# TM55-3008

WAR DEPARTMENT TECHNICAL MANUAL



# GENERATING SET GASOLINE ENGINE DRIVEN ONAN, MODEL OTC-15BE

NOTE. This is a reprint of TM 55-3008, Onan, Model No. OTC-15BE, Service Manual for Onan Electric Plant, undated. No distribution will be made to personnel possessing the original publication.

*WAR DEPARTMENT • 23 NOVEMBER 1944*

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# GENERATING SET GASOLINE ENGINE DRIVEN

## ONAN, MODEL OTC 15BE

*WAR DEPARTMENT • 23 NOVEMBER 1944*

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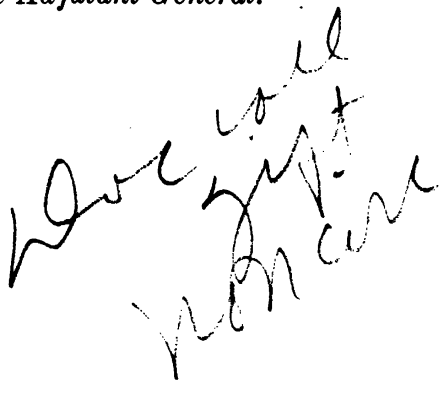

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D. W. ONAN & SONS, MINNEAPOLIS, MINNESOTA, MANUFACTURE 3 MODELS IN THE OTC15 SERIES - OTC15, OTC15B AND OTC15BE.

Difference between OTC-15 and OTC-15B is that Positive of generator is grounded on OTC-15B

FOLLOWING PARTS ARE FOR THE OTC15 AND 15B EXCLUSIVELY - NOT INTERCHANGEABLE WITH SIMILAR PARTS ON OTC15BE.

| PART NO. | DESCRIPTION |
|---|---|
| 19243 | Crankcase |
| 19021 | Bearing plate and generator support |
| 19022 | Bearing plate and generator support gasket |
| 19300 | Gearcase |
| 19301 | Gearcase gasket |
| 19150A | Oil pump assembly and all parts for same |
| 19153 | Oil pump cam follower (not required on OTC-15BE) |
| 19154 | Oil pump cam follower shaft (not required on OTC-15BE) |
| 19475 | Fuel pump ) |
| 19480 | Fuel pump bowl gasket) Complete fuel pump unit will fit |
| 1098 | Fuel pump bowl ) all 3 generators |
| 19220 | Connecting rods (new rods in pairs) |

FOLLOWING PARTS ARE FOR THE OTC15BE EXCLUSIVELY - NOT INTERCHANGEABLE WITH SIMILAR PARTS ON OTC15 AND 15B.

| | |
|---|---|
| 19243G | Crankcase |
| 19021G | Bearing Plate and generator support |
| 19022G | Bearing plate and generator support gasket |
| 19313 | Gearcase |
| 19312 | Gearcase gasket |
| 19357A | Oil pump and all parts for same |
| 19474 | Fuel pump ) |
| 19471 | Fuel pump bowl ) Complete fuel pump unit will |
| 19473 | Fuel pump bowl gasket) fit all 3 generators |
| 19222 | Connecting rods |
| 19223 | Connecting rod inserts |

(WIRING DIAGRAM)

# SPECIFICATIONS

## MECHANICAL DETAILS

ENGINE - The engine is of the two cylinder, horizontal opposed type with cylinder block separable from the crankcase. It is four cycle, L-head air cooled operating on natural gas or gasoline. The standard bore is 2-5/8" except on the 2000 watt A.C. plants when it is 2-3/4"; the stroke 2-1/4"; the compression ratio 5-3/4 to 1. The cylinder head is cast alloy aluminum while the cylinders are cast nickel alloy iron.

Valve guides are of cast iron and removable from the block. Valve seats are of high-expansive alloy iron-removable and replaceable. A valve tappet spring chamber is an integral part of the cylinder casting and is covered by a cast plate retained by a single screw.

The crankcase is cast material and is removable from a cast oil base. Main bearings are pressed into the crankcase and rear bearing plate and are line-reamed. The cylinders are removable from the crankcase and are fitted with pistons having two compression rings and one oil ring.

The camshaft is supported at the forward end by a ball bearing which absorbs the timing gear load, and a babbit-lined bearing at the other end. A cast iron camshaft gear with its integral governor mechanism meshes with a steel crankshaft gear.

An air cleaner is mounted on an adapter on the carburetor intake. The carburetor is of the conventional type. An automatic electric choke is only provided on the electric start plants. The manual plants have manual hand control chokes.

An oil filler opening is located on the crankcase and is equipped with a cap and bayonet gauge assembly. The crankcase is ventilated by the carburetor air intake. Engine is lubricated by a positive pressure oil pump. Oil is forced to front and main bearings and then through drilled openings in the crankshaft to the connecting rod bearings where it is distributed by spray to other moving parts of the engine.

Ignition is furnished by a flywheel magneto generator unit and external breaker mechanism mounted on top of the crankcase behind the carburetor. The magneto is mounted behind the engine cooling blower flywheel. Breaker points are adjustable but the timing is not. Spark plugs are housed in cast aluminum housing and connected with high tension shielded cables.

The engine is cooled by the blower drawing in air through the center of the housing. The air is forced out to both cylinders over cylinder heads, fins and all other areas which must be cooled. It is discharged upward from each cylinder.

## ELECTRICAL DETAILS

### GENERATOR

Standard Direct Current generators are of the four pole type. The armature is coupled with its male taper directly to the female taper of the crankshaft. The armature arbor is hollow and a draw-bolt passes from the crankshaft through the arbor. A nut at the rear retains the position of the armature arbor in the crankshaft taper. Speed is maintained at about 2200 R.P.M.

The outboard end of the armature is carried in a grease sealed ball bearing which requires attention about once each six months. The generator frame is attached to the engine crankcase. A fuel tank is mounted atop the generator frame on the manual models. All generators are forced air-cooled by a blower mounted at the engine end of the generator.

All direct current generators are self excited and so are a completely independent source of power. Battery charging types generate a higher voltage than their rating and the batteries they charge so as to overcome the internal resistance of the battery. On electric start plants the generator is used as the starting motor being furnished the electrical power from a set of starting batteries or from the batteries it is to charge.

An extremely large commutator and brushes minimize the internal losses of the generator. All of the windings are impregnated with indulating varnish and baked. The frame is a rolled steel ring, machined inside. The armature laminations are 26 gauge silicon steel and pole piece laminations are 22 gauge silicon steel. The generator is radio shielded to prevent radio interference. It will operate satisfactorily up to 50° Centigrade temperature rise.

### CONTROLS

MANUAL STARTING - "Manual Started " plants are equipped with a rope starter sheave at the rear of the generator. Starting is accomplished by winding the starting rope in a counter-clockwise direction, facing the generator end of the plant, and pulling the rope rapidly.

SELF START - The "Self Start" plants are equipped with a control panel. They may be started electrically only at the plant by pushing a START button in the control panel. The plants may be stopped by a switch at remote distances from the plant. Such starting systems are commonly used for battery charging plants.

REMOTE CONTROL - The "Remote Control" plants are equipped with a control panel but have a starting relay and switch instead of only a starting switch. This permits electric starting at the plant or at any remote control station up to 250 feet from the plant. This type of system is commonly used with the direct current non-battery charging plants.

## INSTALLATION

LOCATION - The plant should be located centrally with respect to the electrical equipment it is to operate. This allows the use of small size current carrying wires. As a result there is less voltage loss, the equipment operates more satisfactorially and the entire system is more efficient.

If the plant is to be operated as a portable unit, it should be protected against extreme exposure to the elements. If used outdoors in extremely cold weather, extra precautions are necessary to provide easy starting and proper lubrication of the engine. Move the plant only when necessary and then only with the greatest care.

The plant should not be installed where the air is extremely humid. But, if this condition cannot be avoided, frequent inspection of parts which are exposed to the air should be made to insure that humidity is not causing detrimental corrosion and failure of electric plants to operate. These plants are impregnated, plated, and otherwise guarded against corrosion as far as humanly possible but corrosion cannot be entirely overcome.

If permanently installed in a mobile vehicle, the location should be such that there will be proper ventilation and means for exhausting the gases. The plant should be insulated so that mechanical noises and slight vibration will not effect the operation of other equipment or the personnel aboard the vehicle.

Any gasoline engine generates a great deal of heat so that ample means must be provided to remove that heat. If plant is permanent-ly mounted, the room should be at least 10 feet by 10 feet large. Then the plant should be at least 24" from any wall. Air outlet openings 18" square and air inlet openings 16" square properly protected or shielded will provide satisfactory air circulation. A stack or cupola built in the roof will help to dissipate the heat when the plant is shut down and there is no forced air circulation as provided by the plant blower.

When installed aboard a mobile vehicle, the mounting compartment should be as large as possible and plant should be at least 12" away from any wall. For such compartments provide air outlets and stacks directly above the cylinders. Also provide air inlets with openings directly opposite the blower. A stack from this opening to within 1/2" of the blower will help. Openings in the floor may be used.

MOUNTING BASE - If the plant is installed permanently on a base, it should be at least 12" high to allow easy access to all of the parts of the plant, also to guard against damage occurring to the plant caused by its being bumped by other objects in the room. The plant should never be bolted permanently to any foundation. Shock absorber mountings have been provided to prevent vibration from reaching the mounting base - these are either helical coil springs or sheared type rubber bushings.

## PREPARATION

### LUBRICATION

The crankcase should be filled with 2-1/2 quarts of a good oil. If the plant is operated in temperatures above 50 degrees, use an S.A.E. #20 oil; below 50 degrees use S.A.E. #10 oil. If the plant is operated in low temperatures (approximately 10 degrees Fahrenheit) it is satisfactory to use an S.A.E. #10 winter oil. But if the temperatures are zero or lower dilute the oil.

COLD WEATHER OPERATION - For this service first run the plant until oil in the engine is warm. Then drain all the old oil. Mix 2-1/2 quarts of fresh S.A.E. #10 or S.A.E. #10W oil with 1/4 pint of clean kerosene (a good grade of distillate may be used if kerosene is not available). Mix thoroughly and fill the crankcase. Then start the plant immediately and allow engine to run for at least 10 minutes to circulate the new oil mixture throughout the lubricating system.

Do not attempt to mix any oil heavier than S.A.E. #20 as the mixture will separate each time the engine is stopped. When adding oil between drain periods mix 1/2 pint of kerosene with one quart of oil. Never add kerosene only to the old oil in the crankcase.

OIL CHANGE - The oil level indicated by the bayonet gauge in the oil filler cap should be maintained between the full and low mark. Never allow to drop to the danger mark. In average operating temperatures (50 to 80 degress Fahrenheit) oil can be changed at every 200 hours of operation. If the temperature is above 80 or below 50 change at every 100 hours of operation. In zero or lower temperatures (cold weather operation) change oil at every 50 hours of operation.

### FUEL SUPPLY

Fuel is supplied either by gravity from a tank mounted atop the generator, or pumped to the carburetor from a remote tank by the mechanical fuel tank mounted atop the engine. Be sure all fuel connections are tight between tank and pump, and tank and carburetor. Fill the fuel tank with gasoline which may be of the leaded type. The fuel cock controlling the fuel supply must be open.

MANUAL PLANTS - Before starting the plant see that the vent valve in the fuel tank cap is open as otherwise there will be an air-lock and no fuel will flow.

STARTING REMOTE CONTROL PLANTS FIRST TIME - When Remote Control plants are started the first time, it is necessary that the engine be turned over 50 to 100 revolutions by the starting battery, to allow the fuel pump to suck fuel from the fuel tank and fill the carburetor bowl. Do not close the switch continuously. Allow five seconds of cranking and then a rest period of five seconds. Repeat the cranking operation until the plant starts.

## PREPARATION

### EXHAUST SYSTEM

All OTC models are equipped with a muffler directly mounted on the plant. Steel tubing elbows conduct the exhaust gases from the cylinder to an expansion chamber and muffler combination, which extends horizontally directly above the engine blower housing.

A 3/4" pipe nipple extends from the top of the exhaust muffler. From this exhaust outlet nipple, flexible tubing of 1" inside diameter, at least 12" long, should be connected in the event the plant is installed permanently. This provides flexibility between the plant and a permanent solid iron pipe.

If it is desired all flexible tubing from the exhaust muffler to the discharge end of the exhaust can be used. If either tubing exceeds 6 feet in length, it should be increased to 1-1/4" diameter at the muffler, to avoid back pressure in the tubing. For outdoor operation, no exhaust tubing need be connected to the muffler unless it is desired to direct the gases away from the plant.

### BATTERIES

The only batteries that are furnished are for the remote control plants and some electric start battery charging types. These batteries are of the automatic rubber case type. A complete set of cables is furnished for connecting battery to the plant.

When making the connections be sure that the polarity is observed between batteries, be sure to connect the positive (+) post of one battery to the negative (-) post of the other. The positive (+) post of the last battery connection is to be connected to the (+) post on the control panel. The same applies to the negative (-) connection. Reversing these connections would discharge and eventually destroy the battery.

Various types such as glass jar lead plate or Edison batteries may be charged but it is important that the voltage rating of the battery is approximately the same as that of the plant. Any batteries used should be handled and charged according to the battery manufacturers instructions. If these are not available follow these rules:

1. Keep all connections tight and clean.
2. Maintain the level of the electrolyte by adding only distilled water.
3. Do not charge at a higher rate than specified for the battery capacity.
4. Do not overcharge the battery or allow to reach too low a state of discharge. As an average the battery can be used between a hydrometer range of 1150 to 1250.
5. Do not allow the battery to stand in a discharged condition.
6. Periodically charge and discharge to prolong the life of the battery.

## OPERATION AND SERVICE

### STARTING PLANT

Do not attempt to start the plant until you have followed the preceding instructions. Do not connect any load until plant is started.

MANUAL PLANTS - Wind the starting rope around the grooved pulley on the generator end of the unit and give a strong pull the full length of the rope. As this is being done partially close the choke. When cold, the choke must be in a nearly closed position for the engine to obtain a rich enough mixture. When warm, only light choking is required. Care must be taken to avoid flooding or too rich a mixture. If the plant does not start at the first attempt, repeat the process. If the plant does not start after several attempts, examine the ignition system and fuel supply.

After the engine has started, continue to provide a rich mixture until it has warmed up. During the first few minutes push the choke button inward gradually until the full open position is reached without the engine hunting because of too rich a mixture or sputtering from a mixture that is too lean.

ELECTRIC START OR REMOTE CONTROL PANELS - Press the START button in the control panel. Cranking power is obtained from the batteries. Allow about 5 to 10 seconds of cranking and then stop. This is to allow fuel pump to fill carburetor. Repeat in about five seconds. Continue operation until plant starts. If starting battery is completely discharged, plants may be started in same manner as manual ones.

CONNECTING THE LOAD - The equipment to be operated or the batteries to be charged can now be connected to the plant. Provisions are made in the form of terminals, receptacles, or special plugs for making these connections. This will depend entirely on the construction and use of the plant.

STOPPING PLANT - It is well to always disconnect the load (equipment being operated before the plant is stopped). Then press the stop button mounted in the blower housing on manual plants or in the control panel or remote station on electrically started plants.

### DAILY SERVICE

FUEL - Check fuel level each two hours of operation. When necessary to refill, stop engine. DO NOT ATTEMPT TO REFILL WITH ENGINE RUNNING. Use clean gasoline of kind specified.

OIL - Check oil level approximately each fifteen hours of operation when engine is not running. Add oil to raise level to "High" mark on bayonet gauge. Plant should not be operated with oil level below the "Low" mark on gauge.

## WEEKLY SERVICE

Weekly, or after each 50 operating hours, whichever occurs first.

OIL - Check oil level and add oil, if needed. If plant requires oil change (see preparation) drain oil from crankcase while plant is warm. Replace drain plug and refill crankcase to proper level with clean, new oil of proper kind and viscosity.

OTHER LUBRICATION - Place one drop of light lubricating oil on each of the following points: throttle shaft bearings of carburetor, governor link ball joints, carburetor choke shaft bearings.

DUST OR DIRT - Under adverse sand or dust conditions it is necessary to check the power unit and service it more often.

1. Keep the power unit as clean as possible.
2. See that the supplies of fuel and oil are in air tight containers.
3. Check the ignition points more often and clean as is necessary.
4. Clean both the air cleaners and refill the oil cups as often as is necessary. Check daily.
5. Clean commutator and brushes often. See that brushes ride easily in the holders.

## MONTHLY SERVICE

Monthly, or after each 200 operating hours, whichever occurs first.

Follow instructions given under Weekly Service in addition to the following points:

IGNITION - Remove the cover from the ignition breaker mechanism. Turn the engine over by hand until the breaker points are open. Clean the points; set the gap at .020" unless otherwise specified on the plant, and replace the cover.

SPARK PLUGS - Remove the covers from the spark plugs and the spark plug from the cylinder head. Clean and reset the plug point gap so that it is from .025" to .030". If porcelain is cracked or points are too pitted replace the plugs.

FUEL SYSTEM - Close the shut off valve under the fuel tank. Remove the glass bowl from the fuel pump or filter. Clean both the bowl and the screen and then replace. Open valve and check for leaks.

GENERATOR - Remove cover from generator brushes. Inspect commutator on D.C. plants and collector rings on A.C. plants. Inspect brushes and replace with new ones any that are worn to approximately 5/8" length. Brushes must slide freely in holders and have uniformly good spring tension. New brushes must be sanded to seat properly. See detailed instructions under subject of "GENERATOR" and give generator any additional attention that careful visual inspection indicates is needed. Replace generator cover.



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## CONTROL SYSTEM

The electric self-start and the remote control plants have a control cabinet mounted at the generator end of the plant. Reference should be made to the wiring diagram whenever servicing the electrical system.

