KOHLER OF KOHLER

Electric Plants

Instructions

for

Operation and Care

and

Price List of Parts

for

1½ KVA Models

115 Volt, A. C.

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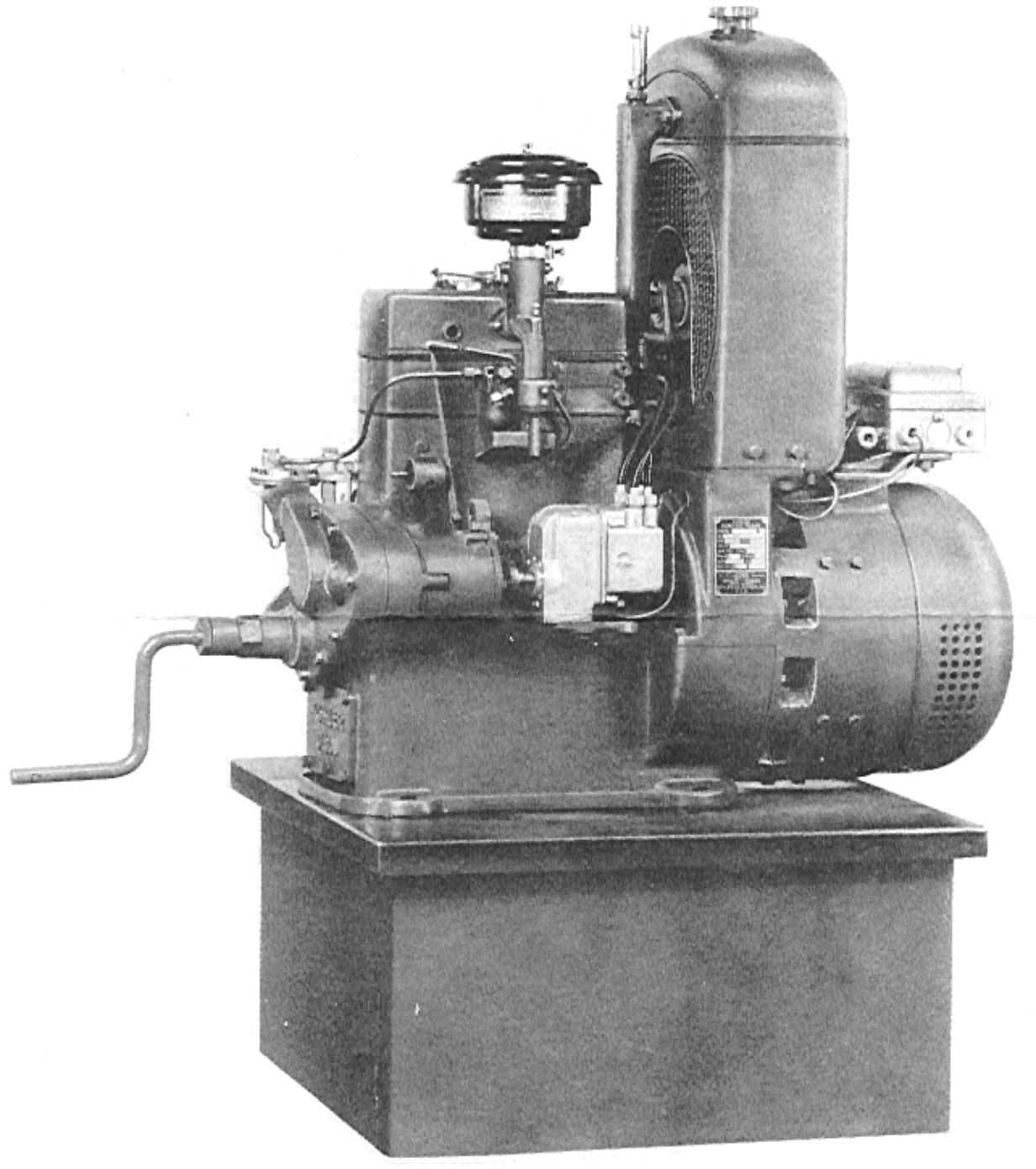
Printed **in U. S. A.**



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INTRODUCTION

Purpose of Book

An Instruction Rook is furnished with each Kohler Electric Plant so the operator may understand his plant and properly care for it. A careful study and observance of the contents of this book will insure satisfactory service and reduce repair bills to a minimum. The Kohler Co. earnestly desires that each plant owner receive satisfactory service from his plant, and this can be assured only if the operator gives the plant proper care and attention. Each owner or operator can well afford to study this book carefully. Carry out faithfully all the recommendations and periodical inspections which are outlined.

Kohler Electric Plant Users are urged to get in touch with the Dealer, Distributor, or Branch Office nearest them in case advice or assistance is needed. Your plant is known to the factory and to our Branch Office by Model and Serial Number ONLY. This information is on the NAME PLATE. When writing or ordering parts, always give number of your plant to avoid errors in giving information or filling orders for parts.

WARRANTY

We warrant and will replace free, of charge for a period of three months from date of delivery of plant to original consumer, all parts of Kohler Electric Plants returned to our nearest branch office, prepaid, which our examination shall disclose to our satisfaction to be defective in manufacture.

This warranty shall not apply to any electric plant which shall have been repaired or altered by anyone other than an employee of the Manufacturer, or which has been improperly installed or repaired, neglected or operated contrary to our instructions.

We make no warranty whatever in respect to the battery or magneto inasmuch as they are warranted by their respective manufacturer.

This warranty is in lieu of all other warranties, obligations, and liabilities on our part, express or implied, and we neither assume nor authorize any other person to assume for us, any oilier liability in connection with the sale of Kohler Electric Plants.

Operation and Care of Your Plant

When you receive your plant you should study this Instruction Rook and give the plant the attention which these instructtons advise. Everything in the nature of machinery requires a certain amount of attention, and Kohler Electric Plants are no exception. We suggest that this book be kept near the plant where it may be referred to from time to time, and in the event a repair is necessary, the proper remedy may be applied.

WHEN WRITING GIVE MODEL AND SERIAL NUMBER OF YOUR PLANT

General Description

The 1½ KVA Model is a self contained gasoline-engine driven direct connected electric generator designed to generate 115 volts, AC, 60 cycle, 1.500 watts.

Component Parts

The gasoline engine is a 4 cyclinder, valve-in-head, 4 cycle type 2 inch bore and 3 inch stroke. It is radiator cooled and employs a high tension magneto.

The generator is self excited, 115, volt, 60 cycle, single phase, AC, 1500 watts, capacity.

Dimensions and Weights

The illustration in Fig. 1 indicates. the overall dimensions, and the weight of the complete plant is 497 pounds.

INSTALLATION

Introduction

ALL ENGINES are affected by the conditions under which they are installed and operated. NO ENGINE or electrical apparatus can function properly and give economical and satisfactory service, unless it is properly installed under conditions that are reasonably favorable.

The operation of any electrical generating set driven by any internal combustion engine is affected by:

Temperature	***Moisture***	***Grit***
Dirt	***Ventilation***	***Dust***
Oil		***Grease***

IMPORTANT — The plant is known to the factory and at our branch offices by Model and Serial Number only. This information is given on the name plate.

All communications regarding the plant must give the correct Model and Serial Number to insure efficient service and a prompt response.

Temperatures Should Be Moderate

An engine must warm up to a running heat before it will function properly, run economically, and operate satisfactorily.

Ail engines that' derive their power from the burning of any fuel-such as the internal combustion engines used in automobiles, tractors, or lighting plants, as well as the steam engine of the locomotive, the steamship, and the power house--are HEAT ENGIN ES.

It is not the engine that does the work, it is the heat units contained in the fuel that are being used. This being understood, it is easy to realize that no engine can function economically or efficiently until the machine warms up to a running heat. In a water cooled gasoline engine, the running heat is about 180 to 200 degrees Fahrenheit. Before putting on the full load, any type of gasoline engine must be warmed up to about 125 degrees.

When a cold engine is started, a large amount of fuel used in the first half hour of operation is spent in warming it up. Some of this fuel passes the pistons and dilutes the oil in the crankcase; some of it passes out through the exhaust pipe without being vaporized. It is, therefore, sound economy to locate the plant in a place which is fairly warm at all times.

Air Should Be Clean

Flying dust, dirt, or grit drawn into the generator and collecting on the commutator will cause the commutator and brushes to wear excessively. If dirt collects in the slots between the commutator bars, inefficient commutation will result. A deposit of dust on the field coils, armature, magneto, or electrical connections may cause short circuits or ignition troubles. Dust drawn in through the carburetor will cause rapid wear of valves, piston rings and cylinder walls. It is estimated that 90 per cent of valve, piston ring and cylinder wall wear is due to dust drawn into carburetor.

Choose a location where temperature and ventilation can be regulated by doors and windows, according to outdoor temperature and load on machine. Additional or larger doors or windows must be provided for plants installed in localities where the summer temperatures is above 80° Fahr. at any time.

Avoid Excessive Moisture

It is absolutely necessary to protect all electrical equipment from water or moisture of any kind. Water is a conductor of electricity, and an enemy to good insulation.

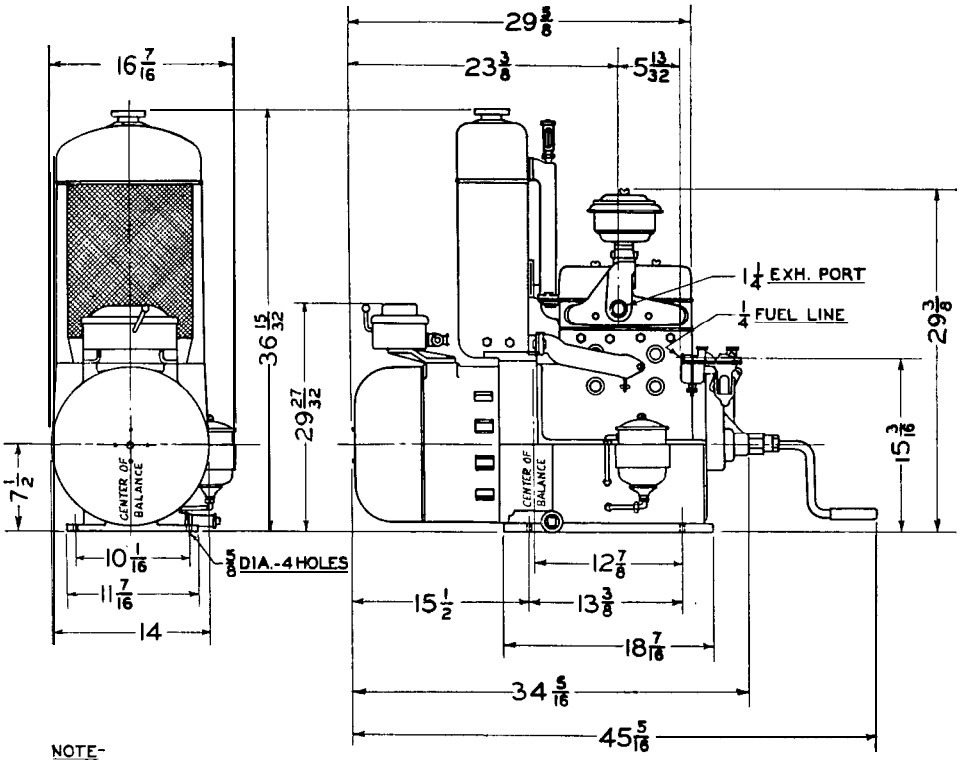
If the field coils, armature and magneto are exposed to moisture, short circuits, grounds, break-downs in the insulation may occur which will prevent the machine from functioning properly. For this reason the plant should not be installed in a damp location.'

Protect Electrical Parts from Oil and Grease

Certain parts of the machine must be lubricated. However, the field coils, armature, electric governor, magneto and all other electrical parts, circuits, and wiring must be protected from oil and grease.

Exhaust

The horizontal sections of the exhaust pipe should pitch downward from the plant to prevent water from flowing into the cylinders of the engine. If a water drain assembly is used in exhaust line, the drain cock should be kept closed at all times when the plant is operating to prevent the escape of poisonous gases. Open it only to drain water which collects in exhaust pipe from condensation.



NOTE-

TOTAL WEIGHT- 497 LBS.

WT. AT EACH FRONT MOUNTING HOLE - 10.5 LBS.

WT. AT EACH REAR MOUNTING HOLE - 23.8 LBS.

DIMENSIONS FOR MODEL 1M21 PLANT - DWG. D-850-M

Figure 1

The carbon monoxide gas discharged by all gasoline internal combustion engines is extremely poisonous when it is allowed to collect in a closed room. Every precaution should be taken to prevent the escape of this gas into the building. All joints must be perfectly tight- and where the exhaust pipe passes through rhe wall care should be taken to prevent the gas from returning along outside of pipe back into the building.

Connecting Exhaust Pipe to Plant

The exhaust pipe should be as short and straight as possible. It is best to avoid a long exhaust- pipe and elbows, as these become cogged with carbon and add resistance, thus decreasing the capacity of the plant. If possible, have the outer end of exhaust pipe slant downward slightly from a horizontal position. The moisture which condenses in the exhaust pipe wilt then run out the end of the pipe instead of into the engine cylinders, where it would cause rusting, make starting difficult, and foul the spark plugs.

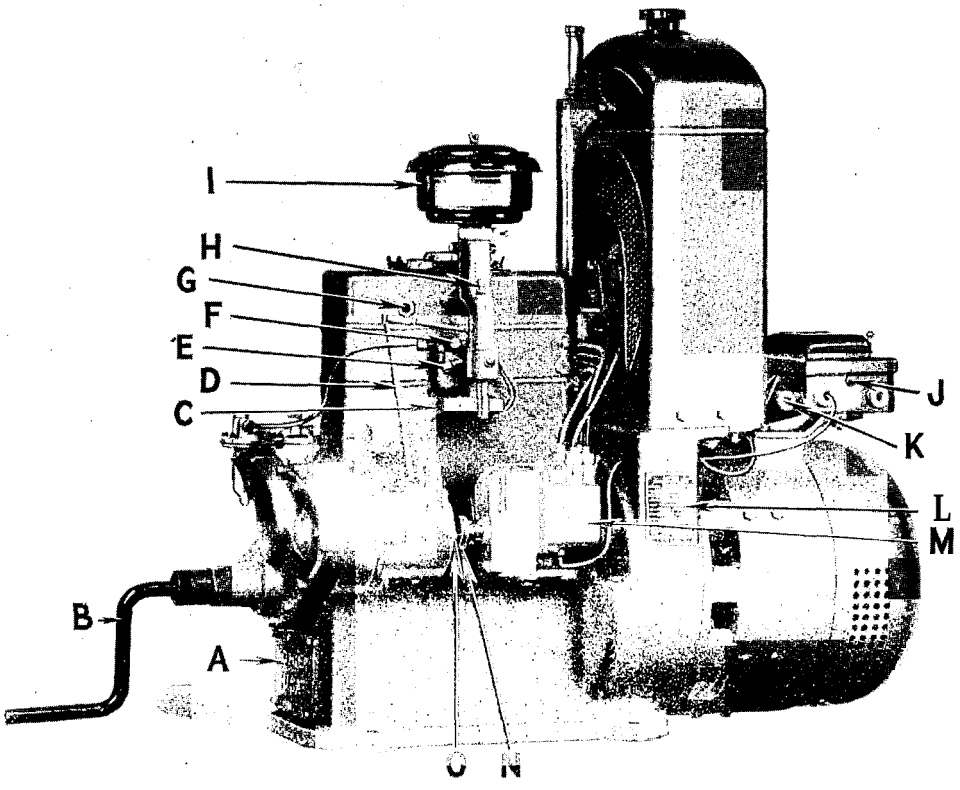


Figure 2
Carburetor Side of Plant

A — Cleanout Plate
B — Starting Crank
C — Carburetor Drip Pan
D — Governor Operating Lever
E — Carburetor Overflow
F — Carburetor Screen
G — Oil Sight Hole
H — Choker
I — Air Cleaner
* J — hlagneto Ground Switch
K — Field Resistance
L — Name Plate
M — Magneto
N — Magneto Coupling
0 — Governor Stop Screw

* On some models this is eliminated and plant is grounded at the magneto

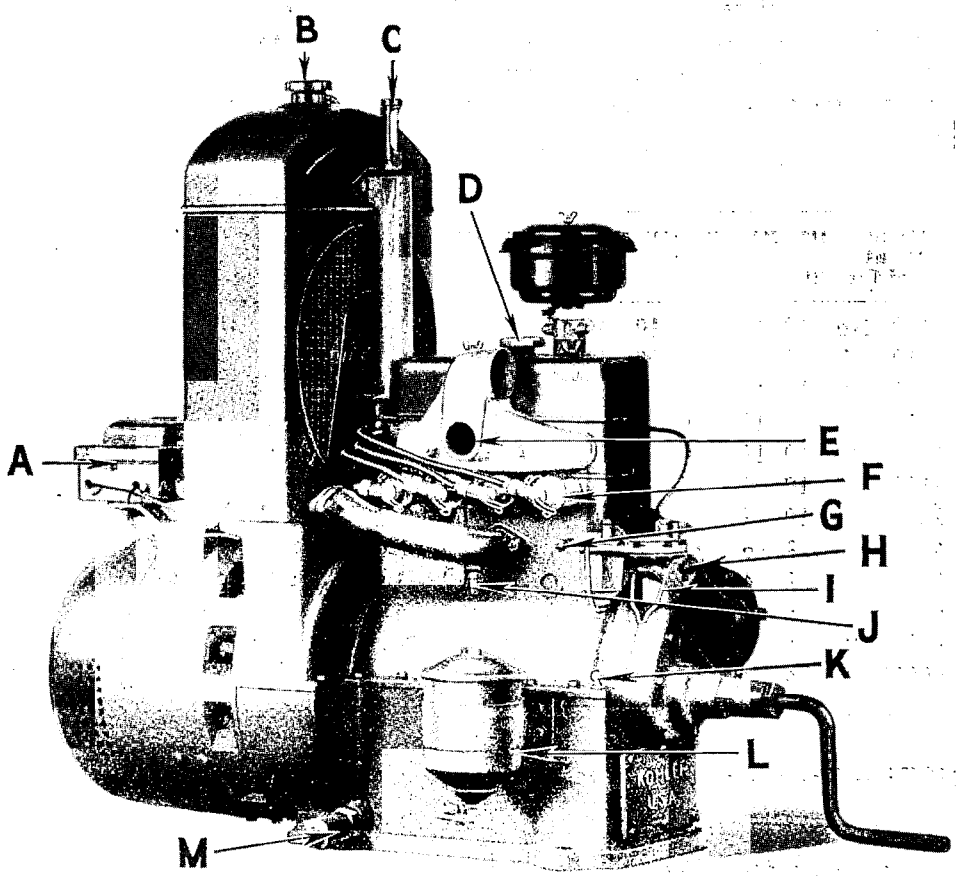


Figure 3
Exhaust Side of Plant

* A — Exciter Field Switch
B — Radiator Cap
C — Thermometer
D — Oil Filler Cap
E — Exhaust Outlet
F — Shielded Spark Plugs
G — Fuel Pump Inlet
H — Fuel Pump
I — Fuel Pump Priming Lever
J — Drain for Cooling System
K — Oil Gauge
L — Oil Filter
M — Oil Drain

* This is eliminated on some models.

Wiring

To secure the fullest use of the current generated by a Kohler Electric Plant, it is absolutely essential that the wiring be of the right size and properly installed. Too often proper consideration is not given to the possible uses for which power will be wanted in the future. When more current is used than the circuits were designed to take care of, the wires will be overloaded.

115 VOLT

Loads in Watts at End **of Circuit**		100'	200'	300'	400'	500'	600'	700'	800'	900'	1000'	1200'	1500'	2000'	2500'	3000'	4000'
100	No.	10	10	10	10	10	10	10	10	10	10,	10	10	10	10	10	8
250	"	10	10	10	10	10	10	10	10	10	10	10	8	8	6	6	4
500	"	10	10	10	10	10	10	8	8	8	8	6	6	4	4	2	2
750	"	10	10	10	10	8	8	8	6	6	6	4	4	2	2	1	1-o
1000	"	10	10	10	8	8	6	6	6	6	4	4	2	2	1	1-o	2-o
1500	"	10	8	6	6	6	4	4	4	4	2	2	1	1-o	2-o	3-o	4-O
2000	"	10	8	6	4	4	2	2	2	2	1	1-o	2-o	3-o	4-o		
4000	"	86	6	4	2	2	1	1-o	1-o	2-o	2-o	3-o	4-o				
5000	"	84	2	2	1	1-o	2-o	2-o	3-o	3-o	4-o						
6000	"	6	4	2	1	1-o	2-o	2-o	3-o	3-o	4-o						
8000	"	4	2	1	1-o	2-o	3-o	4-o									
10000	"	4	2	1-o	2-o	3-o	4-o										

NOTE:-No. 4-O wire is the largest size commercially practical.

NOTE:-The size of wire to be used depends upon the following factors:—

1st. Load to be carried in watts or amperes.

2nd. Distance between load and power plant.

3rd. Strength of wire to withstand strains imposed by weather conditions.

Not less than No. 10 wire supported every 75 feet should be used for outside leads, while a smaller wire may carry the load, it will not possess sufficient strength to withstand strains imposed by weather conditions. No. 4-O wire is the largest size commercially practicable. The adjacent table is based on commercial annealed copper wire commonly used for lighting circuits. If hard drawn wire is used the voltage drop will be increased about 2%. If this is not permissible use next larger size as shown in table.

Smaller wire may be used for indoor service and in places where it is protected from weather conditions. All wiring should meet the Fire Underwriters' specifications for size of load and insulation.

STARTING A NEW PLANT

Before starling a new plant for the first time, a definite procedure should be observed. We recommend the following:

Fill the Crankcase

The engine base holds approximately seven quarts of oil and is filled through the top of the cylinder head cover marked "OIL FILL HERE." Use SAE 20 in minter and SAE 30 in summer. Keep the oil level between the marks Ii and L on the oil level gauge. *Pla nt m ust set level.*

Figure 4

Testing Oil Level—Use of Oil Gauge (Test when plant is idle)

Fill Radiator

With pure soft water.

Fill Gasoline Supply Tank

Be sure the main line switch is open before filling supply tank. Do not fill tank so gasoline stands in filler pipe. Examine plant for leakage and protect filler pipe from dirt and water.

Exhaust Line

Inspect exhaust line joints to see that they are properly installed and tight.

Fuel Lines

C 'heck all fuel line connect ions from plant to tank. Connections must be tight.

Fuel Pump

Operate priming lever of fuel pump until bowl is full.

Connect Starting Battery-(Automatic Models)

The instructions for placing the battery in service should be followed ; then battery should be connected to plant as covered by wiring diagram, Fig. 1 3.

Start Plant-(Automatic Models)

Crank the engine with the hand crank to make certain that it t urns over freely. Nest, close the main line switch and turn on a lamp or appliance of not less than 40 watts. If all connections have been made as directed, the plant will start automatically.

Oil Circulation

After starting a new plant or after changing oil, look through the small hole in the cylinder head cover and observe whether the oil pump is delivering oil. Oil will be discharged from the copper tubing visible itt this opening. In the event the oil is not visible, hold the butterfly valve of the carburetor almost closed so that the plant operates at very slow speed. Do not operate the plant if the oil does not circulate.

OPERATION AND CARE

To keep your plant in first class operating condition we recommend inspections at regular intervals.

AFTER 50 HOURS OF OPERATION

Cooling System

Check the water in the radiator regularly-. If the plant is exposed to high temperatures, these inspections must be more frequent. **li** the plant is exposed to freezing temperatures use anti-freeze solution.

Fan Belt

Examine the fan belt.

Oil

Check oil level in crankcase.

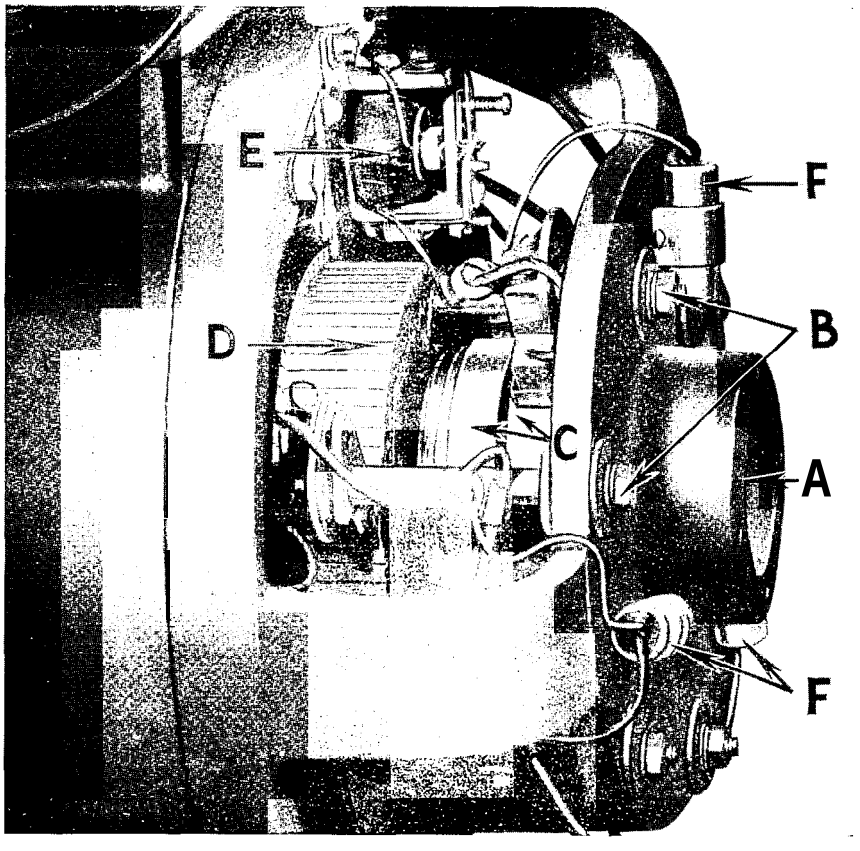


Figure 5
Alternator

A — Generator Bearing
B — Brush Holder Studs
C — Collector Rings
D — Exciter Commutator
E — Voltage Regulating Relay
F — Radio Condensers

For temperatures above 60 degrees F. we recommend SAE 30. For temperatures below 60 degrees F., we recommend SAE 20W. For temperatures 10 degrees F. and colder we recommend SAE 1 OW.

Alter draining oil be sure oil is visible at oil sight hole when plant starts. Run plant very slowly until oil flows ii oil does not circulate.

Figure 7

Draining Oil Base

Oil Filter

The oil filter should be checked regularly.

IGNITION SYSTEM

The ignition system consists of a high tension magneto, magneto cables, and spark plugs.

Magneto

The magneto requires attention at regular intervals.

Timing Magneto to Engine

First remove the cylinder head cover and tighten clown the cylinder head and rocker arm bolt nuts securely. Nest adjust. the valve clearance as previously described.

The firing order is l-3-4-2. The engine cylinder at- crank end is No. 1, and numbered in consecutive orcler, No. 4 being nest to the radiator. To place the engine in position, crank the motor until No. 8 valve (first from radiator) has opened and is almost closed. Now take hold of No. 7 rocker arm (second from radiator) and turn the engine *wry slowly; just* keep jarring the handle slightly until the least bit of lost motion is felt: in No. 7 and No. 8 rocker arms. The piston in No. 1 cylinder is now at the top of its stroke and in firing- position. This can be verified by removing the spark plug from No. 1 cylinder and inserting the little finger, a wire or screwdriver in the spark plug hole.

Nest set the magneto for firing No. 1 cylinder. The exact setting will vary slightly on different engines; if timed too late, loss of power and overheating will result. The best results are obtained by advancing the timing until the engine begins to kick back, and then retarding the magneto one or two teeth, Mesh the coupling teeth together in this position insert the bolts but leave them slack. Start the plant and the magneto will align itself, then tighten the magneto in place, taking care that the magneto and governor shafts are in line and the coupling is not binding. When the magneto is properly located, 3 very slight lost motion will be felt in the magneto coupling.

Removing and Replacing Magneto

The magneto may be removed without ret iming the engine, by placing timing marks in line when magneto is removed. ii the engine is not moved, it will be in proper position when the magneto is replaced. When replacing the magneto, turn until setting marks are in line, and mesh the couplings together in this position.

Cleaning Breaker Points

A film of oil or dirt may at times collect on the contact points, which will prevent perfect short circuiting of the low tension winding. The points are best cleaned with it line file or with a hone, taking care not to round off the edges. The points must face up *squarely over the entire* **urea.**

Attaching Cables

The firing order is 1 -3-1-2. At tach cables accordingly. If insulation on cables becomes worn or oil soaked, they should be replaced.

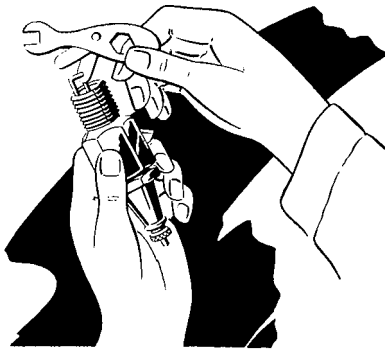


Figure 8
Adjust Gap to 1/32 inch

Testing Magneto for Spark

The magneto may be tested when engine is in operation. To do this, disconnect. one cable from the spark plug. Start the engine under its own power and hold the end of detached cable within 1/1 6" of engine frame. The spark for each cylinder may be tested one at a time in this manner. Pliers with insulated handles should be used for holding cable when making tests with plant in operation, or a slight shock or burn may result.

For further information see pamphlet on magneto.

Spark Plugs

Spark plugs are the most common causes of misfiring, and in case of trouble they should be inspected first. Many times the magneto is blamed for trouble which is due entirely to the spark **plugs.** If the points are too far apart-, the windings of t he magneto will be forced to carry the burden and the armature, condenser or collector ring may break down.

The distance between points should be .025″ for plugs having 1/32″ wire elect i-odes. Heavy duty plugs, having 1/16″ wire electrodes should have a gap adjust ment of .030″ to .035″. This is equivalent lo 1/32″.

If porcelains are chipped or cracked, they must be renewed or new plugs put in. Plugs should be clean inside and out.

How to Test for Spark

To test whether spark is being furnished, first disconnect magneto ground wire; then remove plug wit h cable attached. Next hold spark plug against engine frame (do not touch spark plug points to frame). If a spark is being furnished, it will jump across the gap when engine is cranked. If there is no spark and the magneto is suspected, remove cable from plug and hold end of cable 1/32 of an inch from engine frame. If magneto is not at fault, a spark will be observed as crank is turned.

The spark plugs may also be tested when engine is operating by short circuiting between end of plug and engine frame. If the plug is tiring, the speed of motor will be reduced. If shorting out the plug has no effect on engine speed, it indicates the plug is not firing. Be careful of shocks when testing in this manner.

When **necessary** to replace **spark plugs,** order them from the Kohler Co. so as to secure the correct type, which is important.

COOLING SYSTEM

The cooling system consists of a radiator and fan with a thermo-syphon system.

Fan

Check the fan belt. Replace if necessary. See instructions on installing fan belt

Radiator

Check the water in the radiator the same as you do in your car and make sure that the air passages are kept clean and the air around the radiator circulates freely.

If the plant is exposed to freezing temperatures, add anti-freeze accordingly. The cooling system holds approximately 9½ quarts.

ANTI-FREEZE SOLUTION REQUIRED

Per Cent by Volume	Temperature for Alcohol	Temperature for Glycerine	Temperature for Etheline Glycol	Temperature for Prestone
10	+27° F.	+29° F.		
20	+19° F.	+21° F.	+ 16° F.	+17° F.
30	+10° F.	+12° F.	+ 3° F.	+ 2° F.
40	− 2" F.	0° F.	-11 ° F.	-12" F.
50	−18° F.	-1.5" F.	−31 ° F.	−35° F.

