panel, Blower Housing - With provision for mounting LP Gas Vaporizer - (Optional)
4B	134A1169	1	Panel, Blower Housing - Spec 2203 Only.
5	134D423	1	Adapter, Air Outlet.
7	134C398	1	Plate, Baffle - Left Hand Cylinder.
8	134C399	1	Plate, Baffle - Right Hand Cylinder.
9	134B402	1	Extension, Left Hand Baffle Plate.
10	134B403	1	Extension, Right Hand Baffle Plate.
11	134D458	1	Shroud, Left Hand Cylinder
12	134D459	1	Shroud, Right Hand Cylinder
13	134A487	2	Bracket, Shroud.
14	517-9	1	Plug, Button - Pre-Heater Tube Air Outlet.
15	192B266	1	Plate, Crank Support - Earlier models only having #134E408 Panel.
16	134C1218	1	Shroud, Cylinder - Upper L.H. - Spec 2428 Only.
17	134C1219	1	Shroud, Cylinder - Lower L.H. - Spec 2428 Only.
18	134C1220	1	Shroud, Cylinder - Upper R.H. - Spec 2428 Only.
19	134C1221	1	Shroud, Cylinder - Lower R.H. - Spec 2428 Only.
20	134C1208	1	Elbow, Air Outlet Adapter - Spec 2428 Only.
			FIG. V - EXHAUST GROUP
1	155C352	1	Manifold, Exhaust - Horizontal Exhaust Outlet.
1A	154D562	1	Manifold, Exhaust - Vertical Down Exhaust Outlet - (Optional).
1B	154C727	1	Manifold, Exhaust - Spec 2203 Only.
1C	154D761	1	Manifold Exhaust - Spec 2537 Only.
2	155A170	1	Adapter, Exhaust Manifold Outlet.
3	154A133	1	Gasket, Exhaust Adapter.
4	155A343	2	Gasket, Exhaust Manifold.
5	155B77	1	Muffler, Exhaust - Accessory.
6	155B492	1	Tube, Exhaust - Flexible - 36" - Accessory.
6A	505-31	1	Coupling, Pipe - Exhaust Tube - 1-1/4" Accessory.

Ref. No.	Part No.	Quant.	Description
			FIG. W - GENERATOR PARTS GROUP
			NOTE: For parts in this group which are not interchangeable between models, the applicable Generator Data is given in the part's description and it must agree with the Generator Data on the plant nameplate. See also Reference Chart at end of Parts List.
1			Armature - Includes Ball Bearing & Drive Disc-
*	201A508	1	For models having Generator Data 10CW3C1C, 10CW/69, 10CW/91, 10CW/101, 10CW/118.
*	201A1056	1	For models having Generator Data 10CW/109, 10CW/137.
*	Describe	1	For models having Generator Data 10CW/104 - Stack is 7-1/2" instead of 6" length.
*	201A817	1	For models having Generator Data 705CW/92, 705CW/119.
2	510A52	1	Bearing, Ball - Armature.
3			Frame, Generator - (Less Coils & Poleshoes) -
	210C217	1	With provisions for Control mounting on right hand (#2 Cyl.) side - For models having Generator Data 10CW3C1C, 10CW/101.
	210C267	1	With provisions for Control mounting on left hand (#1 Cyl.) side - For models having Generator Data 10CW/69, 10CW/91, 10CW/109, 10CW/118, 10CW/137.
	210C324	1	With provisions for Control mounting on left hand (#1 Cyl.) side - For models having Generator Data 10CW/104.
	210C316	1	With provisions for Control mounting on left hand (#1 Cyl.) side - For models having Generator Data 705CW/92, 705CW/119.
4			Coil Set, Field - Set of 4 Connected -
*	222A1469	1	For models having Generator Data 10CW3C1C, 10CW/101.
*	222A1495	1	For models having Generator Data 10CW/69, 10CW/91, 10CW/109, 10CW/137 - Accommodates L.H. Mounted Control.
*	222A1563	1	For models having Generator Data 10CW/104 - Fits 7-1/2" Pole Shoe.
*	Describe	1	For models having Generator Data 705CW/92.
*	222A1567	1	For models having Generator Data 10CW/118.
*	222A1584	1	For models having Generator Data 705CW/119.

*- When ordering Always Give Complete Model and Serial Number.