## SELF-STARTING

The self-start control is used on the D.C. plants. It consists of a manually operated start switch, a charge relay and a charging ammeter. On the starting cycle, the current flows from the starting batteries through the start switch to the generator which acts as a starting motor. After starting, the switch is released and opens the starting circuit. As the plant generates current, a charging current flows through the charge relay and ammeter to the starting batteries. This type of control permits starting at only the plant and stopping at either the plant or a remote station.

## REMOTE CONTROL

The remote control is used on the A.C. plants. It consists of a start-stop switch, start relay, charge relay, charge ammeter, a charge rheostat and a set of remote terminals. This control permits starting and stopping either at the plant or at any remote point up to within 250 feet of the plant.

Pressing the start button closes the start relay. Current from the starting batteries is then fed to the generator whose exciter acts as a starting motor. Upon release of the start button, the start relay opens the starting circuit. Upon reaching speed the exciter part of the generator becomes a generator in itself. Current then flows into the charge relay rheostat and ammeter and then to the starting batteries. The rheostat controls the charging rate to the batteries.

PROPER STARTING - The proper method of starting any self-starting switch is to intermittently close the start button for a period of about five seconds, and release for a second or two. Then if the plant does not continue to run, press the start button the second or third time, until the plant continues to operate.

STOPPING CYCLE - When the Stop Button at the plant or at a remote start-stop switch is pressed, the ignition secondary circuit is grounded, thereby causing a failure of ignition and stopping the engine.

SERVICING - Although it is not necessary to regularly service the electrical control system, it is advisable to inspect the relay contracts occasionally. If the controls are pitted or burned they should be cleaned carefully with 00 sandpaper.

# OTC ACCESSORY SERVICE SHEET

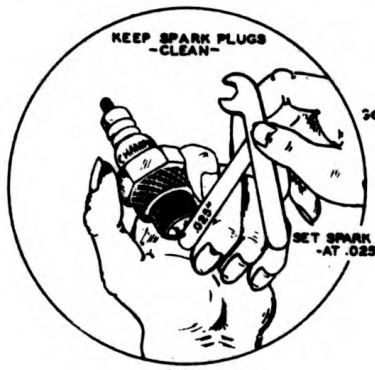
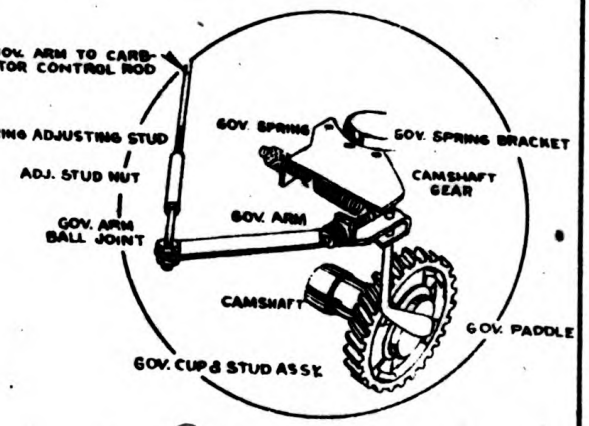


FIG. 2



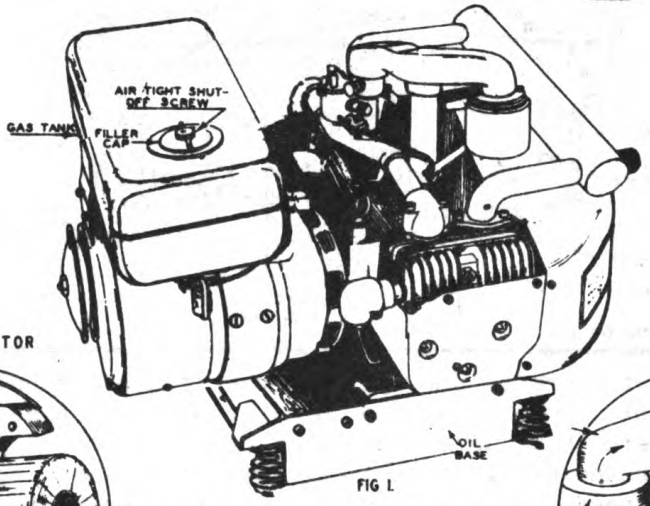
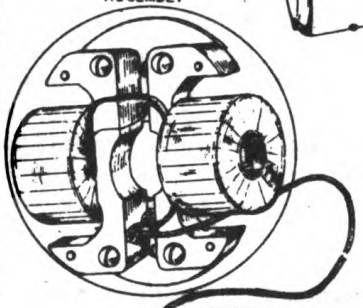
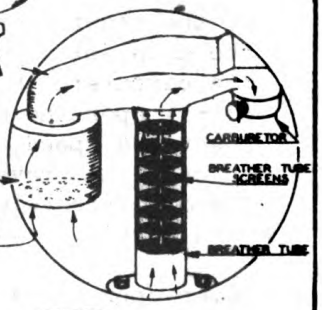
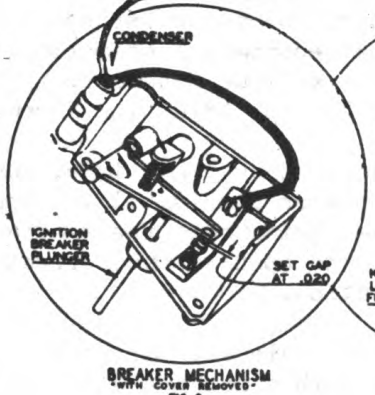



FIG 1.

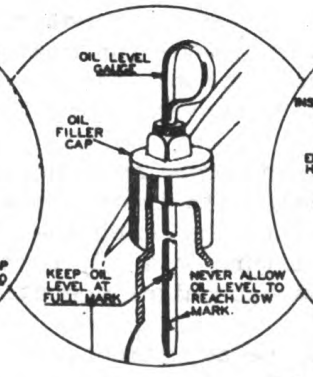
FIG. 4
MAGNETO STATOR ASSEMBLY

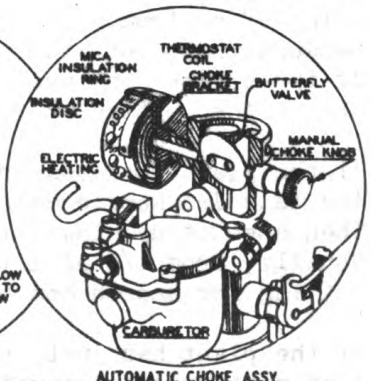




BREAKER MECHANISM
"WITH COVER REMOVED"
FIG 6



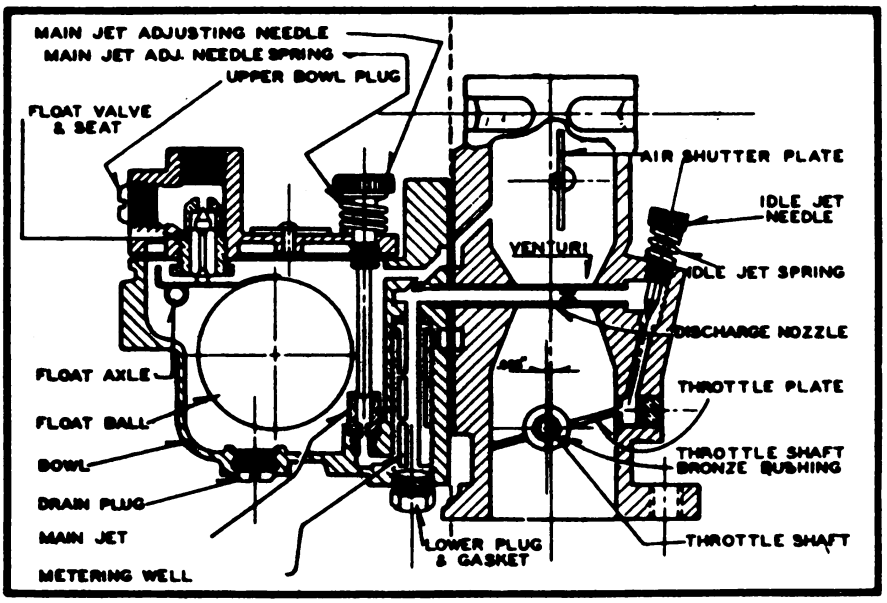



AUTOMATIC CHOKE ASSY.
USED ON FULL ATOMATIC & SELF STARTING MODELS
FIG. 8

## ACCESSORY SERVICE

### CARBURETOR

This plant is equipped with a Zenith TU3Y carburetor of the adjustable jet type. Very little care or attention need be given this carburetor outside of an occasional cleaning about once a year to insure that the bowl has not become filled with sediment.




If the plant operates unevenly under half load or full load, turn the Main Jet Adjusting Needle out 4 or 5 turns, then turn it into the carburetor bowl until the plant begins to lose speed and power. Slowly open the needle adjustment until the plant regains maximum power and speed. That is the correct setting, although sometimes in order to prevent the engine from hunting (gaining and losing speed alternately) it may be necessary to open the adjustment 1/2 turn more.

Never open the Main Jet Adjustment more than 1/2 turn from the point of maximum power in order to get rid of a hunting condition because the plant will not give the most economical operation. If the engine continues to hunt, then it will be necessary to change the setting of the Governor Arm Fulcrum Adjusting Screw.

If the plant operates unevenly under no load or light load, turn the Idle Jet Needle down into the carburetor body until it stops. Then open it up slowly to the place the engine runs the smoothest. Usually, from 1/2 of a turn to 1-1/4 turns open is the correct setting for smooth and economical operation.

If the plant has just one adjustment, the Idle Jet Adjustment, that particular carburetor is equipped with a set non-adjustable main jet. If the plant runs unevenly under no load or light load, turn the Idle Jet Needle down into the carburetor body, until it stops. Then open it up slowly to the place the engine runs the smoothest. Usually, from 1/2 of a turn to 1-1/4 turns open is the correct setting for smooth and economical operation.

## ACCESSORY SERVICE

### CARBURETOR

No final adjustment should be made on the carburetor unless the plant has been in continuous operation for approximately one-half an hour, so that it is at its normal operating temperature.

Continued irregular operation of the engine, hard starting or loss of power, may indicate that the main jet of the carburetor has become clogged. The fuel passage in the jet is very small, and if foreigh material succeeds in getting through the screen and filter bowl in the fuel pump, it may become lodged in this jet. It is necessary to remove the float bowl cover of the carburetor to remove and clean the main jet.

In removing the jet with a screw driver, be careful to use one of the proper size so that the soft brass jet will not be burred or distorted. The jet should be blown out with air to clean it. NEVER USE WIRE to scrape the inside of the jet, as the size may be changed. When the jet is replaced in the carburetor body, be sure that the small fibre gasket is in place below the head of the jet.

### CHOKE SERVICE

MANUAL CHOKE - Manual chokes use a hand control. The knob on the choke wire at the end of the tubing is pulled out to provide for full choke. Then as the plant is started it is pushed in slightly until, as the plant warms up, the choke handle is finally pushed in as far as it will go.

AUTOMATIC CHOKE - The automatic choke consists of a thermostat mounted directly on the choke butterfuly shaft of the carburetor and operated by a nichrome heating element, obtaining current from the D.C. Generator winding. A valve is mounted on the choke shaft and is off-center in the body. When the engine is cranked and the air passes from the cleaner to the carburetor, the off-center position of the choke shaft allows the valve to be pushed open slightly by the air stream working against the tension created by the thermostat on the shaft.

During the period while the engine is warming up to normal operating temperatures, the small choke shaft knob or wheel, located at its top end, will indicate the choke valve is oscillating rapidly. As the engine reaches normal temperature, the oscillation will cease and the choke valve is open. With the engine cold, turning the choke knob to the left, counter-clockwise, should result in the carburetor being completely choked.

Improper operating of the choke assembly will be indicated by hard starting or irregular running during the warm-up periods. A proper adjustment of the assembly can be made by loosening the small screw clamping the thermostat housing to the carburetor choke shaft boss and rotating it in a clockwise direction (when looking at the choke knob), to decrease the air mixture, or in a counter-clockwise (when looking at the choke knob) to increase the air mixture, to a position where it will give the results indicated in the foregoing paragraphs. Re-tighten the clamp screw securely after the proper adjustment has been made.

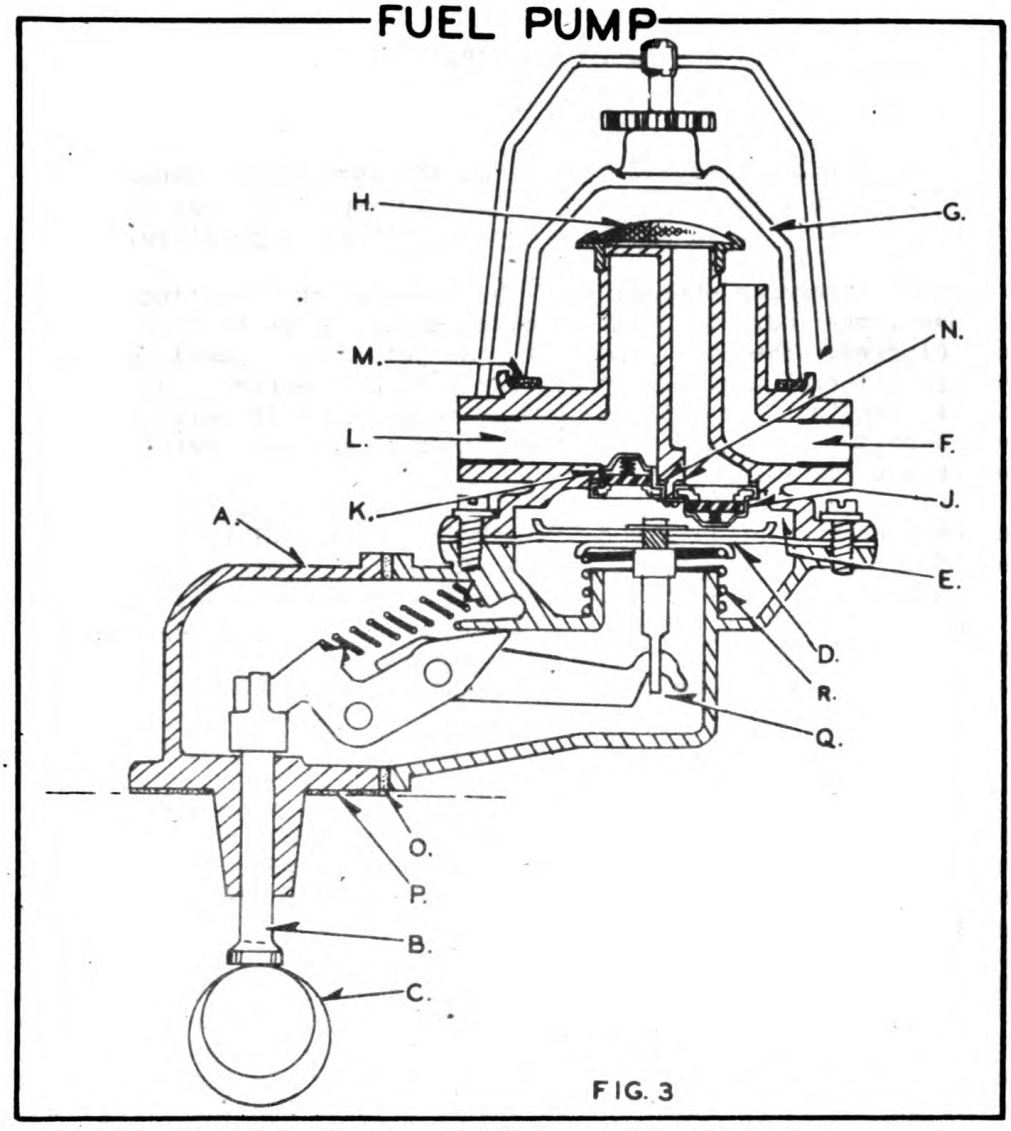



FIG. 3

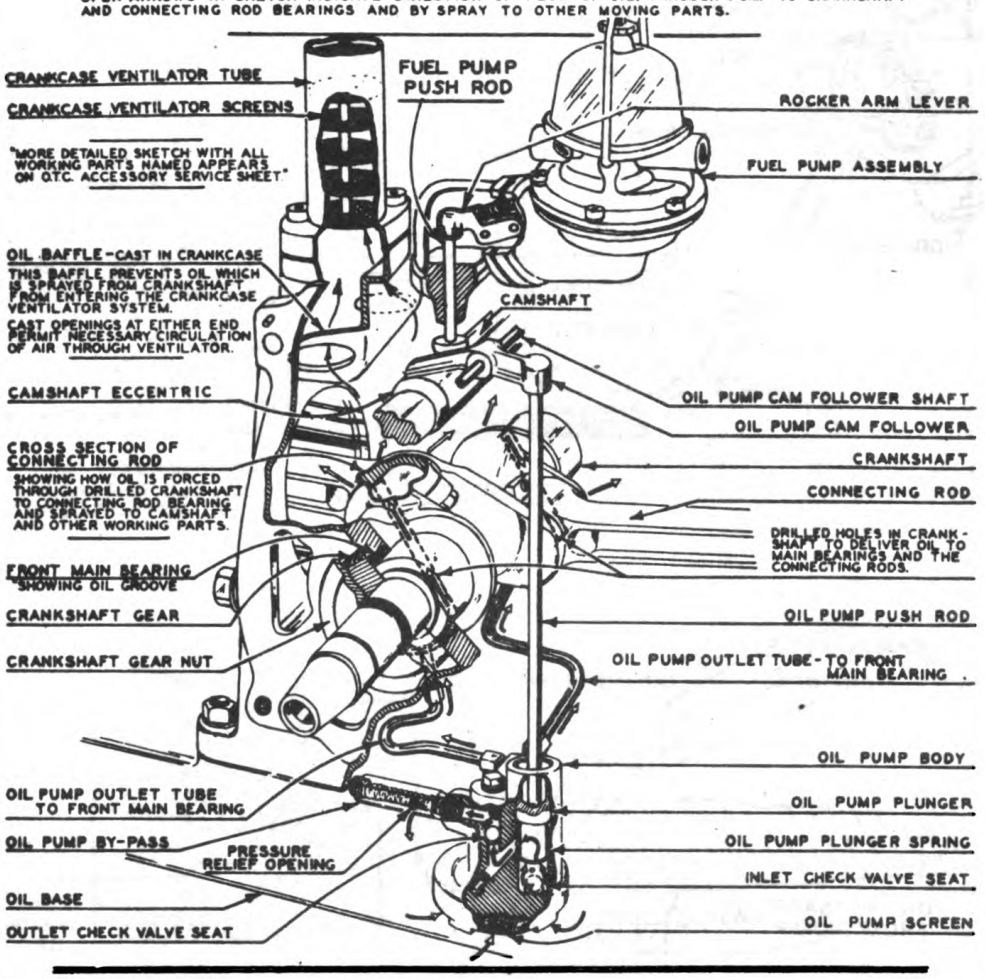
If fuel does not reach the carburetor bowl, check fuel supply, position of shut-off valve, fuel lines and strainer before disassembling the main body of the pump. The pump should be removed from the engine when the moving parts are to be inspected or replaced.