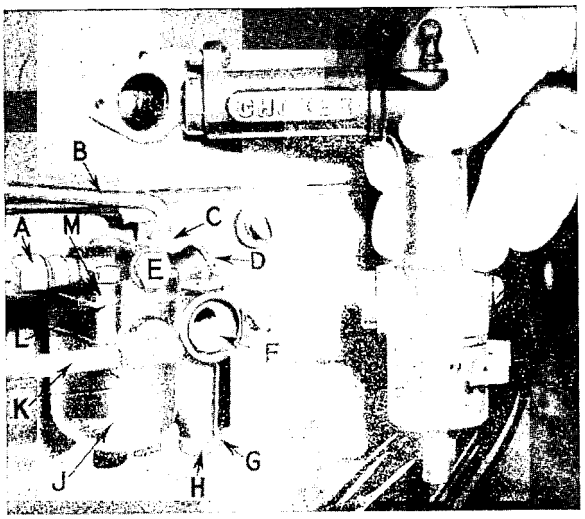
FUEL SYSTEM

The fuel system consists of fuel pump, carburetor, choker and connecting tubing.

Figure 9

Carburetor

A — Supply Line
B — Governor Operating Lever
C — Butterfly Valve Lever
D — Air Line Opening for Vacuum Tank (not used)
E — Screen in Supply
F — Venturi
G — Compensating Jet
H — Main Jet
J — Bowl
K — Overflow Line
L — Gasket
M — Cover



Carburetor

The carburetors which have fixed jets are not adjustable unless the jets are changed. The jets installed are correct for sea level installations and should not he changed unless the plant is installed at higher altitudes. See Figure 9.

Carburetors with an adjustable needle valve can be adjusted to obtain the proper fuel mixture.

The needle valve should be opened about 1½ turns to start the engine and then closed to the proper adjustment at full load. The proper mixture for any one of the three models will be obtained by having the valve open about 1 ¼ turns. After the adjustment has been made it is not necessary to readjust the carburetor unless there is a change in grade of fuel or altitude.

Both types of carburetors are interchangeable on these plants

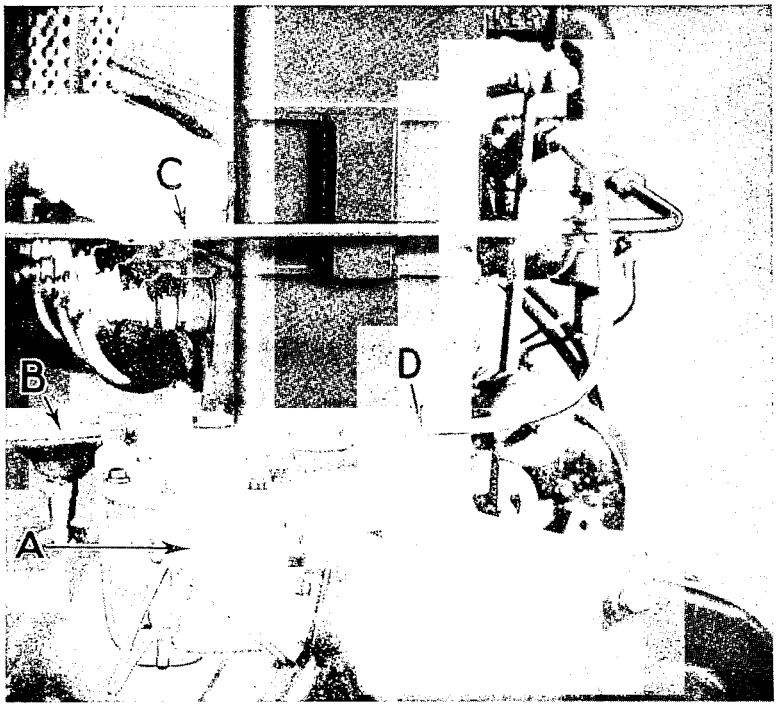


Figure 10
Fuel Pump

A — Fuel Pump
B -Supply Line from Tank to Pump
C — Overflow Line to Tank from Carburetor
D — Supply Line to Carburetor from Pump

Fuel Pump

The fuel pump requires very little attention and under ordinary operating conditions, v-ill give many hours of service without the replacement of any of the parts. With the average fuel lift, it is not necessary to prime the fuel pump and it will pick up the gasoline at cranking speed. However, if the pump does not pick up the id. it is necessary to prime it. This can be done by operating the priming lever.

If the fuel pump fails to operate after the plant has been in service, it should be disassembled and the worn parts replaced. These are illustrated in the parts section and it is not difficult to repair the fuel pump. If it is not convenient to order the parts or repair the fuel pump, the entire assembly may be replaced as the cost of the unit is not excessive.

THERMOSTATIC CHOKE AND ELECTRIC CHOKE

Plants are equipped with a thermostatic choke to improve starting and automatic- plants are also equipped with an electric choke.

Whether or not both chokers are required depends entirely upon the temperature of the installation.

Adjustment of Thermostat--See Figure 11

The thermostat element K is set to hold the choker J in a closed position at 70°F. when the plant is not running. The tension of the element automatically increases as the temperature drops and provides the necessary choking as the weather gets colder.

To adjust the thermostat to increase or decrease the amount of choking:--

1. Remove the control rod G from the thermostat arm I-I and remove thermostat C from the exhaust manifold by taking out the two screws which hold it in place.

2. Hold the element K to one side and loosen the screw N beneath it, and mow the pointer RI in the direction of the arrow to increase choking and in the opposite direction to decrease choking. Moving the pointer one mark changes the tension to correspond to a change of 5°F. in temperature.

3. Replace the thermostat in the exhaust manifold and connect the control rod. The rod must not bind at either end

Important

The thermostat arm must not touch the stop I when the control rod is in place. The choke valve J must act as the stop when it doses inside the carburetor air intake.

When the plant starts at temperatures cold enough for the thermostatic choke to work, the choker valve J will remain closed until the thermostat element heats up enough lo stop choking. This requires from 1½ to 2½ minutes, depending upon temperatures.

An electric choker l'on automatic plants operates while the engine is cranking, regardless of temperature, to provide the necessary choking when the engine is started before the thermostat element has cooled off.

Since temperature is the important factor to consider in the operation of the choker, the procedure to be followed in different installations will vary.

The thermostat may require adjusting and in some cases the electric choke can probably be disconnected entirely. The terminals should be taped.

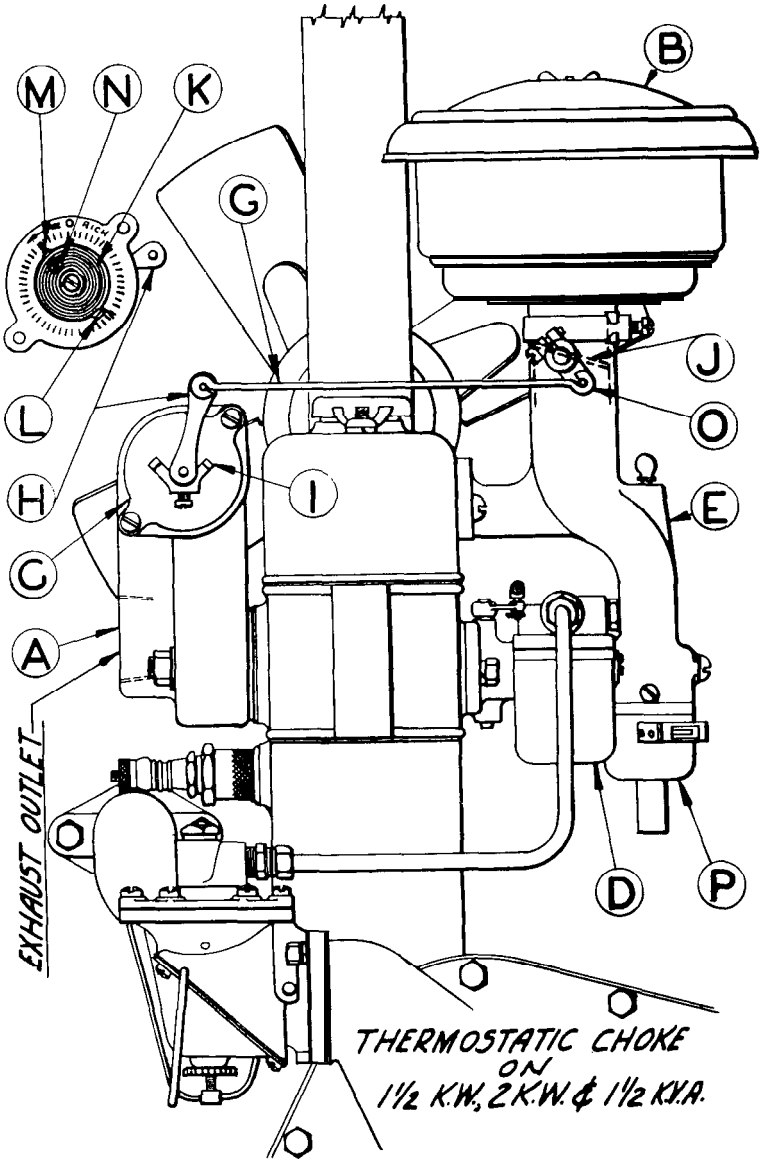


Figure 11

A — Exhaust Manifold No. 5451
B — Oil Bath Air Filter No. 4155
C — Thermostat No. AC-1790
D — Carburetor No. 54.56
E — Choker Manifold No. 5520
G — Control Rod No. 5.545
H — Thermostat Arm
I — stop
J — Choker Valve
K — Thermostat Element
L — Adjustable Post
M — Indicator
N — Adjusting Screw
0 — Choker Arm
P — Electric Choke No. D-699

STARTING SYSTEM

The starting system of automatic plants consists of the starting battery, automatic switch, and governor switch.

Manual plants are hand cranked and a knife switch is used to close the line circuit.

Starting Battery

The starting battery is 24 volts and is kept charged automatically with a low trickle charge under normal operation. The charging rate is adjustable and may be changed from approximately .8 amperes to 1.6 amperes, and the high rate should be used if the low rate does not keep the battery charged.

The battery should be given the same care and attention that the average storage battery requires, and the instructions included with the battery should be followed.

Should the plant fail to start., the battery should always be inspected first. If it does not hold a charge, a battery expert should be consulted. When the battery must be replaced order the same type from the Kohler Co.

How to Operate Plant without Starting Battery

Should the starting battery be run down through lack of use, the plant may be used without it, though for the time that the battery is disconnected the plant ceases to be automatic and must be started each time by means of the hand crank.

1. Disconnect the magneto ground wire from No. 5 terminal
2. Crank the machine by means of the hand crank.
3. If engine is cold, it ma;; be necessary to choke it. This is done by holding up the plunger which projects through the choking coil. This should of course be released as soon as the engine begins to operate.

To Stop Plant after Battery is Disconnected

1. If magneto ground wire is re-connected after the plant begins to operate, the last lamp or accessory turned off will stop it.
2. The plant can always be stopped by grounding the magneto. This is accomplished by removing the magneto ground wire from No. 5 terminal and grounding it to the engine frame

Method of Starting Automatic Models

When a lamp or appliance is turned on, current from the starting battery goes through the automatic switch completing a series of circuits through relays which electrically crank the plant, operate the choker, and deli\-er current to the main service lines.

Switch Circuits

Following are the switch circuits in detail. They should be checked in the order of their performance.

Automatic Switch

Not less than 40 Watt Lamp must be used Per Minimum Load

If the plant is installed under reasonably favorable conditions, there should be no trouble experienced with the automatic switch. If for any reason the automatic feature fails to function, the instructions should be carefully followed on the care and operation of the switch.

The circuits are explained in detail on the following pages. The same symbols are used that appear on the diagram and illustrations. If it is necessary to adjust the switch, a regular procedure should be followed to determine the cause of the trouble. The quickest solution is to check the circuits in the order of their performance.

First Circuit

The first circuit is completed by turning on a lamp or appliance of 40 watts or more.

Battery current flows from the plus battery terminals to the plus (+) switch terminal, through the junction at R, through safety switch contact M, through a wire at the rear of the panel, through the main relay direct current coil H, through contact K2, contact finger C3 to the line, through the LINE terminals and connected load and battery negative.

The purpose of the first circuit is to magnetize coil H, which attracts main relay armature E. remove ignition ground at C, and complete second circuit at D.

If the armature E does not move, there will be an indication of one or more of the following conditions:

1. Load too small, must be 40 watts.
2. Battery weak.
3. A loose or open connection.
4. A defective lamp or appliance.
5. Coil H or other lines open.
6. Armature E not adjusted Correctly.
7. Safety switch button M not closed.
8. Relay contact C3 not closed against contact K2.

Second Circuit

The purpose of the second circuit is to close the cranking relay. (Relay at extreme right-RR).

Current from the plus (+) battery terminal goes to contact R, through safety switch contact M, then to a junction bolt at one end of coil H, through generator relay contact finger Cl, back contact FF, coil T, through contact D, to terminal No. 4, governor switch contacts V, terminal No. 3 and to negative side of battery.

If this cranking relay fails to close, the trouble may be due to:

1. Weak battery.
2. Coil defective.
3. Poor contact at D, V, FF, or M.

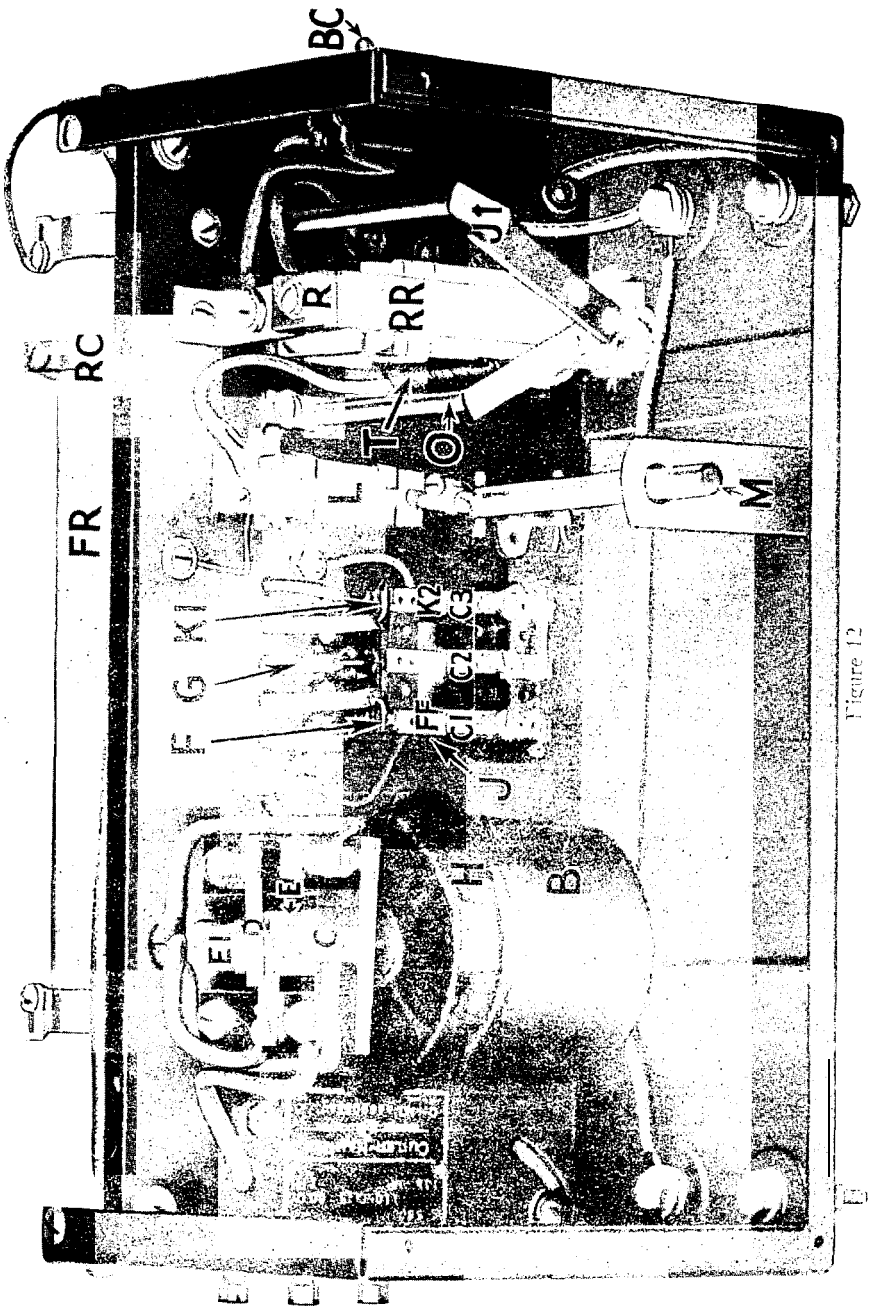


Figure 12

Automatic Switch

B — Main Relay Series Coil
C — Magneto Ground Contact
C1 } — Relay Contact Fingers
C2 }
C3 }
D — Second Circuit Contact
E — Main Relay Armature
E1 — Adjusting Nut
F — Battery Charging Contact
FR — Exciter Field Resistance
G — Generator Relay Load Contact
H — Main Relay D.C. Coil
J — Generator Relay Coil
J1 — Auxiliary Control Contact
K1 — Auxiliary Load Contact
K2 — Series Contact to Coil "H"
L — Safety Switch Resistance
M — Safety Switch Button
O — Choker Contacts
R — Cranking Relay Contact
RC — Field Adjusting Clip
RR — Cranking Relay Armature
T — Cranking Relay Coil
BC — Battery Charging Rate Switch

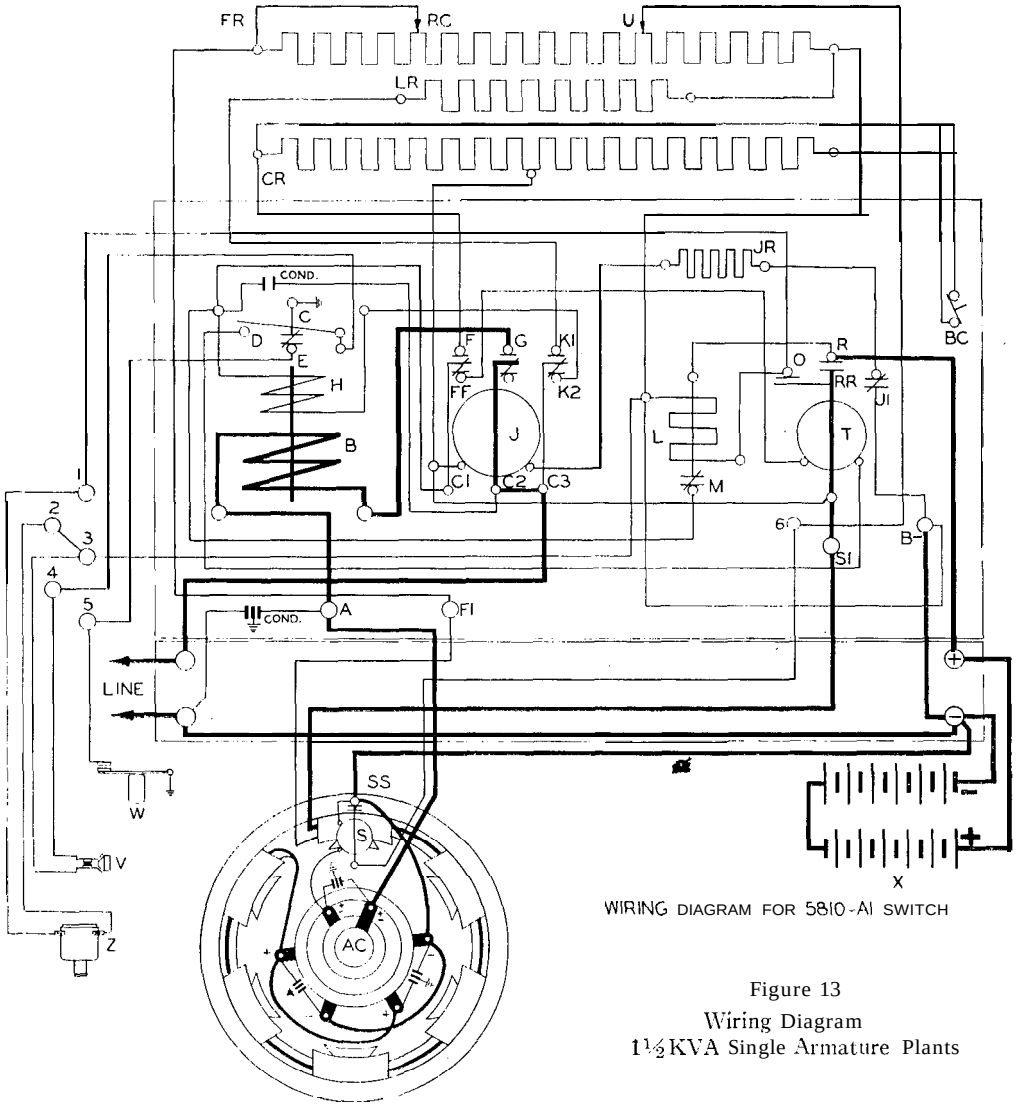


Figure 13
Wiring Diagram
1½ KVA Single Armature Plants

A — Alternator Terminal
B — Main Relay Series Coil
C — Magneto Ground Contacts
D — Second Circuit Contact
E — Main Relay Armature
F — Battery Charging Contact
G — Generator Relay Load Contact
H — Main Relay DC Coil
J — Generator Relay Coil
J1 — Auxiliary Control Contact
JR — Fixed Resistor
K1 — Auxiliary Load Contact
K2 — Series Contact to Coil "II"
L — Safety Switch Resistance
M — Safety Switch Button
N — Negative Battery Terminal
O — Choker Control Contact
P — Positive Battery Terminal
R — Cranking Relay Contact
S1 — Cranking Series Lead
T — Cranking Relay Coil
U — 1 Step Relay Tap
V — Governor Switch Contacts
W — Magneto Contacts
X — 24 Volt Battery
Z — Engine Choker
AC — Alternator Brush
BC — Battery Charging Rate Switch
CR — Battery Charging Resistance
FR — Exciter Field Resistance
LR — Auxiliary Load Resistance
MG — Cranking Motor and Exciter
RC — Field Adjusting Clip
RR — Cranking Relay Armature
1-2 — Choker Terminals
3-4 — Governor Switch Terminals
5 — Magneto Terminal
6 — Field Relay Terminal
+ — Direct Current Positive
- - Direct Current Negative
+ — Alternator Brushes
C1, C2, C3 — Relay Contact Fingers
COND. — Condenser

Note: Dashed lines for concealed wires. Heavy lines for heavy currents.

Third Circuit

The third circuit is the cranking circuit, which includes the choking circuit and the safety switch.

Current from the plus (+) terminal of the storage battery goes to contact R, cranking relay RR, to S1 and cranking series field, plus exciter brush, exciter armature, negative brushes and then returns to the battery terminal N.

Current also goes from contact 0 to the choker via terminals 1 and 2. A second circuit from 0 is through safety switch element L.

If the plant fails to crank after the starting relay closes:

1. The starting battery may be weak.
2. Poor contact at R.
3. Poor brush contact.
4. Cranking winding burned out.
5. Safety switch open

Fourth Circuit

The purpose of the fourth circuit is to supply direct current to the shunt field and to energize coil J of the generator relay.

Current from the exciter armature goes from the plus exciter brush through shunt field to terminal F1, resistance FR, and back to negative.

When governor switch contacts open J1 closes and current from the exciter follows a path to terminal S1 to a terminal at the left of contacts FF, then through coil J, a fixed resistor JR, to contact J1 and the negative side of battery.

If the generator relay fails to close, the following may be the cause:

1. Exciter voltage too low-must be above 50 volts-test between S1 and minus (-) switch terminals.
2. Non-adjustable armature spring at bottom may be too tight.
3. Coil J burned out.
4. Resistance JR burned out.
5. Loose or broken wires.

Fifth Circuit

The purpose of the fifth circuit is to supply alternating current to the supply lines and to charge the storage battery.

In addition to the fifth circuit the DC circuits as described under the fourth circuit continue in operation.

Direct current for battery charging passes through the cranking series field to switch terminal S1, center tap of charging resistance CR, through this resistance to contact F, Cl of generator relay, safety switch contact M, stationary contact R and to positive battery terminal.

Alternating current from AC brush of alternator goes to terminal A, then through coil B of main relay to contact G above generator relay through contact finger C2 to lamps or appliances on the line and returns to terminal at bottom of box and coil S of a relay mounted on generator end bracket. A parallel circuit from terminal beneath C2 goes through relay armature C3 to K1 and auxiliary load resistance LR. The negative terminal, negative exciter brush and one side of the alternator are connected.

The alternating current passing through coil B energizes the main relay armature E, as long as the line loacl is 40 watts, or more. The generator is provided with a small relay, mounted just above the AC brushes which includes two normally open contacts. This relay has a coil which closes the armature and contacts at about 800 watts line load. The closing of contacts by-passes a section of the adjustable field resistance FR, at point U, which effectively raises line voltages on loads above 800 watts to compensate for decreased engine speeds and other losses. Failure of the fifth circuit may not allow alternating current to pass from alternator to the load lines.

Battery Charging Switch

If the battery charging switch BC is at "low", the cut-rent for recharging the battery must flow from terminal S1 to center of charging resistance CR, through one-half of this resistance to contact F, armature spring contact C1 and into the battery at the positive (+) terminal. This will be the low rate of about .8 amperes charge. When the switch BC is at "high", current flows through both ends of coil CR. The charge at the high rate is about 1.5 amperes.

The battery can be given a boost charge by connecting the positive battery terminal to the S1 terminal with a piece of No. 14 or larger insulated wire. If this connection has been made, it is necessary to disconnect the magneto ground wire and hand crank the plant. The charging rate will be from 15 to 25 amperes and can be reduced by reducing the speed of the plant.

While the plant is used to charge the battery in this manner, it cannot be used for other purposes.

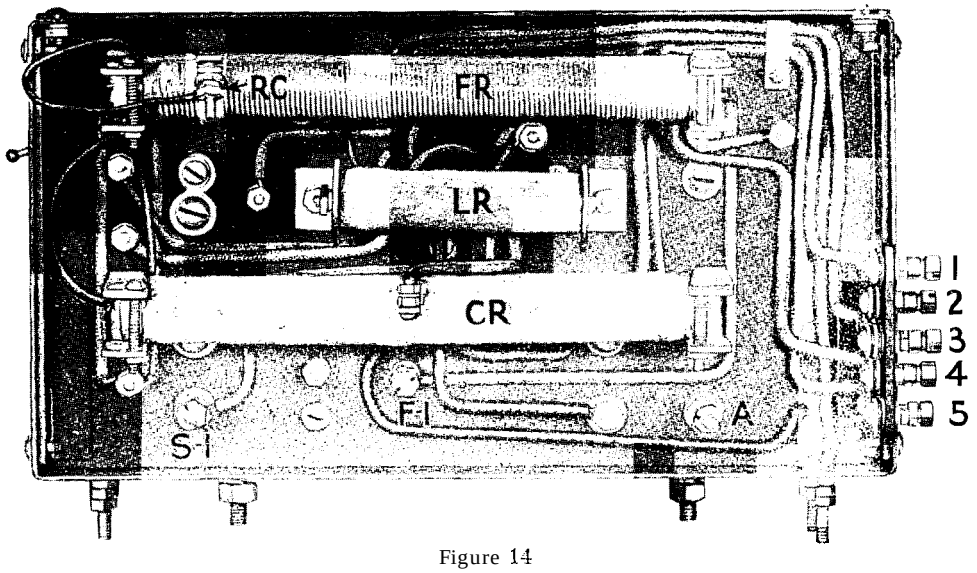


Figure 14
Back of Automatic Switch

A — Alternator Terminal
CR — Batter\- Charging Resistance
F1 — Field Terminal
FR — Exciter Field Resistance
LR — Auxiliary Load Resistance
RC — Field Adjusting Clip
S1 — Cranking Series Terminal
1 & 2 — Choker Terminals
3 & 4 — Governor Switch Terminals
5 — Magneto Ground Terminal

Safety Switch (M)

If for any reason the engine does not start firing after about one to two minutes of cranking, the safety switch tripper (M), which contains a heat element (L) disengages and breaks the second circuit. This stops the plant from cranking and protects the batter\- from discharging. The safety switch button (M) must be pressed in flush with the switch box before the plant will again crank.

Field Resistance Coil (FR)

The top coil on the back of the switch is a field resistance coil and its purpose is to pro\-ide a variable resistance from the negative line to the shunt windings of the generator and regulate the voltage.

The setting of the adjusting clip "U" determines the voltage change when the voltage regulating relay operates.

The setting of the clip "RC" affects the voltage of the plant at all loads.

Failure to Generate

If the generator voltage does not build up when engine reaches normal speed there are certain reasons which can be checked in order. After the gene&or frame has been removed or especially roughly handled, it may be necessary to connect a 6 or 12 volt storage battery to terminals S1 and N in order to magnetize the field frame. Automatic plants are not affected by loss of residual magnetism because the cranking battery automatically restores such magnetism during the cranking period. Manual plants may require restoration of such magnetism and this can be done by connecting a storage battery of 6 or 12 volts for 2 or 3 seconds across the two adjacent brush studs which connect to the commutator. The plus battery cable should be connected to the plus brush of the exciter stud and the negative battery terminal to the negative brush stud. Check brush polarity on wiring diagram. It is advisable to insert a small piece of cardboard or other insulating material under each brush during this remagnetizing operation in order to avoid heavy currents through the armature which are of no benefit. Some caretakers have been successful in magnetizing the field frame by first starting the engine by hand and then short-circuiting between one positive and one negative brush after the engine is at running speed. Such short-circuiting should only be for one or two seconds

Condensers

There are two condensers mounted within the automatic switch. These condensers are not interchangeable. The unit between terminal A and one line terminal is of .16 microfarad capacity and has three sections within one case. This is used to reduce radio interference when plant is used to supply power to radio receivers.

A condenser of 1 microfarad capacity is connected to coil H and discharged through coil H to demagnetize armature E whenever the safety switch contact M opens during the cranking period. This condenser is also necessary when some load is switched on momentarily and then disconnected before engine can reach full speed. This breaks the second circuit at D before engine cotnpletes the cranking cycle.

Governor Switch

The governor switch is included in the second circuit described above and the adjustment is illustrated in Figure 15.

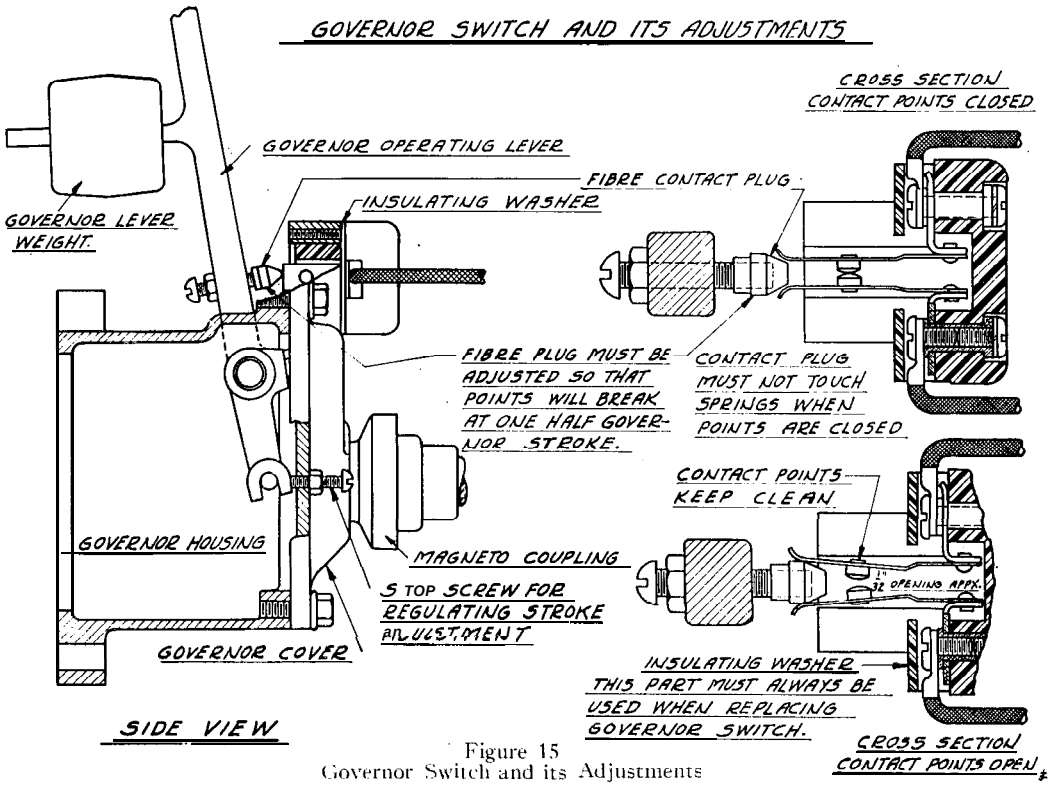


Figure 15
Governor Switch and its Adjustments

Governor Switch Adjustments

The governor switch contact points must be together when the plant is stopped. When the plant is started and has attained a speed of about 850 R.P.M. the mechanical governor arm moves forward and the contact points in the governor switch are separated by the fibre contact plug which breaks the cranking circuit.