Ref. No.	Part No.	Quant.	Description
			FIG. W - GENERATOR PARTS GROUP (Cont.)
5			Shoe, Pole -
	221B94	4	6" long - For models having Generator Data 10CW3C1C, 10CW/69, 10CW/91, 10CW/101, 10CW/109, 10CW/118, 10CW/137.
	221B96	4	7-1/2" long - For models having Generator Data 10CW/104.
	221B97	4	4-1/2" long - For models having Generator Data 705CW/92, 705CW/119.
6	212C202	1	Rig Assembly, Brush - Includes Brushes and Springs.
7	214A57	4	Brush, Commutator.
8	214A54	8	Brush, Collector Ring.
9	212B1106	4	Spring, Commutator Brush.
10	212A1123	8	Spring, Collector Ring Brush.
11	212B1120	4	Block, Holder - Collector Ring Brush.
12	212A1121	4	Guide, Commutator Brush.
13	213B116	1	Ring, Insulator - Brush Guide.
14	212B1138	1	Spider, Brush Rig Mounting.
			Bell, End -
15	211D91	1	For all Generator Data EXCEPT 10CW/137.
15A	211A140	1	For Generator Data 10CW/137.
			Cover, Bearing -
16	232A601	1	For all Generator Data EXCEPT 10CW/137.
16A	232A1031	1	For Generator Data 10CW/137.
17	232B814	3	Cover, End Bell Opening - Top & Sides.
18	232B841	1	Cover, End Bell Opening - Bottom.
19	232A615	1	Clip, Bearing Stop.
20	232C784	1	Support, Generator Frame.

FIG. X - CONTROL PARTS GROUP

NOTE: Control parts can be identified on the Wiring Diagram furnished with the plant. - For Model Spec "1850", refer to end of group first.

1	★	1	Box, Control.
1A	★	1	Panel, Control Box - Upper.
2	301B856	1	Cover, Control Box - Lower - Connections.
3	332A419	1	Block, Terminal - Load Connections.
4	301A974	1	Bracket, Start-Stop Switch Mtg. (Used only with #308-90 Switch).
5	332A437	1	Marker, Terminal Block - Marked M1, M2, M3, M4.
6	301A878	1	Plate, Control Box Baffle.
7	312P87	3	Condenser, Load Terminal - 0.1Mfd. - Feed Thru - Used only on Plants with Radio Noise Suppression.

★ - Order by description, giving complete Model and Serial Number.

Ref. No.	Part No.	Quant.	DESCRIPTION
			FIG. X - CONTROL PARTS GROUP (Cont.)
8	332A440	2	Jumper, Terminal - Voltage Selection.
9	332A484	3	Jumper, Terminal to Condenser - For Plants with Radio Noise Suppression.
10	332A464	1	Jumper, Terminal to Ground.
11	312A17	1	Condenser - 0.5 Mfd. - Battery Terminal - For Plants with Radio Noise Suppression.
12	307B40	1	Solenoid, Start.
13	308P2	1	Switch, Toggle - Hand or Electric Start - Not Used on Plants with Manual Choke.
14	307B597	1	Relay, Choke Disconnect - Not used on Plants with Manual Choke (Replaces #307B4).
			Switch, Start-Stop -
15	308-90	1	Mounts in Rectangular Hole - For replacement use #308A166.
	308P154	1	Mounts in Round Hole.
16	302A58	1	Ammeter, Charge (10-0-10).
17	306A28	1	Relay, Start-Disconnect.
18	307B253	1	Relay, Stop - Not used on Plants with Manual Choke.
19	307B180	1	Relay, Reverse Current.
20	305A1	1	Regulator, Voltage - Charge Circuit.
21	332A222	1	Block, Terminal - Remote Control - 4 Place - Not used on Plants with Manual Choke.
23	332A333	1	Block, Terminal - 2 Place.
25	332A483	1	Marker, Terminal Block - Marked 5 and A1.
26	304A251	1	Resistor, Voltage Regulator - 30 Ohm 5 Watt - Not used on Plants with Manual Choke.
27	304A256	3	Resistor, Charge - 6 Ohm, 75 Watt - Prior to Spec H.
27A	304A483	1	Resistor, Charge - 225 Watt - Tapped & Adjustable 6 Ohm maximum on shorter end and 3 Ohm maximum on longer end - Begin Spec H.
28	309B10	1	Switch, Ignition Cutoff - Low Oil Pressure (Mounted on Oil Filter Pressure Line) - (Optional) - Listed also in the Oil Pump Group.
29	308-97	1	Switch, Momentary Contact - Opens Low Oil Pressure Cutoff Switch Circuit - Includes Nut - Mounts on Oil Filter Bracket - Replaces #308P37- (Optional) - Listed also in Oil Pump Group.
30	301C853	1	Cover, Control Box - Upper.
31	338B217	1	Harness, Wiring - Stop & Choke Circuits - Includes 25-1/2" Unshielded Magneto Stop Lead & 36" Cutoff Switch Lead - For Plants with Manual Choke & Safety Cutoff Switch - (Optional).