Failure of the pump to function may be due to a leaking valve, gasket or diaphragm, or to a weak or broken spring. After removing the six screws from the pump body, the two main castings may be separated to permit inspection of the interior mechanism. Replace worn or damaged parts with new ones. Valves (J) and (K) are interchangeable. Valve (J) is installed with spring down and valve (K) is installed with spring up. They are held in place by a straddle plate and two screws. Gaskets (N) must be in place before valves are installed.

The vertical driving member of the diaphragm assembly (D) hooks under the end of the lever mechanism at the point (Q) and must be disengaged at that point to be removed. When installing a new diaphragm assembly, hold the body casting in an upside down position to facilitate engagement of the diaphragm assembly with the hook on the lever at point (Q).

# OIL AND FUEL PUMP ASSEMBLY
# MODEL – O.T.C. 15 & 15B

A CLOSE STUDY OF THE ACCOMPANYING SKETCH WILL ENABLE THE OPERATOR TO BECOME THOROUGHLY ACQUAINTED WITH THE OPERATING PRINCIPLE OF THE FUEL AND OIL SYSTEMS OF THE MODEL "O.T.C." ENGINE. PARTS ARE SHOWN IN EXACT RELATION TO THEIR POSITION IN THE ENGINE. OPEN ARROWS IN SKETCH INDICATE DIRECTION OF FLOW OF OIL, THROUGH PUMP TO CRANKSHAFT AND CONNECTING ROD BEARINGS AND BY SPRAY TO OTHER MOVING PARTS.




THE FUEL PUMP OF THE MODEL "O.T.C." ENGINE IS OPERATED BY THE FUEL PUMP PUSH ROD WHICH RIDES ON AN ECCENTRIC OF THE CAMSHAFT. THE PUSH ROD IN TURN OPERATES THE FUEL PUMP ROCKER ARM LEVER PUMPING FUEL INTO THE FUEL FILTER BOWL AND ON THROUGH INTO THE CARBURETOR.

THE OILING SYSTEM IS OPERATED BY A CAM FOLLOWER LEVER WHICH RIDES ON THE SAME ECCENTRIC AS THE FUEL PUMP PUSH ROD. THE OIL PUMP PUSH ROD OPERATING FROM THIS CAM FOLLOWER LEVER, WORKS THE PLUNGER OF THE OIL PUMP LOCATED IN THE BASE OR OIL RESERVOIR OF PLANT.

THE OPERATION OF THE PUMP PROPER IS AS FOLLOWS: THE PLUNGER SPRING LOCATED UNDER THE PLUNGER FORCES SAME TO ITS UP POSITION SUCKING OIL THROUGH THE INLET CHECK VALVE INTO THE PUMP. THIS SUCTION AT THE SAME TIME CLOSES THE OUTLET CHECK VALVE KEEPING OIL IN THE SYSTEM FROM RETURNING TO THE PUMP. ON THE DOWN STROKE OF THE PLUNGER, THE INLET CHECK VALVE IS CLOSED AND THE OIL FORCED THROUGH THE OUTLET CHECK VALVE INTO THE PUMP OUTLET TUBES TO THE FRONT AND REAR CRANKSHAFT BEARINGS.

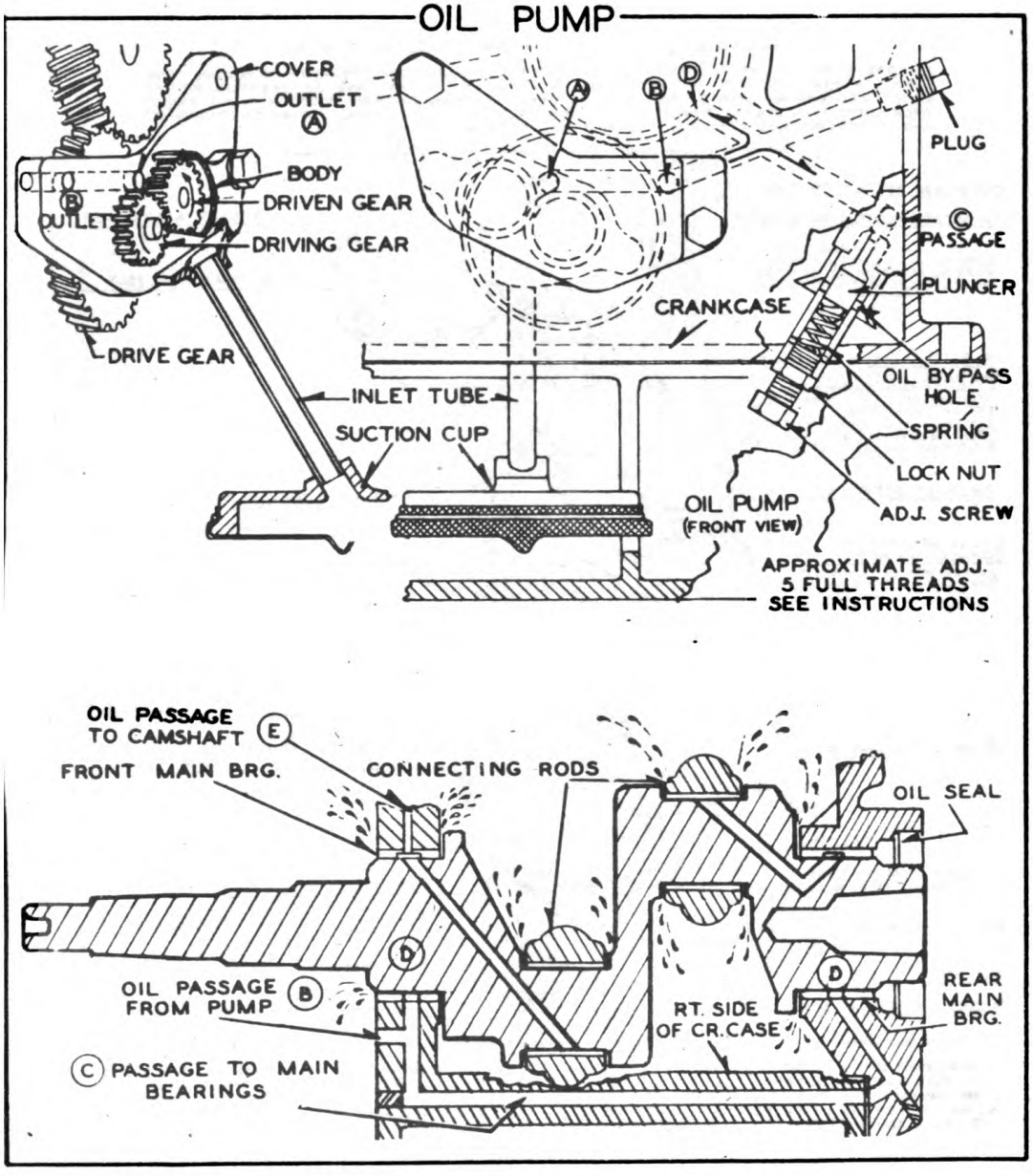
WHEN THE PRESSURE IN THE PUMP EXCEEDS APPROXIMATELY 50 POUNDS, IT IS RELIEVED BY THE SPRING LOADED BY-PASS VALVE SHOWN IN SKETCH ABOVE. THIS EXCESS PRESSURE IN THE PUMP FORCES THE BALL CHECK IN THE BY-PASS PAST THE PRESSURE RELIEF OPENING, ALLOWING EXCESS OIL TO RETURN TO THE OIL BASE. ANY FOREIGN MATTER IN THE OIL IS PREVENTED FROM ENTERING THE SYSTEM BY THE OIL PUMP SCREEN WHICH ENCLOSES THE ENTIRE BOTTOM OF PUMP.

OIL FORCED TO THE MAIN BEARINGS ENTERS AT THE CENTER OR GROOVED SECTION OF BEARINGS. THIS GROOVE COINCIDES WITH THE DRILLED OPENINGS THROUGH THE CRANKSHAFT AND ALLOWS OIL TO BE FORCED THROUGH TO THE CONNECTING ROD BEARINGS. AT THIS POINT OIL IS FORCED THROUGH THE CREVICES AT THE SIDES OF THE CONNECTING ROD BEARINGS AND IS SPRAYED TO THE CYLINDERS, CAMSHAFT AND OTHER PARTS.

THE CRANKCASE VENTILATOR SYSTEM IS PROTECTED FROM THE SPRAYING OIL BY AN OIL BAFFLE WHICH IS CAST INTO THE CRANKCASE. OPENINGS AT EITHER END OF BAFFLE ALLOW NECESSARY CIRCULATION OF AIR THROUGH THE VENTILATOR SYSTEM.

OTC-15BE

# OIL PUMP



## OIL PUMP

The oil pump is of the gear type which is positive in action and insures lubrication at all times providing there is a sufficient quantity of oil in the base of the engine.

OPERATION - The crankshaft gear meshes with and drives the main drive gear which is on the outside of the crankcase but within the gearcase. This operates the driving gear which meshes with the driven or idling gear which turns freely on a shaft in the oil pump body. The oil is sucked from the oil base thru the screened intake cup and inlet tube into the oil pump body.

## LUBRICATION

Drilled passages in the pump body, crankcase, crankshaft bearings and crankshaft conduct oil under pressure to crankshaft bearings and connecting rod bearings. Other internal parts requiring lubrication are lubricated by oil spray from these bearings.

Oil leaves the pump chamber through the outlet (A) and passes through drilled passages (B) and (C) to the crankshaft bearings. The passage (C) extends lengthwise along the side of the crankcase, thus permitting oil to be supplied to oil grooves in both the front and rear crankshaft bearings, as at (D). Drilled passages in the connecting rod journals connect with the oil grooves in the crankshaft bearings and serve to conduct oil to the connecting rod bearings.

A pressure relief valve connects with the oil passage and provides an adjustable means by which the oil pressure within the system may be regulated.

This relief valve is adjusted at the factory to maintain a working pressure of approximately 15 pounds per square inch. Higher pressures force the plunger to a position that permits oil to pass through the by-pass holes and directly into the crankcase, thus preventing any appreciable increase in pressure within the system.

One of the oil passages extends through the side of the crankcase and is closed by a screw plug at that point. Removal of this plug permits connecting an oil pressure gague for testing purposes.

Ordinarily the factory adjustment of the relief valve should not be disturbed. If the adjusting screw must be removed for any reason, the original adjustment should be noted so that it may be properly reset.

If it becomes necessary to adjust the relief valve, the adjusting screw should be set so as to extend five full threads into the body, as shown, and the lock nut securely tightened. This will provide an approximately correct adjustment which should be checked later by oil pressure gauge while the plant is operating. Any correction of the adjustment needed should be made.

## ACCESSORY SERVICE

GOVERNOR OPERATION - The governor on these plants is composed of a series of balls operating in ramps cast in the iron camshaft timing gear. See Accessory sheet. The ramps in which the balls are carried, are so designed that as the speed of the engine increases, these balls tending to move outward from the center of the shaft move forward and force the governor cup away from the face of the timing gear. A thrust point located at the center of this cup, bears against the governor shaft paddle and moves it forward. This in turn, rotates the governor shaft at the top of which is located the governor arm, linked to the throttle arm of the carburetor.

A spring mounted atop the engine and adjustable, holds the governor arm against the attempted motion of the governor cup of the governor balls, and the balance power between the governor spring and the governor balls, regulates the speed of the engine, and the voltage output of the generator.

The proper operation of the governor assemblies is abolsutely essential, as it controls the speed of the engine and the voltage output of the generator. When the governor is operating normally, the speed of the engine will be controlled within 45 RPM. That is, if the normal speed of the plant is 1800 R.P.M. no load, the speed will drop to 1755 R.P.M. when the load is increased to maximum on the generator.

If the governor assembly has not been tampered with, no change in its operation should occur. If for any reason the governor does not properly control the speed within the 45 R.P.M. range, the voltage variation, and consequently the brilliancy of lamps, will vary greatly, as the load is increased or decreased.

The only external adjustment on the governor is made by turning the governor spring nut. Increase the spring tension to increase the speed of the engine, and the voltage output of the generator, or decrease the voltage output of the generator and the speed of the engine by turning the nut in the opposite direction. After the proper adjustment has been made to bring the voltage output to the proper figure, the screw should be turned until it seats itself in its locked position.

BREAKER POINTS - The ignition breaker points used on these plants are operated by a non-metallic plunger extending from the breaker arm to the camshaft on which is cut a ramp or eccentric, which moves the plunger in and out to open the breaker points. These breaker points should be inspected occasionally, cleaned and set at .020" clearance. If the points have become badly burned and pitted, they should be replaced. An inspection should be made of the breaker arm return spring to see that it is in its proper position.

Rapid deterioration of the breaker points can be caused by a defective condenser. The breaker point condenser is mounted directly behind the breaker arm on the breaker mechanism housing. If excessive arcing occurs at this point, a faulty condenser is indicated and should be replaced by a standard Autolite or replacement condenser of .25 MFD capacity.

## ACCESSORY SERVICE

SPARK PLUGS - The spark plugs used in this plant are 14 m.m. champion #J8 or AC #43. They should be removed, cleaned and gap set to .025" to .030." A close inspection should be made to determine by the condition of the porcelain and spark electrodes if the plugs should be replaced. As a rule replacements should be made after 1500 to 200 hours of operation. The new plugs should be the same or comparable make and type.

Visual Tests of spark plug operations:

1. If the insulator is a light brown, operation is satisfactory.
2. If insulator is a dead white color, plug is too hot or mixture too lean.
3. If insulator has dull sticky deposit, plug is too cold or mixture too rich.
4. If insulator has shiny black deposit, plug is too cold or engine is pumping oil.
5. If electrodes are burned, plug is too hot or poor fuel has been used.

A "hot" plug has a large area of the insulator exposed to the burning gases. A "cold" plug has a small area of the insulator exposed to the burning gases.

AIR CLEANER - The standard air cleaner is the dry type. It can and should be cleaned periodically. Remove the three screws holding it to the air cleaner casting. Then rinse thoroughly in gasoline until all dirt is removed. Allow to dry and then dip in lubricating oil as used in the crankcase. Suspend in air and allow the oil to drain. It will probably take a period of one hour to do this. After the oil is drained, replace the air cleaner on the adapter.

If the air cleaner is of the oil bath type, it should also be clean -ed periodically. Remove the air cleaner from its holder. Pour out the old oil and clean out the dirt in the cup. Dip the cleaner in kerosene or gasoline to clean the screen. Allow to dry. Refill the oil cup with fresh oil as used in the crankcase. Replace the cleaner.

## SIX MONTHS INSPECTION

At about a six month operating interval, all of the points in Monthly Service should be carefully rehcecked.

GENERATOR BALL-BEARING - Loosen set screw in hub of starting rope sheave and remove sheave from shaft. Remove the generator ball-bearing plate and gasket. Clean hardened grease from the bearing. Refill with about one tablespoonful of approved ball bearing lubricant. Do not use ordinary cup grease. Use a new gasket. Replacing it and the plate. Tighten the screws carefully. Replace the sheave and tighten set screw securely. Clean away any grease that may have crept through the bearing to the inside of the generator.

Check all electrical connections including main line cables. If the plant has batteries, clean the contact posts, tighten the connections and cover with a petroleum jelly.