If the plant does not start when a lamp or appliance is turned on, and the governor switch is suspected, try short circuiting No. 3 and No. 4 terminals on the fibre panel located on the hood end of automatic switch. If the plant starts after short circuiting between the terminals, the trouble is in the governor switch contact points. The difficulty is probably due to dirty contact points or contact points being out of adjustment. If the governor switch contact points do not close and the fibre plug is out of adjustment, it may be regulated by means of the adjusting screw. With the plant stopped, turn on a light or appliance, loosen the lock nut with wrench, then with a screw driver turn out the adjusting screw until the governor switch contacts close. This will be in-

dicated by a click in the switch box and the plant will immediately begin cranking. Turn out the adjusting screw one turn beyond the point where the plant star-led and lock it securely in this position. The governor switch contact points should separate when the governor is about half way in it-s stroke.

Care must be taken not to turn the adjusting screw out too far or the go\--ernor switch contact plug will not break the circuit the nest time the plant is started until the safety switch disengages. If this occurs, the plant will not start automatically until the safety switch but ton is pushed in.

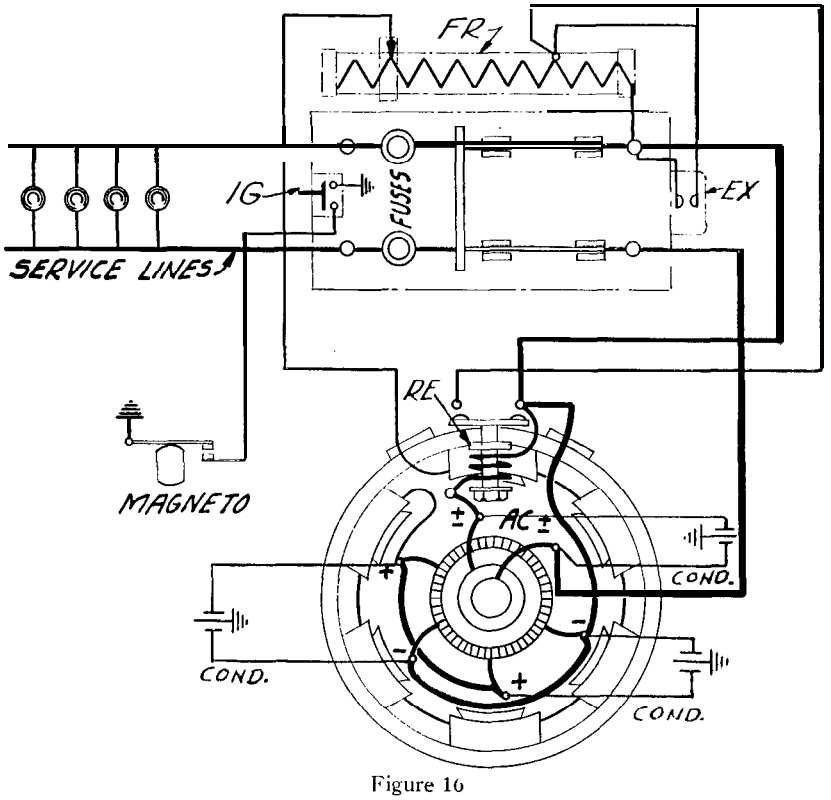


Figure 16
Wiring Diagram — Manual Plants

Starting System-Manual Plants

A manual plant must be started with the hand crank and the choker must be operated manually.

The control button on the switch is used for slopping the plant and should be IN when the plant is started.

Failure to Generate

If the plant- fails to generate after it has started to run, press the round black but ton at the end of the switch box (EX, Fig. 16). This will decrease the resistance in the shunt field and will usually cause the plant to generate immediately.

After pressing this button, if the plant continues to run at normal speed without generating, the cause may be due to loss of residual magnetism, due to shocks and jars sustained during shipment. To restore the residual magnetism, it is only necessary to form a momentary short circuit between one of the positive and one of the negative brushes on the machine. This can be done by holtling a piece of wire so the ends of same will each touch a positive and negative brush, when the plant is operating. The wire must be instantly removed as soon as current is generated.

Directions for Changing Automatic Plant to Manual

Remove all wires from automatic switch as per following directions:

1. All wires from tibre panel on end of switch.
2. Wires from terminals in back of switch connected to A and S1.
3. Wire from negative post underneath right end of switch.
4. Wire from F1 which is connected to resistance coil on rear of the switch
5. Remove resistance coil FR by loosening nuts which clamp the coil in place.
6. Remove switch.

To connect wiring for manual operation :

1. Lay the resistance coil FR on non-metallic, non-combustible material.
2. Connect the wire which was connected to F1 to end of resistance coil.
3. Connect wire from bottom of switch (See 3 above) to other end of resistance coil and to one service line.
4. Connect wire from terminal A to other service line.
5. All other loose wires should be taped with the exception of the magneto ground wire No. 5, which can be used for stopping engine by touching to any part of plant, thus grounding the magneto.

A manual switch can be installed on the plant identical to that used with the manual models.

PREPARATION OF A PLANT FOR STORAGE

If the plant is placed in storage, cylinder should be treated with a non-rusting and non-corrosive lubricant to prevent rusting of cylinder walls, pistons and rings.

Magneto and electrical parts should be protected from oil and moisture.

The cooling system should be protected against. freezing by draining and adding a small amount of anti-freeze solution so as lo prevent water in the cooling system from freezing.

Exposed machine parts which may become corroded or rusted if esposed to moisture should be protected with a non-rusting solution.

Spark plugs should be removed from engine and a small amount of non-rust, non-corrosive lubricant may be placed in the combustion chamber after which the engine can be turned over two or three times wit-h the hand crank so as to properly coat cylinder walls, pistons and rings.

If the plant is exposed to excessive moisture, it may be advisable to remove the magneto and store it in a dry place.

REPAIRS AND ADJUSTMENTS

Caution

If the plant does not operate properly and the owner feels that the plant is at fault, he can test it by connecting a 40 watt lamp in a test socket. If plant operates properly with a lamp in this socket, it is an indication that the fault lies outside of the machine. **However,** if the plant does not. function as it should, repairs or adjustments are necessary.

Overloading

If properly installed and cared for, the plant can be depended upon to furnish 115 volt current up to its rated capacity. There is a tendency on the part of some to put 3 far greater load on the plant than it wits ever designed to carry. This should not be done. While the Kohler Plant is a very rugged and substantially built machine, continued overloading is certain to cause trouble and expense.

Short Circuits or Grounds

Short circuits or grounds in the external wiring system will cause trouble. If the plant begins to act erratically and the voltage fluctuates, causing the lights to dim and brighten alternately, you are either overloading the plant or there is something wrong with the wiring or with some of the power appliances in use.

Stop the Plant Immediately and Make an Investigation

The trouble should be remedied before the plant is again operated.

Open Circuit

An open circuit in the external wiring will not affect the operation of the plant except that no light will be obtained beyond the point where the circuit is broken

Grounded Circuit

The plants described in this manual are parallel wound, and therefore a ground will not affect the operation, unless there should be a ground on both the positive and negative sides, which would then form a short.

Short Circuit

A short circuit is a condition where a large part or the whole of t-he current generated passes directly from the positive to the negative wire.

Tracing Defects in Wiring System

If the defect is due to an open circuit, the location of the trouble is usually easily found by tracing the various circuits, t urning on different lights, until by a process of elimination the place where the circuit is broken can be located. This will usually be a broken wire or a loose connection easily repaired. If the trouble is due to a short circuit, it: is not. so easily detected.

If there are several circuits, try them separately and watch the performance of the engine, which will usually indicate on which circuit the defect is located. After determining in which circuit the trouble occurs, carefully examine the wiring at **all** points to find where the wires touch each other, the ground, or some substance which is a conductor of electricity. The trouble will usually be located at some point where the insulation is worn off by chafing against some other substance. If the wires run through metal or a wooden conduit, or should there be junction boxes on the line where moisture is liable to collect, the difficulty will usually be found at one of these places.

The procedure to be followed in all cases will depend on how the system is wired. Defects of this nature can only be discovered by careful examination of the different points where trouble is likely to occur.

SPECIFICATIONS, TOLERANCES, AND CLEARANCES

1. Intake valve seat ..... 1/32" x 45° Chamfer x 25/32" Dia.
2. Exhaust valve seat ..... 1/32" x 45° Chamfer x 25/32" Dia.
3. Intake valve guide side clearance ..... .002"
4. Exhaust valve guide side clearance ..... .002"
5. Intake valve tappet clearance ..... .006" Hot
6. Exhaust valve tappet clearance ..... .006" Hot
7. Valve timing ..... 40° Before low dead center
8. Main bearing diameters Front ..... brg. 1.3125", Rear brg. 1.251"
9. Main bearing diametral clearance Front brg. .00125", Rear brg. .00125"
10. Main bearing thrust clearance ..... .004"
11. Connecting rod bearing diameter 1.2499
12. Connecting rod bearing diametral clearance ..... .00075"
13. Connecting rod bearing side clearance ..... .0085"
14. Camshaft bearing diameters ..... Front 1.500", Rear 1.4375"
15. Camshaft hearing clearances ..... Front .00195", Rear .00145"
16. Cylinder bore ..... 2.000"
17. Piston clearance ..... .00175"
18. Number and type of piston rings Per Piston ..... 4 Rings (3 plain-1 oil ring)
19. Piston ring side and bottom clearance ..... Side .00125", Bottom .007"
20. Piston pin diametral clearance ..... .001"
21. Ignition timing-maximum degrees advance ..... Approx. 30°
22. Recommended types of spark plugs ..... Champion spark plug No. 7, 18 mm. or the equivalent.

WHEN WRITING GIVE RIODEL AND SERIAL NUMBER OF YOUR PLANT

REPAIRS TO GASOLINE ENGINE

Repairs or adjustments which may become necessary after a period of operation are included in the following instructions in the approximate order in which these repairs or adjustments may normally occur.

If the plant will not carry its rated capacity load of approximately 1.5 amperes at 11.5 volts or 1500 watts, the gasoline engine may lack sufficient power. This trouble may be due to several conditions, and perhaps the one condition which will occur before any other is that of a lack of compression due to leaky valves.

Compression

To test the engine for compression use the hand crank and turn the engine over very slowly. If the compression is good, there will be a noticeable resistance in rotating the engine as each of the pistons reach the top of the stroke, and the crankshaft will have 3 tendency to kick backward. When there is a lack of compression in one or more cylinders, the ease of cranking will indicate it. If the exhaust pipe is removed and the ear placed close to the exhaust opening while the motor is revolved by the hand crank, it is possible to judge the compression in this manner. If any of the valves or the piston rings are leaking, the escape of the confined vapor will make a hissing noise as it passes through the leaky valve or by the piston rings.

Following arc the causes of poor compression :

1. **Leaky** valves, particularly exhaust valves.
2. Improper valve clearance. A clearance of .006″ to .008″ should he maintained.
3. Leaky spark plug-cracked porcelain or leaky gasket
4. Loose cylinder head—leaky gasket-cvlinder head not pulled down evenly.
5. Valves not seating properly, due to excessive carbon deposits or sticky valve stems.
6. Worn or sticking piston rings.
7. Scored cyclinclers or worn pistons.

The engine will not function properly or deliver its full power if the compression is not good, and in case it is found to be at fault, the valves should be reground, piston rings replaced, joints made tight, or spark plugs renewed as the case may require.

Removing Cylinder Head

Drain all water from cooling system, after which remove all water and gasoline connections. The nuts holding rocker arm brackets to

head should then be removed and the entire assembly lifted off. Remove the eight push rods and lay them out carefully, so they can be replaced iii their original position. Unscrew the nine nuts holding cylinder head and **lift** head and carburetor assembly off the engine. Be sure not to injure the copper asbestos cylinder head gasket. Do not pry the head up wit h a screwdriver. Use a block of wood, tapping gently until the head is loosened. (See Fig. 17).

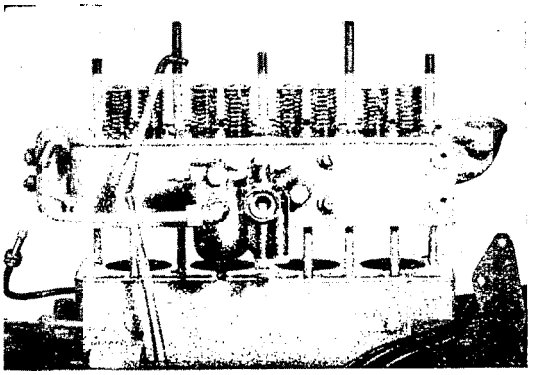


Figure 17
Removing Cylinder Head

Grinding Valves

Remove valves by depressing the valve spring and pulling keeper out of slot on the end of the valve stem. Observe the marks punched cm the cylinder head and valves. Always replace the valves in their respective places.

If, after washing in gasoline, the valves or valve seats are pitted (show black specks) or are not seating properly, they should be "ground-in".

Apply the compound sparingly around the entire valve seal, put a light lifting spring over the stem, lubricate the stem and drop the valve back into its place in the cylinder head. The spring should just barely hold the valve off its seat. A two pronged tool that will lit the valves and a hand brace or a screw driver can be used to grind the valves.

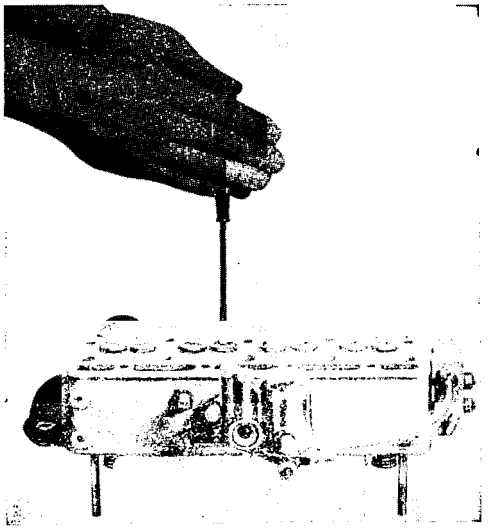


Figure 18
Grinding Valves

Place the tool in the valve head to be ground. Press down until the valve is seated. Turn the valve a quarter turn, first in one direction, then in the other. Do this three or four times. Release the pressure on the valve and the little spring will lift it off its seat. Now turn the valve about 10 or 15 degrees to another position, and repeat the grinding. Do this until all the compound is rubbed off the valve seat. Withdraw the valve and put on some fresh compound. Repeat the grinding operations.

Clean the valve seat in the cylinder head and the face of the valve with gasoline occasionally to see how the grinding is progressing. To have a good seat it is necessary for both to be free of all pits and grooves and for both seat and valve to show a uniform light gray band all the way around. It is not necessary to have the valve seating across its entire width. If the band is 1/32″ wide it will make a good seat. When finally replacing the valve, oil the valve stem and clean out all of the grinding compound from the valve chamber.

Replacing the Cylinder Head

To replace the cylinder head, reverse the method given for removing. Carefully clean the joint surfaces and the gasket. Replace the push rods in their original positions, being certain they center in the sockets in tappets. When replacing the nuts holding head to cylinder, tighten down evenly, as there is a danger of wrinkling the gasket, causing a water leak. Replace all water and gasoline connections. Coat gaskets with grease, and be careful to get connections water and air tight.

It is highly important that the proper clearance of .006″ to .008″ be maintained between the top of valve stem and face of rocker arm. If this distance is too great, the valves will open late and close early; while if it is too small, they will not close at all, thereby causing a great loss of power.

Before proceeding to adjust the valve clearance, tighten down the cylinder head and rocker arm bolts securely. The valve adjustments should be made only when the engine is hot; if made when cold, they will not be accurate, due to the change in temperatures when the engine warms up to a running heat. A .006″ gauge is furnished with all plants to be used in adjusting the valve clearance.

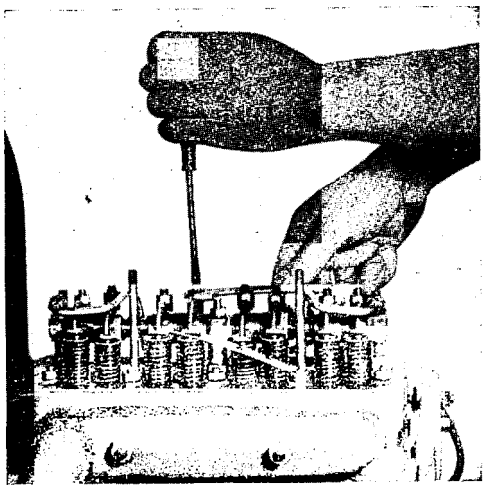


Figure 19
Adjusting Valve Clearance

To adjust clearance, proceed as follows: Turn the crank until the cylincler you are working on is on the firing center and both valves arc coinpletely closed. Also make sure that valves are not being held open by carbon deposits or a sticky or dirty stem. Then insert a gauge measuring .006″ to .008″ between the face of the rocker arm and top of the valve stem. The clearance is correct when this gauge or its equivalent can just be moved. If a gauge is not available, send for one.

In making the adjustment necessary to secure the proper clearance, first loosen the upper lock nut on the rocker arm. Then by turning the adjusting screw to the right or left, the clearance can be decreased or increased. Be sure to lock the adjustment securely with the lock nut after

adjustment is made. To do this, hold the screw tight with a screw driver while the top nut is tightened. (See Fig. 19). Valve clearance adjustment should be made while the engine is warm.

Installing New Fan Belt

a. Disassembly to Remove Old Belt. To remove the fan belt from the plant proceed as follows :

1. Remove generator endcover by taking out the four retaining screws.
2. Remove generator brushes from brush holders.
3. Remove the eight rap screws, which hold the generator frame to the flywheel housing after inserting a block of wood under each side of the generator frame to prevent it from toppling.
4. Remove the radiator overflow tube from the magneto side of the unit.
5. Pull off the generator assembly and set it to one side (Fig. 20). If necessary, use a bar to pry the bracket away from the frame.
6. Remove engine cooling fan from bracket. and take off the old belt.

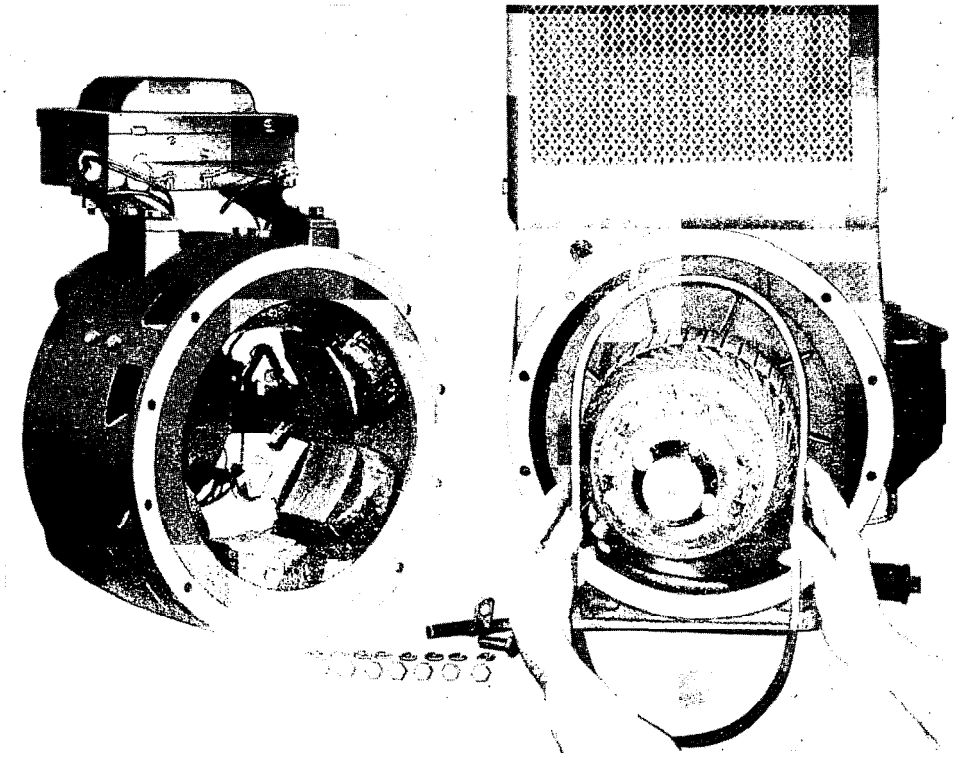


Figure 20
Installing new fan belt

b. Installing New Belt and Reassembling Unit.

1. Slip new belt over armature and onto generator flywheel pulley (Fig. 20).
2. Pull belt onto fan pulley, and tighten fan into place after checking belt tension.
3. Replace generator assembly. Be sure the outer rare of generator ball bearing enters the bearing housing of the brush holder bracket squarely
4. Replace the eight cap screws. Before tightening them, tap the brush holder bracket lightly with a hammer and block of wood above and below t lie generator bearing housing. When the bearing is properly aligned, tightening the cap screws forces the generator assembly tightly against t lie engine bell housing.
5. Replace the generator brushes. Be sure the generator brushes are put back in their original positions
6. Start the unit after assembling it. Listen for Iloise in the generator bearing. Noise indicates improper alignment. To correct alignment, tap the bracket above and below the bearing until it runs quietly.
7. If the ball bearing is not sealed, repack the housing with correct grade of grease, and replace the generator end cover.

Splitting the Engine: Removing Engine from Oil Base

a. General. When it is necessary to fit new main bearings, connecting rod bearings, pistons, piston rings and pins, or to repair the oil pump in this unit, the cylinder block must be removed from the oil base (crankcase). Before splitting the unit remove the generator assembly from the engine according to instructions for replacing the fan belt, or leave the generator bolted to the upper part of the cylinder block and split the engine according to the instructions below:

b. Detailed Instructions. To split the engine proceed as follows:

1. Drain water from radiator, oil from crankcase, and gasoline from fuel pump and carburetor. Disconnect and remove fuel lines and radiator overflow pipe. Disconnect output leads at switchbox. Remove air cleaner and spark plugs.
2. Remove fuel pump from gear cover (two cap screws hold it in place).
3. Remove the ten cap screws holding gear cover in place, and pull off g-ear cover. When t-he cover is off, remove the crankshaft gear, camshaft gear and governor (or magneto) drive gear.

NOTE: When removing gear cover, be sure not to lose fiber cam thrust plug when it is forced out.

4. Remove the thirteen cap screws holding the cylinder block to the oil base.
5. Remove the four cap screws holding the lower half of the generator assembly to the flywheel housing.
6. Remove the oil gauge so it will not be bent when the block is lifted off the oil base.
7. Lift the engine and generator from the oil base and lay it on a suitable platform about 12 inches high, magneto side down (Fig. 21). Tie a string around the oil pump tappet to prevent it from falling into the case.

NOTE: Do not withdraw the camshaft while the engine is in an upright position, or the tappets will drop into the oil base.

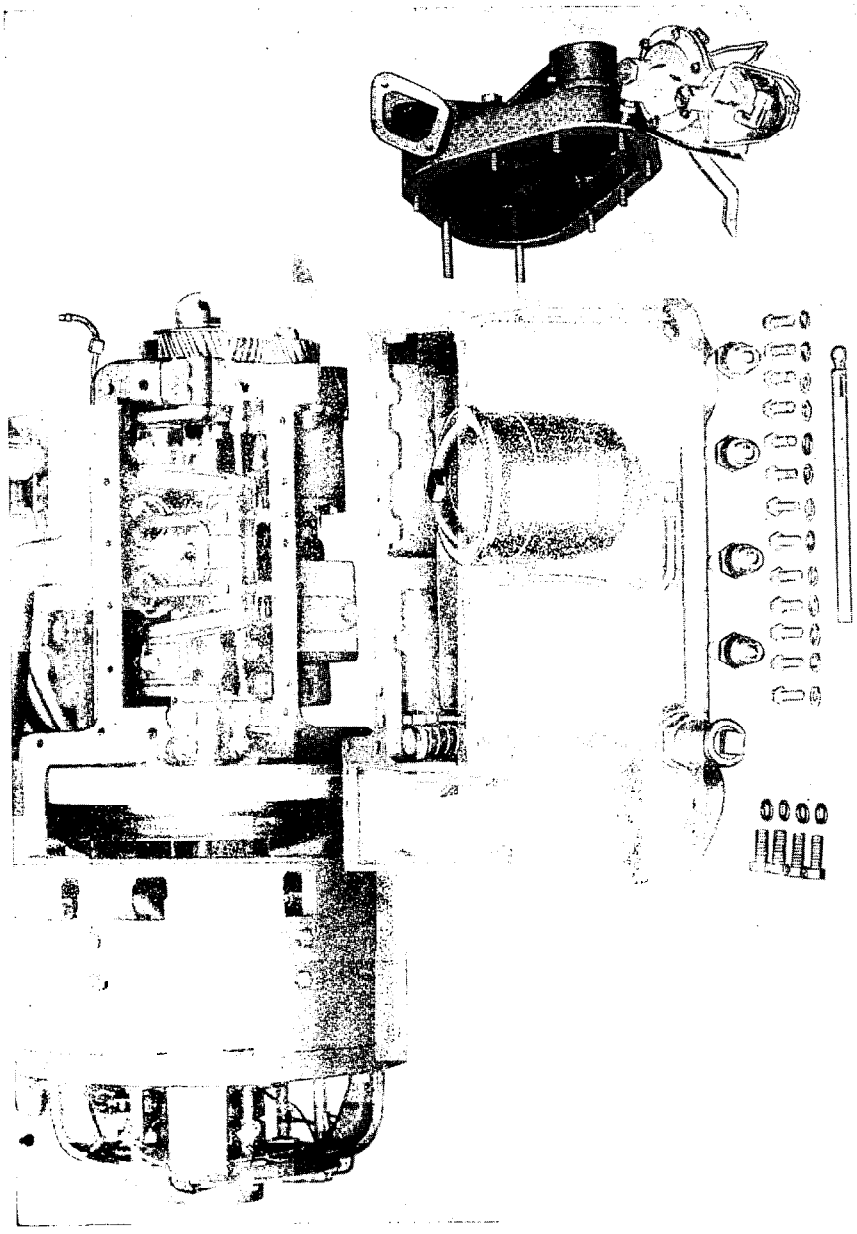
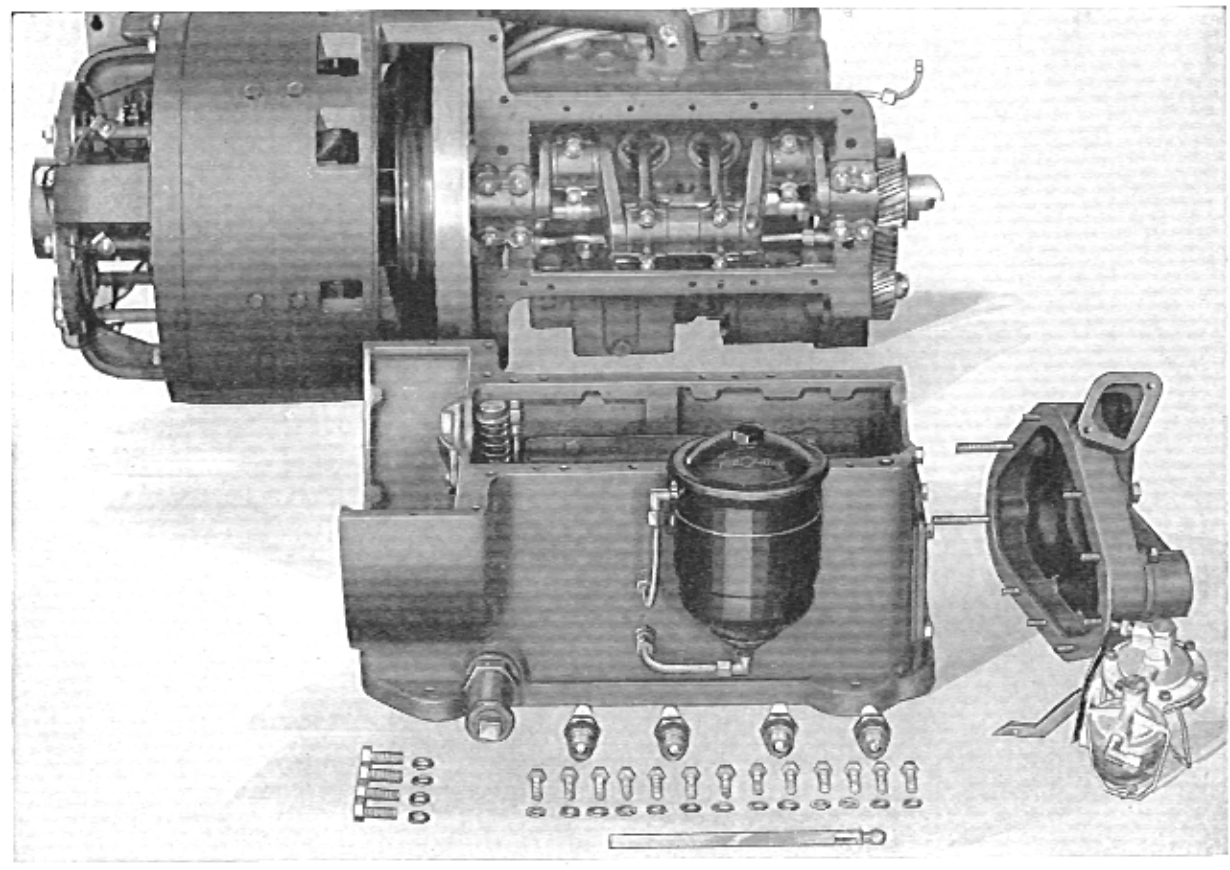


Figure 21
Splitting the engine: removing engine from oil base.



Cylinders and Pistons

a.. Inspection. After splitting the engine, disconnect the connecting rod bearings and withdraw the pistons from the cylinders. Examine t lie cylinder walls. If they at-e scored or worn excessively, they will have to be reground, and new pistons will have to be fitted. Clean the pistons and rings with gasoline and examine them. If the rings are properly fitted they will have a bright, highly polished surface. Any dark colored or rusty spots or tool marks on rings indicate that the rings are worn and do not tit the cylinder walls tightly. Improperly fitted rings should be replaced ,or they may cause pistons to pump oil.

b . Fitting Pistons in Cylinders. Proper clearance between piston and cylinder wall is 0.002 inches. With rings removed, a piston of correct size should just fall through the cylinder. Be sure to replace pistons in same cylinders front which they were removed. The cylinders are numbered consecutively 1, 2, 3, 4 from crank end to radiator end, and each connecting rod is marked with a number corresponding to the cylinder to which it is fitted. When fitting a piston, check the clearance with a 0.002 inch shim (Fig. 22). New pistons should not wedge when being fitted with this size shim, hut a noticeable drag mill be felt.

c. *Replacing Piston Pins.* The piston pins in the engine are full-floating and are held in the piston by means of spring steel retainers (Fig. 2.3). The steel pin is fitted to the bronze bushing in the upper end of the connecting rod with 3 snug hand-press fit, and to the piston itself with a tight hand-press fit (should be snug enough to require considerable force to inset-t the pin). To test fit of pin in rod bushing-, clamp pin in a vise, after at taching the connecting rod. The weight of the rod should be sufficient to allow the rod to drop gradually. Use the same test when fitting pin in piston (Fig. 23). Use a shim to test pin fit. Replace piston pins that are worn, or are loose in bushing or piston. If connecting rod bushing is worn, replace it.