Ref No.	Part No.	Quant.	DESCRIPTION
			FIG. X - CONTROL PARTS GROUP (Cont.)
	338B145	1	Includes 22" Shielded Magneto Stop Lead & 38" "S1" Lead - For Plants Prior to Spec F with Electric Choke but without optional Cutoff Switch - Works for 338B123.
	338B205	1	Includes 17" Shielded Magneto Stop Lead, 20" "S1" Lead & 17" "2" Lead - For Plants Begin Spec F with Sisson Automatic Choke, with optional Left Side mounting of Control & without optional Cutoff Switch - (Optional).
	338B206	1	Includes 23" Shielded Magneto Stop Lead, 27" "S1" Lead & 23" "2" Lead - For Plants Begin Spec F with Sisson Automatic Choke, with standard Right Side Mounting of Control and without optional Cutoff Switch.
32	308A9	1	Switch, Start-Stop - Remote - 230 Volt, Normally Open.
33	416A77	2	Cable, Battery - 28".
33A	416A38	2	Cable, Battery - 60" - Spec 2428 only.
34	416A4	1	Cable, Battery Jumper - 6-3/4"
35	323-207	1	Receptacle - 3 Prong - Spec 2206 only.

THE FOLLOWING SPECIAL CONTROL PARTS ARE OPTIONAL AS USED ON MODEL "SPEC 1850".

NOTE: Control Box is wall mounted type but mounted on bracket on left side of Generator. AC output leads are terminated in Junction Box. These special parts are not illustrated. For parts not listed here, refer to the illustrated parts.

302-212	1	Meter, Running Time.
308-68	1	Switch, RUN-STOP - DRDT.
332A607	1	Block, Terminal - 12 Place - 6" long.
332A642	1	Strip, Marker - Blank - Use with Block 332A607.
308A29	1	Switch, START - Push Button.
338C235	1	Harness, Wiring - 9 Wires - Unshielded - Magneto Stop Lead is 44" long.
301D1852	1	Box, Control - With Hinged Cover - Nominal 10 x 12 x 4" deep.

Ref. No.	Part No.	Quant.	DESCRIPTION
			THE FOLLOWING SPECIAL CONTROL PARTS ARE OPTIONAL AS USED ON MODEL "SPEC" 1850". (Cont.)
	301B1853	1	Panel, Control Box - 9-3/4 x 10-1/2".
	301C1854	1	Bracket, Control Box Mounting.
	301B1855	1	Box, Resistor.
	508-26	1	Grommet, Rubber - 3/8" - Mounting Bracket.
	508-1	1	Grommet, Rubber - 3/4" - Output Box.
	508-8	1	Grommet, Rubber - 1/2" - Output Box.
	330-28	1	Box, AC Output.
	330-6	1	Cover, AC Output Box

SERVICE KITS

NOTE: For other kits, refer to the group for the part in question.

168K56	1	Gasket Kit, Plant - Complete

GENERATOR CROSS-REFERENCE CHART

Generator Data (as given on nameplate) referenced to plant Spec No. (as appears after diagonal in plant model, given on nameplate). Refer to this chart when selecting applicable parts from the Generator Parts Group.

GENERATOR DATA (see nameplate)	USED ON PLANT SPEC. NO. (appears after diagonal in plant model)
10CW3C1C	1
10CW/69	1329, 1511, 1597, 1775, 1776, 1824, 2217
10CW/91	665, 980, 1338, 1615, 1970, 2537
705CW/92	980
10CW/101	1689, 1819, 1837, 1850
10CW/104	1725
10CW/109	1813, 1841
10CW/118	1991, 2148, 2203, 2428
705CW/119	1991, 2148, 2203, 2428
10CW/137	2206

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