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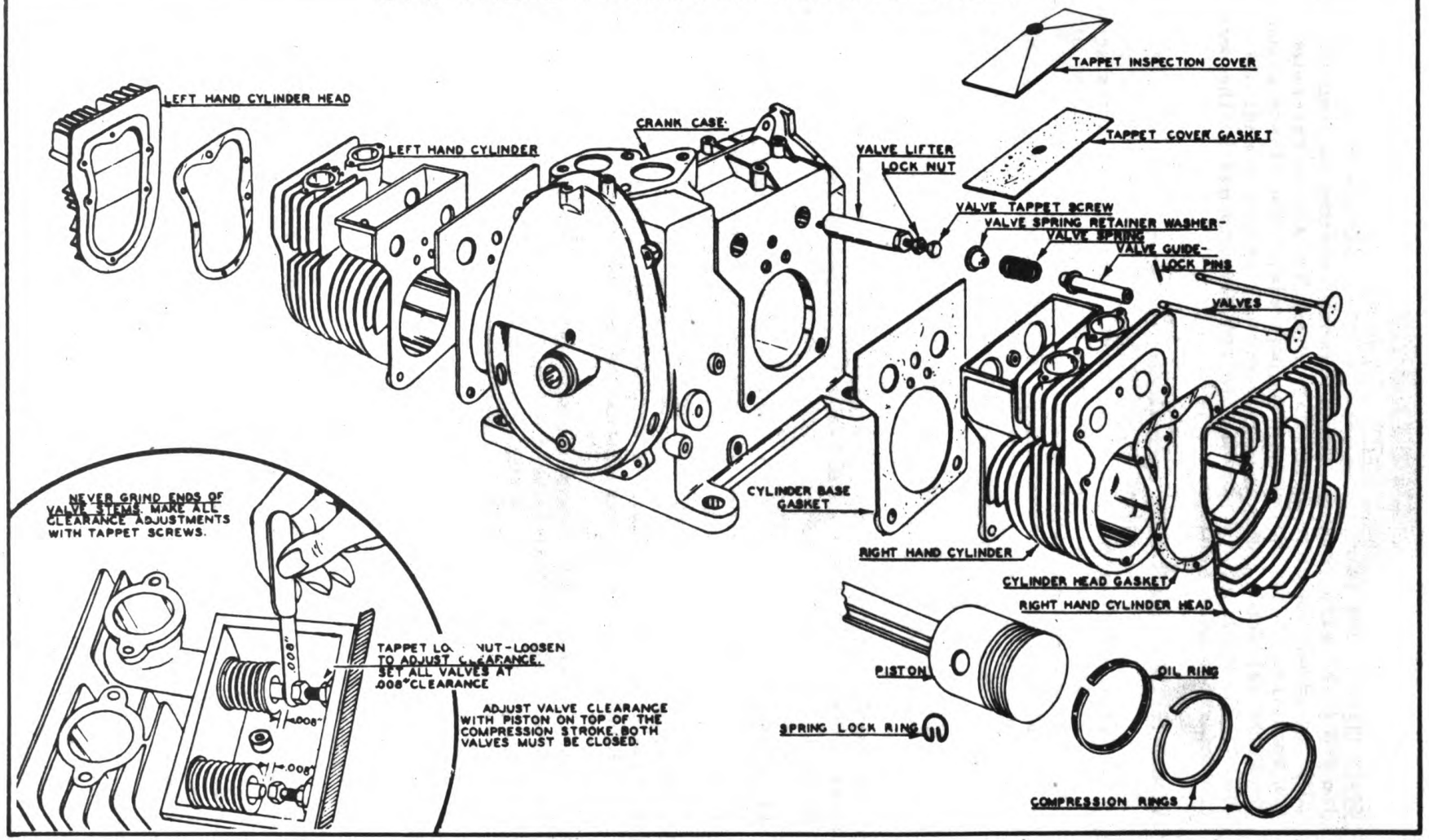
# OTC VALVE & CYLINDER SERVICE SHEET



## YEARLY ENGINE SERVICING

At the end of 2500-3000 hours of operation, approximately one year, the engine should be completely checked. All of the accessories should be cleaned, checked and adjusted. Also the pistons, cylinders, cylinder heads, piston rings, valves, etc. should be inspected. Carbon should be removed. Adjustments made, rings replaced and valves reground if necessary.

One of the most frequent service operations on even the best of gasoline engines is valve grinding. This is accompanied by a thorough cleaning of carbon.

REFER TO OTC VALVE AND CYLINDER SERVICE SHEET

Have the following parts on hand before attempting to regrind valves:

- 2 Cylinder head gaskets
- 2 Cylinder base gaskets
- 2 Valve inspection plate gaskets
- 4 Inlet and exhaust manifold Gaskets
- 1 Oil Base Gasket
- 1 Complete set of Piston Rings

The following is also suggested:
1 complete set of valves, valve springs, valve locks and guides.

DISASSEMBLING ENGINE FOR VALVE OR PISTON SERVICE: To disassemble the engine for this service follow the outlined procedure:

1. Remove carrying handle.
2. Remove blower housing and cylinder air baffles.
3. Remove exhaust muffler.
4. Remove air cleaner and crankcase breather assembly.
5. Close fuel valve and disconnect fuel line from carburetor.
6. Disconnect governor arm linkage by removing nut at ball joint connected to the throttle on carburetor.
7. Remove spark plug shields and disconnect high tension cables.
8. Remove carburetor, choke and intake manifold assembly.
9. Remove cylinder head. Do not pry - but tap sharply with a hammer if necessary.
10. Remove cylinder bolts and cylinder from crankcase. Be careful pistons do not drop and become damaged.
11. If connecting rods are to be removed, drain the oil and remove the oil base.

PISTON RINGS - Inspect piston rings carefully for fit in grooves, for tension and for seating on cylinder wall. If they fit snugly in grooves, have considerable tension when compressed to cylinder size and have bright smooth exterior surfaces, indicating correct fit to cylinder walls, they may be continued in service. Remove carefully from pistons to avoid breakage or permanent distortion. Keep in proper order so they will be replaced in same grooves and with same sides toward head of piston. Clean grooves carefully. Clean the oil return holes in pistons and in the oil-control piston rings. Scrape any carbon from exterior surfaces of pistons, including heads. Scrape carbon from inside of rings. Replace rings on pistons.

## YEARLY SERVICE

If there is any doubt about the serviceability of the old piston rings, install new ones. Fit each new ring individually to the cylinder and insert it from the crankcase end of cylinder. Observe the gap which should be approximately .010" as measured by a feeler gauge. If ring is too large it may be necessary to file gap slightly before the ring can be squared up in the cylinder.

See that each ring will slide freely in its groove and that the groove is clean and slightly deeper than the thickness of ring. If new rings are of tapered type the smaller diameter will be marked "Top", or identified in some other manner. This identified end should be placed nearer the top of the piston head.

After installing rings, lubricate rings and piston walls. Clean carbon from inside cylinders, clean gasket surfaces well. When placing cylinders over pistons, compress each piston ring carefully so it will enter the cylinder proper. Do not use excessive force. Draw the nuts down evenly, then tighten securely.

GRINDING THE VALVES - Compress the valve springs by hand and remove the locks. Remove the valves. Clean carbon deposit from valve ports, valve guides, tops of cylinders, cylinder heads and valves. Inspect valve guides for wear. These may be replaced with new ones when badly worn after long service. Valves sticking in guides may cause serious damage to the plant due to overheating, therefore, remove carbon deposits in the guides and on the valve stems.

Check the valves carefully. If the stems are warped or badly worn, replace with new valves. Valves with badly pitted or burned faces will require refacing on a valve refacer. The face should be refinished to a 45° angle with stem. If in too bad condition to reface without producing a thin edge, the valve should be replaced with a new one. Also reface the valve seats if they are badly pitted.

Use a fine grade of valve grinding compound for grinding the valves. Each valve must be ground to its own seat. Use a vacuum cup type tool and a light pressure. With a light coat of grinding compound on the valve face, place the valve in its proper seat. Turn it back and forth several times, about one-third of a turn. Then raise far enough to clear the seat and turn about one fourth turn to a new position and repeat. After several cycles of these operations, remove the valve and clean the compound from valve and seat. Inspect both and, if necessary, repeat the grinding until a bright band (1/16' wide) of uniform width extends entirely around valve face and seat.

Check each valve for a tight seat by making pencil marks across the face at intervals. Then rotate the valve part of a turn against the seat with a firm pressure. Lift out to observe if the pencil marks are all rubbed out. Regrind, if necessary. Clean valve faces, stems and seats thoroughly and reassemble to cylinders, replacing each valve in the seat to which it was ground.

## YEARLY SERVICE

TAPPET ADJUSTMENT - After the cylinders have been reassembled and tightened securely to the crankcase, the tappets should be adjusted. Adjust so the clearance between the valve stem and the valve tappet screw head is .006" to .008" for the intake valve and .008" to .010" for the exhaust valve. To obtain this proper clearance, use an accurate feeler gauge. Lock the valve tappet screw lock nut securely after the adjustment has been properly made. Tappet adjustment must be made on each cylinder with the piston at top dead center on the compression stroke.

GOVERNOR ADJUSTMENT - The proper operation is essential for correct engine speed and generator output. When the plant was disassembled, unless the entire governor arm was removed from the governor paddle shaft the only adjustments necessary would be a slight increase or decrease of spring tension at the knurled adjustment screw. Turning this screw to the right (clockwise) increases the tension on the spring and consequently the speed of the plant. Turning it to the left, decreases the speed. After proper adjustment has been made the screw should be locked securely with the lock nut turned down tightly against the spring housing of the governor arm. Place a few drops of oil on the ball joints of the governor arm linkage.

If the governor arm has become loosened from the governor shaft which extends above the top of the gearcase cover, loosen the clamp holding the arm to the shaft. Insert a screw driver in the slot in the top of the governor shaft. Turn the shaft clockwise as far as possible. Hold it in that position. Allow the governor adjusting spring to hold the arm in a normal idle position and relock the clamp screw. Then the governor adjusting screw will be reset.

The fulcrum adjusting screw on the governor arm is only set if the main adjusting screw does not provide satisfactory regulation. The fulcrum screw controls the sensitivity. Turn the screw clockwise to increase the sensitivity and counter-clockwise to decrease it. Be careful to avoid a situation where the governor will "hunt" i.e. continually oscillate so that the engine is speeding up and slowing down. Decrease the sensitivity slightly in that case.

CARBURETOR - The gasket between the intake manifold and carburetor should be replaced and the screws tightened. When replacing the gasket, inspect the carburetor. Remove any sediment or dirt that has accumulated in the bowl. Oil the moving parts as the throttle and choke arm.

RUNNING - When a reconditioned plant is first started, little or no load should be connected during the first several hours of operation. This will allow the new and reconditioned parts to wear in without excessive wear and prolong their life.

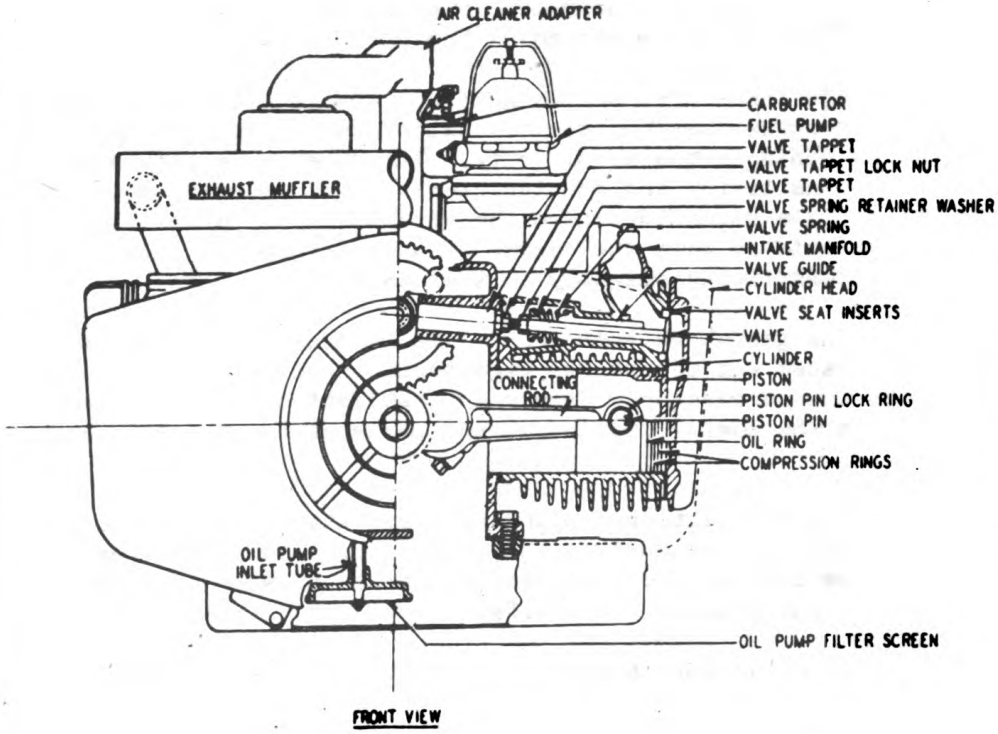
It is advisable after such a run-in period to go over each of the nuts and bolts, especially those holding the cylinder and cylinder head and retighten them. Also, remove the valve tappet cover and recheck the clearances, readjust them if necessary. Completely service plant.

CROSS SECTION
—OF—

# OTC SERIES ELECTRIC PLANT

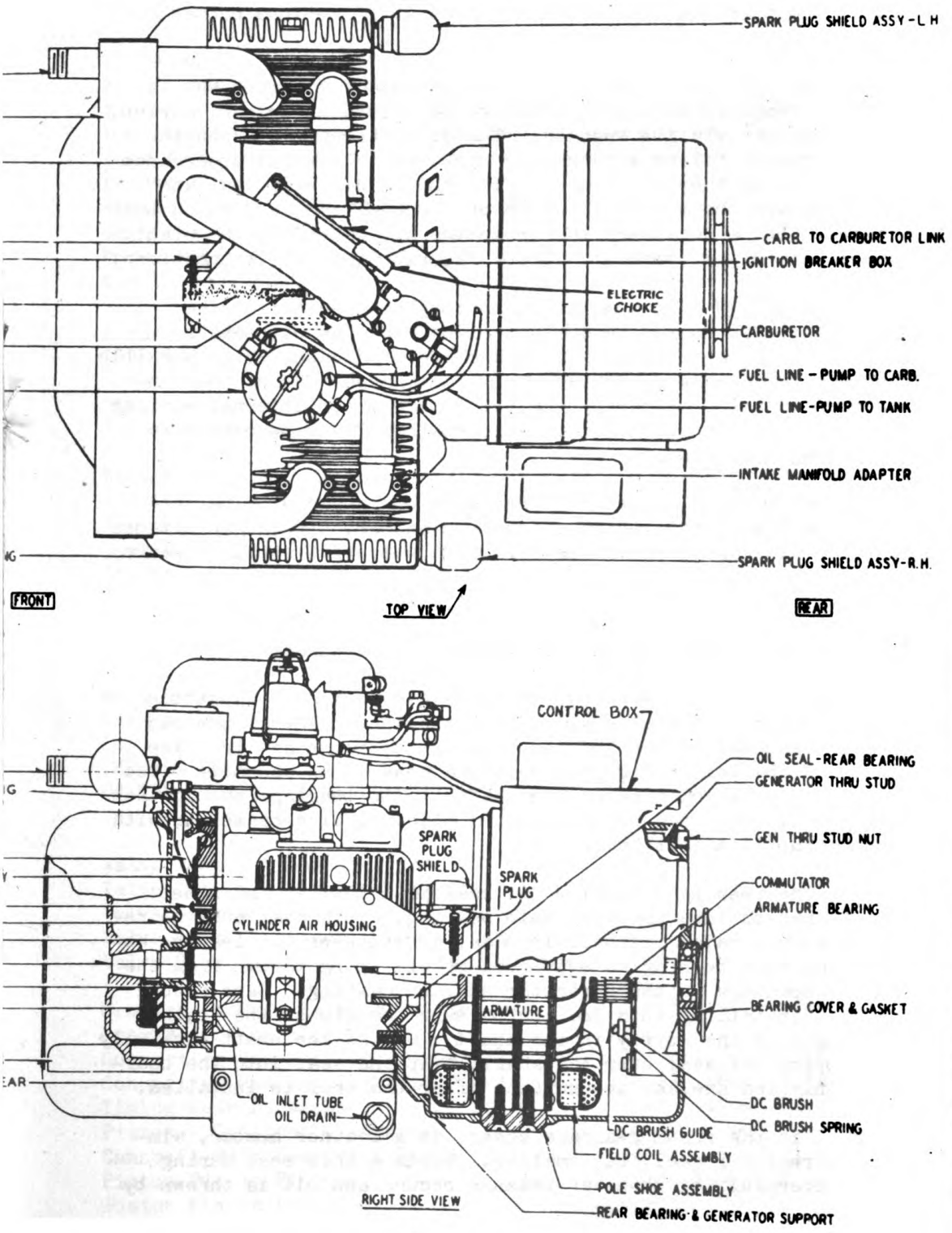
**DIMENSIONS**

LENGTH...OVERALL... 29¼"
WIDTH.....OVERALL.... 19"
HEIGHT.....OVERALL... 17"




FRONT VIEW

EXHAUST OUTLET
EXHAUST MUFFLER
AIR CLEANER
GOV. ARM
FULCROM ADJ STUD
GOV. SPRING
GOV. ADJ STUD
FUEL PUMP
ENGINE BLOWER HOUS
EXHAUST OUTLET
GOV. SHAFT BUSHI
GOV. SHAFT & PADDLE
GOV. CUP & STUD AS
GOV. CUP STOP SCRE
ENGINE GEARCASE
GEARCASE OIL SEAL
ENGINE CRANKSHAFT
CRANKSHAFT GEAR NU
MAGNETO STACK
ENGINE COOLING BLOWE
OIL PUMP DRIVE G



## MAJOR ENGINE OVERHAUL

After long periods of operation (1 to 5 years or more) a major overhaul of the engine and generator may become necessary. This is essential if the plant has become inefficient or if serious noises develop within the engine.

An overhaul of this plant should not be attempted by anyone who is not entirely familiar with the operation of modern motor car, marine, truck, tractor or aviation engines. The dismantling of the engine and generator will follow a natural course, and a careful observance of these parts, as they are removed from the plant, will indicate which of them must be replaced, which can be repaired, and which must be adjusted. It is necessary to remove the oil base from the plant, to accomplish a major overhaul. Check "Yearly Service" instructions.

CRANKCASE INSPECTION - To complete a thorough inspection of the crankcase, the case should be drained of oil and the oil base removed. By placing a trouble lamp inside the crankcase, it is possible to inspect all the working parts, or by feeling the fit of the connecting rods on their bearings, and the fit of other internal working parts, it will be possible to determine whether it is necessary to consider a major overhaul.

Worn or scored pistons, pins and rings must be replaced. The cylinders can be honed or bored to oversize diameter, and larger pistons can be used. This work should be done by a competent shop, properly equipped, or the cylinder itself can be replaced if it is impractical to hone it. The connecting rod can be adjusted if necessary, by carefully filing or dressing the connecting rod cap, to reduce the clearance between the connecting rod bearing and the crankshaft.

MAIN BEARINGS - The main bearings of the engine are not adjustable and should seldom need replacement. If this is necessary, the old bearings are punched out of the case and new bearings set in. The oil groove of the babitted bearings should head in an opposite direction to that of the rotation of the shafts. The bearings should then be line reamed. This can be done with a piloting line reamer or with a reamer set up in a drill press.