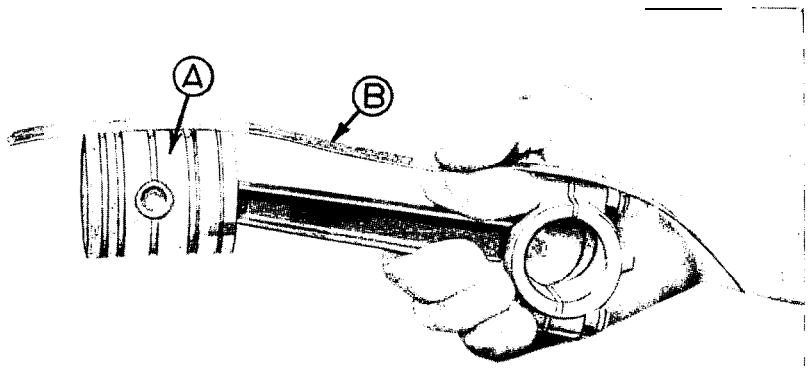


Figure 22
Fitting new piston with shim
A — Piston B — 0.002-inch shim

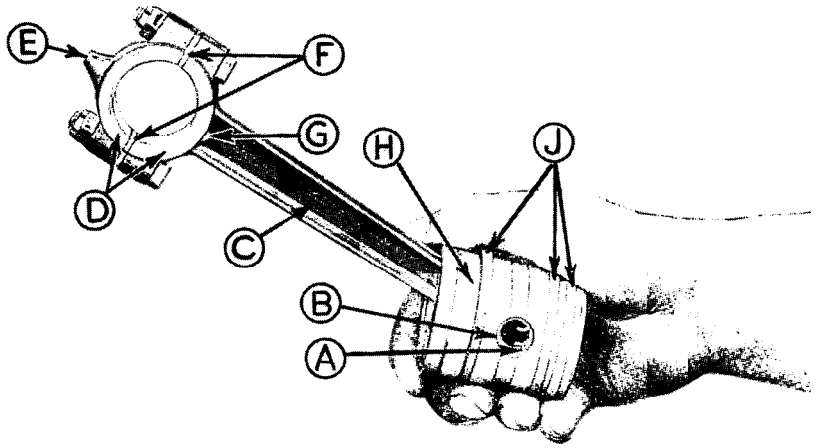


Figure 23
Fitting piston pin.

A — Piston pin retainer
B — Piston pin
C — Connecting rod
D — Connecting rod bearings
E — Oil dip
F — Bearing shims
G — Oil hole
H — Piston
J — Piston rings

Connecting Rods and Bearings

a. *General.* Each connecting rod bearing is numbered to correspond to the cylinder to which it belongs. When properly adjusted, the bearing clearance should be 0.002 inches for smooth operation. Examine the condition of the bearings after removing the connecting rods from the crankshaft. If they are scored, scrape or tit the rods with new bearings.

b. Fitting New Connecting Rod Bearings. New rod bearings must be fittetl properly to the crankshaft. To do so, wipe the shaft and bearing clean and then apply a little Persian red or blue, mixed in oil, to the shaft. Place the bearing half on the shaft, and slide it hack and forth around the pin. Remove the bearing and note the impression on it. Cut down the high spots on the bearing with a hearing scraper, and repeat the rubbing test. At least 80 percent of the bearing should touch the shaft. After fitting the bearings, adjust the bearing clearance of each connecting rod on the crankshaft individually. Connect each rod to the shaft, putting in sufficient shims to secure proper clearance. If the rods are attached so that they are left out of the cylinder when hearing clearance is adjusted (Fig. 24) the clearance can be tested by raising the rod to a horizontal position after the bolts have been tightened. If the rod gradually drops, due to its own weight, the fit is approximately correct. The bearings should not bind, and should be able to be moved laterally slightly. Be sure to replace all cotter pins on bearing studs after tightening nuts.

c. *Oil Dip of Connecting Rod.* When the cranks are in the bottom center position, the top of the oil clips on the connecting rods should be 2-23/32 inches

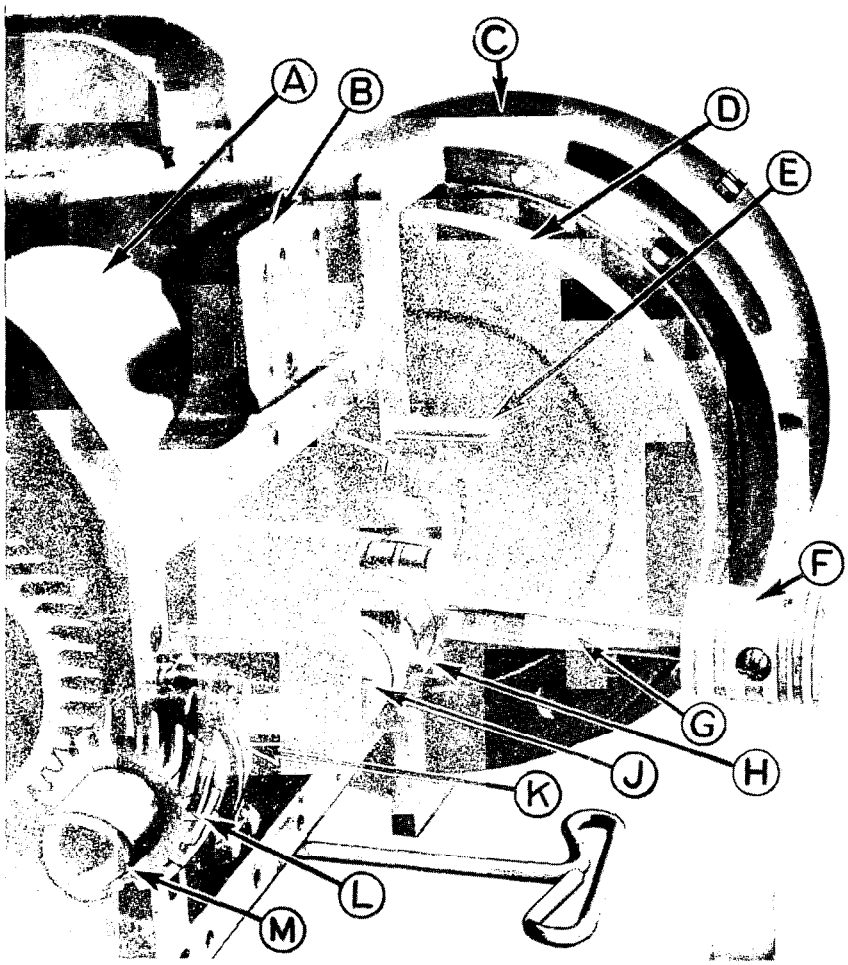


Figure 24

Fitting connecting rod bearings

A — Governor housing
B — Magneto bracket
C — Generator frame
D — Flywheel
E — Oil pump tappet
F — Piston
G — Connecting rod
H — Oil dip
I — Crankshaft
K — Main hearing
L — Crankshaft gear
M — Starting jaw

below the level of the cylinder block base. This will give a clip of 1/32 inches when the plant is assembled, as the oil baffle plate is bolted inside the oil base so thnt the drain slots on ends of plate are 2-11 /16 inches below the top of the oil base. The method of measuring the oil dip is shown in Figure 25. When replacing connecting rod bearing caps attach them so the hole in the oil dip faces to the exhaust side when viewed from the crank end of l-he engine; otherwise the bearing n-ill not be lubricated and will burn out. See nest paragraph for instructions on checking height of oil baffle plate. This is very important to assure proper lubrication.

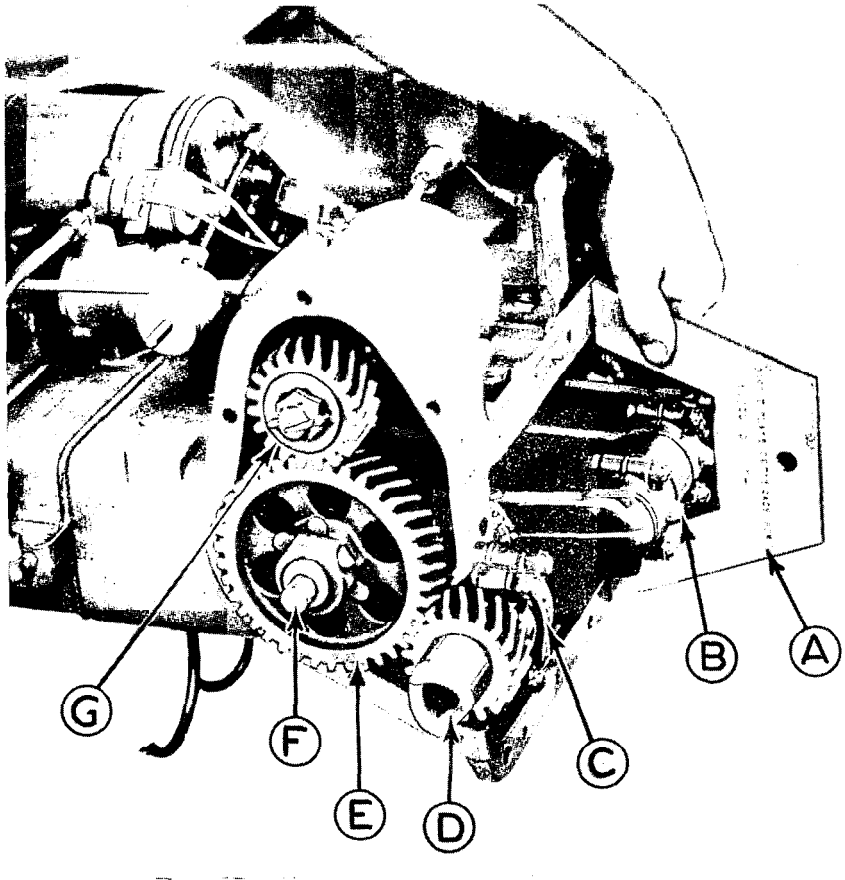


Figure 25
Measuring oil dip of connecting rod

A — Measuring gauge
B — Connecting rod oil dip
C — Front main bearing
D — Starting jaw
E — Camshaft gear
F — Camshaft thrust plug
G — Magneto drive shaft gear

Oil Baffle Plate and Oil Pump

a. Height of Baffle Plate. Figure 26 shows the correct way to check the height of the oil baffle plate in the oil base. The baffle plate is in correct position when the drain slots in the end of the plate are 2-11/16 inches from the top of the oil base. If the baffle plate is too high, the engine may pump oil because too much oil is splashed on the cylinder walls. If the plate is too low, the connecting rod bearing will not receive enough lubrication and may burn out. To adjust position of plate for correct dip, loosen the capscrews holding it to the oil base. Raise or lower plate to correct position and tighten the screws.

b. Oil Pump. When the engine has been disassembled, remove the oil pump to clean it out, if necessary. Operate the plunger by hand to see that connections are tight. Examine all bolts and nuts to see that they are properly tightened.

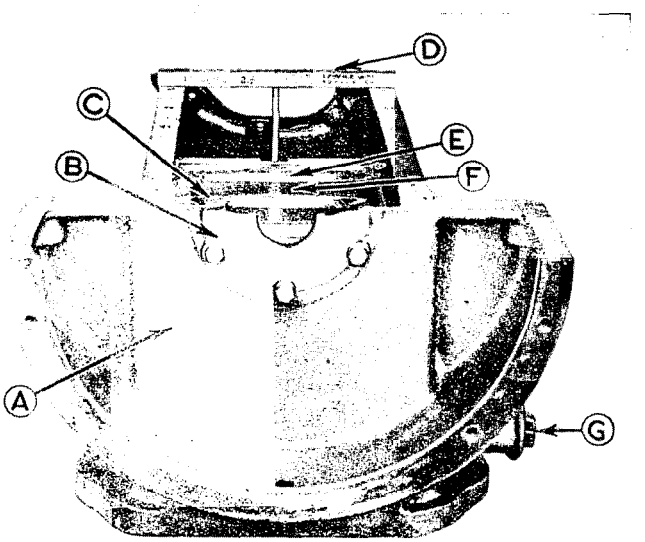


Figure 26

Checking baffle plate height in crankcase

A — Oil base
B — Split co\-er (oil retaining ring)
C — Oil pump plunger
D -- Gauge
E — Oil troughs
F — Baffle plate
G — Drain plug

Fitting Main Bearings

To fit new main bearings on the engine crankshaft, split the engine and remove the generator assembly, as described previously in this section. Remove the bearing caps and after lifting out the crankshaft, examine the bearings. If the bearings are scored or cut, scrape them to fit, if practicable, or fit new bearings. Follow the same procedure for fitting main bearings as described in

paragraph for connecting rod bearings. Adjust bearings for clearance of 0.002 inches after replacing crankshaft. When bearings are properly adjusted, the shaft can be turned easily by pulling on the flywheel. There should be no binding. Replace cotter pins in main bearing bolts after tightening nuts.

Crankshaft and Camshaft Gear Timing

The crankshaft and camshaft gears in the 1½ KVA Kohler unit are marked SO S. For proper timing they must be meshed so that the O on the crankshaft gear matches the O on the camshaft gear (Fig. 27).

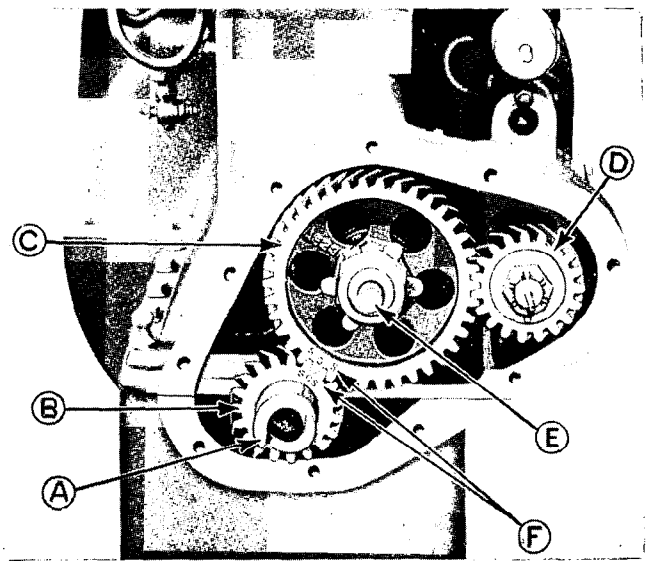


Figure 27

Correct meshing of camshaft and crankshaft gears

A — Starting jaw
B — Crankshaft gear
C — Camshaft gear
D — Magneto drive gear
E — Camshaft thrust plug
F — Timing marks

Replacing Engine on Oil Base

After making internal repairs on the engine in the Kohler unit, clean off the flange joints and examine condition oi gaskets. Coat the face of the cylinder block joint with shellac and press gasket firmly into place. Be sure not to blind any of the holes. After gasket has stuck fast apply a lit tle oil to it. Remove the string or rubber band from tlie oil pump tappet, and replace the engine on the oil base. Set it in place squarely. He sure not to displace gasket. To replace t lie remainder of the engine components, reverse the disassembly procedure given in preceeding paragraphs.

GENERATOR AND FLYWHEEL

Removing Brush Holder Bracket

a. General. The commutator or collector rings may require servicing when the plant has been operated for a long period. For access to the commutator to dress the bars or undercut the mica, or for access to collector rings for sanding, remove the brush holder bracket from the generator assembly.

b. Procedure. To remove the brush holder bracket, proceed as follows:

1. Remove generator end cover. Four retaining screws hold it in place.
2. Remove brushes from brush holders and disconnect leads connected to voltage regulating relay and switchbox.
3. Remove the cap screws holding the brush holder bracket to the generator frame, and pull the bracket off (Fig. 28).

Removing Collector Rings and Armature

a. Collector Rings (Pig. 29). Collector rings may wear excessively due to brush sparking, excessive brush holder spring tension, or a stuck or binding brush. Ii they do, replace them. To remove collect or rings :

1. Remove generator brush holder bracket according to instruct ions above.
2. Remove armat ure leads which fasten to terminals inside the collector rings.
3. Remove the two bolts from the collector rings;.
4. Withdraw collector rings front armature shaft over the ball bearing.
5. New collector rings may be installed by reversing the above disassembly procedure.

b. Armature. To remove the armat ure, follow the same procedure described in subparagraph (*a*) above for taking off collector rings, and do the following in addition :

1. Remove the cap screw and two washers holding generator ball bearing on end of armature shaft. Remove ball bearing.
2. Slide armature spacer off shaft.
3. Remove armature from shaft with armature tool (Fig. 30). To replace armature, reverse the above procedure. Insert driving screw of armature tool in armature shaft, slip armature onto shaft. Alter aligning the armature keyway with the shaft key, press the armature into position. Aftet the armature has been started, the armature spacer can be used to push the armature further onto the shaft. Hold the armature with a belt to prevent it from turning when being replaced on shaft.

Removing Field Coils

The field coils can be removed from the generator frame after removing the armat ure, as previously described, or they can be removed after disassembling the entire generator frame from the engine flywheel housing as explained in

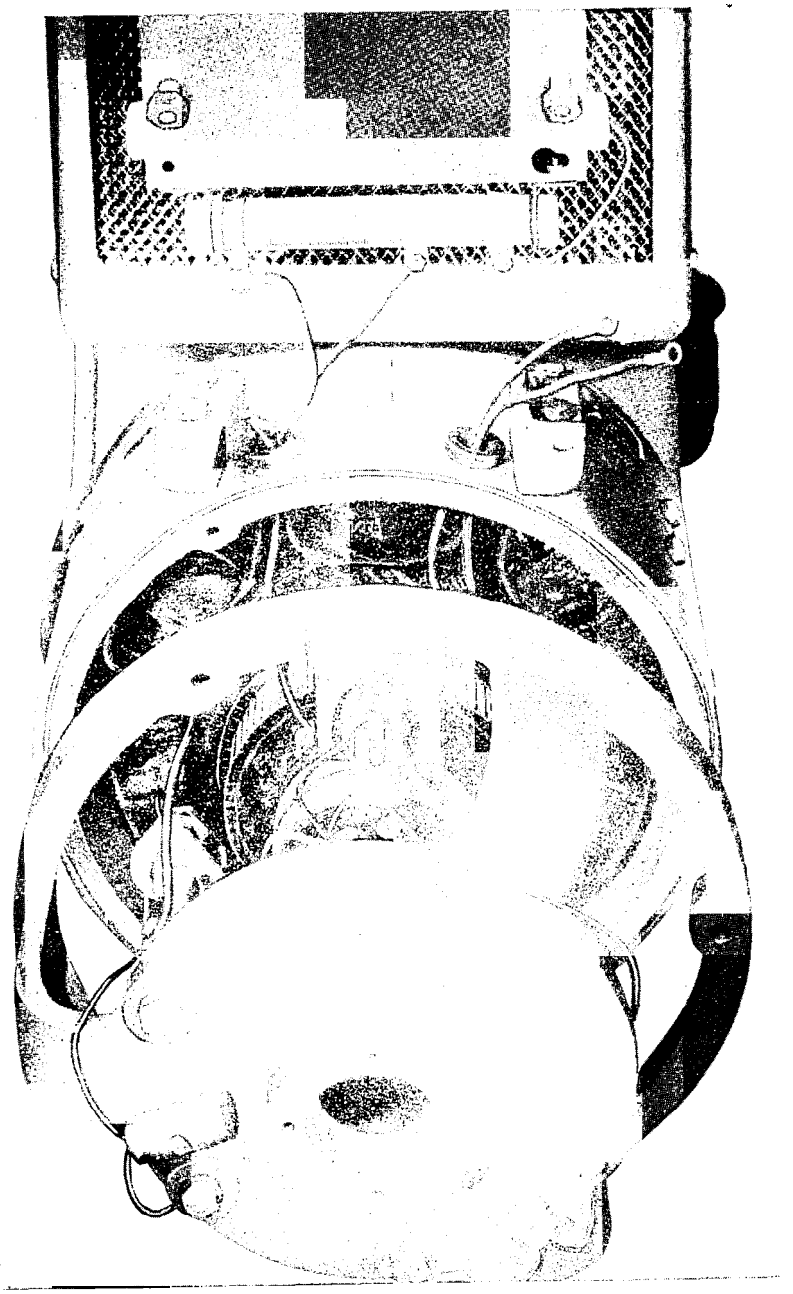


Figure 28

Generator with brush holder bracket and switch box removed from generator frame

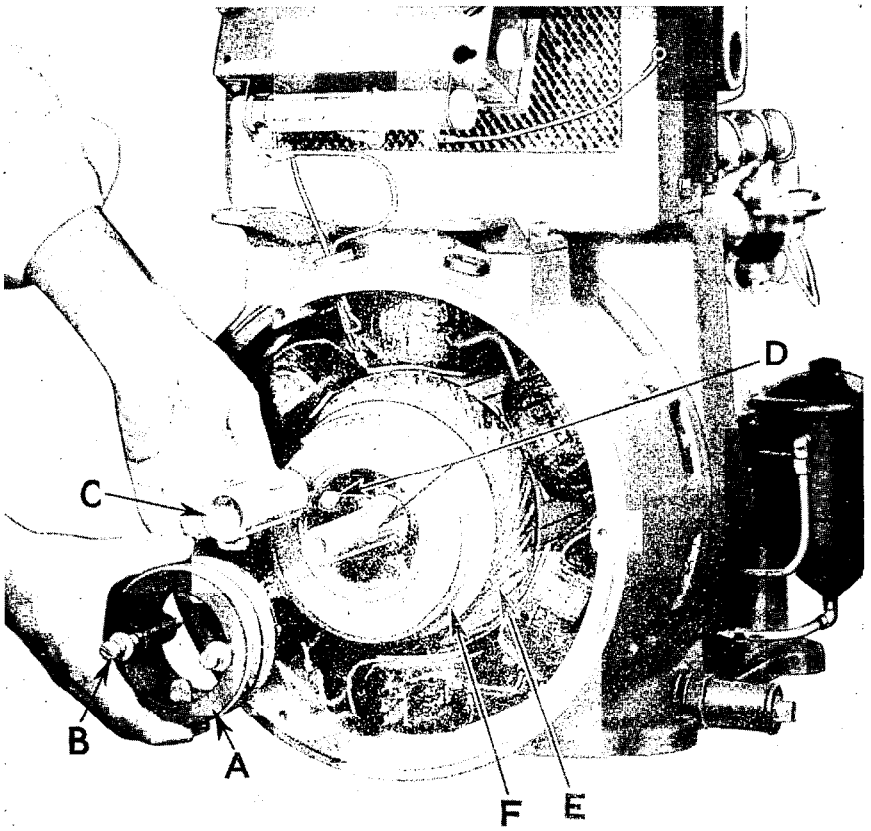


Figure 29

Removing collector rings from armature shaft

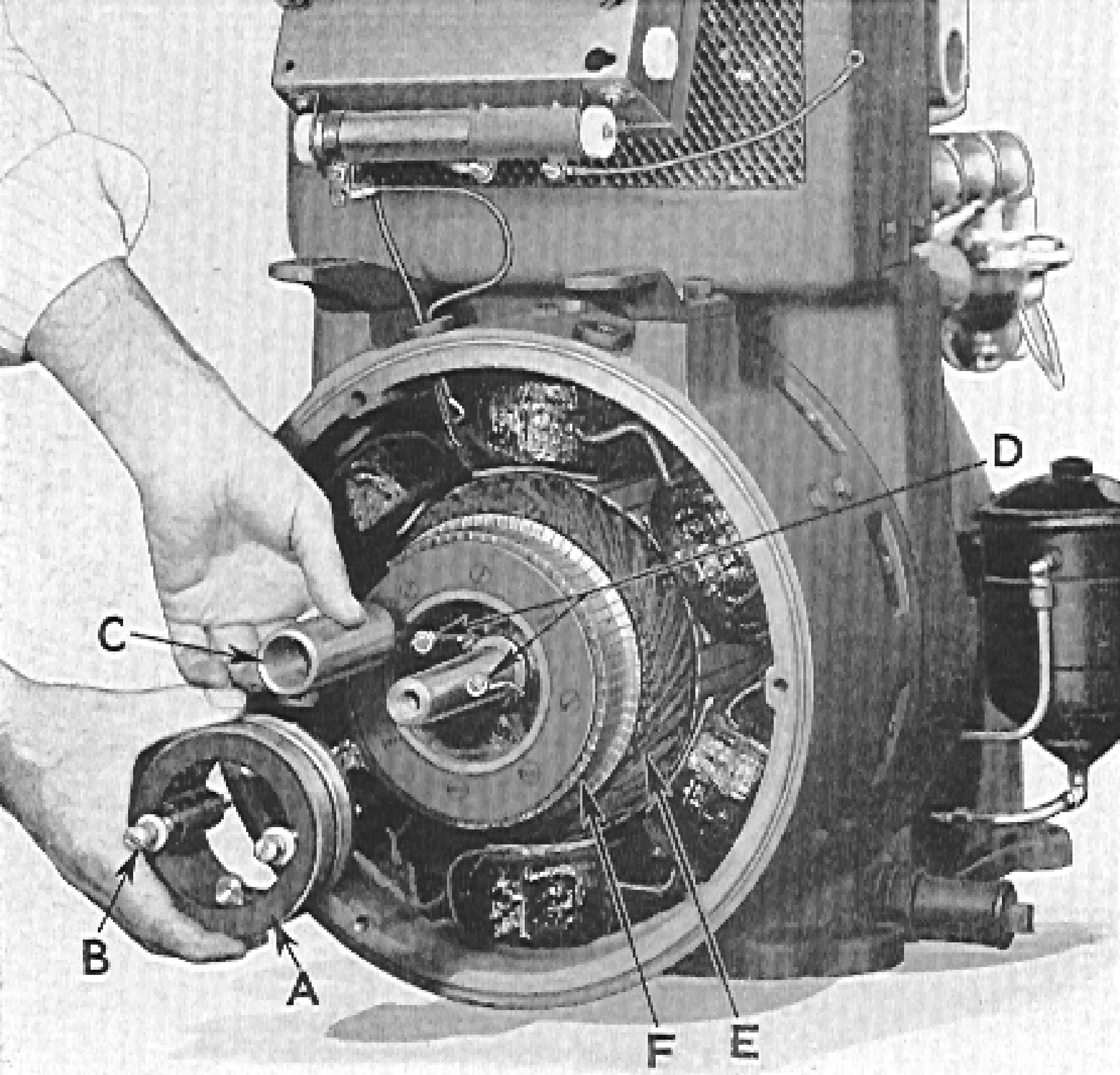
A — Collector rings
B — Collector ring bolts
C — Armature spacer
D — Armature lead wires
E — Armature
F — Commutator

instructions for replacing a fan belt. Each field pole is held in place by two bolts through the generator frame. The poles are built up of thin, soft, iron sheets with threads which are stripped easily if too much pressure is used to tighten bolts when replacing them. Figure 31 shows interior of generator frame with field coil detached.

Testing the Generator

a. Testing for Grounds in Armature. The armature circuits can be tested for grounds with the brush holder bracket removed, or with the entire generator assembled.

1. If brush holder bracket has been removed, test the rings and then the commutator (each is insulated from the other). One ground will show trouble on both rings.


D
C
B
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E

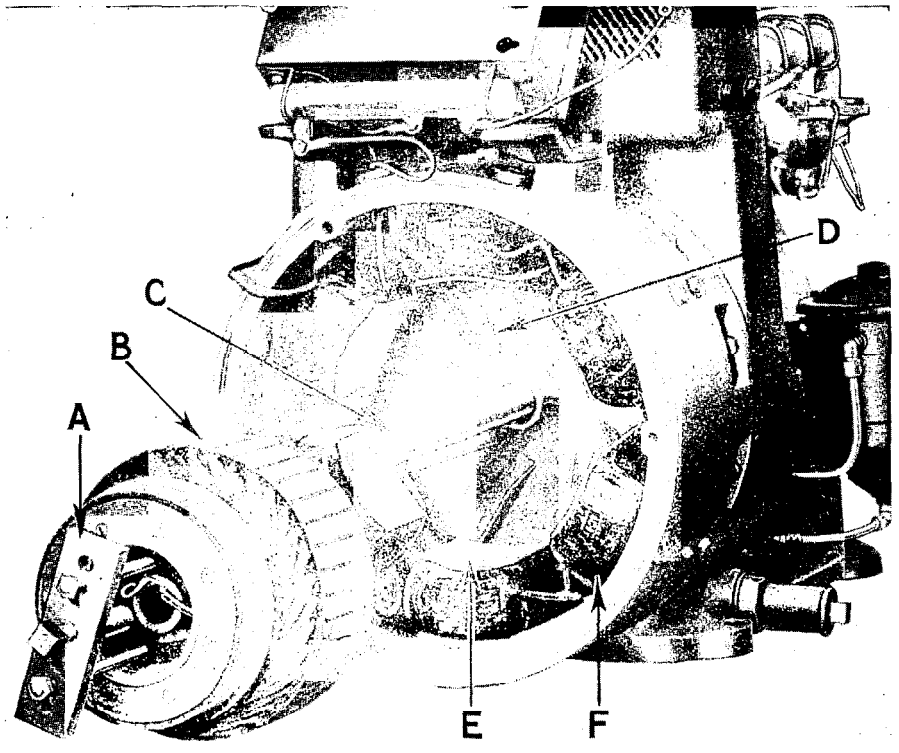


Figure 30

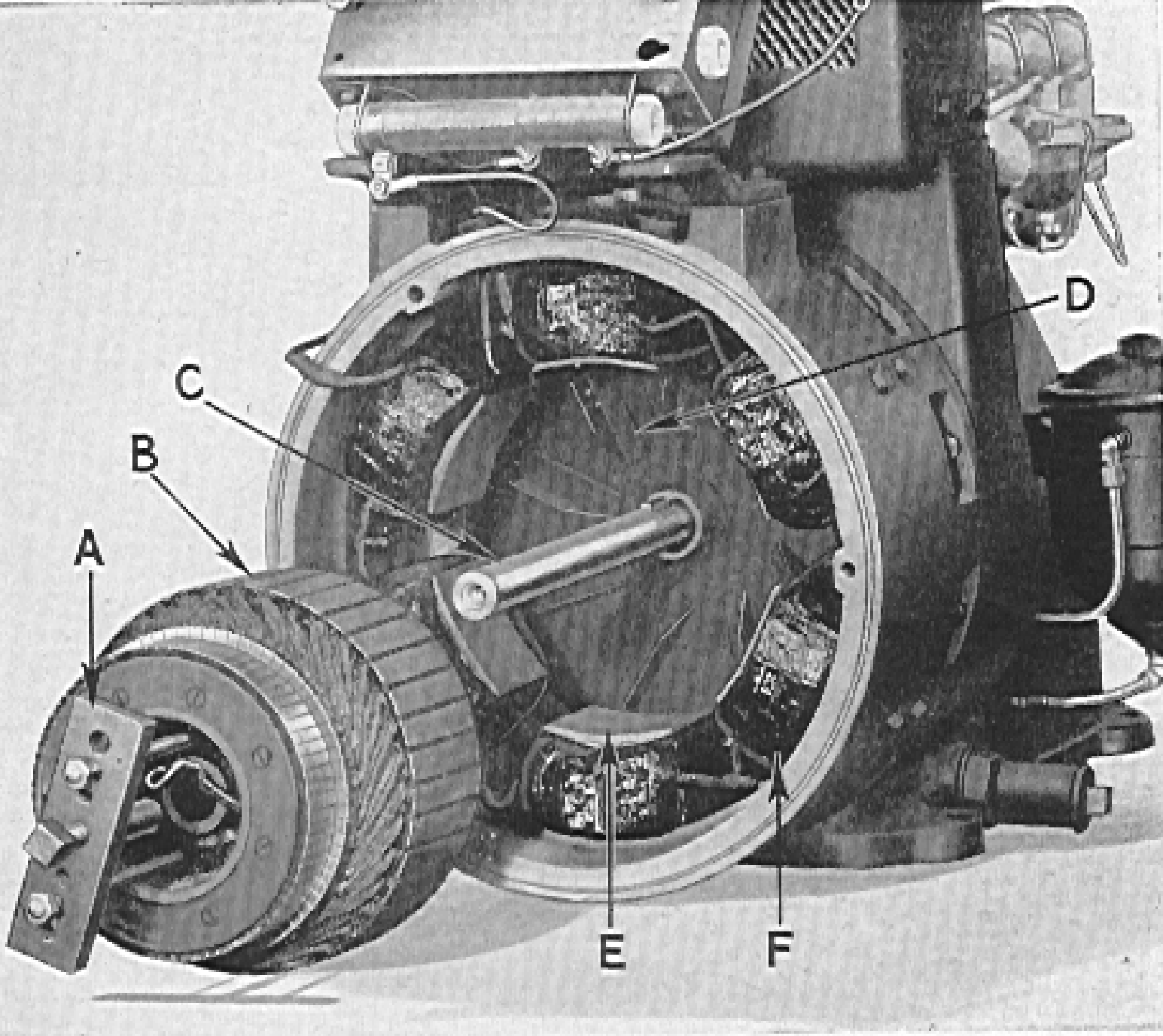
Removing armature from shaft

A — Armature tool
B — Armature
C — Armature shaft
D — Generator fan
E — Field pole
F — Field coil

2. To test for grounds in armature with generator completely assembled, isolate the commutator from the rings by placing a strip of paper under the brushes on the rings and commutator. Use a magneto ringer, field phone, or other test device.

b. Testing for Grounds in Field Coils. Field coils can be tested either after removing the entire generator frame from the engine flywheel housing, or after removing the armature from the generator frame. To test coils, remove all wiring from coil terminals and ground one end of a test wire equipped with battery and bell, light, or voltmeter in the circuit. Attach the other lead of the test circuit to one of the coils. If current flows, one or more of the coils is grounded. To determine which one, disconnect the coils from each other and test separately.