OIL SEALS - The rear main bearing oil seal is a leather and sheet metal unit pressed into the rear main bearing. This seal must be replaced whenever a major overhaul is made, or whenever oil leakage occurs from the rear bearing as evidenced by oil being thrown from the ventilating openings in the generator adaptor casting. Care should be used when installing this seal to be sure the lip of the leather is not damaged by the keyway in the shaft. Grease the shaft carefully before slipping the seal over the shaft. Tap the seal into the bearing cap evenly and shellac the surface after the seal is installed.

The oil seal in the front gearcase cover, is a leather member, similar to the rear oil seal, but smaller. Replace this seal during each major overhaul, or whenever leakage occurs and oil is thrown by the crankcase fan drive pulley.

TIMING GEARS - The camshaft of the engine on these plants is driven by a helical cut gear from the crankshaft. A steel gear is keyed on the crankshaft and retained by a large hexagon nut and washer. This gear meshes very closely with the cast iron camshaft gear into which the governor operating mechanism is built.

Replacement of the cast iron camshaft gear should not be made under normal operating conditions, unless the crankshaft gear is also replaced. When replacement becomes necessary, indicated by extreme noisiness of the gear assembly, it is necessary to remove the gearcase from the front of the engine. First drain oil from the case and remove the blower housing and cooling blower from the front of the engine. Disconnect the governor link from the carburetor and remove the forward gearcase. The timing gears will then be exposed. The hexagonal nut on the crankshaft should be removed and the timing gear can then be pulled from the crankshaft.

TIMING MARKS - Before installing a new timing gear on the crankshaft, the timing mark on the camshaft and crankshaft gear should be lined up to provide correct timing of the camshaft. After the timing gear has been pressed or tapped on to the crankshaft, the nut should be replaced and tightened securely.

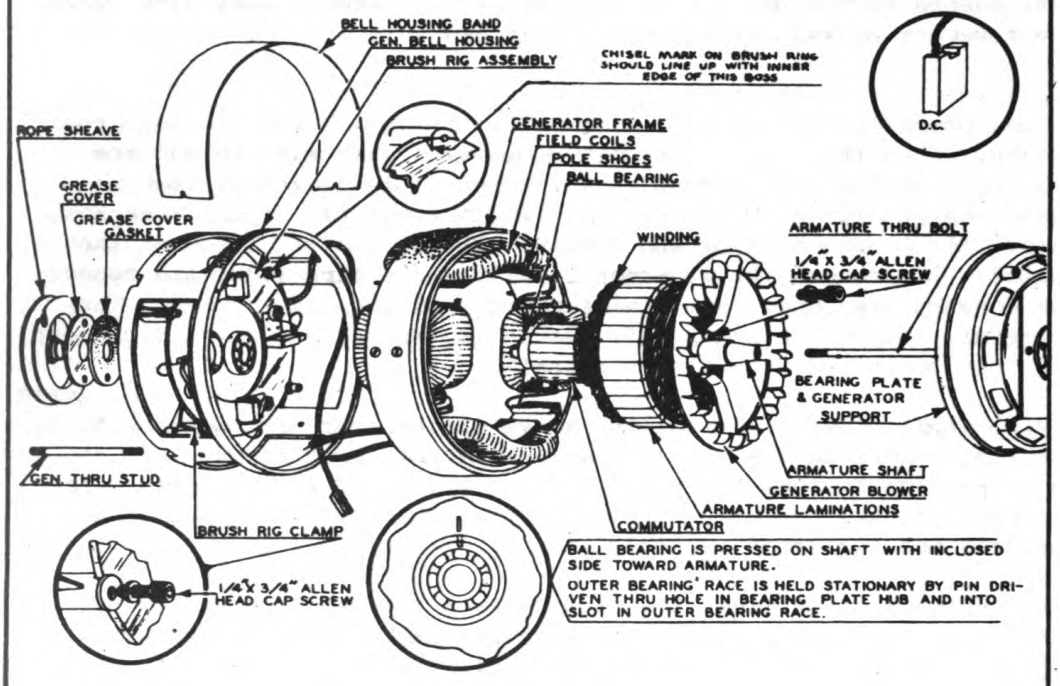
When replacement is made, the mesh between the gears should be noted carefully. A piece of ordinary newspaper should pass between the teeth of the gear without creating binding. A heavy piece of wrapping paper should not pass between the gear teeth. This test will indicate a clearance or backlash of from .003" to .005" which is desirable.

GASKETS - Whenever any major work is done on the engine, be sure that all gaskets are replaced with new ones when reassembling. A great deal of careful work and fine workmanship can be undone by trying to save a few pennies by not replacing with new gaskets.

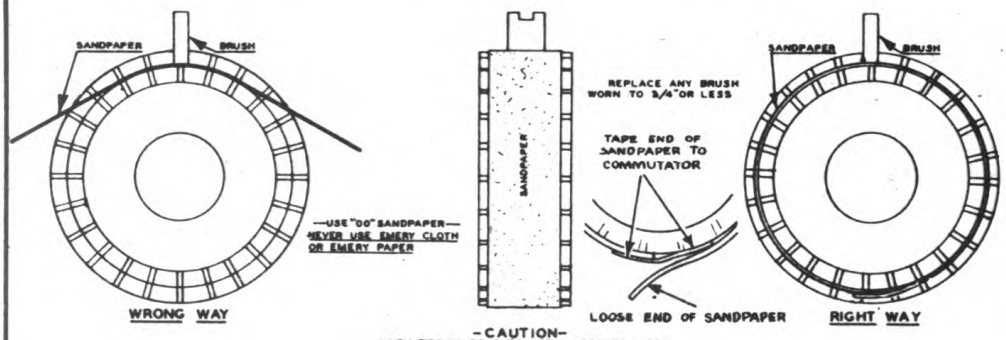
THE FOLLOWING IS A TABLE OF CLEARANCES FOR BEARINGS AND OTHER PARTS OF THE ENGINE, AND SUGGESTED METHODS FOR CHECKING THEM.

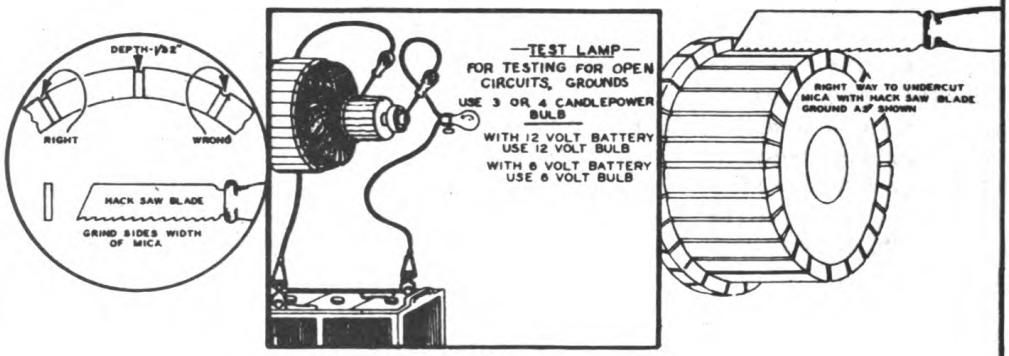
| | MINIMUM | MAXIMUM | TESTING DEVICES |
|---|---|---|---|
| Valve Tappet Clearance (Intake) | .006" | .008" | Thickness gauge |
| Valve Tappet Clearance (Exhaust) | .008" | .010" | Thickness gauge |
| Valve Seat Width (All) | .031" | .078" | (1/16" to 3/32") |
| Valve Stem Clearance in Guide (Intake) | .002" | .003" | Go-No Go Gauge |
| Valve Stem Clearance in Guide (Exhaust) | .002" (loose) | .003" | Go-No Go Gauge |
| Crankshaft Main Bearing (Diameter) | .0015" | .002" | Micrometer |
| Crankshaft End Play | .008" | .012" | Thickness Gauge |
| Connecting Rod Bearing (Diameter) | .001" | .002" | Micrometer |
| Connecting Rod Bearing (End Play) | .002" | .005" | Thickness Gauge |
| Timing Gear Backlash | .002" | .005" | Paper or hand fit |
| Piston - Cylinder Clearance | .005" | .006" | Micrometer |
| Camshaft Main Bearings (Rear) | .0015" | .002" | Micrometer |
| Piston Pin in Piston | HAND PUSH FIT | | |
| Piston Pin in Rod | .0002" | .0005" | |
| Piston Ring Ap. | .010" approximately. | | |

# OTC - - DIRECT CURRENT GENERATOR ASSEMBLY




# CARE OF COMMUTATOR AND BRUSHES



## GENERATOR SERVICE

The most common cause of a generator failing to produce current is an external short somewhere on the main line. To test this, the main line circuit should be disconnected. Place a test lamp across the output of the generator. If the plant fails to generate then the trouble lies in the generator.

The generator must be kept clean and any metal dust, dirt or grime must be removed. If the interior surfaces of the generator are oily, this must be thoroughly cleaned with some solvent such as gasoline, kerosene or carbon tetrachloride. Insulating surfaces and the commutator should be carefully cleaned of metal dust and carbon dust worn from the brushes and commutator. Loose wires can cause failure of the generator to produce current.

COMMUTATOR - Mica is used for insulation between the commutator bars. After the armature is turned, the mica is cut away about 1/32" below the surface of the bars. The surface of the bars will wear down to the level of the mica eventually. The mica is harder than the copper and it forms ridges which cause the brushes to jump and make poor contact. High mica should be undercut carefully, and the commutator turned and cleaned.

Ordinarily the commutator will require only an occasional wiping with a dry lint free cloth. It can be dressed with 00 sandpaper as shown on Generator Assembly page, if wiping with a cloth is not sufficient to clean it. If blackening appears, the cause must be determined and corrected. Use no lubricant on the commutator. It will only cause sparking and increase commutation difficulties.

FILTER CONDENSERS - All generators are equipped with 1/2 to 1 MFD condensers, mounted inside the generator frame. This condenser is connected across the line circuit and its purpose is to reduce radio interference from this source. A shorted condenser will result in no lights or current from the generator. To test whether the condenser is shorted, disconnect the lead wires from the brush terminal to which it is connected. If the generator produces current, replace the condenser. If it does not, failure is caused by some other source.

TESTING DC WINDING OR ARMATURE FOR GROUNDS - First, disconnect battery if any and line wires from plant. RAISE ALL BRUSHES FROM COMMUTATOR. Place one end of test lamp wire on commutator. Touch other end of test lamp wire on clean surface of armature shaft. If test lamp burns, the commutator or DC winding is grounded. If test lamp does not burn, the DC winding is not grounded. NOTE: A shorted or grounded DC armature circuit will generally be indicated by overheating of the armature or burned windings. The plant will run, but no current will be generated with plant running.

## GENERATOR SERVICE

TESTING FIELDS FOR OPEN CIRCUITS - First, disconnect battery and line wires from plant. RAISE ALL BRUSHES. Disconnect DC field wire. Connect one end of test lamp wire to one DC field wire. Connect other end of test lamp wire to other DC wire. If test lamp does not burn, DC field circuit is open. NOTE: Broken wires or loose connections between generator field and control panel should be checked first. An open circuit in the field winding would prevent the plant from generating.

TESTING FIELDS FOR GROUNDS OR SHORT CIRCUITS - Disconnect battery and line wires from the plant. RAISE ALL BRUSHES. Disconnect DC field wire. Connect one end of test lamp wire to DC field wire. Place other end of test lamp wire to ground on a clean surface of the generator frame. If test lamp burns, the field circuit is grounded. NOTE: A ground in the field circuit would be indicated by excessive flickering of the lights on the line, a dim light, or the generator failing to produce current. Shorted field coils will run much cooler than the rest, and may be located by feeling the temperature of the coils.

BRUSH RIG POSITION - If the brush rig has been moved it should be turned to the position marked by the small indicating point on the frame of the generator, and the notch or mark on the brush rig. This is called the neutral position, and unless the brush rig is properly replaced in this position, excessive arcing of the brushes, heating of the generator fields and armature, and low voltage production will result.

BRUSHES - Brushes require periodic inspection and eventually must be replaced. Brushes must move freely in holders when spring tension is removed. Brushes must seat well. Replace with new brushes those worn to approximately 5/8" length. Spring tension should be from 15-1/2 to 19-1/2 oz. when tested with end of spring just even with the outer end of the brush holder. Install new springs, if needed.

An extra set of brushes should be kept on hand. If necessary to replace, they must be sanded to seat properly. Provide several strips of number 00 sandpaper about 10-1/2" long. For the commutator, the strips should be 3/4" wide. Two or three feet of scotch tape will be required. Remove the fuel tank from the plant. Lift all brushes high in holders and place ends of springs in such position as to hold them high.

Place the sandpaper and scotch tape around the commutator and/or collector rings as shown in the diagram preceding. Place brushes in holders. Release brushes so they rest on sandpaper with normal spring tension. Crank plant until brushes are sanded to proper seats. Examine each brush every few revolutions and sand no more than necessary to produce proper seats. If necessary, renew the sandpaper. Remove sandpaper and tape, blow away the dust, put brushes in holders and complete the plant assembly.

Loosen the armature through-stud nut until the nut extends beyond the end of the through-stud. Strike a sharp blow with a hammer on the nut, and parallel with the stud, to loosen the taper joint between armature shaft and engine crankshaft. Remove the nut and pull the armature from the plant.

REASSEMBLING THE GENERATOR TO THE ENGINE - The reassembly may be made by reversing the procedure used in disassembling. Before the armature is reinstalled on the crankshaft, grease the taper that carries the forward end of the armature in the crankshaft so it will not rust in operation. Before installing the frame on the crankcase, remove the bearing cap from the rear of the generator, clean the bearing surface in the frame and the bearing on the armature carefully. Line up the notch in the bearing with the pin in the end frame. The frame should be installed over the armature very carefully, and the four cap screws that retain it should be tightened gradually and alternately, never pulling one down tight before the others are nearly down. Repack the bearing with ball bearing grease.

REMOVING GENERATOR FROM ENGINE - Remove the carrying case base from the plant and set the plant on a bench. Place a 2" x 4" block under each side of engine base, thus supporting the weight of the plant without weight resting on the tubular carrying frame. Remove the five screws which attach the carrying frame to the plant. One of these screws is beneath the generator. Lift the plant from the frame. By lifting first the side opposite the oil drain, and tipping the plant slightly, the drain assembly will pass through the hole in the frame. Set plant on the bench.

Close the fuel shut-off valve, disconnect the fuel line at swivel connection. Remove four screws from the fuel tank bracket and set the fuel tank aside. Remove generator cover. Disconnect the leads which connect the generator circuit to receptacle box. Remove the screws holding receptacle box to generator frame and lay the receptacle box to one side without disconnecting from the governor booster coil.

Raise all brushes to such positions in their holders that their springs, dropping down to one side, will hold brushes high in holders. Loosen set screw in hub of cranking sheave and remove sheave. If key is loose, lay it aside to avoid losing it.

Remove the four nuts from the studs which pass through the generator frame. Remove the generator frame by pulling it away from the engine. It should separate at the joint where the frame proper joins the adapter casting. (Do not attempt to pull the generator bearing support casting from the frame proper without first having disconnected the field leads.) If generator frame sticks to the adapter casting, a properly directed blow with a hammer and blunt-nosed punch will loosen it. When removing, do not allow the weight of the assembly to slide along or strike any part of the armature.

## SERVICE DIAGNOSIS

### GENERAL

BEFORE CHECKING FURTHER FOR TROUBLES BE SURE THAT ALL WIRING IS PROPERLY INSTALLED, AND THAT PLANT HAS BEEN SERVICED WITH PROPER GRADE OF FUEL AND OIL.

1. ENGINE FAILS TO START OR IS HARD TO START:
   - (a) Poor compression.
   - (b) Too Heavy Oil. Thickened due to drop in Temperature.
   - (c) Fuel Tank Empty - Low Grade of Fuel used.
   - (d) Air Lock in Fuel Line.
   - (e) Improper Fuel Mixture - Air Cleaner Clogged.
   - (f) Defective Ignition.
   - (g) Spark Plug Fouled - Too large or small gap - Porcelain Cracked.

2. ENGINE STARTS, BUT DOES NOT CONTINUE RUNNING:
   - (a) Overheated - Poor Ventilation.
   - (b) Piston Sticking.
   - (c) Air Lock in Fuel System. Air Vent Clogged.
   - (d) Dirt, Water or Ice in Fuel System.
   - (e) Heavy Load on Plant from Motors, Appliances, Etc.
   - (f) Defective or Shorted Stop Button.
   - (g) Short Circuit on Line. Defective Motors or Appliances.
   - (h) Faulty Ignition - Breaker Arm Sticking.

3. PLANT STARTS, BUT DOES NOT PRODUCE CURRENT:
   - (a) Open Line Wire or Switch.
   - (b) Defective Panel Wiring, or Hook Up.
   - (c) Blown Fuses.
   - (d) Brushes Stuck in Holders and not touching Commutator.
   - (e) Brushes worn too low and not seating properly. (See Generator Section).

4. PLANT RUNS TOO HOT:
   - (a) Spark Advanced or Retarded.
   - (b) Exhaust Back-up - Improper Discharge.
   - (c) Improper Ventilation (See Installation Section).
   - (d) Air Cleaner "Too Dirty".
   - (e) Low Oil Level or Improper Grade for Climatic Conditions.
   - (f) Carburetor Mixture too Rich.

5. PLANT USES EXCESSIVE AMOUNT OF OIL:
   - (a) Oil not changed often enough - Dirty Oil (See Lubrication Section).
   - (b) Too Rich a mixture, causing excessive Cylinder Wear. Check oil level.
   - (c) Piston Rings Stuck, due to improper Lubrication, overheating or defective plugs.
   - (d) Engine Overheated, due to poor ventilation.

## SERVICE DIAGNOSIS

### ENGINE

1. LACK OF POWER.
   - (a) Low or Poor Compression
   - (b) Ignition System Defective
   - (c) Carburetor not Functioning
   - (d) Valves not seated or timed properly
   - (e) Air Cleaner Restricted
   - (f) Low Octane Fuel
   - (g) Overheating
   - (h) Improper Grade Viscosity of Oil.
   - (i) Restricted Exhaust

2. OVERHEATING.
   - (a) Insufficient Cooling
   - (b) Improper Grade & Viscosity of Oil.
   - (c) Fuel Mixture too Lean or Rich
   - (d) Air Cleaner Restricted
   - (e) Ignition System Defective - See "Magneto" Section
   - (f) Valve Timing Too Early
   - (g) Overload

3. POOR COMPRESSION.
   - (a) Incorrect Valve Clearance
   - (b) Valve Stems Or Lifters Sticking
   - (c) Valve Stems or Guides Worn
   - (d) Valve Springs Weak or Broken
   - (e) Valve Timing Incorrect
   - (f) Cylinder Head Gasket Leaking
   - (g) Piston Rings Broken, Worn or Stuck
   - (h) Pistons or Rings Improperly Fitted
   - (i) Incorrect fuel mixture
   - (j) Cylinder Scored or Worn Excessively

4. EXCESSIVE CYLINDER AND PISTON WEAR.
   - (a) Improper Grade & Viscosity of Oil
   - (b) Lack of Oil
   - (c) Dirty Oil
   - (d) Overheating
   - (e) Piston Improperly Installed and Fitted
   - (f) Piston Rings not Properly Fitted to Piston Groove and Cylinder Wall
   - (g) Piston Rings Stuck in Piston Grooves or broken
   - (h) Air Cleaner Not Clean
   - (i) Carburetor Fuel Mixture Too Rich

5. CRANKSHAFT BEARING FAILURE
   - (a) Crankshaft Bearing Journal Out of Round
   - (b) Crankshaft Bearing Journal Rough
   - (c) Crankshaft Oil Passage Restricted
   - (d) Bearings Sprung
   - (e) Bearings Loose
   - (f) Bearings Improperly Fitted
   - (g) Bearings Loose in Crankcase
   - (h) Crankshaft or Bearings out of Alignment
   - (i) Lack of Oil
   - (j) Low Oil Pressure
   - (k) Improper Grade & Viscosity of Oil

6. CONNECTING ROD BEARING FAILURE
   - (a) Crankshaft Surface Rough
   - (b) Restricted Oil Passage
   - (c) Bearings Sprung
   - (d) Bearings Loose
   - (e) Improperly Fitted
   - (f) Loose Connecting Rod
   - (g) Bent Connecting Rod
   - (h) Lack of Oil
   - (i) Low Oil Pressure
   - (j) Improper Grade & Viscosity of Oil

## SERVICE DIAGNOSIS

### ENGINE

7. BURNED VALVES AND SEATS
   - (a) Improper Valve Clearance
   - (b) Weak Valve Springs
   - (c) Improper Valve Timing
   - (d) Late Ignition Timing
   - (e) Excessive Carbon Deposits Around Seat and Valve Head
   - (f) Valves Sticking in Guides
   - (g) Improper Type Valves
   - (h) Valve Heat Too Thin Causing Hot Sections
   - (i) Fuel Mixture Flow Restricted
   - (j) Valve Seats too Narrow
   - (k) Overheating

8. VALVE STICKING
   - (a) Incorrect Valve Clearance
   - (b) Insufficient Clearance Between Valve Stem and Guide
   - (c) Valve Springs Weak or Broken
   - (d) Valve Stems Scored or Dirty
   - (e) Valve Lifters Sticking
   - (f) Use of Fuel with High Gum Content

9. EXCESSIVE OIL CONSUMPTION
   - (a) Piston Rings Broken, Worn or Stuck
   - (b) Piston Rings Improperly Fitted
   - (c) Piston Ring Slots Clogged with Carbon
   - (d) Cylinder Bore Out of Round or Excessive Taper
   - (e) Cylinder Bore Scored or Badly Worn
   - (f) Main & rod Bearings Worn or Excessive End Play
   - (g) Overheating .
   - (h) Improper Grade & Viscosity of Oil
   - (i) Excessive Oil Pressure
   - (j) Oil Level too High
   - (k) Oil Leaks at Gaskets and Seals

10. IGNITION SYSTEM
   - (a) Loose connections
   - (b) Pitted breaker points
   - (c) Defective Condenser
   - (d) Low power source
   - (e) Stop wire Grounded
   - (f) Ignition coil defective
   - (g) Incorrect setting of points
   - (h) Leak in system

11. LOW OIL PRESSURE
   - (a) Improper Grade & Viscosity of Oil
   - (b) Oil Pressure Relief Valve Stuck
   - (c) Oil Pump Screen Clogged
   - (d) Excessive main and rod bearing clearance
   - (e) Oil Pump Gear to Housing Clearance Excessive
   - (f) Oil Pump Worn

12. POPPING, SPITTING & SPARK KNOCK

Pinging or Spark Knock - Caused by Ignition being advanced too far. Popping or Spitting - Advance or Late Ignition.

   - (a) Defective Ignition System
   - (b) Carburetor Not Properly Adjusted
   - (c) Valve Clearance Adjusted Too Close
   - (d) Weak Valve Springs
   - (e) Hot Spot in Cylinder Head
   - (f) Exhaust Valve Head Too Thin
   - (g) Excessive Carbon Deposits in Combustion Chamber
   - (h) Valves not Seating Properly
   - (i) Valve Timing Early
   - (j) Piston & Rings in Poor Condition
   - (k) Inferior Grade of Fuel

## SERVICE DIAGNOSIS

### GENERATOR

1. GENERATOR HEATING
   (a) Overload on the line
   (b) A short circuit of a coil or number of coils in the winding.
   (c) Grounds in the windings or commutator
   (d) Poor commutation
   (e) Overheating of the entire unit may be caused by:
      (1) Unequal air gap
      (2) A shorted out or grounded field winding
      (3) A reversed field coil winding

   NOTE: Any of these troubles cause a large circulating current in the exciter armature windings to the commutator, to the brushes and brush connections, which will cause artificial overloading of the armature. The air gap should not vary over a few percent either way from the average value. All field coils of the shunt type should have within 10% of the same resistance, and a higher value than this indicates shorted turns in the winding.

2. FIELD COIL HEATING
   (a) Too high an operating speed of the plant, with a resultant high output voltage.
   (b) A partial short-circuit of one coil.

3. POOR COMMUTATION
   (a) The brushes not set correctly in respect to the neutral position.
   (b) Brushes may not be fitted to the surface of the commutator.
   (c) Brushes binding in the holders.
   (d) Brushes may not be equally spaced around the commutator.
   (e) The brushes may have reached their limit of wear, with the result that there will be an insufficient amount of brush spring tension.
   (f) Brush pressure insufficient.
   (g) Some brushes may have excessive pressure, and be taking more than their share of the current.
   (h) The carbon brushes may be of an unsuitable grade. Metal graphite brushes are generally not used on voltages higher than 30 to 40 volts. Great care must be taken to be sure that the proper grade is operating on the machine when replacements are made.
   (i) Commutator bars may be loose or projecting above the others.
   (j) High Mica. This prevents a proper contacting surface between the brush and the commutator.
   (k) A variation in the air gap of the machine or strength of the field poles, will also cause severe sparking at the commutator.

## SERVICE DIAGNOSIS

### GENERATOR

4. FAILURE OF GENERATOR BUILD-UP
   (a) The speed of the set may be below normal.
   (b) A reversed field winding.
   (c) A reversed shunt field.
   (d) The brushes incorrectly located, and not on neutral position.
   (e) An external short circuit on the line would prevent its building up.
   (f) An open circuit in the shunt field.

5. BRUSHES - See that the brushes move freely in the holders and at the same time make firm even contact with the commutator. The brushes should all have the same spring tension to prevent one from carrying more than its share of the load. An extra set of brushes should always be kept on hand.

See that both the interior and the exterior of the machine are kept free from metal dust, dirt of any description or water.

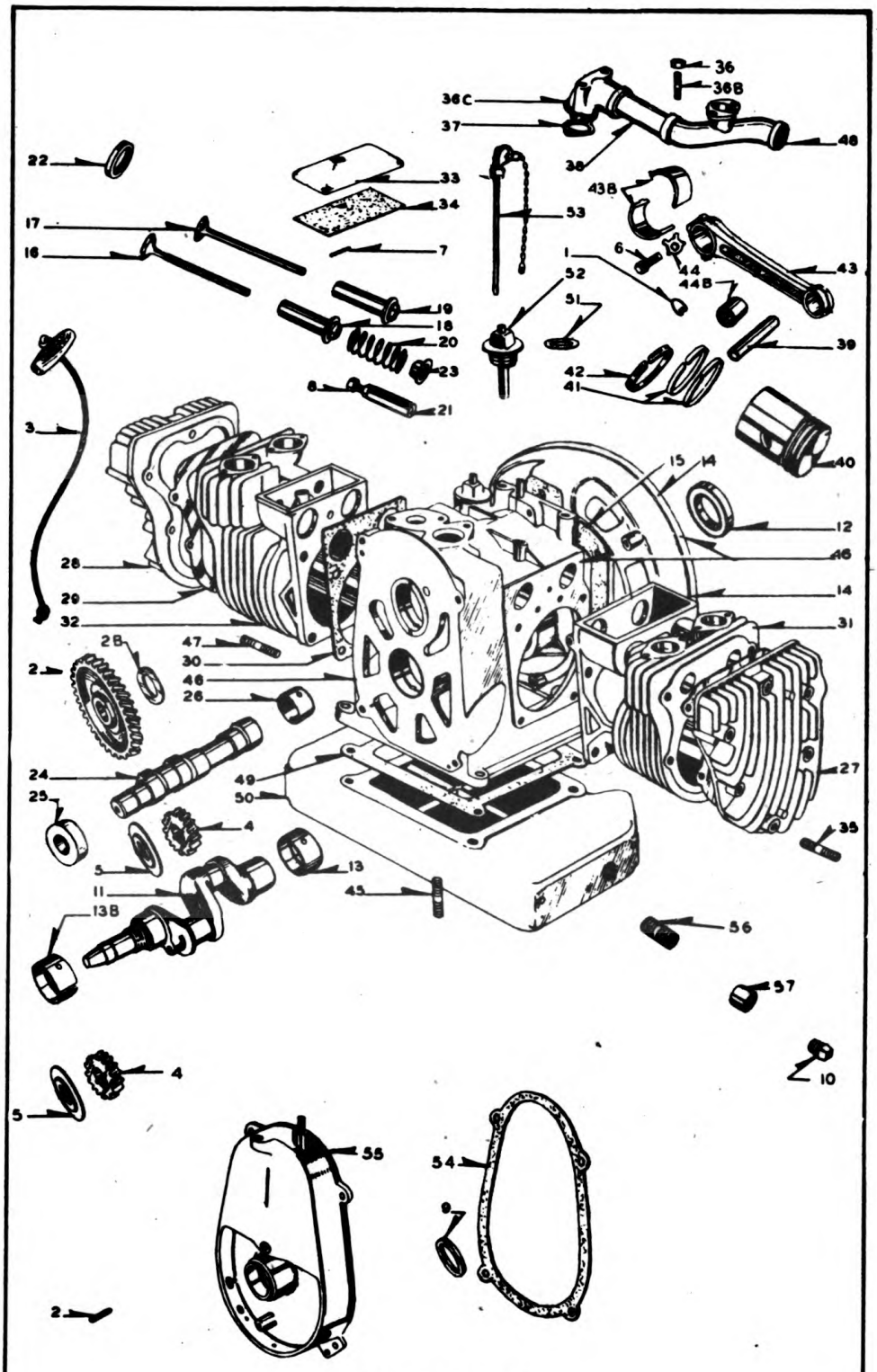
6. NOISE IN BRUSHES - Noise in brushes is due to a rough commutator, caused by high and low bars. This difficulty may only be corrected by turning the commutator in a lathe.

7. COMMUTATOR - Mica is used for insulation between the commutator bars. After the armature is turned, the mica is cut away about 1/32" below the surface of the bars. The surface of the bars will wear down to the level of the mica eventually. The mica is harder than the copper, and it forms ridges which cause the brushes to jump and make poor contact. High mica should be undercut carefully, and the commutator re-turned and cleaned.

The commutator should maintain a polished surface. Blackening of all the bars indicates incorrect brush positions. Blackening of groups of bars at regular intervals indicates a rough, eccentric commutator.

A severly burned bar or number of bars, indicates an open circuit in the armature, which will also be noted by excessive flashing when the machine is operating with load. This type of difficulty can only be corrected by competent armature repair service men.

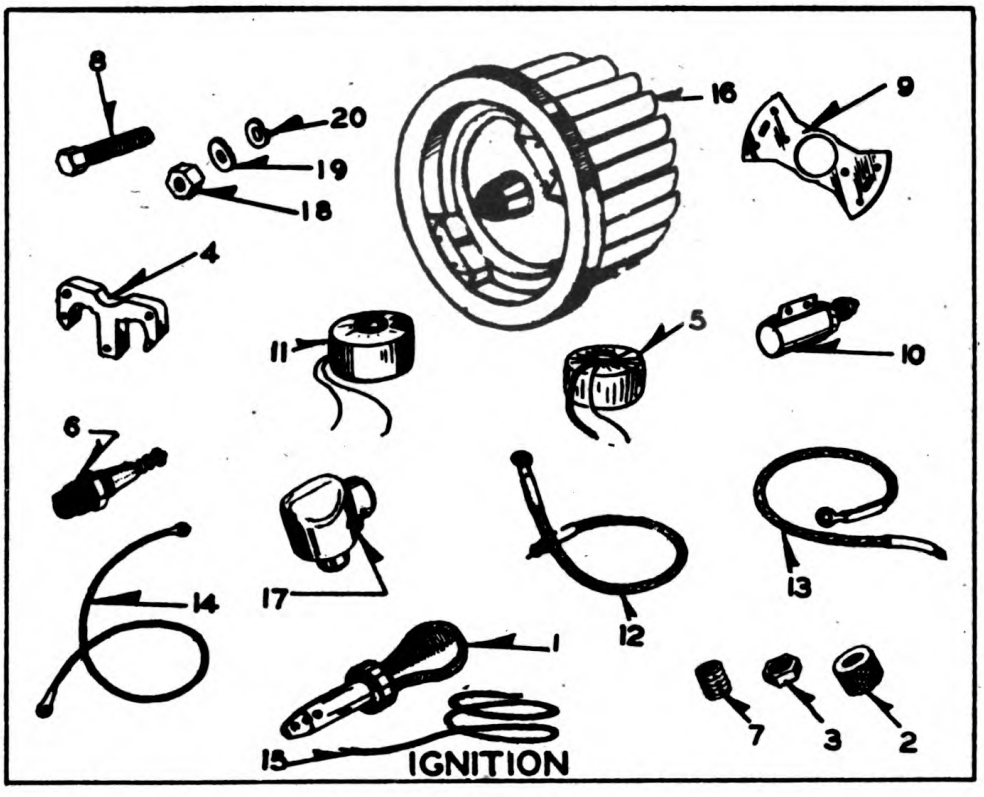
Ordinarily the commutator will require only an occasional wiping with a non-linting material, but if blackening appears and grows worse, the cause must be determined and removed. Use no lubricant on the commutator. The use of any lubricant will only cause sparking and increase the commutation difficulties.