NOTE: When coils are hot they n-ill often show grounds which will not show after the coils have cooled.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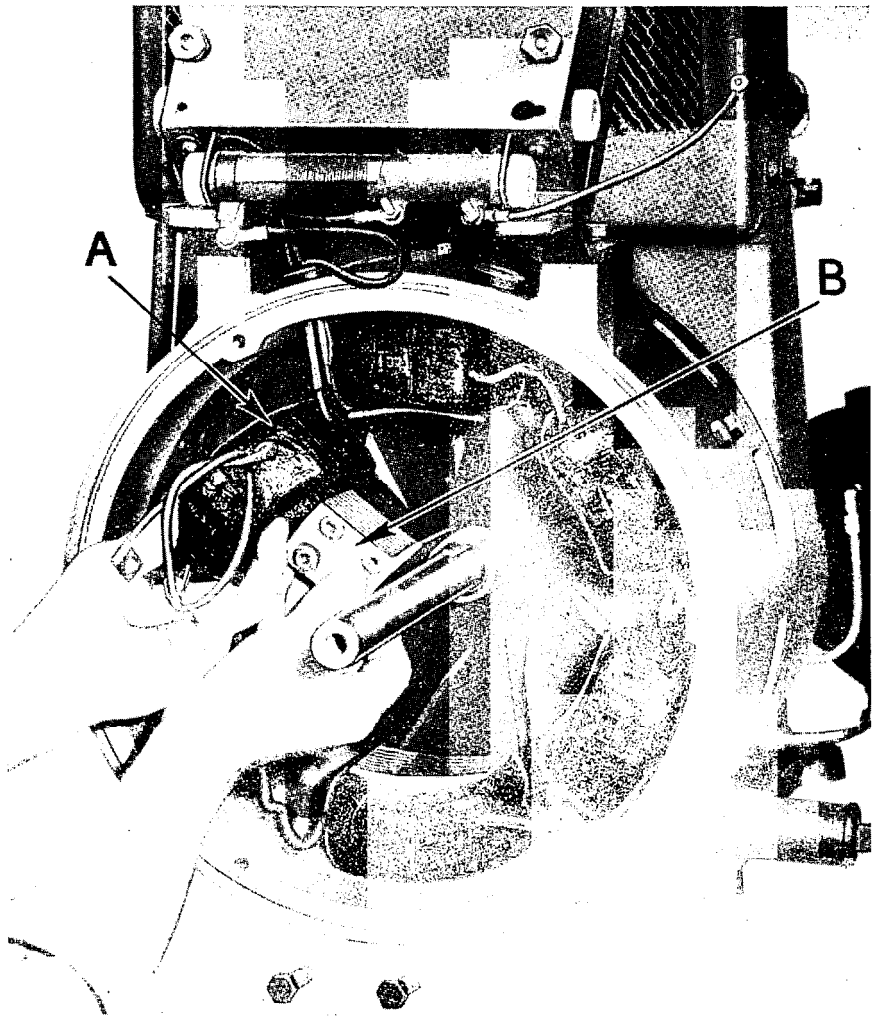
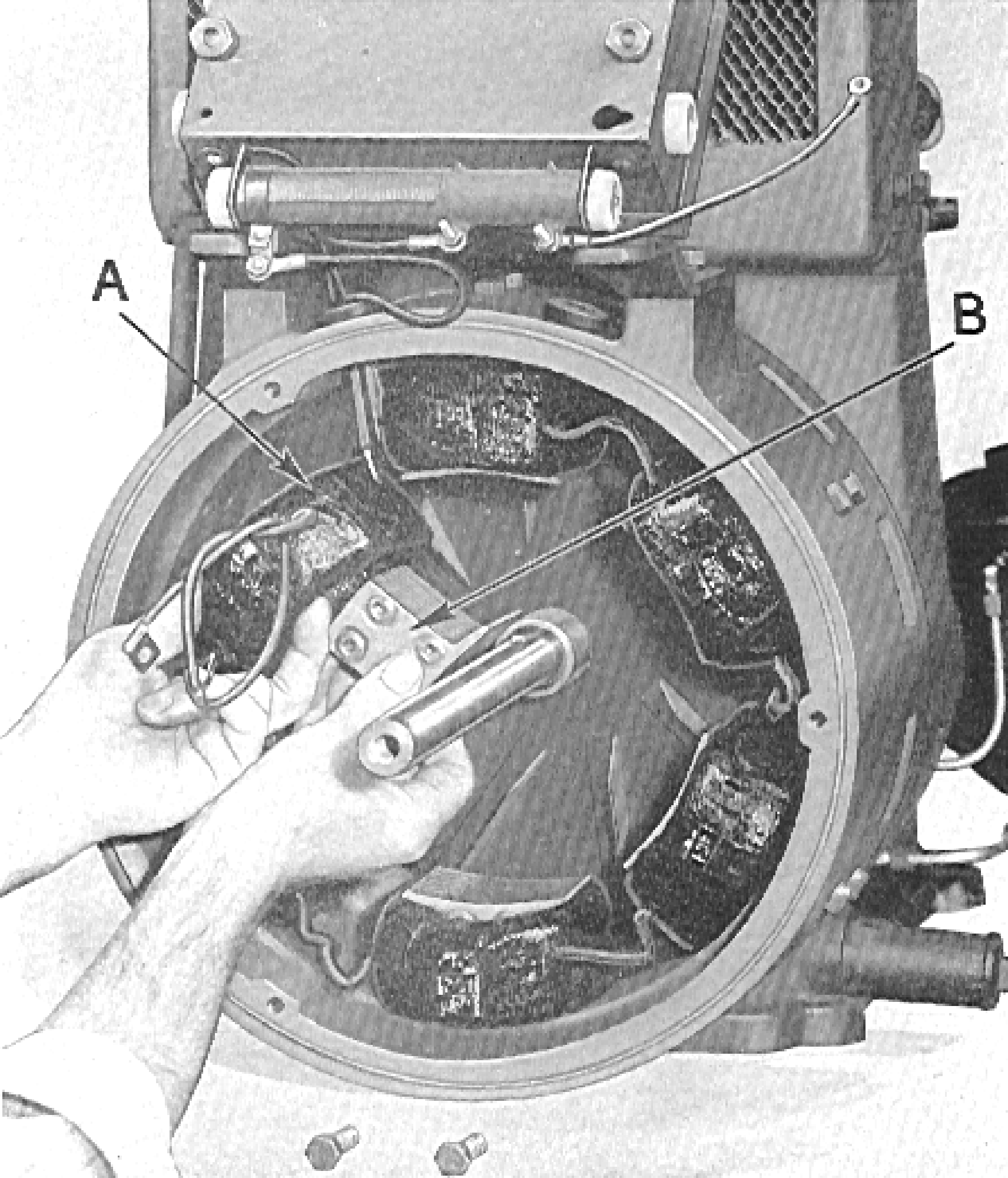


Figure 31
Removing field coils
A — Field coil B — Field pole

c. Testing for Open Circuits in Coils. Each field c-oil consists of two insulated coils taped as a single coil. Before testing coils, place a strip of paper under each brush, in the same manner as for testing the armature with the generator completely assembled (subparagraph (*a*) above). Remove cable S-l from the terminal at the back of the voltage regulating relay, and remove cable F from its terminal. Attach one wire oi the test- circuit to cable S-l terminal. Test for a complete circuit from a positive d-c brush to the S-l terminal, using the same


A
B

lest as previously described for locating grounds (subparagraph (*b*) above). Test the cl-c shunt field circuit by attaching one test wire to 3 positive d-c brush stud, and touching the other to the cable F terminal. Absence of current flow indicates an open. To locate an open in the alternator field, disconnect one of the field leads from either of the two a-c brush studs, and test the circuit.

Removing Flywheel

a. General. After the armature has been removed, the flywheel can be removed as shown in Figure 32

b. Procedure for Removal.

1. Remove Woodruff key from armature shaft. In removing this key, do not burr or cut edges of grooves that the key fits.
2. Remove armature spacer.
3. Remove generator fan.
4. Remove engine fan belt. To do so, loosen engine-fan holding nut and drop fan in housing to permit lifting belt over fall.
5. Clean the two holes specially drilled for the flywheel puller.
6. At tach flywheel puller and remove flywheel.

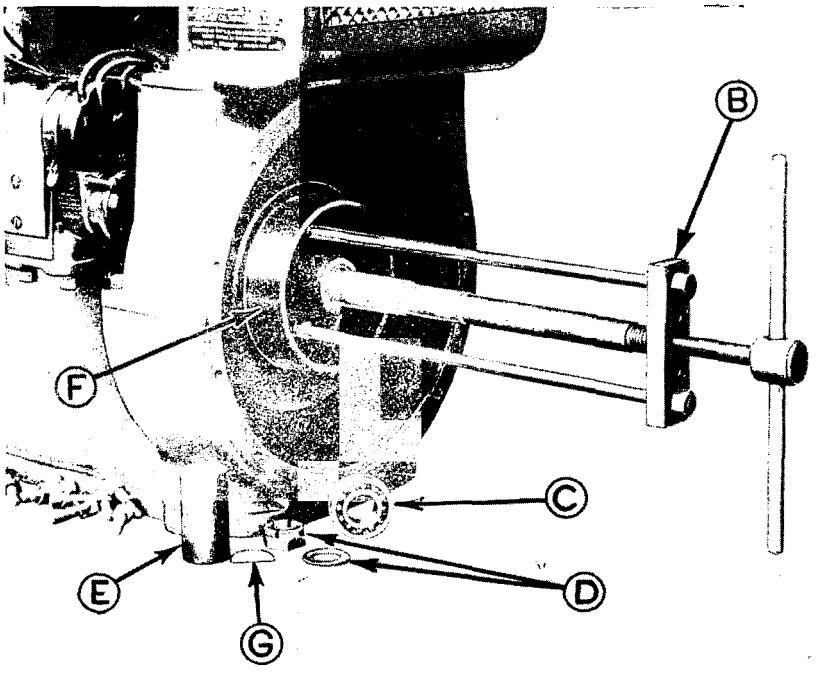


Figure 32
Removing flywheel

B — Flywheel puller
C — Generator ball bearing
D — Generator bearing nut and washer
E — Armature spacer
F — Flywheel
G — Woodruff key

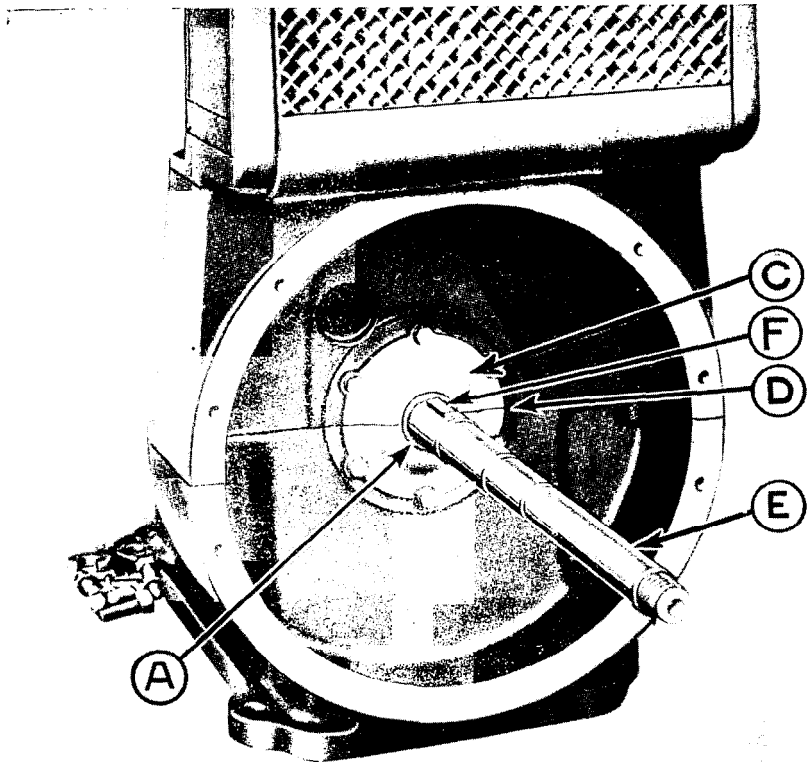


Figure 33

Flywheel removed, showing split covers

A — Clearance between split covers and crankshaft
C — Split cover
D — Split cover joint
E — Armature shaft
F — Woodruff key

c. Split *Covers (oil retainers).* The split covers, which hold oil in engine oil base, are visible after flywheel has been removed (Fig. 33). The split covers are held in place by six cap screws, mid are fitted with copper asbestos packing washers. Clearance between crankshaft and split covers should be 0.004 to 0.006 inches. If an oil leak develops through the split covers, drain the crankcase, and remove the upper half of the split cover. Replace the gasket and washers if worn. An oil leak through the cap screws can be checked by removing each of the screws and coating the threads with shellac.

NOTE: Do not attempt to repair an oil leak at the split covers by splitting the plant. The leak may be through the cap screw holes in the upper split cover. These are inaccessible unless the flywheel is removed.

Special Installations

When a special installation is considered which involves additional accessories such as transfer switches, change-over switches, multiple switches, an additional unit for multiple operation or a marine installation, we will be pleased to cooperate and give all the assistance we can. Requests for information should be directed to Kohler Co., Kohler, Wisconsin, attention Service Department.

Radio Interference

Radio Interference from an electric plant may be of two types: that caused by the generator and that caused by the ignition system. In most installations the interference caused by the generator is most objectionable and annoying. To eliminate this type of interference, we have installed condensers in the generator and the control switch.

To reduce interference as much as possible, it is also advisable to eliminate arcing of the brushes. It may be necessary to sand the brushes and commutator with fine sandpaper and readjust the brush holder.

When ignition interference is present, it may sometimes be eliminated by shielding the spark plugs and cables. Suppressors or resistor units may also be placed in series with the spark plugs leads.

DIAGNOSES OF TROUBLES AND THEIR REMEDIES

Kohler Electric Plants are correctly designed, and constructed of the best material by skilled mechanics under the supervision of engineers who have had years of experience in the construction of gasoline engines and electrical equipment. Each plant is thoroughly tested before shipment- is made from factory.

If installed under proper operating conditions and given the care which all machinery of this kind must have, they will give long, dependable, and economical service.

If, however, the plant is not properly installed under conditions that are reasonably favorable for its operation, or does not receive proper care, satisfactory results cannot be expected, and sooner or later trouble will be experienced.

If conditions are not right, and the plant is not functioning properly, certain symptoms will appear. In the following pages are given various symptoms and the cause that is responsible for it and the remedy to apply.

Do not proceed blindly. If the plant does not operate as it should, note carefully how it acts. Turn to the symptom exhibited, find the cause and apply the correct remedy. Remember that cold weather, dirt in the supply line strainers or carburetor jets, water in the gasoline, fouled spark plugs or choked exhaust pipe or muffler, are responsible for most of the difficulties experienced with gasoline engines. Do not take the machine apart until you have located the trouble.

Remember that a low or inferior grade of gasoline will not permit the plant to start promptly during cold weather.

1. Engine Fails to Crank Automatically When a Light is Turned On

1. Safety switch disengaged, indicated by the fact that the gilded button on front of switch projects outward about 1/2". The safety switch protects the starting battery from exhaustion in case the engine fails to

start. Failure of engine to start may be due to a number of causes, among which are: (1) lack of gasoline; (2) water in gasoline; (3) fouled spark plugs; (4) weak spark; (5) magneto wires improperly connected to spark plugs; (6) improper valve adjustment.

If the engine fails to start in about me minute, the safety switch will break the cranking circuit. When this happens, first ascertain the cause for failure to start. When the matter has been remedied, then push button in before attempting to start. (See M, Fig. 12. Page 20).

Safety switch may also disengage if bearings are too tight or if lubricating oil is congealed due to cold weather, putting an unusual drain on the starting battery.

2. Weak Battery. Starting battery under normal conditions should be kept charged by the generator, a portion of its current being shunted into battery. It should register 1.280 when fully charged. If gravity falls below 1.200 battery is discharged and needs attention.

3. Defective lamp or appliance. In case plant does not start automatically when lamp or appliance is turned on, test out with others to make sure that the fault does not lie with the lamp or appliance.

4. Corroded or loose battery connections.

5. Open circuit in wiring system. Examine for loose connections, broken wires, open switch and burnt out fuses. If fuses are burnt out, ascertain cause.

6. Governor switch out of order (See Fig. 15, Page 25). Governor switch contact points should be together when the plant is idle, so the battery circuit can flow across the contact points and permit the cranking function. The following causes may stop the flow of current and prevent closing of battery circuit: (1) dirty contact points; (2) bent or weak governor switch springs; (3) loose or broken governor switch contact plug; (4) broken snitch body; (5) stop screw for governor arm advanced too far; (6) broken or improperly connected governor switch wires. A common cause of failure of governor switch to function is that stop screw is in too far, so that switch points cannot close.

7. Generator not functioning properly. The following are causes for non-functioning of the generator: (1) dirty commutator; (2) worn, broken or sticking brushes; (3) broken brush springs; (4) broken or loose wires; (5) ground, short circuit or open circuit in armature. Grounds and short circuits in the armature are caused by rough handling, water or oil soaking insulation, defective insulation in coils, crushed lead wire or foreign substance lodging between commutator bars. An open circuit may be caused by wires being burned, due to short circuit, lends not soldered properly or solder broken away.

8. Automatic switch inoperative. The following may cause failure of switch to operate to crank the plant: (1) relay coil "H" may be burned out thus preventing the operation of relay armature "E" when first appliance is turned on; (2) connected load too small; (3) contact point- "D" at top of relay makes no contact; (4) contact points "FF" on center (generator) relay are bent or dirty; (5) governor switch "V"

dirty or out of adjustment; (6) Cranking heat switch contact points "M" dirty or this switch has tripped; (7) weak battery or loose terminals; (8) broken line circuit, or; (9) poor exciter brush contact. If cranking relay flutters, the starting battery probably is weak.

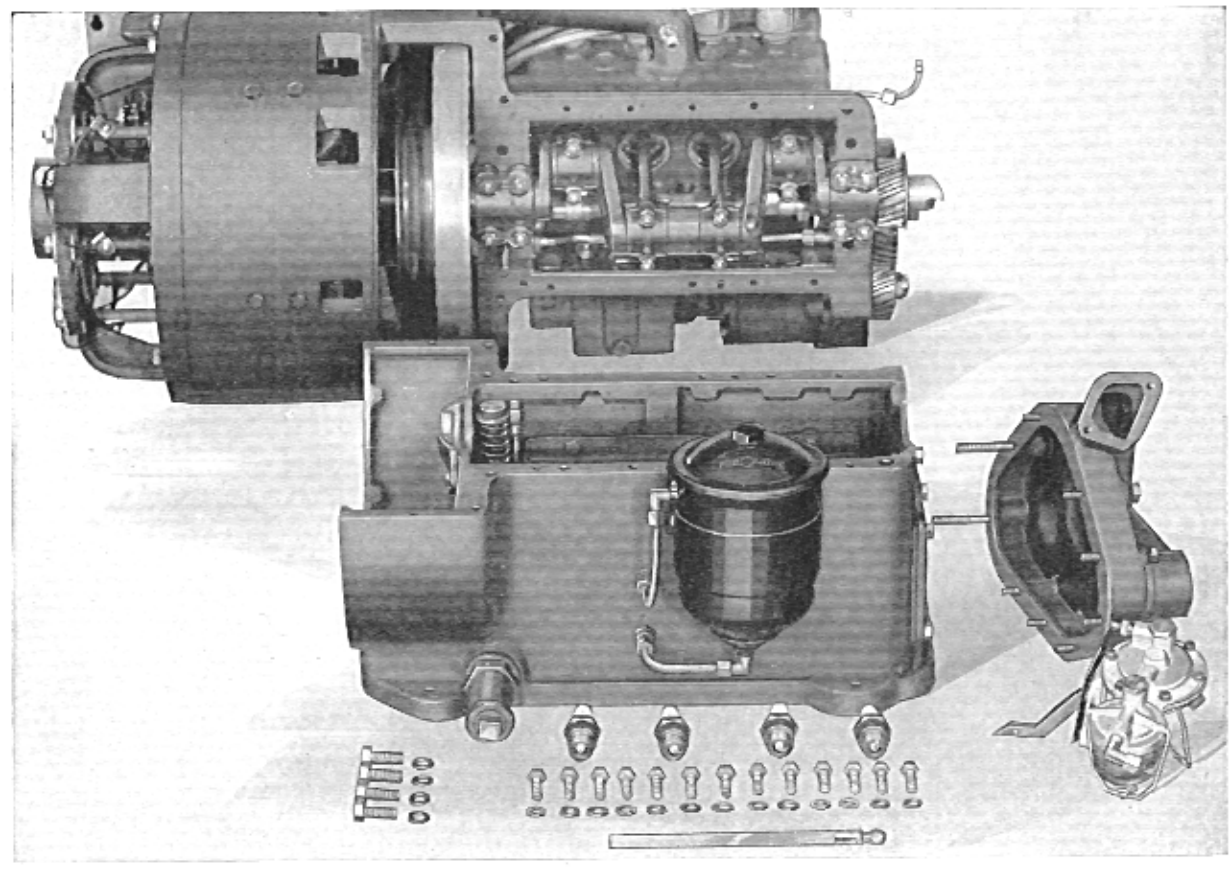
9. Engine does not turn freely, due to: (1) pistons corroded and seized; (2) water in cylinder; (3) crankshaft out of alignment; (4) foreign matter between armature and generator; (5) tight bearings; (6) congealed lubricating oil.

II. Engine Cranks But Fails to Start Firing

1. Lack of fuel. Failure of plant to receive a supply of fuel may result from the following causes: (1) cold weather, particularly if low test gasoline is used; (2) water in gasoline; (3) no gasoline in the supply tank; (4) leaky or punctured supply tank; (5) clogged supply line, due to dirty strainers in the supply tank or carburetor; (6) air leaks in supply line connections. **If m&n fuel tank is not properly vented, fuel will not be drawn freely.**
2. Clogged carburetor. (1) sticking of needle valve iii the carburetor; (2) excessive choking, due to sticking, rusted or bent valve or stem; (3) clogged main or compensating jet, due to foreign substances in fttcl. **Avoid use of varnish or paint cans as fuel containers.**
3. Fuel pump at fault.
4. Defective magneto due to: (1) over-oiling, which causes dirty distributor brushes; (2) dirty rotating disc; (3) dirty collector ring; (4) worn or improperly adjusted breaker points; (5) loose or defective cables; (6) short circuit between brushes, caused by crack in distributor plate; (7) burnt **out** armature or condenser.
5. Defective, cracked or fouled spark plugs. Points not adjusted to 1/32" gap.
6. Excessive choking ilttc to: (1) bent or unadjusted choker valve stem; (2) body of clinker out id alignment; (3) screw iii hotair manifold not removed in hot weather; (4) choker manifold out of alignment.
7. Improper timing. Instructions for timing are given on Page 12. Check engine in accordance with directions given.
8. Improper valve adjustment due to: (1) worn or bent push rods; (2) worn or broken rocker arm adjusting screws; (3) broken rocker arm support bracket; (4) sticky rocket- arms: (5) loose cylinder head. Check valve clearance in accordance with instruct iotts given elsewhere iii this hook.
9. Engine too cold, combined with use of low grade of fuel.
10. **Water** in cylinder due to: (1) leaky cylinder head gasket; (2) cracked cylinder block or head; (3) condensation from a long exhaust not fitted with a water drain.

III. Engine Cranks Slowly Under Battery Current

This may be due to the following causes: (1) weak battery; (2) use of too heavy motor oil (use only light oil in cold weather); (3) partial short circuit in the armature; (4) open or short circuit in armature or field



coils; (5) short circuit in third circuit of automatic switch. If plant has been repaired this may indicate tight bearings or generator not in alignment.

IV. Engine Starts But Misfires

Caused by the following : (1 j dirty, defective, or unadjusted spark plugs: (2) defective or crossed magneto cables (firing order is 1-3-4-2) ; (3) defective magneto; (4) improper timing (check timing in accordance with instructions) ; (5) poor compression, caused by scored cylinders; leaky valves, worn or defective piston rings, leaky spark plug gaskets, defective cylinder head. When replacing cylinder head gasket, shellac both sides before replacing, but be careful not to use too much shellac, especially around the opening for the cylinders. (6) tappets out of adjustment, giving too much or too little clearance for the valves; (7) weak or broken valve springs; (8) bent, worn. or sticking valve stems; (9) air leak between intake manifold and carburetor; (10) water in gasoline; (11) excessive lubrication; (12) mixture too lean (main compensating jet or spray nozzle should be set in center of venturi tube): (13) choker valve caught up, causing too rich mixture; (14) water in cylinder.

V. Engine Alternately Cranks and Starts

Relay "E" not adjusted properly.

VI. Engine Backfires Through Carburetor

The following are some causes for backfiring: (1) cold motor; (2) mixture too lean, clue to clogging or improper setting of main compensating jet; (3) poor grade of gasoline; (4) air leak between the carburetor and cylinder head ;(5) dirty gasoline; (6) leaky or improperly adjusted intake valves, due to bent or worn push rods, broken rocker arm adjusting screws, bent or defective valve stems, excessive carbon deposit on valve seat or stem; improper timing (See article on timing); (8) water in gasoline; (9) choke not functioning properly; (10) obstruction in exhaust line clue to collection of carbon or foreign matters, frozen or condensed water, or exhausting of gas into closed area; (1 1) spray nozzle not in center of venturi tube of carburetor; (12) air leak from push rod clearance passage into intake manifold, **clue to** crack or sand hole in casting.

VII. Engine Kicks Back When Being Cranked By Hand

This condition may be caused by the following: (1) magneto advanced too far; (2) improper meshing of crankshaft gears and marking within letters "O" and "S", which should coincide with the crank and cam gears (3) water in cylinder.

VIII. Engine Knocks

Knocking in engine may be due to the following causes: (1) excessive carbon in cylinders from using poor grade of fuel, obstruction in exhaust line, leaky piston rings or defective spark plugs; (2) magneto incorrectly timed; (3) connecting rod or main bearing burned out; (4) loose piston

pin or bushing; (5) loose piston ; (6) loose generator ball bearings, due to lack of lubrication, wear or improper alignment; (7) loose gears on crankshaft, camshaft or magneto drive shaft; (8) loose magneto coupling; (9) heavy overload; (10) weak spring in oil pump; (11) weak valve springs.

IX. Engine Lacks Power

The following may cause this condition : (1) mixture too rich, due lo obstructions of needle valve, leaky flout or bent or worn needle valve ot axle; (2) tnixture too lean, due to partial obstruction in gas supply; (3) low grade or dirty fuel ; (4) cold motor; (5) poor compression ; (6) excessive carbon ; (7) improper valve adjustment; (S) choked exhaust pipe or muffler; (9) defective or broken spark plugs; (10) defective magneto; (11) weak or broken valve springs; (12) bent or sticking valve stem or rocker arm; (13) lack of lubrication because of no oil, oil lines clogged or pump not operating; (14) tight bearings; (15) carburetor lever adjusted so as to run plant slowly.

X. Engine Operates But Speeds Up and Slows Down Alternately

This may be due to the following causes: (1) partial obstruction in the gas supply; (2) cold motor: (3) leak between carburetor and cylinder head; (4) governor mechanism sticking or out of line.

XI. Engine Runs But Fails To Generate

Test for the following: (1) poor brush contacts on the commutator, due to dirty commutator, sticking or worn brushes or high mica between bars; (2) open circuit in the internal wiring system ; (3) open circuit in field coils; (4) open circuit in automatic switch in coil "J", (See Figs. 12 and 13); (5) open circuit in automatic switch at contact point "G"; (6) shorted commutator bars, due to material lodged in slots.

XII. Lights Flicker at Normal Speed

The following are causes for this condition: (1) dirty or rough commutator ; (2) sticking or tight brushes; (3) high mica; (4) faulty ignition clue to defective spark plugs or defective magneto; (5) high ot low commutator bars; (6) clogged muffler; (7) valves out oi adjustment; (8) not enough ventilation; (9) irregular load.

XIII. Engine Fails to Stop

When all appliances are turned off and if you have checked carefully to make sure that no appliance is still in use, look for the following: (1) magneto ground brush corroded or dirty or not making contact; (2) spring in ground brush weak; (3) ground wire, leading from automatic switch to magneto, broken or disconnected; (4) contact points "C" of automatic switch (See Fig. 12) not making contact. with magneto ground post; (5) magneto ground wire disconnectetl or broken; (6) armature "E" does not drop out when load is reduced.

XIV. Low Voltage

(1) Cold motor; (2) speed too low, due to carburetor operating lever not being adjusted properly; (3) excessive back pressure in exhaust line, due to muffler being clogged with carbon; (4) binding or sticking condition in governor mechanism preventing throttle valve from moving freely; (5) overload, short circuit or ground.

XV. Engine Runs too Fast

(1) A sticky or binding condit ion of throttle valve mechanism preventing the governor from giving accurate control; (2) carburetor throt tle lever not adjusted properly.

XVI. Engine Continues to Crank with Service Switch Out

Points "C" and "D" in the automatic switch making contact with armat ure "E", causes the plant to crank until the safety switch disengages. (See Figs. 12 and 13.)

XVII. Engine Overheats

This may be caused by the following: (1) lack of water in radiator; (2) poor circulation in radiator due to deposit of mineral scale (this scale may be removed from radiator by use of a solution of sal soda and water and flushing); (3) fan belt slipping or fan blades bent; (4) excessive carbon, causing pre-ignition; (5) improper timing; (6) lack of lubrication; (7) air passages clogged with dirt and dust; (8) fan sticks and stops from lack of lubrication.

XVIII. Pistons Pumping Oil

This may be due to: (1) leaky valves; (2) oil level too high; (3) piston rings sticky, broken or ineffective, due to loss of tension; (4) cylinder walls scored or worn; (5) rings lit too loosely in pistons; (6) oil dip of connecting rods too great ; (7) poor quality of oil or dilution of oil by fuel; (8) defective ignition, either spark plug or magneto; (9) oil soaked magneto cables causing defective insulation and ignition leaks; (10) air or oil leak from push rod clearance passage into intake manifold; (1 1) oil leak around intake valve guides.