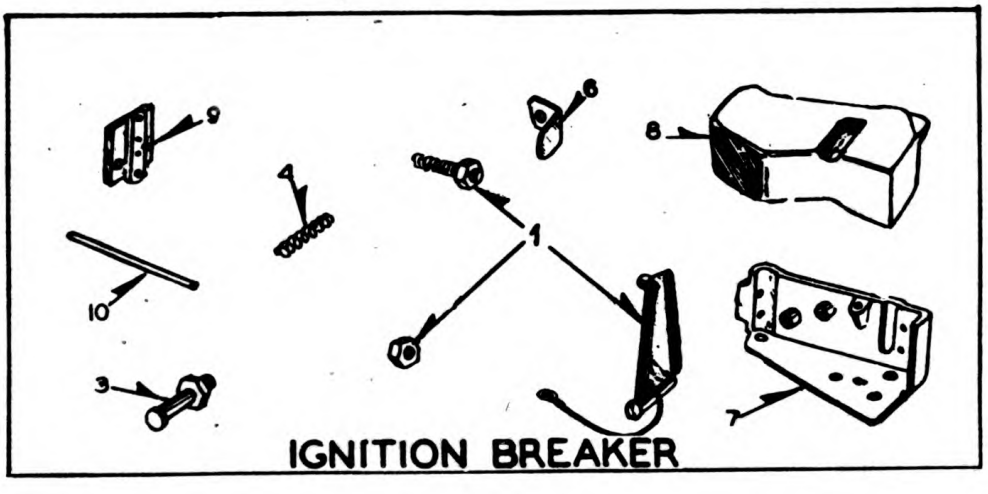

ENGINE PARTS

## OTC STANDARD E
## FORGED ROD AND CRANKSHAFT

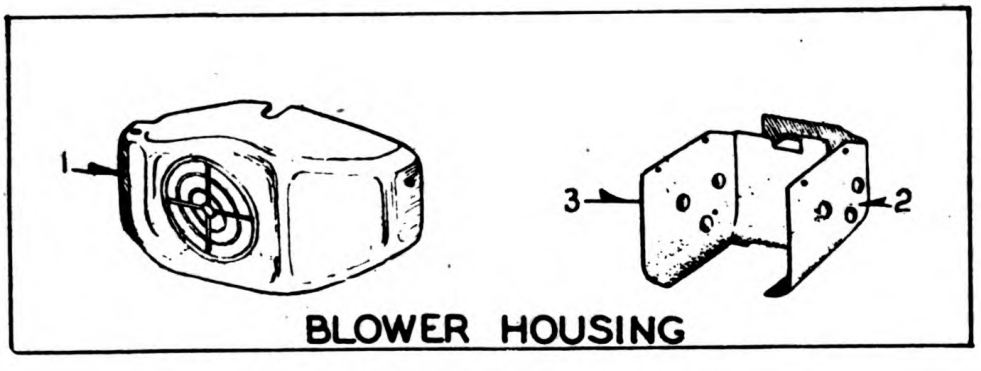
| NO. | PART NO. | PART NAME | PRICE EACH |
|---|---|---|---|
| 1 | 609 | Piston Pin Lock Ring | .05 |
| 2 | 19086 | Camshaft Gear (4 used) | $ 3.50 |
| 2B | 19082 | Camshaft Gear Spacer Washer | .10 |
| 3 | 1057 | Starter Rope | .50 |
| 4 | 19001 | Crankshaft Gear | 3.00 |
| 5 | 8002 | Crankshaft Gear Nut | .60 |
| 6 | 19226 | Connecting Rod Cap Screw - Use with Connecting Rod 19222 | .10 |
| 7 | 8032 | Valve Spring Retaining Washer Lock Pin | .05 |
| 8 | 8037 | Valve Tappet Screw - 1/4" x 3/4" SAE | .25 |
| 9 | 8127 | Gearcase Oil Seal - Graphite Cork | .20 |
| 10 | 10702 | Oil Drain Plug - 3/8" Pipe Plug | .10 |
| 11 | 19006 | Crankshaft - Forged | 12.00 |
| 12 | 19003 | Crankshaft Oil Seal - Victor #60562 | 1.00 |
| 13 | 19011 | Crankshaft Bearings - Front & Rear | .75 |
| 14 | 19021G | Bearing Plate and Generator Support - Used with Geared Type Oil Pump | 3.50 |
| 15 | 19022G | Bearing Plate and Generator Support Gskt | .25 |
| 16 | 19029 | Exhaust Valve | .75 |
| 17 | 19030 | Valve Intake | .75 |
| 19 | 19031B | Valve Guides- Intake & Exhaust | .30 |
| 20 | 19032 | Valve Spring | .15 |
| 21 | 19033 | Valve Lifter | .90 |
| 22 | 8033 | Valve Seat Insert | .50 |
| 23 | 19035 | Valve Spring Retainer Washer | .10 |
| 24 | 19080 | Camshaft | 6.50 |
| 25 | 19077 | Camshaft Bearing - Front | 1.00 |
| 26 | 19078 | Camshaft Bearing - Rear | .65 |
| 27 | 19089 | Cylinder Head - Right Hand | 3.75 |
| 28 | 19090 | Cylinder Head - Left Hand | 3.75 |
| 29 | 19092 | Cylinder Head Gasket | .65 |
| 30 | 19173 | Cylinder Base Gasket | .20 |
| 31 | 19175 | Cylinder - Right Hand | 12.00 |
| 32 | 19176 | Cylinder - Left Hand | 12.00 |
| 33 | 19183 | Valve Box Cover | .40 |
| 34 | 19184 | Valve Box Cover Gasket | .10 |
| 35 | 19185 | Stud for Cylinder Head - 5/16" x 2-1/8" | .10 |
| 36 | 19187 | Nut for Intake Manifold | .05 |
| 36B | 19189 | Stud for Intake Manifold | .10 |
| 36C | 19190 | Intake Adapter | .85 |
| 37 | 19191 | Intake Adapter and Exhaust Muffler Gasket | .10 |
| 38 | 19192 | Intake Adapter Tube - 1"OD x 3-1/16"x21 Ga | .35 |
| 39 | 19201 | Piston Pin | .50 |
| 40 | 19209A | Piston & Pin | 4.25 |
| 41 | 19211 | Piston Ring - Compression - 3/32" x 2-3/4" | .35 |
| 42 | 19212 | Piston Ring - Oil - 3/16" x 2-3/4" | .50 |
| 43 | 19222 | Connecting Rod - Forged - | 3.75 |
| 43B | 19223 | Connecting Rod Bearing Inserts - Used with Forged Rod Per Pr | 1.10 |
| 44 | 19224 | Washer for Connecting Rod Cap Screw 19226 | .05 |
| 44B | 19225 | Piston Pin Bushing - Used with Forged Rod | .15 |
| 45 | 19242 | Stud for Oil Base - 3/8" x 1-5/8" | .15 |
| 46 | 19243G | Crankcase and Bearing Plate Assembly - with Bearings Fitted - Used with Gear Type Oil Pump - Specify Cylinder Bore when ordering crankcase | 35.00 |
| 47 | 19244 | Stud for Cylinder Base - 5/16" x 1-5/8" | .15 |
| 48 | 19272A | Intake Manifold - Center Section | 2.25 |
| 49 | 19276 | Oil Base Gasket | .20 |
| 50 | 19285 | Oil Base | 6.50 |
| 51 | 19297B | Gasket for Oil Filler Cap | .10 |
| 52 | 19297 | Oil Filler Cap and Bushing Assembly | .50 |
| 53 | 19298 | Oil Filler Gauge with Chain | .35 |
| 54 | 19312 | Gearcase Gasket | .25 |
| 55 | 19313 | Gearcase - Used with Wico or Onan Magnetos- with Governor Shaft & Bearings | 4.50 |
| 56 | 76775 | Oil Drain Pipe Nipple - 3/8" Close | .10 |
| 57 | 76776 | Oil Drain Pipe Coupling - 3/8" | .15 |




IGNITION




IGNITION BREAKER




BLOWER HOUSING

## IGNITION

| NO. | PART NO. | PART NAME | PRICE EACH |
|---|---|---|---|
| 1 | 1748 | Battery Hydrometer.....$ | .75 |
| 2 | 5944 | Wire Shield Flange Coupling Nut..... | .25 |
| 3 | 5945 | Wire Shield Nipple Lock Nut..... | .10 |
| 4 | 8408A | Magneto Coil Shoe.....(2 used) | 1.00 |
| 5 | 8410 | Magneto Coil - AS 9260 - Right Hand..... | 2.40 |
| 6 | 8910 | Spark Plug J10 Champion 14 mm..... | .65 |
| 7 | 19305 | Wire Shield Nipple..... | .20 |
| 8 | 19402 | Magneto Wheel Bolt - 3/8" x 2-1/4" S.A.E. (3135) Hex. Hd..... | .25 |
| 9 | 19410 | Duplex Magneto Backplate..... | .85 |
| 10 | 19411 | Magneto Condenser .5 MFD..... | .75 |
| 11 | 19412 | Magneto Coil - AS 10871 - Left Hand..... | 2.40 |
| 12 | 19418 | Spark Plug Cable - Right Hand - 20-1/4"..... | .65 |
| 13 | 19414 | Spark Plug Cable - Left Hand - 17-3/4"..... | .65 |
| 14 | 19415 | Magneto to Breaker Condenser Lead - 19-1/2". | .25 |
| 15 | 19417 | Magneto Primary Stop Wire - 19-1/2"..... | .20 |
| 16 | 19425A | Magneto Wheel Assembly with Rim..... | 10.00 |
| 17 | 19853A | Spark Plug Shield Assembly.....(2 used) | .75 |
| 18 | | Hex. Nut - 1/2" U.S.S. - Used only with Crankshaft #19006 Forged Crkshaft.. | .05 |
| 19 | | Flat Washer - 1/2" - Used only with Crankshaft #19006 Forged Crkshaft.. | .05 |
| 20 | | Lock Washer - 1/2" - Used only with Crankshaft #19006 Forged Crkshaft.. | .05 |

## IGNITION BREAKER

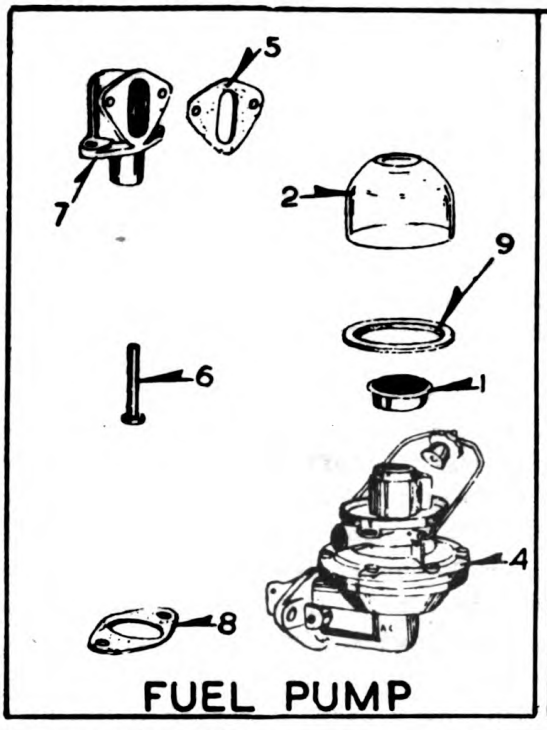
| | | | |
|---|---|---|---|
| 1 | 19337 | Ign. Contact Point & Arm Set..... | 1.00 |
| 3 | 8441 | Ignition Breaker Arm Stud..... | .20 |
| 4 | 12013 | Breaker Arm Spring..... | .10 |
| 6 | 12020 | Breaker Spring Bracket..... | .10 |
| 7 | 19340 | Ignition Breaker Plate..... | .95 |
| 8 | 19341 | Ignition Breaker Plate Cover..... | .75 |
| 9 | 19343A | Contact Strip Insulator & Contact Strip Assy | .35 |
| 10 | 19344 | Breaker Plunger..... | .25 |

## BLOWER HOUSING

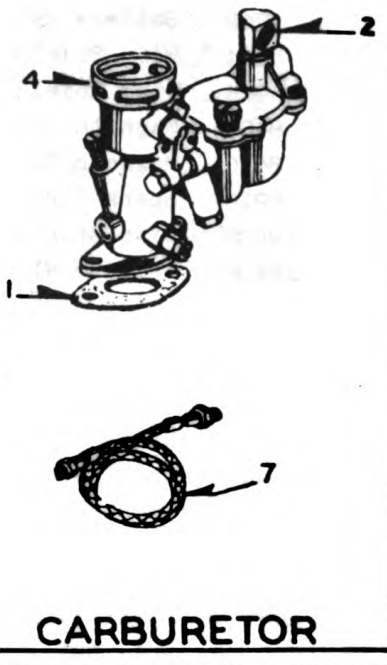
| | | | |
|---|---|---|---|
| 1 | 19325 | Blower Housing Only..... | 10.00 |
| 2 | 19335 | Cylinder Air Housing - Right Hand..... | 2.75 |
| 3 | 19336 | Cylinder Air Housing - Left Hand..... | 2.75 |

## FUEL PUMP

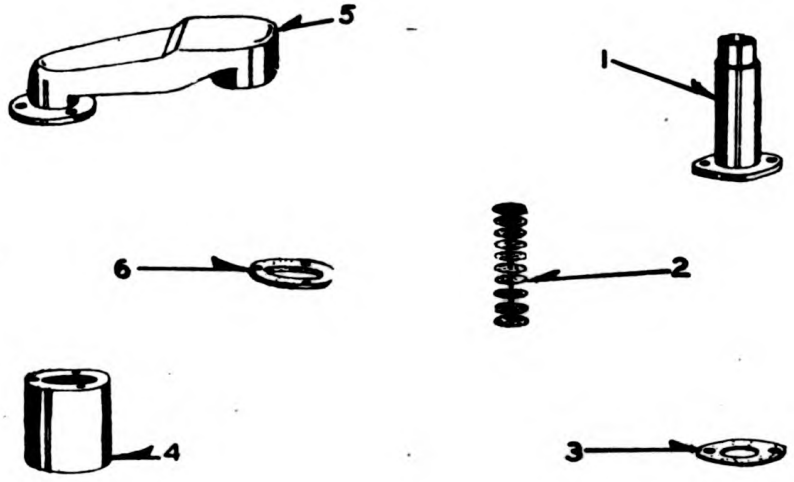
| | | | |
|---|---|---|---|
| | 19488 | Fuel Pump Kit - Not Illustrated..... | .75 |
| 1 | 19474B | A.C. Fuel Pump Filter Screen #864009..... | .20 |
| 2 | 19471 | Fuel Pump Glass Bowl..... | .30 |
| 4 | 19474 | Fuel Pump Assembly - #1537966..... | 7.50 |
| 5 | 19476 | Fuel Pump Gasket..... | .10 |
| 6 | 19477 | Fuel Pump Push Rod..... | .40 |
| 7 | 19478 | Fuel Pump Adapter - Cast Alum..... | 1.25 |
| 8 | 19479 | Fuel Pump Adapter Gasket..... | .10 |
| 9 | 19473 | Fuel Pump Bowl Gasket..... | .10 |
| | | Fuel Pump Push Rod Cotter Key - 3/64" x 5/8" | .05 |



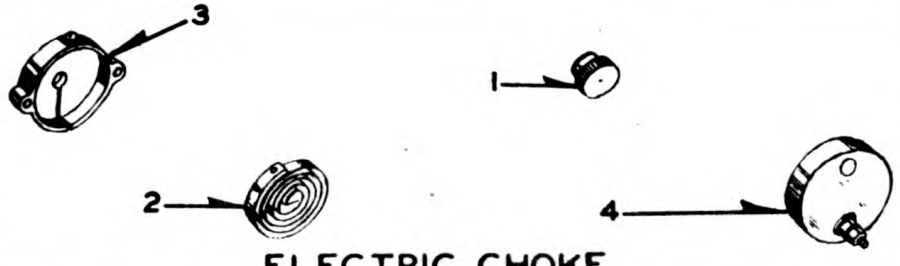

FUEL PUMP




CARBURETOR




AIR CLEANER




ELECTRIC CHOKE

## CARBURETOR

| NO. | PART NO. | PART NAME | PRICE EACH |
|---|---|---|---|
| 1 | 5656 | Carburetor Flange Gasket | $ .10 |
| 2 | 10697 | Inverted Male Elbow - 1/4" x 1/8" | .25 |
| 4 | 19802 | Carburetor Assembly - Zenith | 12.00 |
| 7 | 19468 | Fuel Line - Pump to Carburetor (Flexible) | 1.25 |

## AIR CLEANER

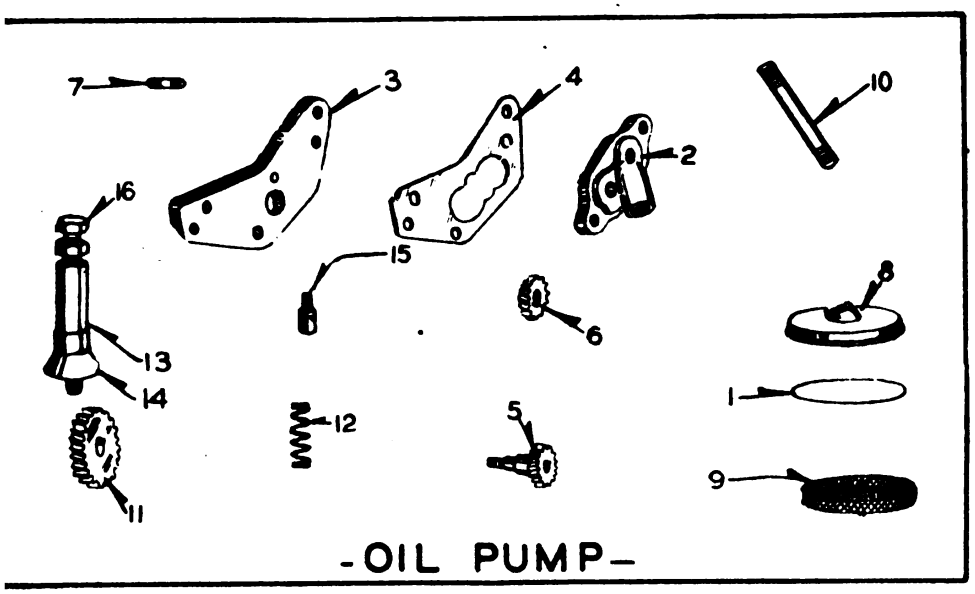
| | | | |
|---|---|---|---|
| 1 | 19248 | Breather Tube | 1.25 |
| 2 | 19249A | Breather Tube Screen Assembly | .75 |
| 3 | 19479 | Breather Tube Flange Gasket | .10 |
| 4 | 19952 | Air Cleaner | 2.00 |
| 5 | 19953 | Air Cleaner Adapter | 1.00 |
| 6 | 19963 | Air Cleaner Gasket | .10 |

## ELECTRIC CHOKE

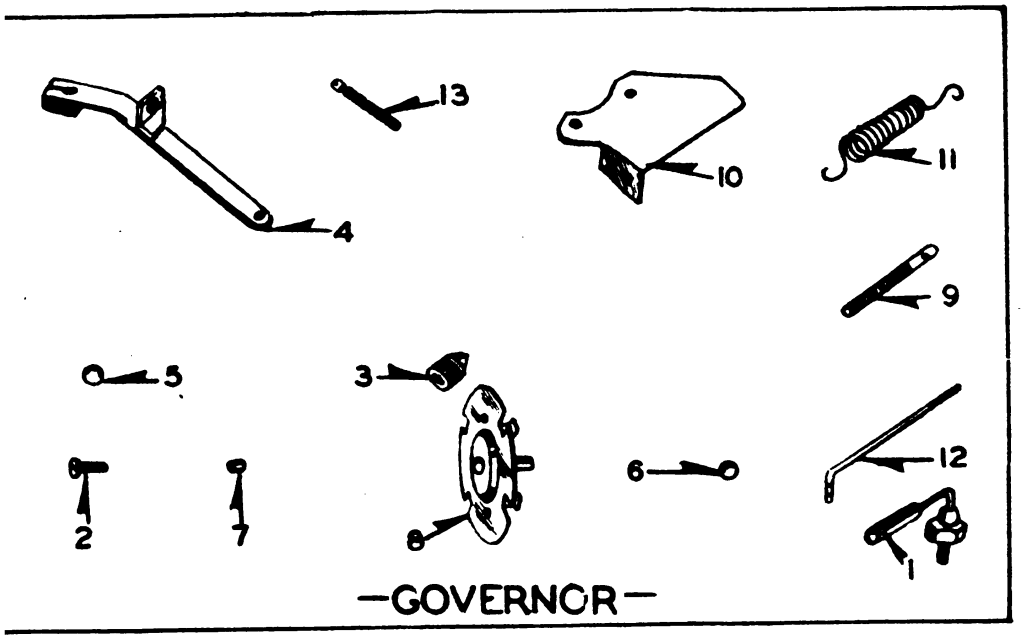
| | | | |
|---|---|---|---|
| 1 | 19922 | Choke Shaft Knob | .35 |
| 2 | 19924 | Thermostat Element | .75 |
| 3 | 19928 | Bracket for Automatic Choke | .40 |
| 4 | 19929A | Cover for Automatic Choke - with Heating Element | 1.50 |