XIX. Engine Runs at Slow Speed

This condition may be due to: (1) misadjustment of throttle arm to cat-l ouretor feeding insufficient gas; (2) poor compression; (3) retarded spark; (4) defect ive ignition ; (5) obst ruct ion in gas supply.

XX. Engine Stops for Want of Gasoline

This may be due to: (1) storage tank empty; (2) air leak in supply pipe or connection; (3) too great a gasoline lift; (-1) fuel pump defective.

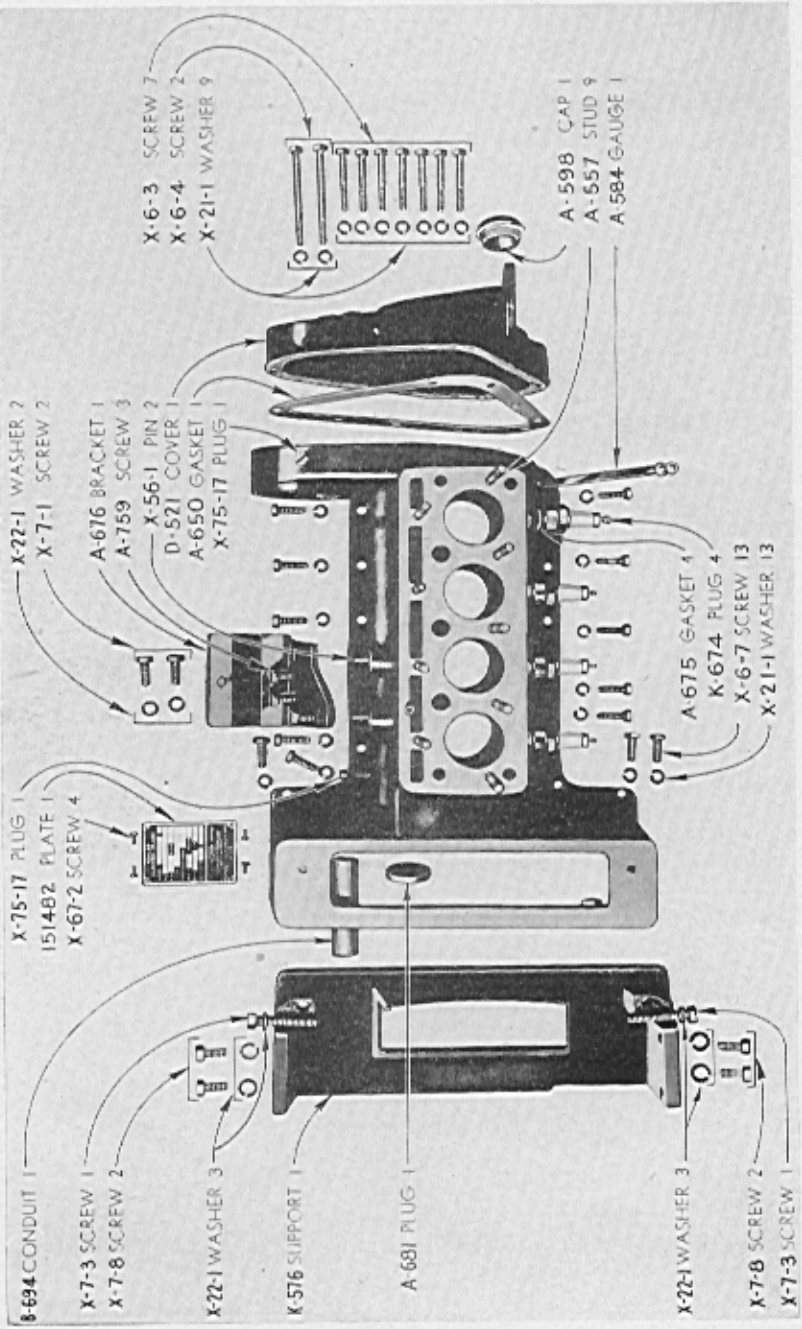


Figure 34

CYLINDER ASSEMBLY

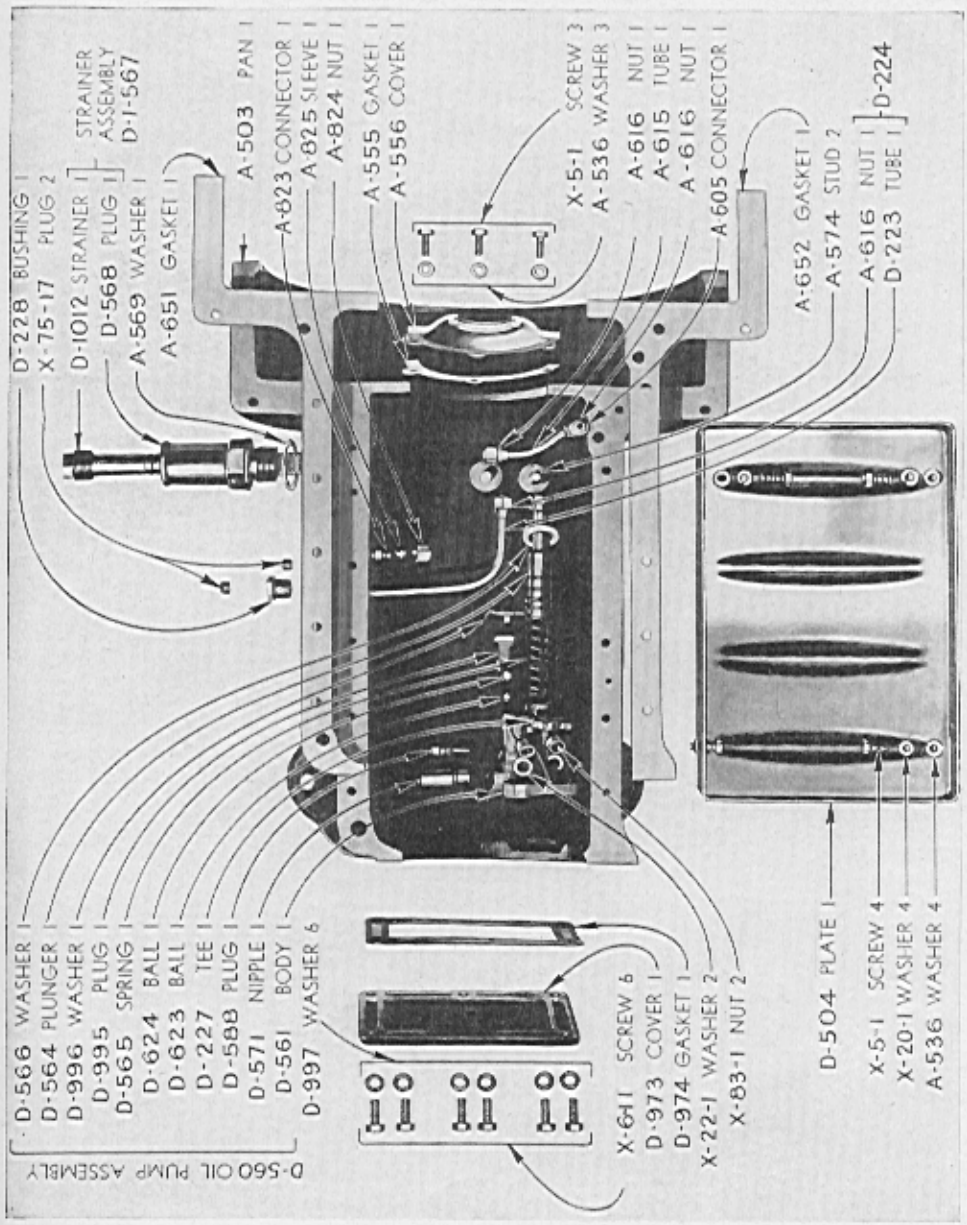


Figure 35

OIL PAN ASSEMBLY

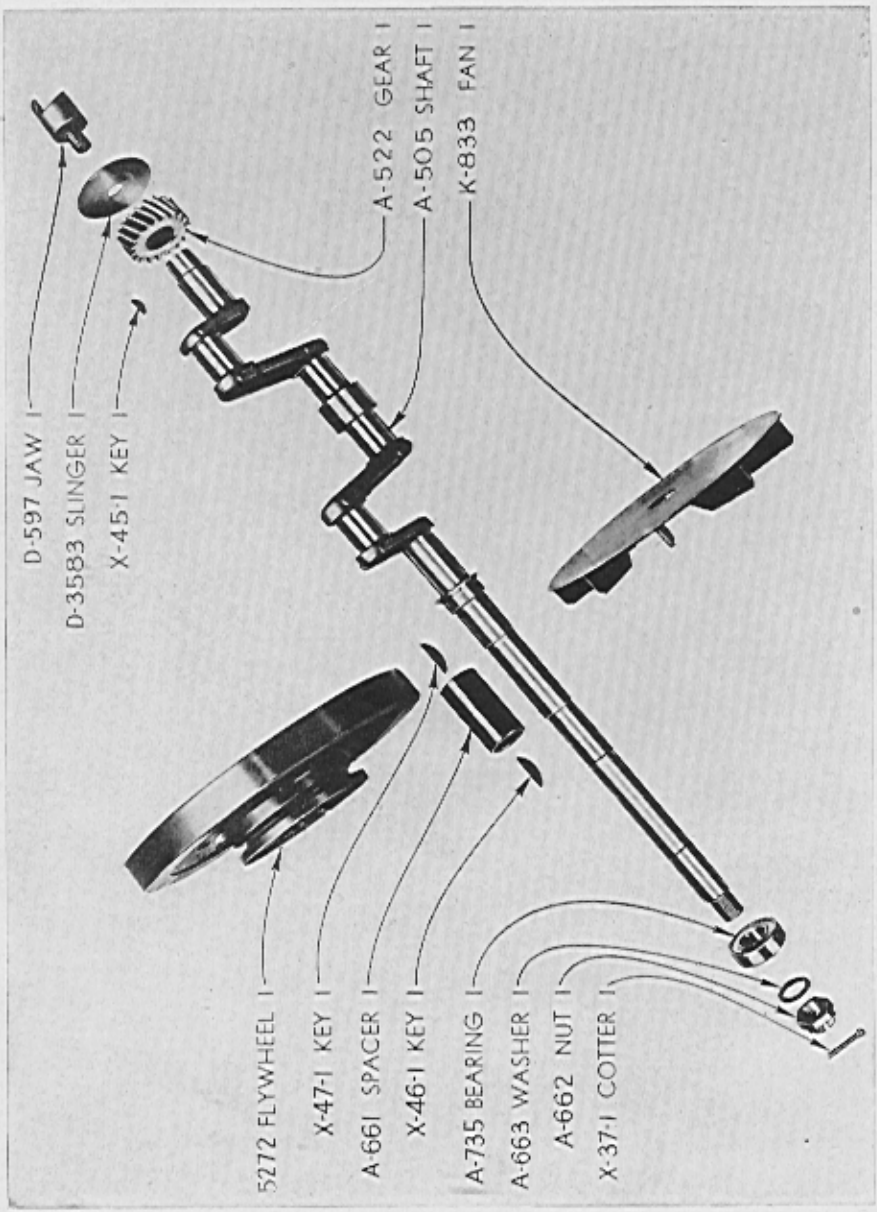


Figure 38

CRANKSHAFT AND PARTS

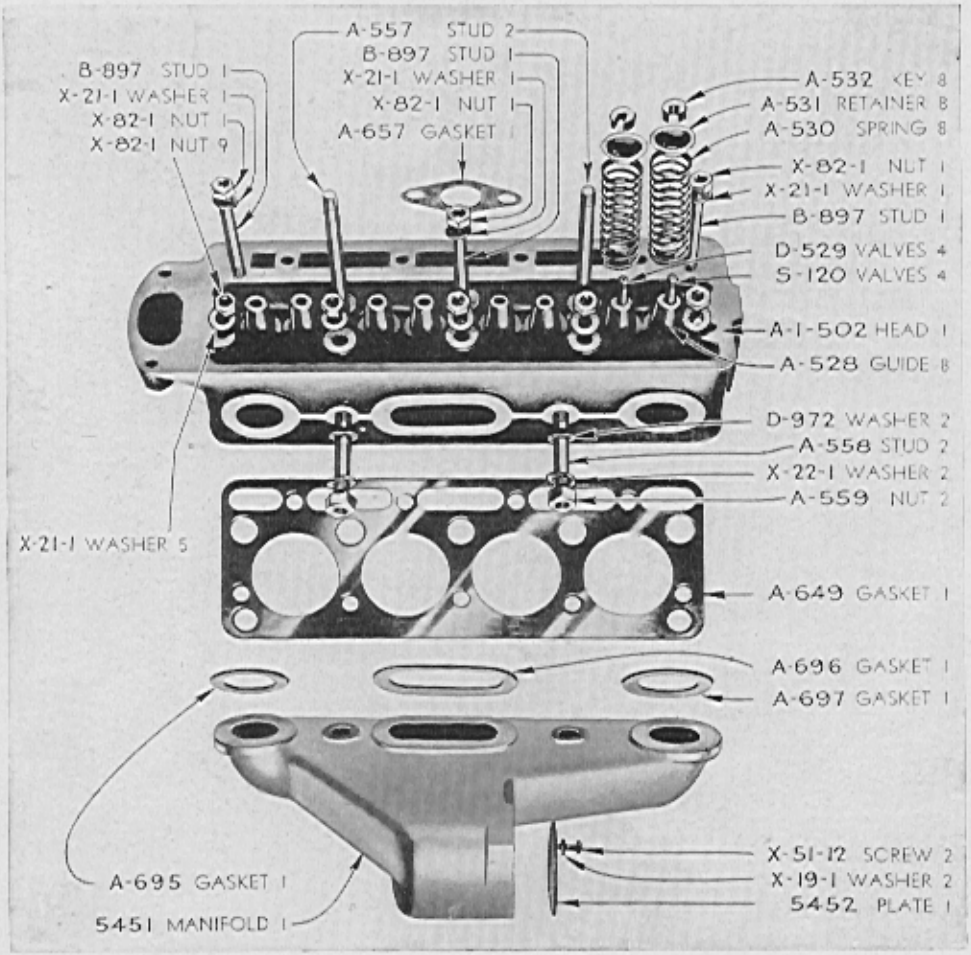


Figure 40

CYLINDER HEAD AND PARTS

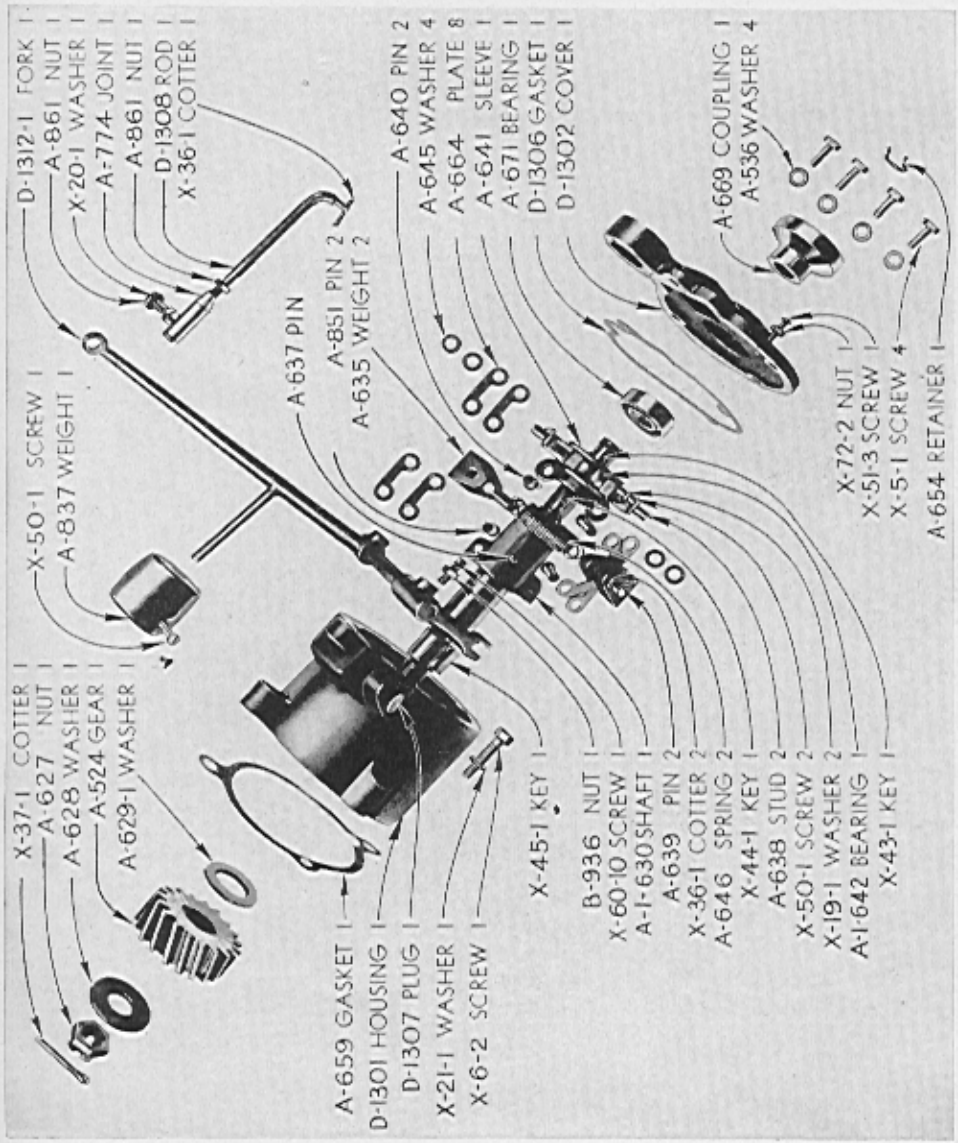


Figure 41

MECHANICAL GOVERNOR

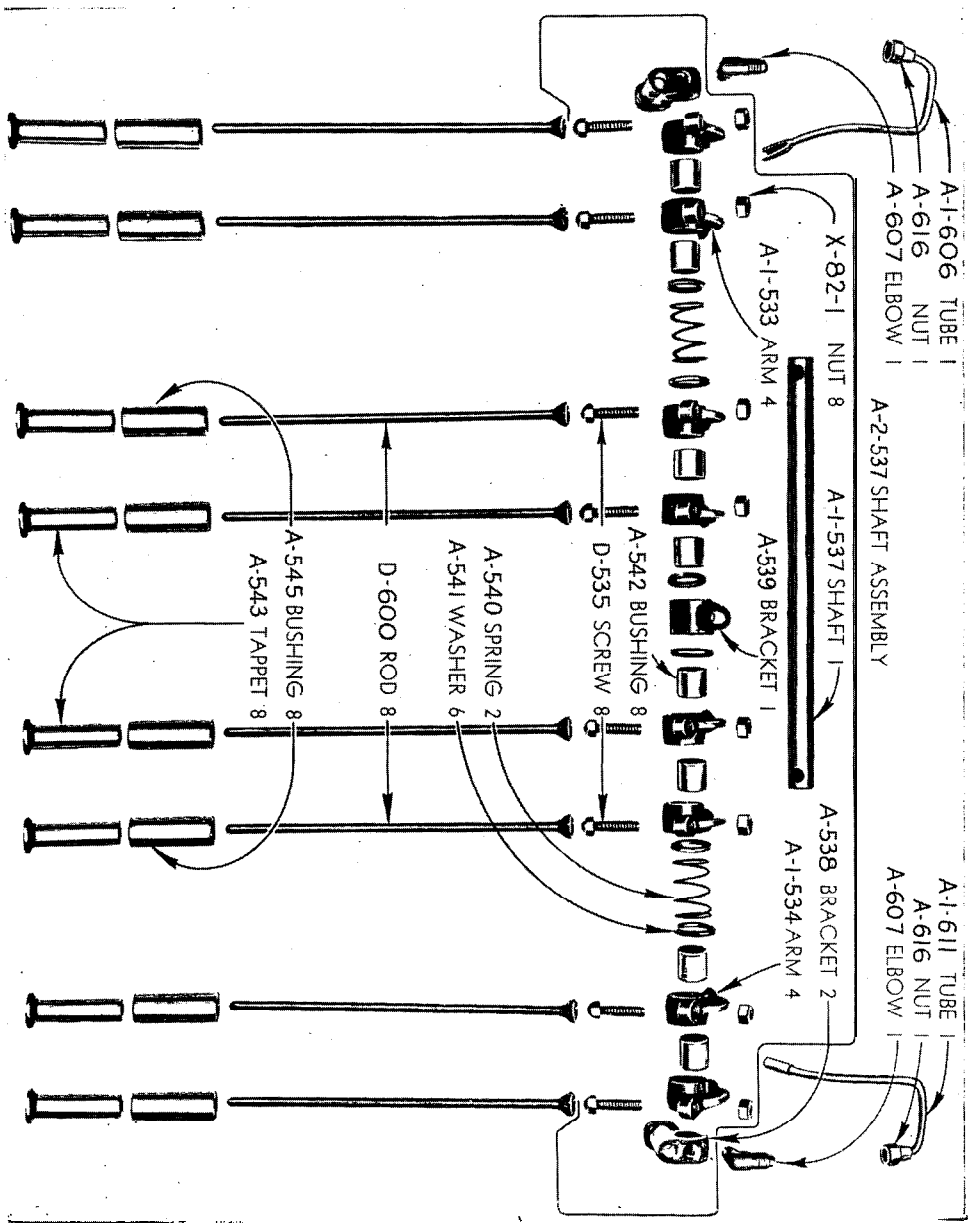


Figure 42

ROCKER ARM AND PUSH ROD PARTS

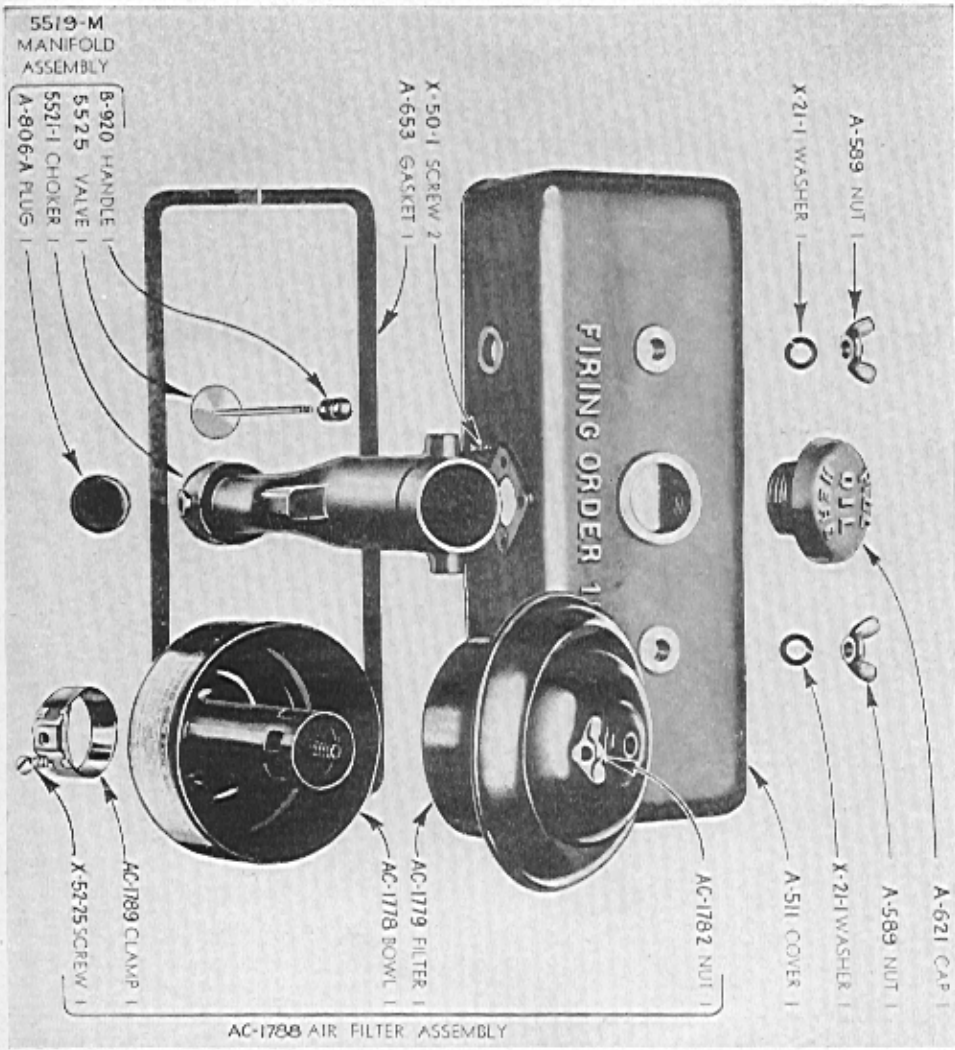


Figure 43

CYLINDER HEAD COVER AND AIR CLEANER

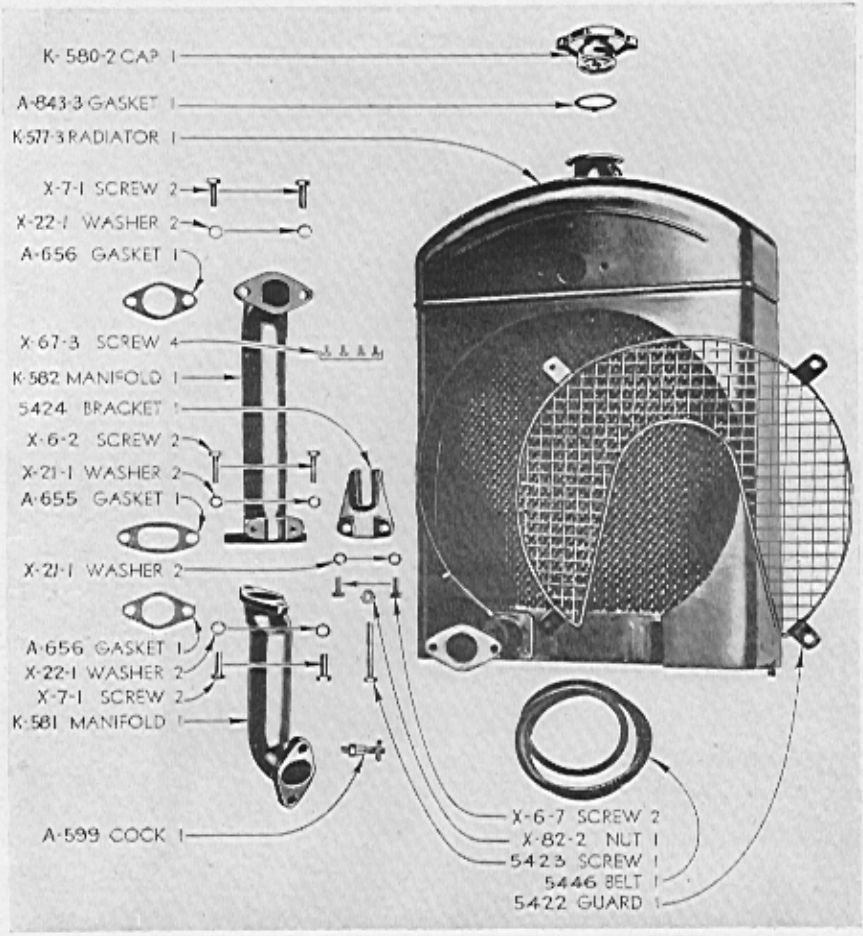


Figure 44

RADIATOR AND MANIFOLDS

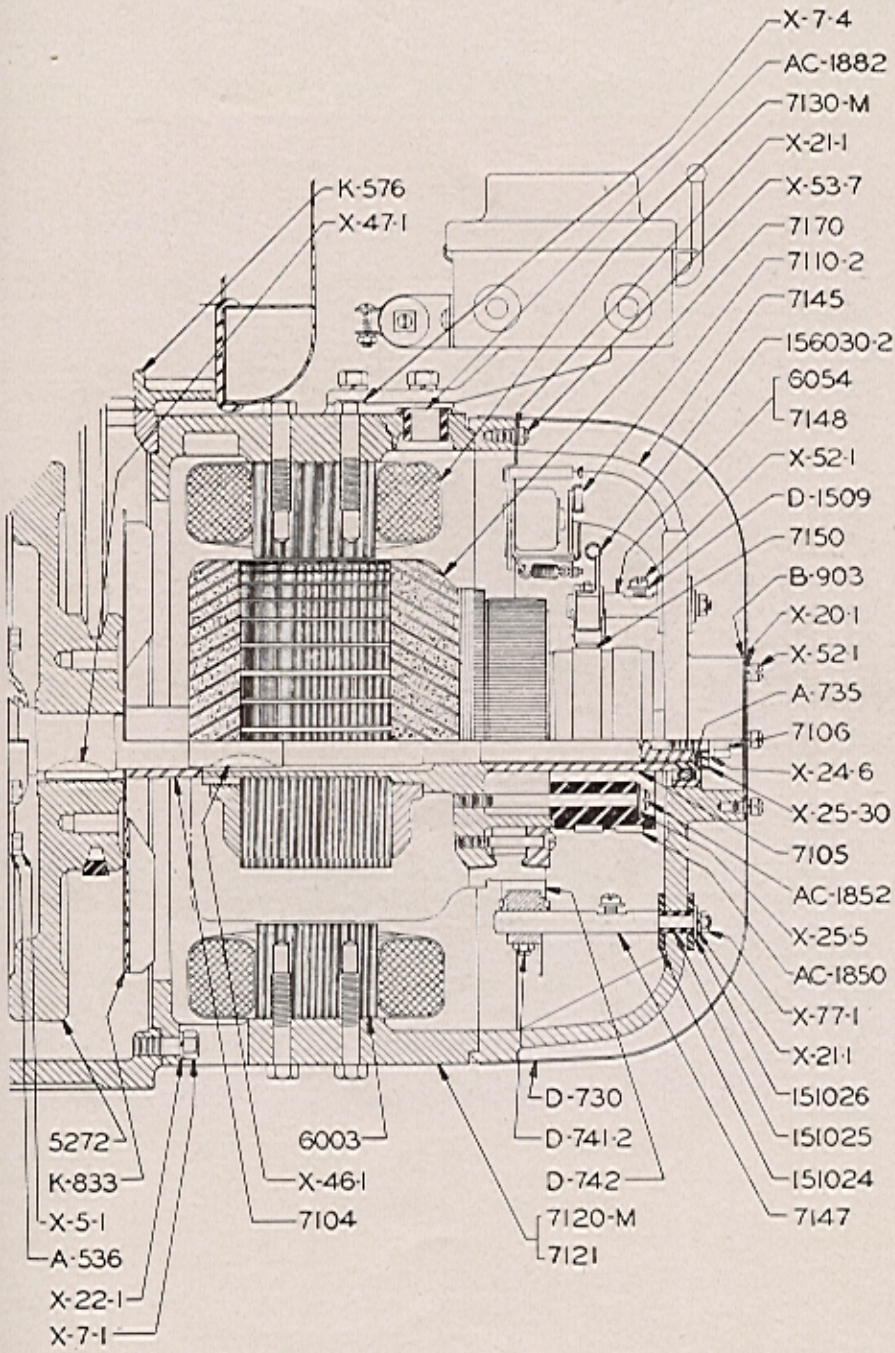


Figure 45

GENERATOR OUTLINE SKETCH, SIDE VIEW

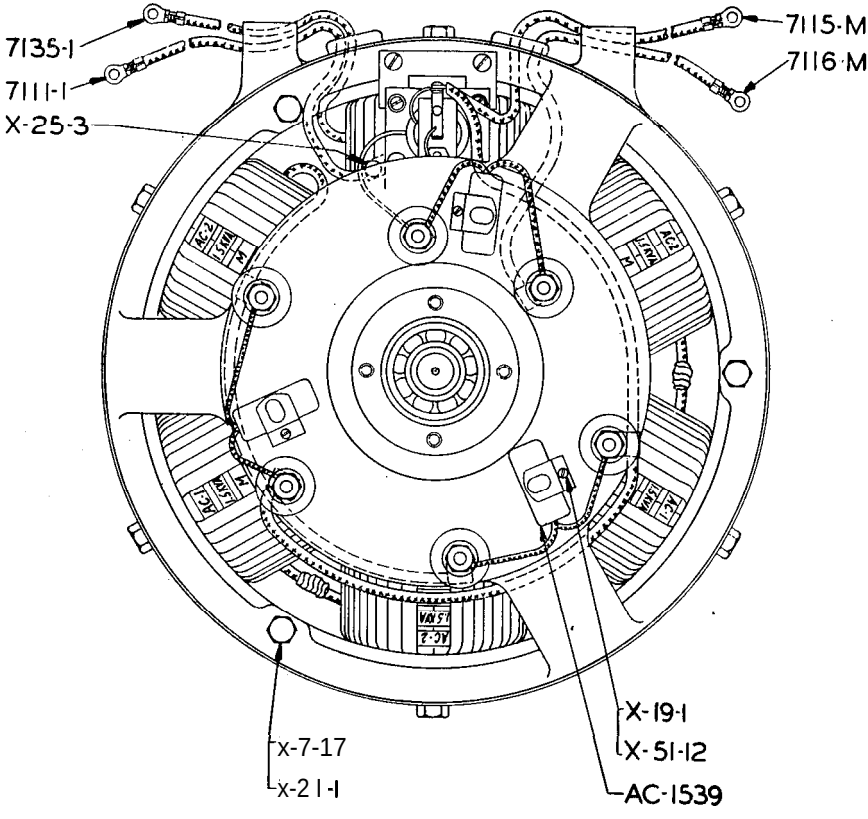


Figure 46

GENERATOR OUTLINE SKETCH. END VIEW

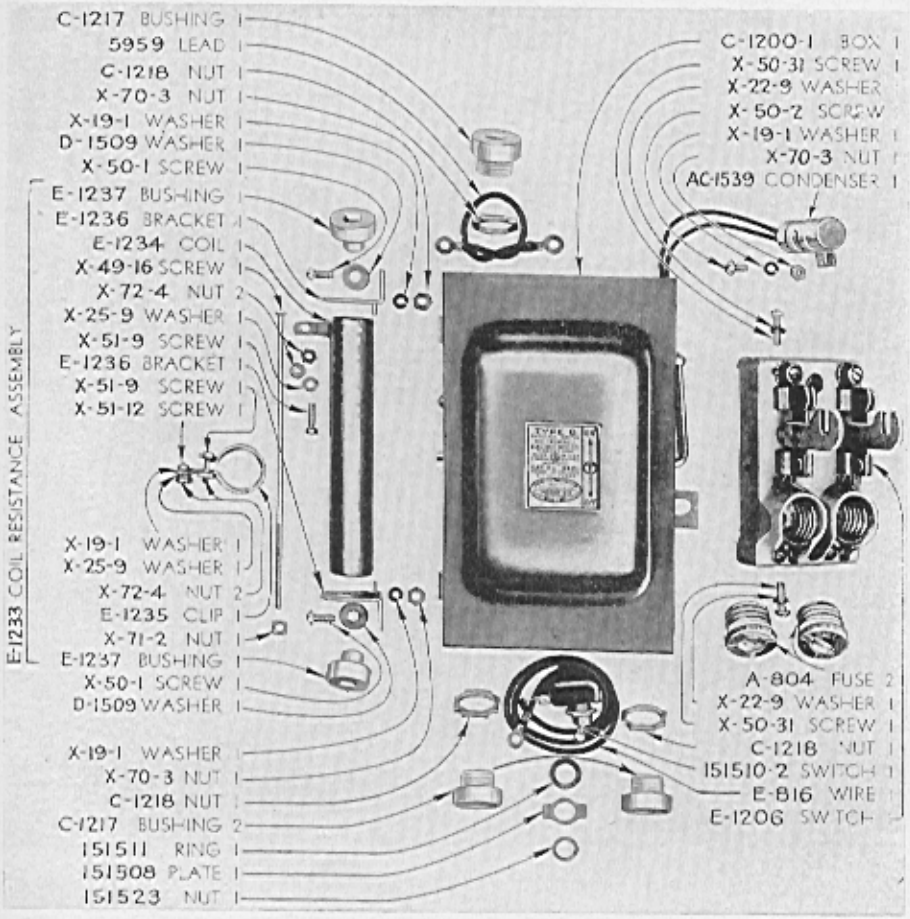


Figure 47

MANUAL SWITCH AND PARTS

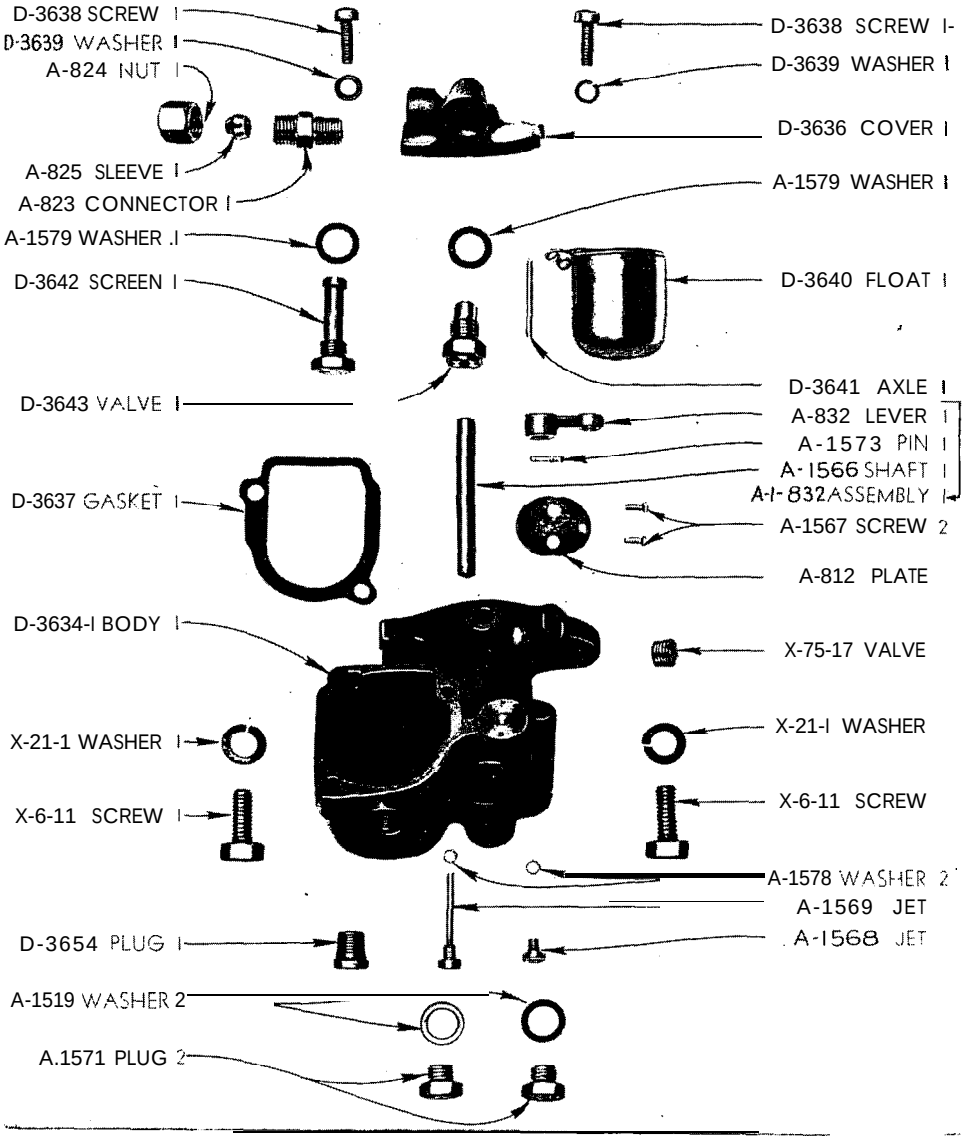


Figure 48

D673-2 ZENITH CARBURETOR AND PARTS

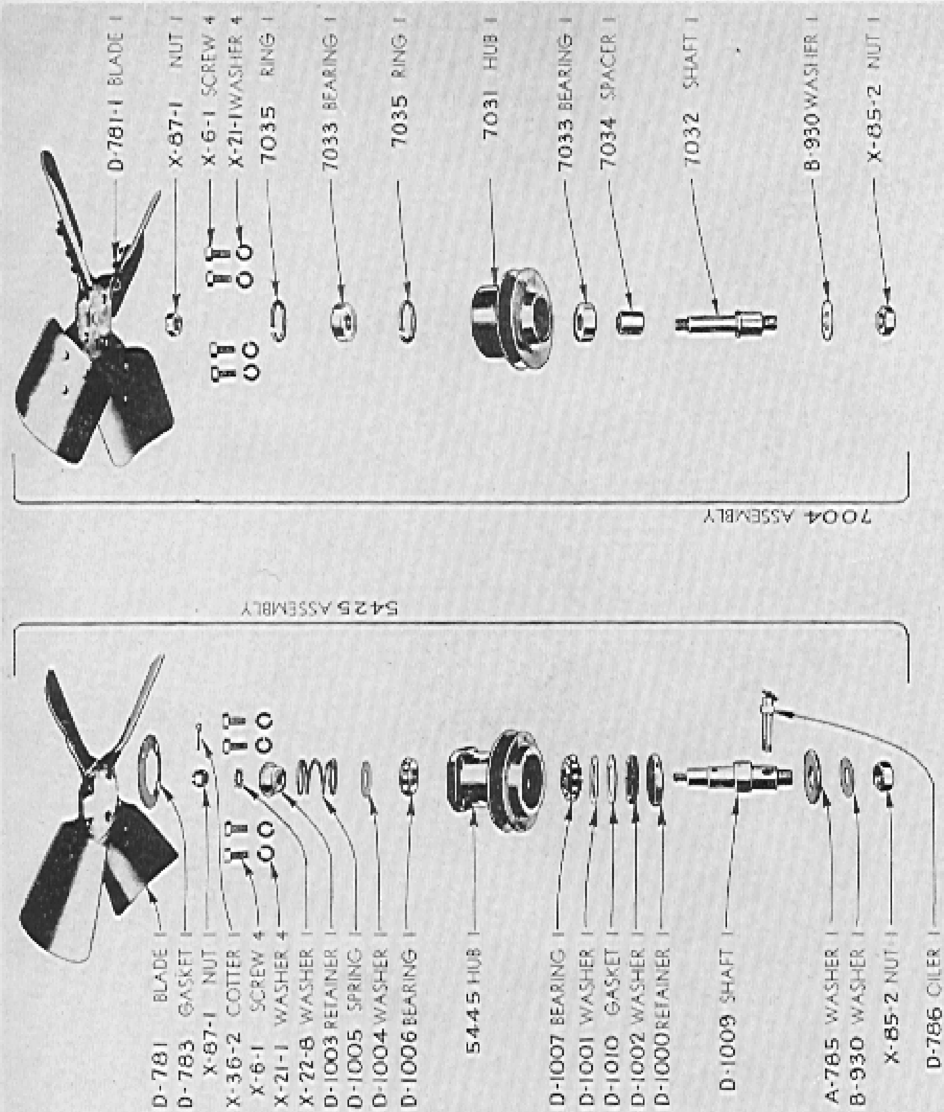
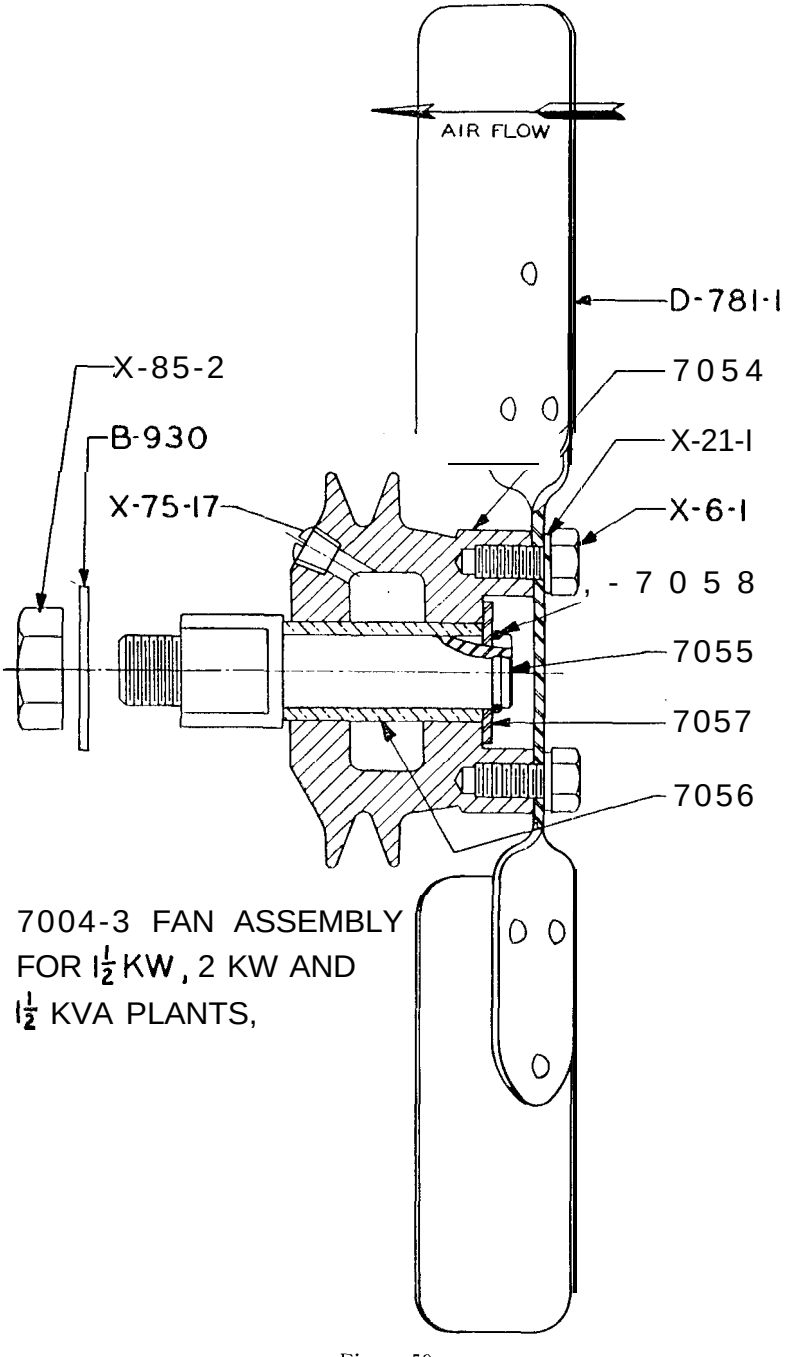


Figure 49

FANS AND PARTS



7004-3 FAN ASSEMBLY FOR 1½ KW, 2 KW AND 1½ KVA PLANTS,

Figure 50

7004-3 FAN ASSEMBLY

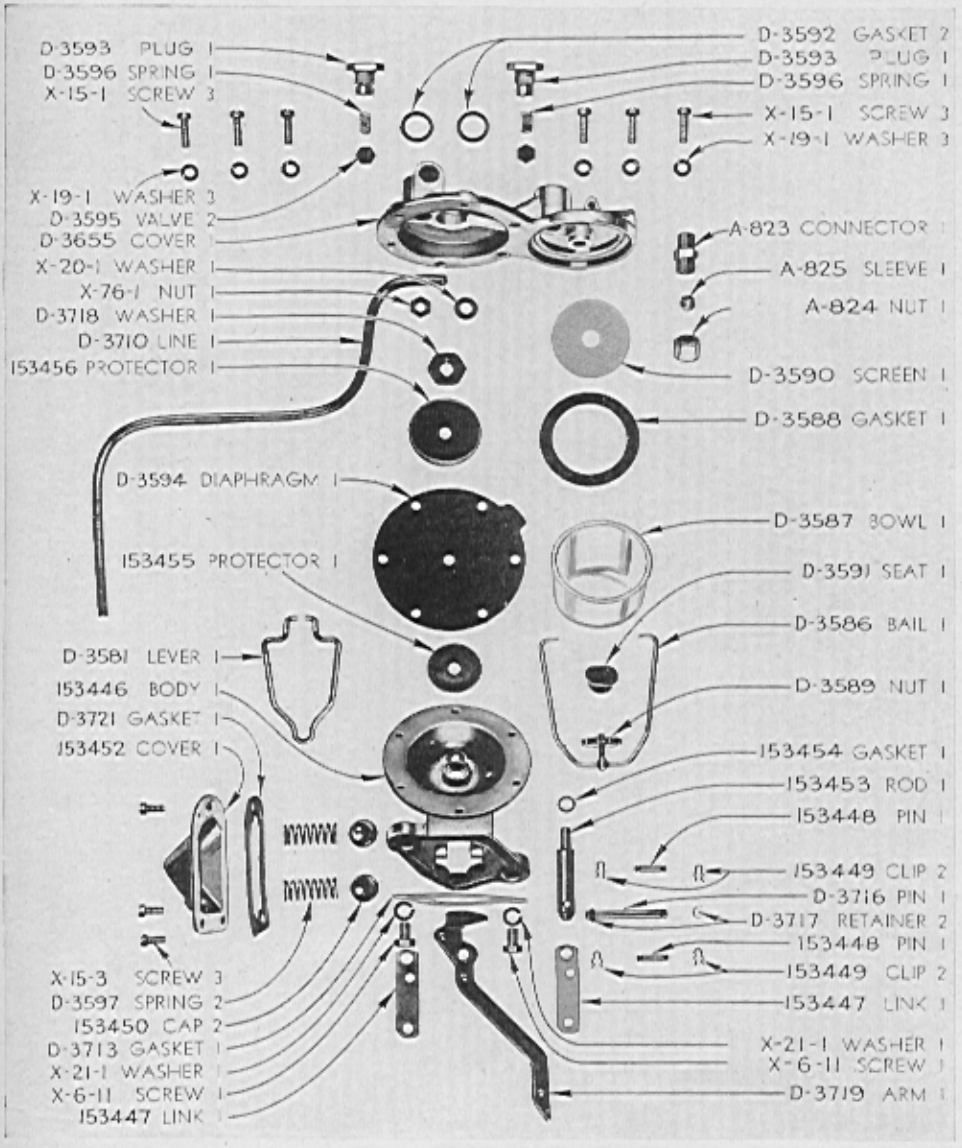


Figure 51

FUEL PUMP AND PARTS

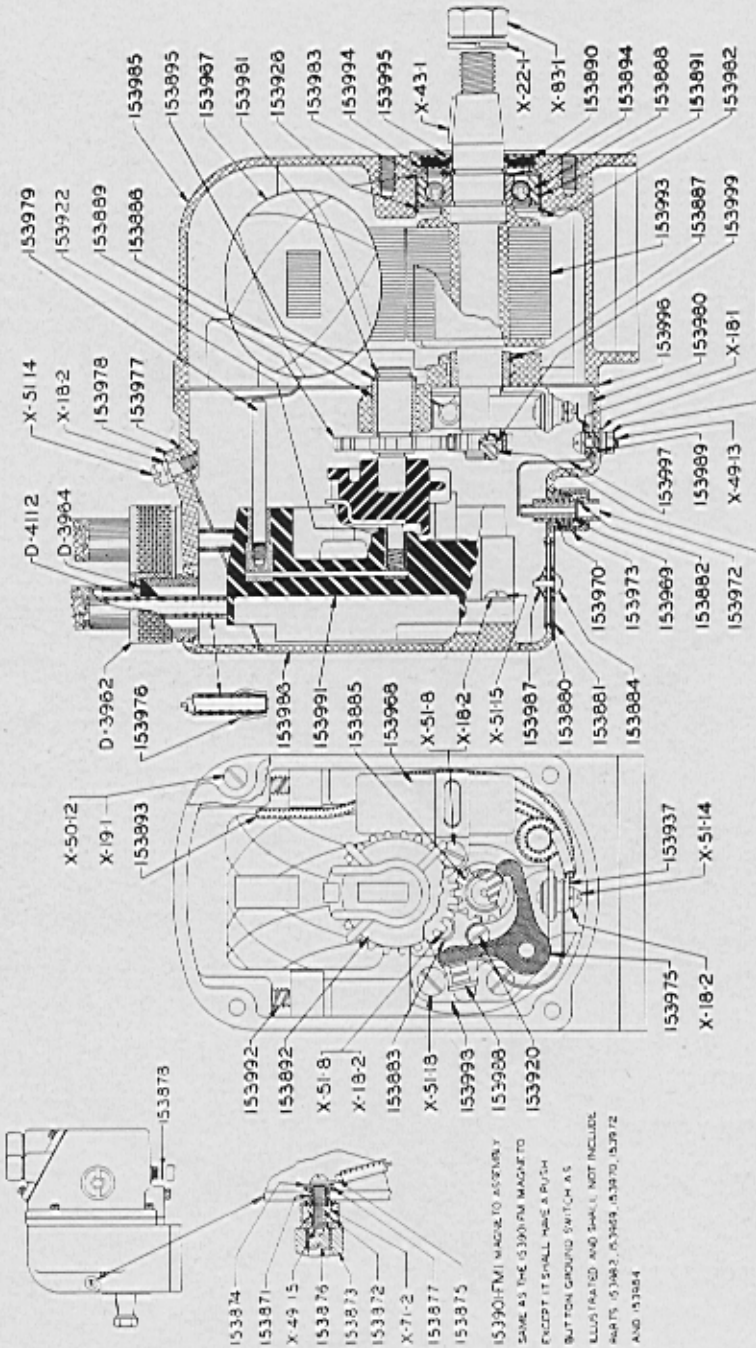


Figure 52

FAIRBANKS-MORSE MAGNETO, CROSS SECTION

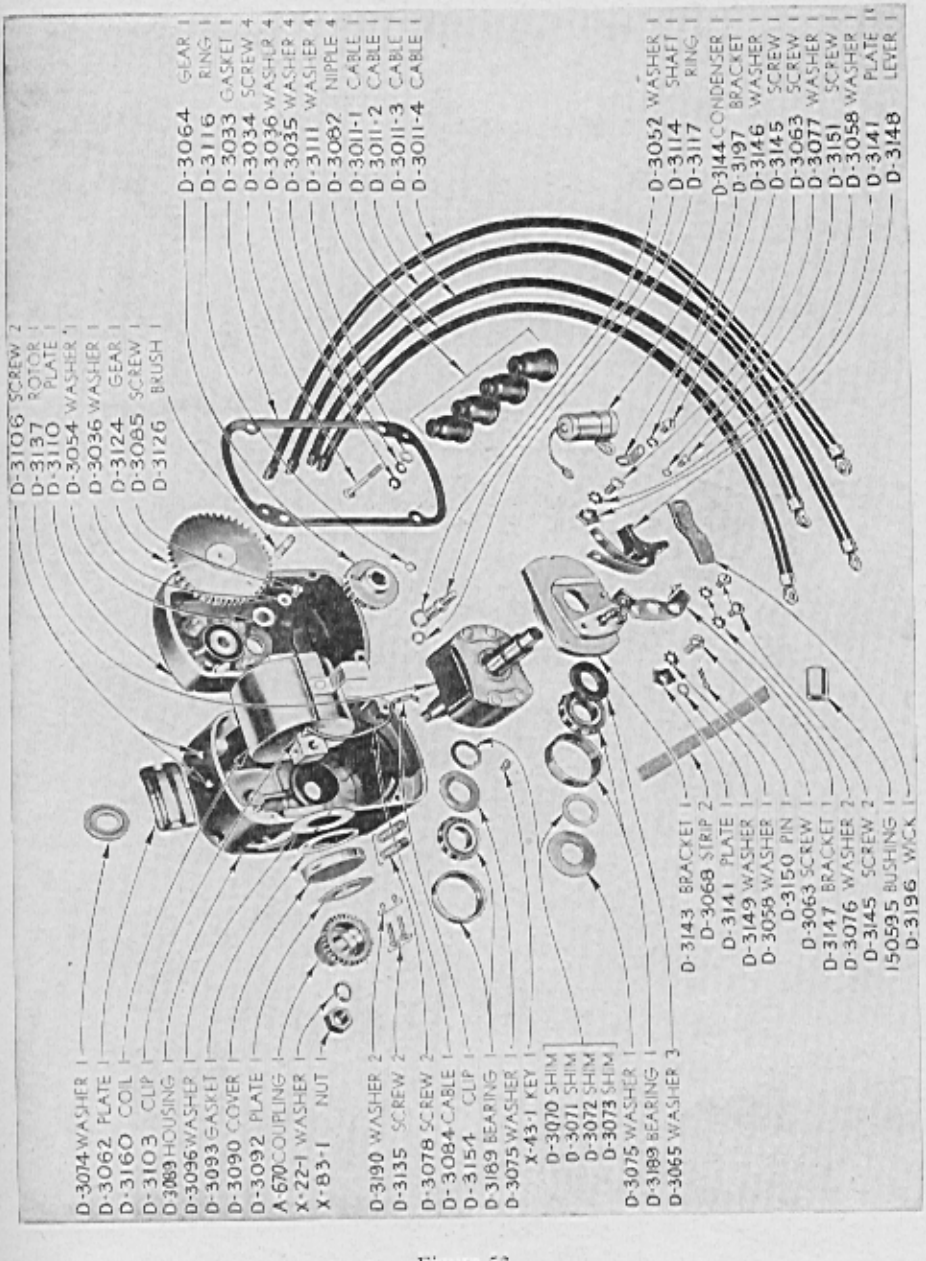
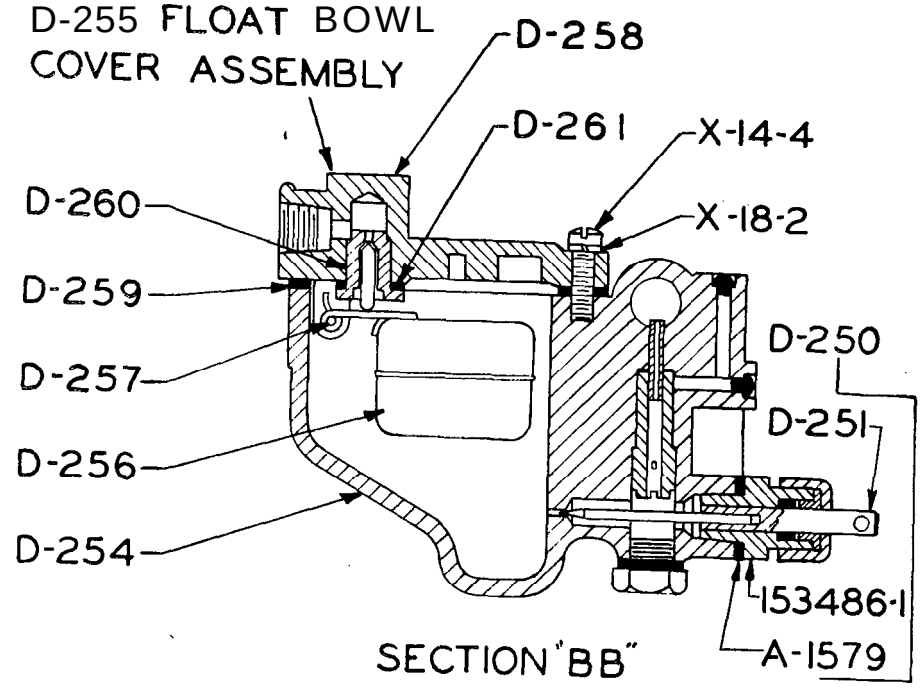


Figure 53

D-3000 MAGNETO AND PARTS



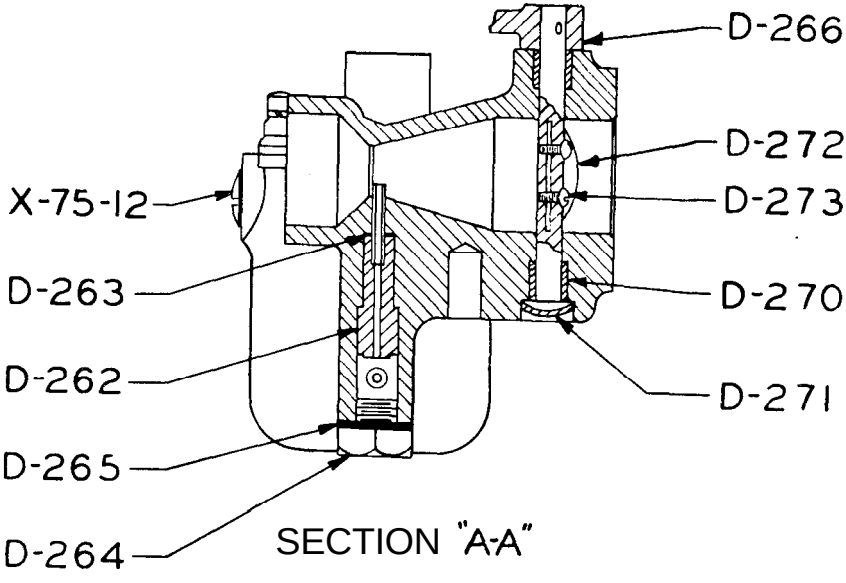


Figure 54

D-673-S CARBURETOR AND PARTS

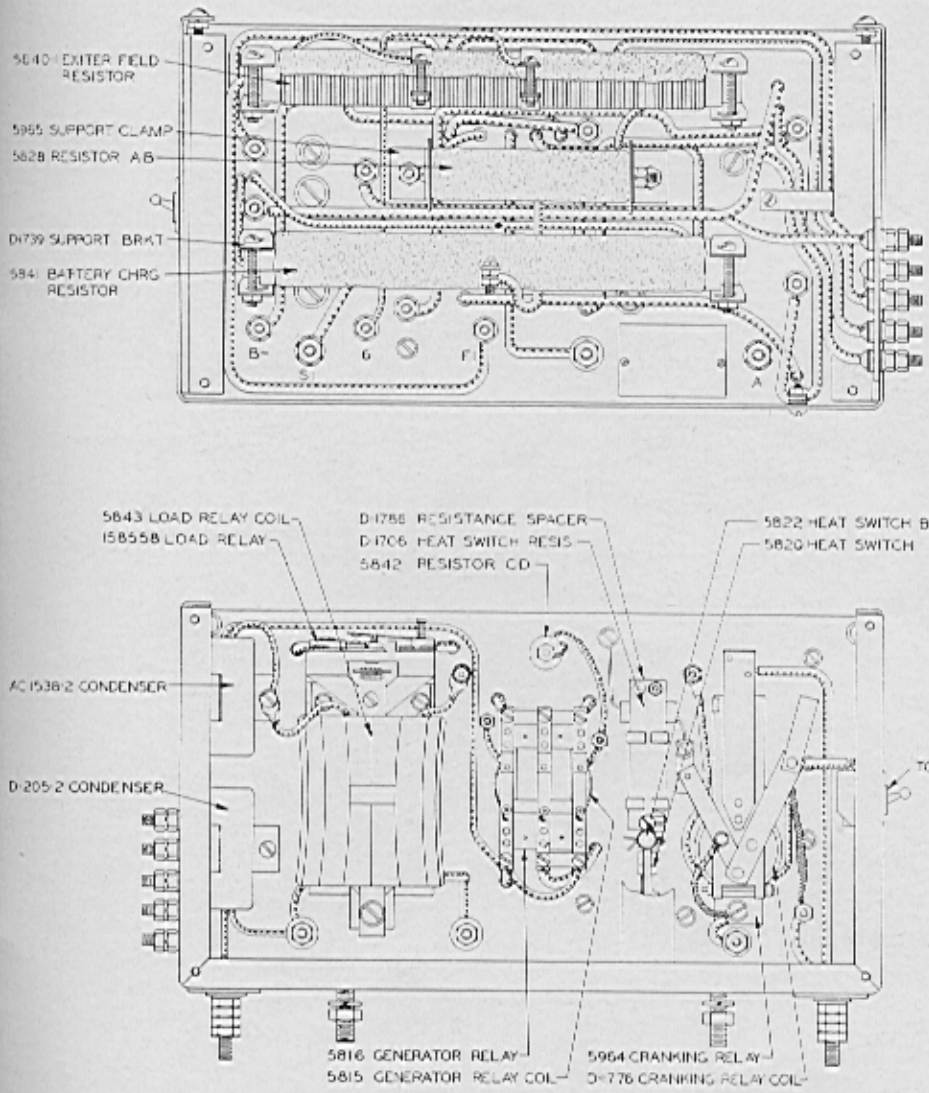


Figure 55

AUTOMATIC SWITCH

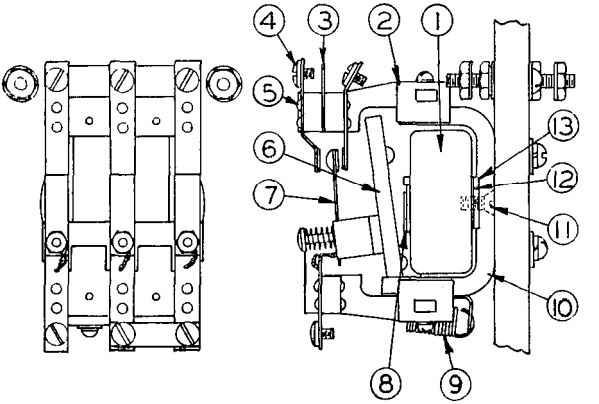


Figure 56

GENERATOR RELAY OF AUTOMATIC SWITCH

Item No.	Part No.	Item No.	Part No.
1	5815	8	5849
2	5851	9	5837
3	5854	10	5834
4	X-68-1	11	x-31-1
5	5852	12	5968
6	5853	13	5967
7	5847		