## OIL PUMP

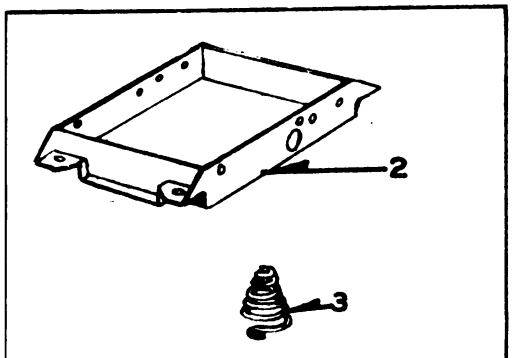
| | | | |
|---|---|---|---|
| 1 | 19349 | Lock Ring for Oil Pump Screen | .20 |
| 2 | 19357 | Oil Pump Body with Idler Shaft | 1.75 |
| 3 | 19358 | Oil Pump Cover | .50 |
| 4 | 19359 | Oil Pump Body Gasket | .10 |
| 5 | 19363 | Oil Pump Body Driver Gear w. Shaft | 1.75 |
| 6 | 19364 | Oil Pump Body Idler Gear | 1.25 |
| 7 | 19365 | Oil Pump Stud | .05 |
| 8 | 19367 | Oil Pump Intake Cup | .80 |
| 9 | 19368 | Oil Pump Screen | .30 |
| 10 | | Pipe Nipple - 1/8" x 2-1/8" Long | .10 |
| 11 | 19362 | Oil Pump Drive Gear | 2.00 |
| 12 | 12272 | Oil Pump Pressure Relief Spring | .10 |
| 13 | 12273B | Oil Pump Pressure Relief Block | 2.75 |
| 15 | 12275 | Oil Pump Pressure Relief Valve - 5/16" OD x 17/32" MST | .25 |
| 16 | 12276 | Oil Pump Pressure Relief Bolt - 3/8"x3/4"SAE-Hex. Hd. | .25 |
| | 19357A | Oil Pump Assembly | 11.50 |



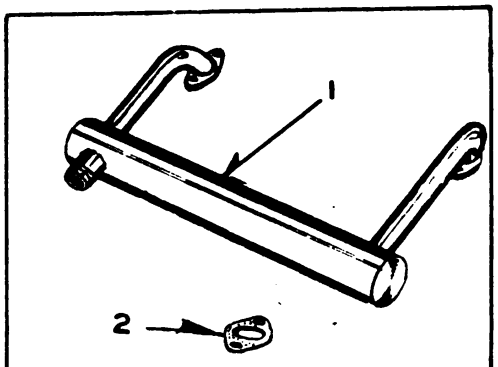

-OIL PUMP-




—GOVERNOR—




MTG. BASE




MUFFLER

## GOVERNOR

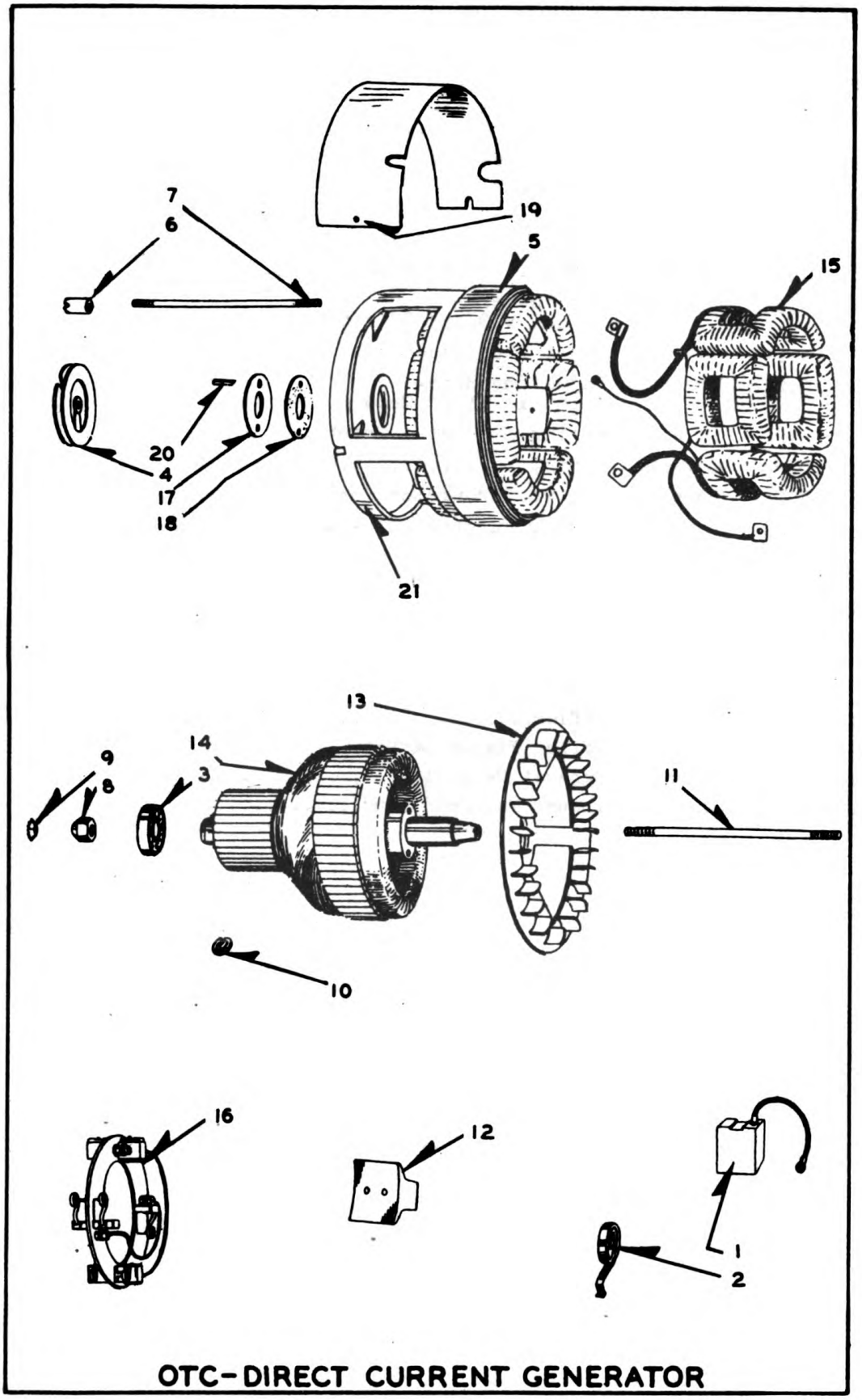
| NO | PART NO. | PART NAME | PRICE EACH |
|---|---|---|---|
| 1 | 568 | Governor Ball Joint #52 Edelmann..... | $ .20 |
| 2 | 8043-1 | Governor Cup Stop Screw - 6-32 x 5/8"..... (2 used) | .05 |
| 3 | 8058 | Governor Adj. Screw Nut - 7/16" Rod x 7/16" Screw Stock..... | .10 |
| 4 | 19104 | Governor Arm..... | .45 |
| 5 | 19111 | Governor Shaft Ball 1/4" Steel..... | .05 |
| 6 | 19114 | Governor Flyball - 3/8" Steel..... (16 used) | .10 |
| 7 | 19118 | Governor Cup Spacer - 22 Ga. x 3/16" OD x 7/32"..... | .05 |
| 8 | 19119A | Governor Cup & Stud Assembly..... | .75 |
| 9 | 19121 | Governor Adjusting Screw - 3/16" x 2-1/2" Cold Rolled..... | .15 |
| 10 | 19123 | Governor Spring Bracket & Cover..... | .75 |
| 11 | 19124 | Governor Spring..... | .15 |
| 12 | 19125 | Governor Arm to Carburetor Control Rod..... | .40 |
| 13 | 19131 | Governor Spring Fulcrom Adjusting Screw..... | .15 |

## MOUNTING BASE

| | | | |
|---|---|---|---|
| 2 | 19281 | Mounting Base - Saddle Type..... | 6.50 |
| 3 | 19286 | Conical Mounting Spring..... | .15 |

## MUFFLER

| | | | |
|---|---|---|---|
| 1 | 19862 | Exhaust Muffler..... | 5.00 |
| 2 | 19191 | Exhaust Muffler Flange Gasket..... | .10 |
| 3 | 19188 | Stud for Exhaust Manifold..... | .05 |
| 4 | 19187 | Nut for Exhaust Manifold Stud..... | .05 |



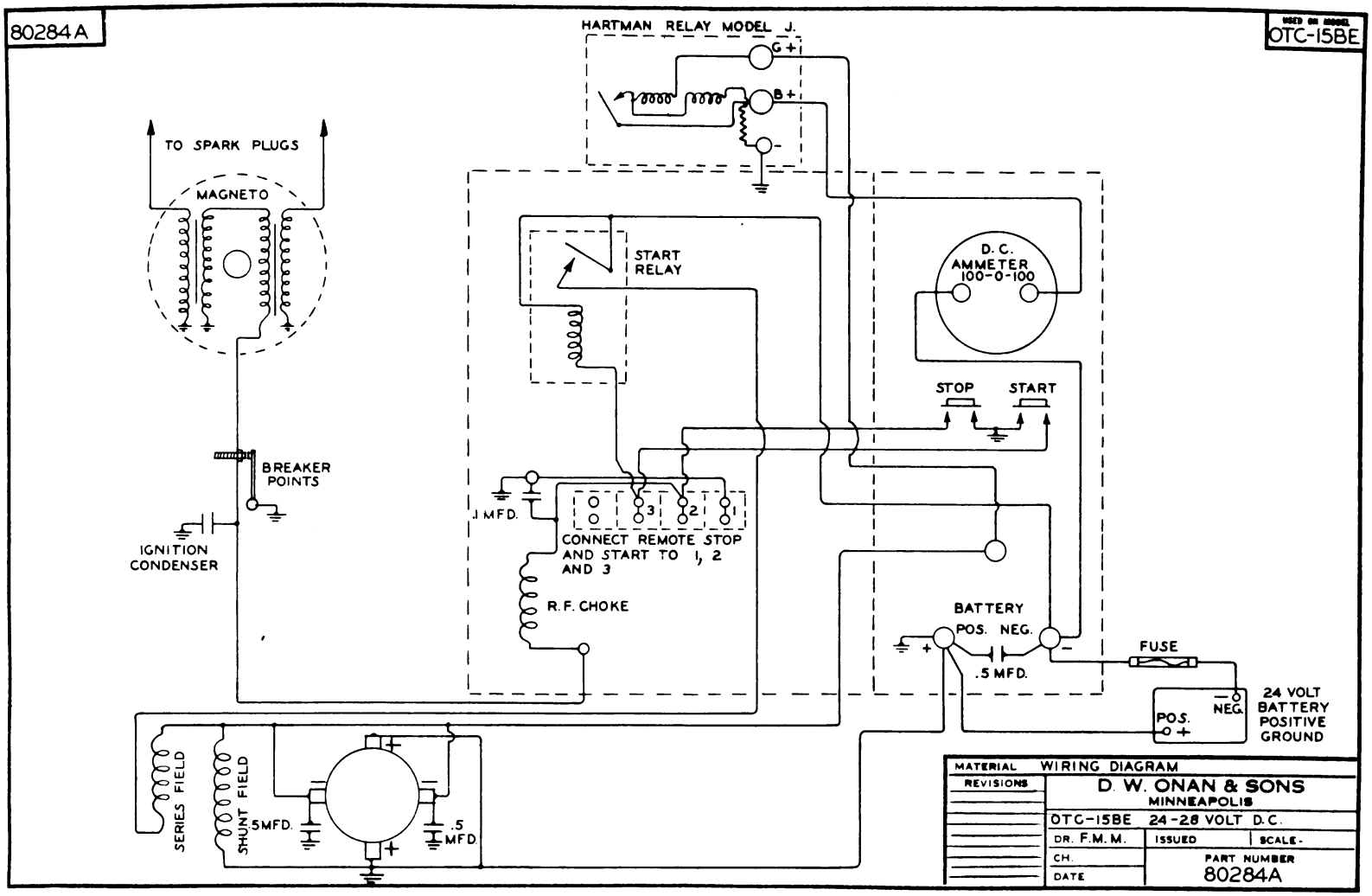

OTC-DIRECT CURRENT GENERATOR

## GENERATOR PARTS

| NO. | PART NO. | PART NAME | PRICE EACH |
|---|---|---|---|
| 1 | 841 | Carbon Brushes.....(8 used) | $ .65 |
| 2 | 842 | D.C. Brush Springs.....(8 used) | .25 |
| 3 | 1261 | Armature Ball Bearing..... | 3.00 |
| 4 | 15681 | Rope Sheave Pulley..... | 2.50 |
| 5 | 19502A | Generator Frame (with field coils and pole shoes)..... | 50.00 |
| 6 | 19508 | Generator Thru Stud Nut..... | .25 |
| 7 | 19509 | Generator Thru Stud..... | .25 |
| 8 | 19520 | Armature Thru Stud Nut..... | .35 |
| 9 | 19521 | Armature Thru Stud Nut Washers..... | .10 |
| 10 | 19522 | Lock Ring..... | .15 |
| 11 | 19525 | Armature Thru Stud..... | .35 |
| 12 | 19540A | Pole Shoe Assembly..... | 2.00 |
| 13 | 19578 | Generator Blower..... | 2.50 |
| 14 | 19609 | Armature Assembly..... | 45.00 |
| 15 | 19624 | Field Coil Set..... | 24.00 |
| 16 | 19638 | Brush Rig Assembly..... | 12.00 |
| 17 | 19676 | Generator Grease Cover..... | .25 |
| 18 | 19677 | Generator Grease Cover Gasket..... | .10 |
| 19 | 19682 | End Bell Band..... | .60 |
| 20 | 19683 | Rope Sheave Pulley Key..... | .10 |
| 21 | 19694 | End Bell Housing..... | 4.50 |

## CONTROL PARTS

| PART NO. | DESCRIPTION | QUAN. USED | PRICE EACH |
|---|---|---|---|
| 77084 | Start relay coil #PS 2292..... | 1 | $ 1.50 |
| 1517 | Start relay spring..... | 1 | .10 |
| 1522 | Start relay lower contact #692..... | 1 | .35 |
| 77200 | Start relay assembly..... | 1 | 5.00 |
| 19700 | Control box cover..... | 1 | 2.00 |
| 19701 | Control box bracket..... | 1 | 3.75 |
| 75105 | Choke coil..... | 1 | .65 |
| 76907 | Ammeter 100-0-100 - U.S. Gauge Co... | 1 | 2.50 |
| 77151 | Terminal block - 4 contact..... | 1 | 2.00 |
| 76603 | Automatic switch - Type D - Style 200 - 100 Amp. - 24 volt... | 1 | 14.25 |
| 1031 | Start relay carbon contact reinforcement..... | 1 | .05 |
| 1426 | Start relay frame..... | 1 | .95 |
| 1431 | Start relay insulating panel..... | 1 | .40 |
| 1566 | Start relay coil core..... | 1 | .35 |
| 1776 | Start relay frame insulating washer. | 1 | .15 |
| 8740 | Push button - black..... | 1 | .15 |
| 8740 | Push button - natural..... | 1 | .15 |
| 5928 | Condenser .5 MFD-ECC-1C-370..... | 1 | .50 |
| 1806 | Choke coil mounting bracket..... | 1 | .25 |
| 1809 | Choke coil mounting bracket..... | 1 | .10 |
| | Start relay armature pin #16 x 1/4" | 1 | .05 |
| 1516A | Start relay armature & blade assy... | 1 | 1.10 |



## TOOLS

| PART NO. | PART NAME | PRICE EACH |
|---|---|---|
| 77511 | Screwdriver | $ .40 |
| 77535 | Pair Pliers | .30 |
| 77570 | Adjustable Wrench - #882 | .60 |
| 77623 | Open End Wrench - 3/8" x 7/16" - #831 | .40 |
| 77627 | Open Wrench - 9/16" - 1/2" | .55 |
| 77625 | Open End Wrench - 9/16" - 5/8" | .60 |
| 77630 | Open End Wrench - 5/8" - Thin | .75 |
| 77675 | Short Extension #20160 | .20 |
| 77676 | Slide T Wrench #20152 | .60 |
| 77662 | Socket - 9/16" | .20 |
| 77660 | Socket - 7/16" | .20 |
| 77661 | Socket - 1/2" | .20 |
| | Socket Head Wrench Set Consisting of: | |
| 77705 | Wrench for 10-32 Socket Head Screw | .15 |
| 77706 | Wrench for 1/4-20 Socket Head Screw | .15 |
| 77707 | Wrench for 5/16-18 Socket Head Screwl | .15 |
| 77706 | Wrench for 3/8-16 Socket Set Screw | .15 |
| 77704 | Wrench for 1/4-20 Socket Set Screw | .15 |
| 77581 | Contact Paint Wrench | .10 |

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