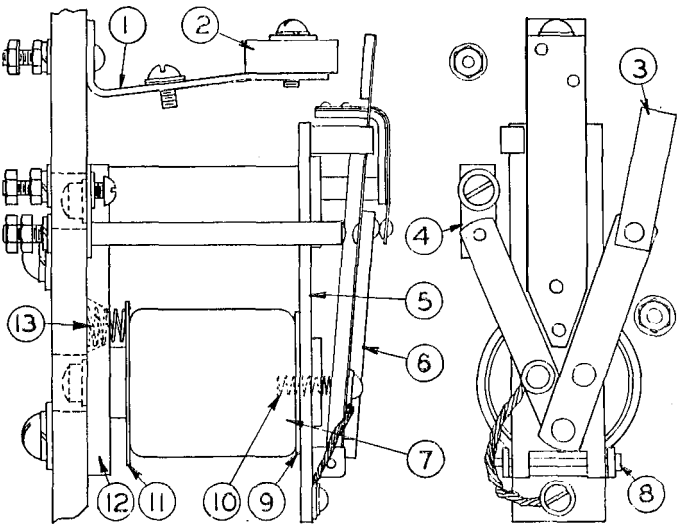


Figure 57

CRANKING RELAY OF AUTOMATIC SWITCH

Item No.	Part No.	Item No.	Part No.
1	D-1746	8	D-1737
2	D-1744	9	D-1777
3	5824	11	D-1742
4	D-1820	12	D-1868
5			
6	D-1715 D-1711	13	D-1716 151541
7	D-1776		

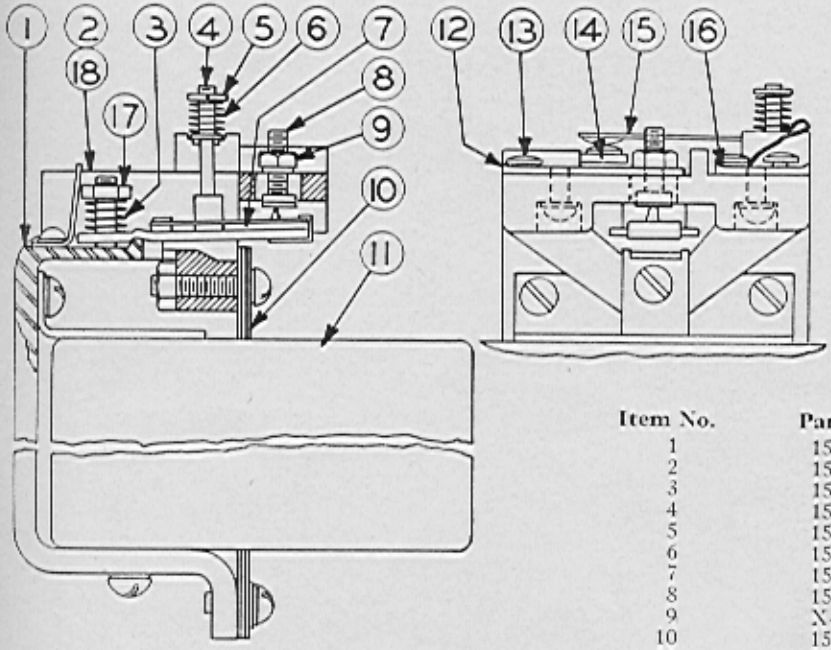


Figure 58

LOAD RELAY OF AUTOMATIC SWITCH

Item No.	Part No.
1	158697
2	158665
3	158674
4	158664
5	158668
6	158671
7	158673
8	158675
9	X-72-3
10	158661
11	5843
12	158667
13	158662
14	158672
15	158670
16	158666
17	158691
18	158660

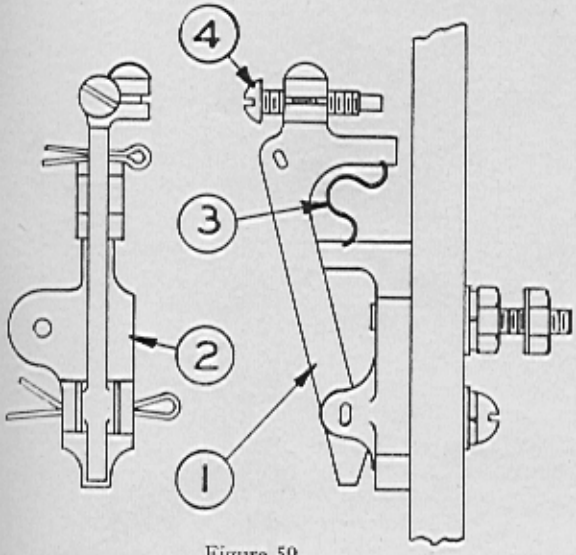


Figure 59

HEAT SWITCH OF AUTOMATIC SWITCH

Item No.	Part No.
1	D-1753
2	D-1752
3	D-1755
4	D-1758

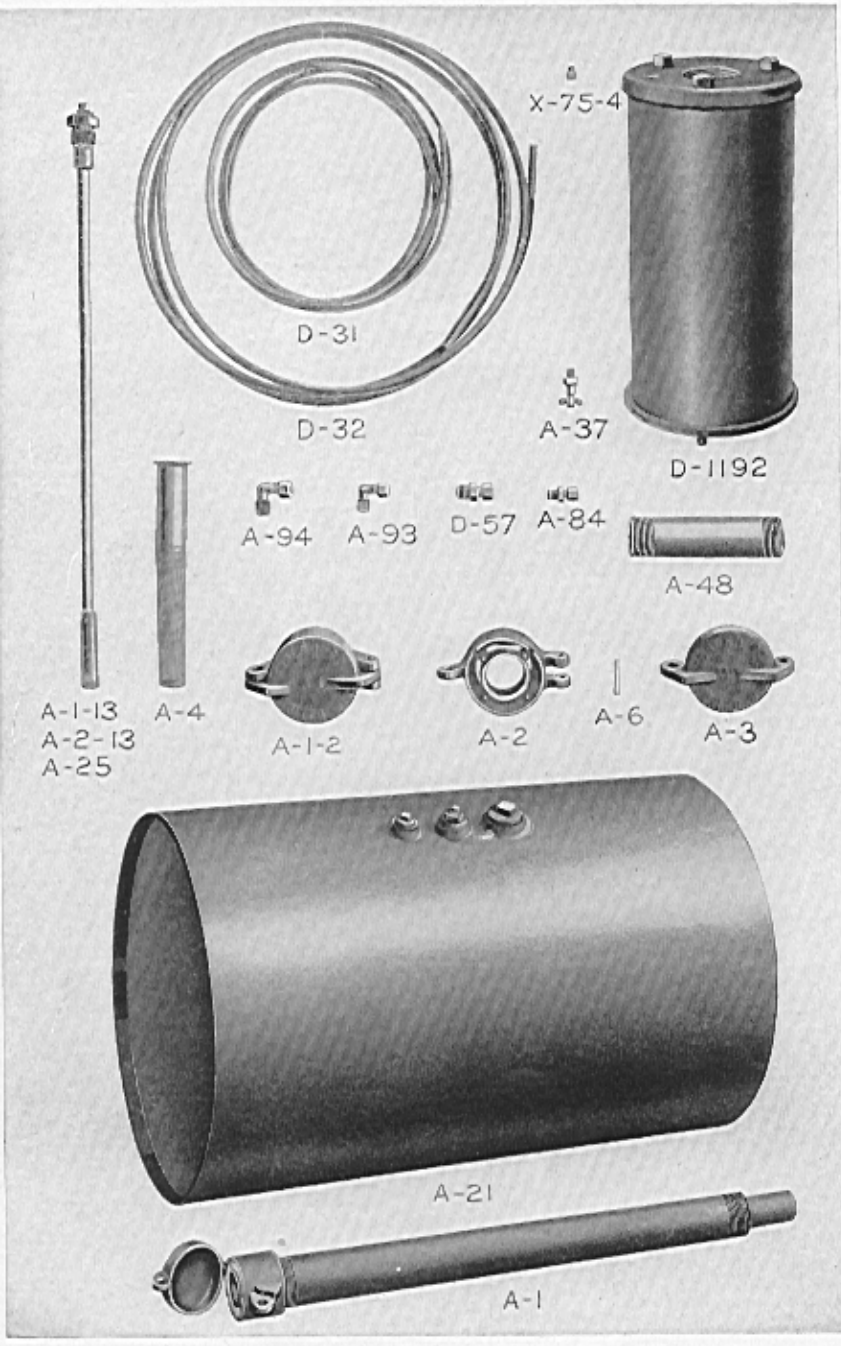


Figure 60

MUFFLER, SUPPLY TANK and FITTINGS

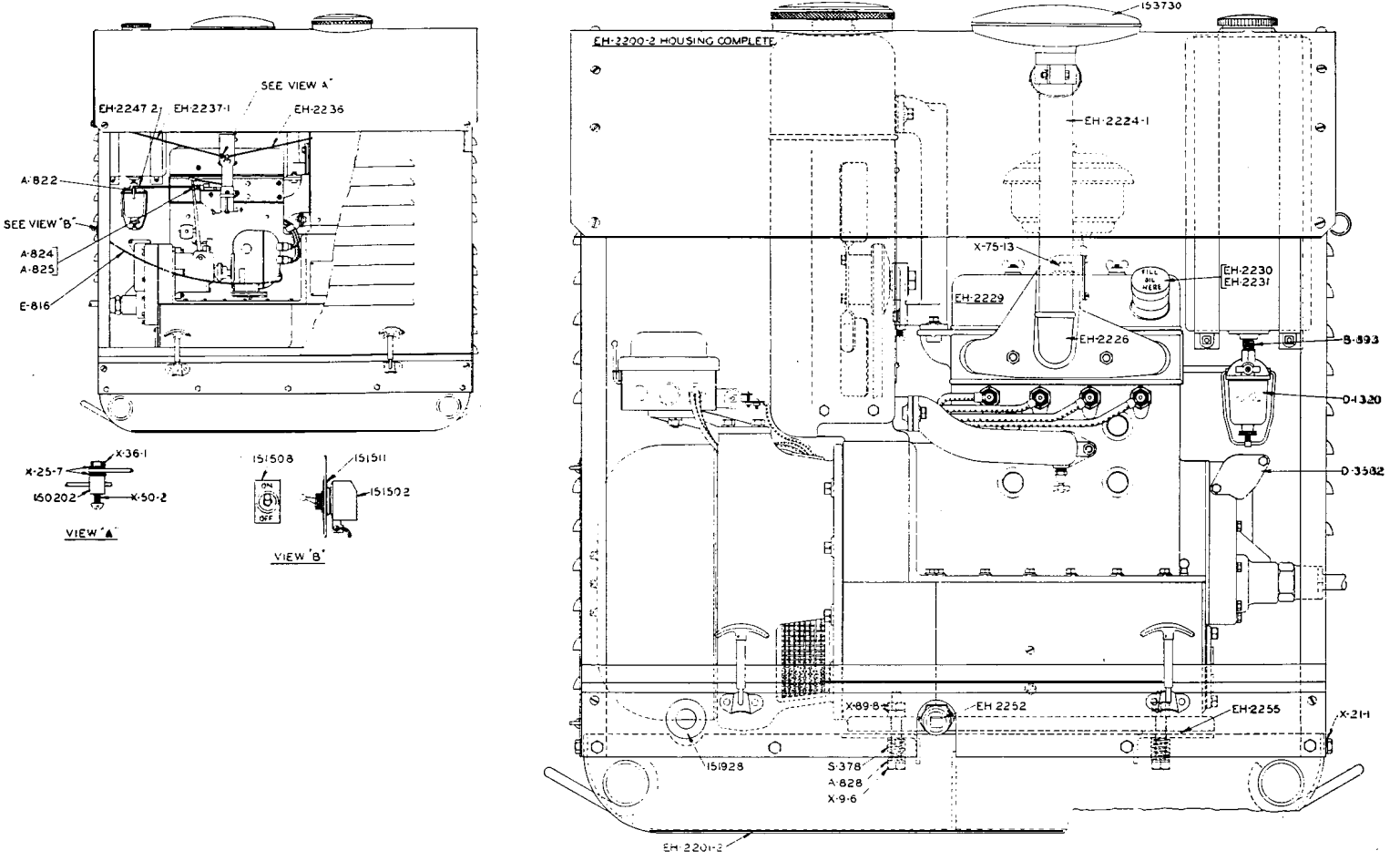


Figure 61. **HOUSING PARTS**

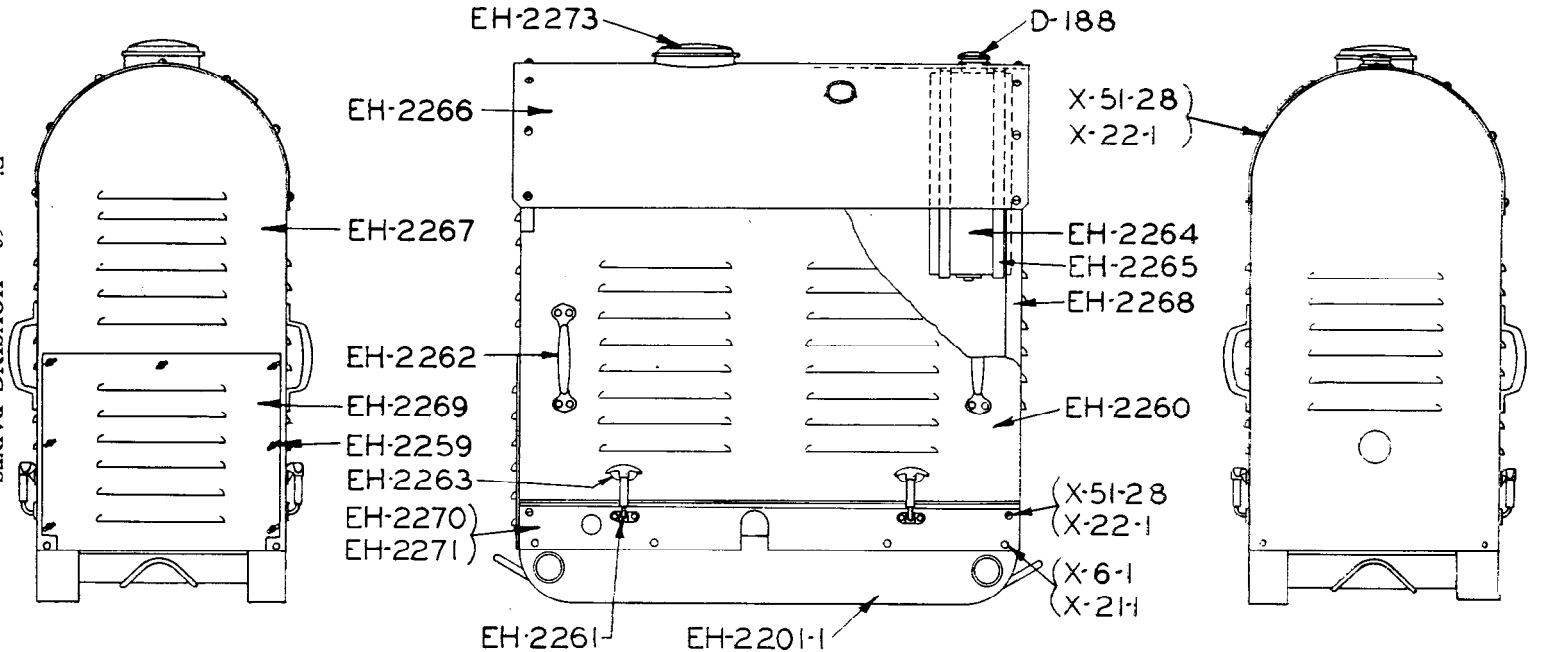


Figure 62. **HOUSING PARTS**

Part Number	No. Per Plant	DESCRIPTION	Price Each
x-5-1	14	Hexagon Cap Screw 1/4-20x5/8.	$ .03
X-6-1	24	Hexagon Cap Screw 5/16-18x1/2.	.03
X-6-2	3	Hexagon Cap Screw 5/16-18x1 1/4.	.03
X-6-3	7	Hexagon Cap Screw 5/16-18x2 1/4.	03
X-6-4	2	Hexagon Cap Screw 5/16-18x3 3/4.	05
X-6-7	4	Hexagon Cap Screw 5/16-18x1.	05
X-6-l 1	4	Hexagon Cap Screw 5/16-18x3/4..	03
x-7-1	12	Hexagon Cap Screw 3/8-16x1.	03
X-7-2	8	Hexagon Cap Screw 3/8-16x1 1/4.	03
x-7-3	2	Hexagon Cap Screw 3/8-16x2	03
x-7-4	12	Hexagon Cap Screw 3/8-16x1 5/8.	.03
X-7-8	4	Hexagon Cap Screw 3/8-16x3/4..	.03
x-7-17	3	Hexagon Cap Screw 3/8-16x1 1/2..	10
X-9-6	4	Screw, Hexagon Cap 1/2x3 1/2 NC	05
x-14-9	3	Fillister Head Machine Screw No. 8 32x1/4..	.10
x-15-1	4	Fillister Head Screw No. 8—32x5/8.	.03
x-15-3	3	Fillister Head Screw No. 8—32x3/8.	.03
X-18-1	1	Lock Washer No. 6—5/64 x 1/32..	.03
X-18-2	10	Lockwasher No. 8	03
x-19-1	16	Lock Washer 3/16..	.03
x-20-1	14	Lock Washer 1/4..	.03
x-21-1	72	Lock Washer 5/16.	.03
x-22-1	50	Lock Washer 3/8.	.03
X-24-6	1	Lock Washer 1/2..	03
X-25-3	1	Lock Washer 1/8.	.03
X-25-S	2	Plain Washer 5/16.	.03
X-25-7	3	Plain Washer 9/16.	.03
X-25-30	1	Washer 3-3/64 x 1 1/4 x 1/8	.03
x-31-1	5	Screw No. 8 32x3/8..	.03
X-36-1	15	Cotter Pin—1/16x1 1/2.	.03
X-36-2	17	Cotter Pin—1/16x3/4.	03
x-37-1	2	Cotter Pin—1/8x1 1/4.	03
x-43-1	2	Woodruff Key No. 3.	03
x-44-1	1	Woodruff Key No. 6.	.03
x-45-1	3	Woodruff Key No. 9.	.03
X-46-l	1	Woodruff Key No. 127.	05
x-47-1	1	WoodruffKeyNo.128	08
x-49-12	2	Round Head Machine Screw No. 4—36x3/16.....	.03
x-49-13	1	Round Head Machine Screw No. 6—32x1/2.....	.03
A-50	1	1 1/4" I. P. Tee.....	.30
x-50-1	7	Round Head Machine Screw No. 10—32x1/2.....	.03
X-50-2	1	Round Head Machine Screw 10x3/8 N. F.....	03
x-50-12	5	Round Head Machine Screw No. 10—24x7/8.....	03
X-50-18	1	Round Head Machine Screw No. 10—24x5/8.....	03
x-51-3	1	Round Head Machine Screw No. 8—32x1.....	03
x-51-12	9	Round Head Machine Screw No. 8—32x3/8.....	03
x-51-14	3	Round Head Machine Screw No. 8—32x5/16.....	.03
X-51-18	4	Round Head Machine Screw No. 8—32x9/32.....	.03
X-51-28	18	Screw, Round Head Machine 3/16x3/8 NC.....	03
X-52-1	14	Oval Fillister Head Cap Screw 1/4-20x1/2.....	05
x-53-7		Oval Fillister Head Cap Screw 5/16-18x5/8.....	03
X-56-l	2	Dowels	.03
D-3 1	1	Copper Tubing 1/4 inch, 12 ft.....	1.20
X-60-10	1	Governor Arm Set Screw 1/4-20x3/4	.05

When ordering parts give Model and Serial Number of your Plant

Part Number	NO. Per Plant	DESCRIPTION	Price Each
X-64-1	4	Foundation Bolt ½-13x7	$ .05
X-65-1	4	Hexagon Nut ½-13	.03
X-67-2	4	Instruction Plate Rivet	.03
X-67-3	4	Drive Screws	.03
X-68-1	9	Screw, Terminal	.03
X-70-2	3	Hexagon Nut--Plain No. 10-24	.03
x-70-3	2	Hexagon Nut –Plain No. 10-32	.03
X-71-2	1	Hexagon Nut 6-32	.03
X-72-2	1	Hexagon Nut-Special No. 8-32	.03
X-72-3	1	Nut, Hexagon,	.03
x-75-13	1	Plug, Pipe 1"	.05
x-75-17	6	Pipe Plug ⅛	.03
X-76-1	6	Hexagon Nut ¼-28	.03
x-77-1	6	Hexagon Jam Nut 5/16-18	.05
X-82-1	26	Hexagon Nut-Plain 5/16-24	.03
X-82-2	1	Hexagon Nut 5/16-18	.03
X-83-1	5	Hexagon Nut-Plain ⅜x24	.03
X-85-2	1	Hexagon Check Nut ⅝-18	.03
X-86-1	8	Castle Nut A-24	.03
X-87-1	9	Castle Nut ⅜-24	.03
X-89-8	8	Nuts, Hexagon ½ NC	.03
s-120	4	Exhaust Valve	.60
D-188	1	Cap, Gasoline Tank	.75
D-205-2	1	Condenser, 1 Mfd	.50
D-224	1	Carburetor Block Tube Assembly	.30
D-225	1	Purolator Outlet Tube	.15
D-226	1	Purolator Inlet Tube	.15
D-227	1	Comp. Tee	.20
D-228	1	Reducing Bushing	.15
D-229	1	Bushing, Rubber	.10
D-240-2	1	Radio Shielding Kit (Bosch Magneto)	49.50
D-245	1	Magneto Coupling-Complete	1.30
D-246	1	Magneto Coupling-Male	.65
D-247	1	Magneto Coupling-Female	.65
D-242	1	Radio Condenser, .10 Mfd.	.50
D-250	1	Adjusting Screw and Gland Assembly	1.00
D-251	1	Adjusting Screw, Including Packing and Nut	.75
D-254	1	Body	2.75
D-255	1	Float Bowl Cover Assembly,	2.00
D-256	1	Float	.50
D-257	1	Float Pinion Pin,	.05
D-258	1	Float Bowl Cover	.40
D-259	I	Cover Gasket	.10
D-260	1	Inlet Needle and Seat	.80
D-261	1	Inlet Seat Gasket,	.03
D-262	1	Nozzle	.50
D-263	1	Nozzle Gasket	.03
D-264	1	Plug Screw	.15
D-265	1	Plug Screw Gasket	.03
D-266	1	Throttle Lever and Shaft Assembly	.60
D-270	2	Throttle Shaft Bushing	.20
D-271	1	Welch Plug	.05
D-272	1	Throttle Shutter	.15
D-273	2	Shutter Screws	.05

When ordering parts give Model and Serial Number of your Plant

ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-274		Gasket Set.	$ .15
S-378		Spring	05
A-1-501		Cylinder Block Assembly (See A-3-501)	52.00
A-3-501		Cylinder Assembly with Pistons, Rings, Pins and Retainers	58 00
A-1-502	1	Cylinder Head less Valves	13 65
K-2-502	1	Cylinder Head with Valves	17.25
A-503	1	Oil Base	11.40
A-2-503	1	Oil Base Assembly,	17.75
D-504	1	Oil Base Baffle Plate	25
A-505		Order 5271-1	
A-506	1	Camshaft	6 25
A-l-507	4	Connecting Rod Assembly	2 40
D-508	4	Piston (Specify Size)	1.25
D-508-1	4	Piston (Semi-finished),	1.05
A-510	4	Piston Pin-Standard	.15
A-510-3	—	Piston Pin-.003 Oversize	.15
A-510-5		Piston Pin—.005 Oversize	15
A-510-10	—	Piston Pin-.010 Oversize	15
A-511	1	Cylinder Head Cover	1.50
A-512	4	Connecting Rod Bushing	.15
A-1-513	1	Crankshaft Bearing-Front	7.5
A-1-515	1	Crankshaft Bearing-Rear	.80
A-l-51;	4	Connecting Rod Bearing,	90
A-519	1	Camshaft Bearing-Front	1.10
A-520	1	Camshaft Bearing-Rear.,	.80
D-521	1	Gear Cover	4.20
A-522	1	Crankshaft Gear	1.15
A-523	1	Camshaft Gear	2.20
A-524	1	Magneto Drive Gear	1.15
A-525	1	Crankshaft Bearing Cap-Front	.30
A-526	1	Crankshaft Bearing Cap-Rear	.25
A-527	8	Crankshaft Bearing Stud	.05
A-528	8	Valve Stem Guide	.15
D-529	4	Valve Intake	.30
A-530	8	Valve Spring	.05
A-531	8	Valve Spring Retainer	.03
A-532	8	Valve Spring Retainer Key	.03
A-l-533	4	Rocker Arm with Bushing-Right	.45
A-l-534	4	Rocker Arm with Bushing—Left	.45
D-535	8	Rocker Arm Adjusting Screw	.10
A-536	14	Packing Washer ¼	.03
A-l-537	1	Rocker Arm Shaft	1.45
A-2-537	1	Rocker Arm Shaft Assembly	8 25
A-538	2	Rocker Arm Shaft Bracket F and R	.80
A-539	1	Rocker Arm Shaft Bracket Center	.85
A-540	2	Rocker Arm Spacing Spring	0 3
A-541	6	Rocker Arm Spacing Washer	.03
A-542	8	Rocker Arm Bushing	.05
A-543	8	Valve Tappet	.30
A-545	8	Valve Tappet Bushing	1.5
A-547	2	Crankshaft Front Bearing Shim .094	.03
A-548	4	Crankshaft Front Bearing Shim .008	.03
A-549	10	Crankshaft Front Bearing Shim .002	.03
A-550	2	Crankshaft Rear Bearing Shim .094	.03

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Part Number	NO. Per Plant	DESCRIPTION	Price Each
A-551	4	Crankshaft Rear Bearing Shim .008	$ .03
A-552	10	Crankshaft Rear Bearing Shim .002	.03
A-553	1	Order 5272	
A-555	2	Rear Split Cover Gasket	Set .05
A-556	2	Rear Split Cover-upper and lower	Set .85
A-557	11	Cylinder Head and Cover Stud	.03
A-558	2	Exhaust Manifold Stud	.03
A-559	2	Exhaust Manifold Stud Nut	.05
D-1-560	1	Oil Pump	2.30
D-l-561	1	Oil Pump Body	1.40
D-564	1	Oil Pump Plunger	.40
D-565	1	Oil Pump Plunger Spring	05
D-566	1	Oil Pump Spring Washer	.03
D-l-567	1	Oil Drain Plug and Strainer	.60
D-568	1	Oil Drain Plug (See D-l-567)	.20
A-569	1	Oil Drain Plug Washer	.03
A-571	1	Oil Pump Nipple	.10
A-573	1	Oil Pump Tappet	.35
A-574	2	Oil Pump Stud,	.03
K-576	1	Radiator Base	3 10
K-577-3	1	Radiator	21.70
A-579	2	Rear Split Cover Joint Gasket	Set .03
K-580-2	1	Radiator Cap W/2 Spring.,	1.50
K-581	1	Water Inlet Manifold.,	1.05
K-582	1	Water Outlet Manifold,	1.00
A-583	2	Water Inlet Stud,	.03
A-584	1	Oil Gauge	.10
D-588	1	Oil Pump Lead Plug	.15
D-589	2	Cylinder Head Cover Stud Nut	.03
A-590	1	Camshaft Thrust Washer	1 5
A-591	1	Camshaft Thrust Plug	.10
A-592	1	Camshaft Thrust Plug Spring	.03
c-593	1	Starting Crank	.90
c-1-593	1	Starting Crank and Support	1.55
B-l-595	1	Order 5680	
A-596	1	Starting Crank Pin	.03
A-597	1	Order D-597.	
D-597	1	Starting Crank Jaw	.80
A-598	1	Starting Crank Hole Cap.	.20
A-599	1	Pet Cock	.20
D-600	8	Push Rod	.20
A-601	8	Connecting Rod Bolt.	.05
A-602	1	Order5451	
A-605	1	Oil Line Connector	.10
A-1-606	1	Oil Return Tube Assembly,	.15
A-607	2	Oil Line Ell	.10
A-610	2	Oil Line Split Nut	.10
A-1-611	1	Oil Tube to Rocker Arm Shaft Assembly.	.30
A-l-615	1	Oil Pump Tube Assembly.	.15
A-616	4	Oil Line Nut.	.05
A-617	8	Connecting Rod Bearing Shim .063	.03
A-618	24	Connecting Rod Bearing Shim .008	.03
A-619	24	Connecting Rod Bearing Shim .002	.03
A-621	1	Oil Filler Cap	.15

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ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-623	1	Oil Pump Inlet Ball ¾	$ .03
D-624	1	Oil Pump Outlet Ball ½	.03
A-627	1	Magneto Drive Shaft Nut	.10
A-628	1	Magneto Drive Shaft Washer	.03
A-629-l	1	Magneto Drive Shaft Thrust Washer	.20
A-1-630	1	Magneto Drive Shaft Assembly	3.05
A-631	1	Magneto Drive Shaft Bushing	.70
A-632	1	Camshaft Lock Nut	.10
A-633	1	Camshaft Lock Washer	03
A-635	2	Order 5650	
A-637	1	Governor Flyweight Hub Pin	.03
A-638	2	Governor Sliding Sleeve Stud	.03
A-639	2	Governor Flyweight Pin	.03
A-640	2	Governor Sliding Sleeve Link Pin,	.03
A-641	1	Governor Sliding Sleeve	.70
A-2-642	1	Governor Sliding Sleeve Collar Assembly	1.05
A-645	4	Governor Link Plate Washer	03
A-646	2	Governor Spring	10
A-649	1	Cylinder Head Gasket	.40
A-650	1	Gear Cover Gasket	.05
A-651	1	Oil Base Gasket—Right	.05
A-652	1	Oil Base Gasket-Left	.05
A-653	1	Cylinder Head Cover Gasket	.05
A-654	1	Magneto Coupling Lock Ring	05
A-655	1	Water Outlet Gasket	.05
A-656	3	Water Outlet and Inlet Gasket	.05
A-657	1	Carburetor Flange Gasket	.05
A-659	1	Governor Housing Gasket	.05
A-664	8	Governor Link Plate	.03
A-669	1	Order D-246	
A-670	1	Order D-247	
A-671	1	Drive Shaft Bearing	1.15
D-673-8	1	Carburetor	7.50
K-674	4	Spark Plug	.65
K-674-l	4	Service Plug	.35
A-676-1	1	Magneto Bracket	.55
A-681	1	Cylinder Casting Plug Large	.05
A-695	1	Exhaust Manifold Gasket Front	05
A-696	1	Exhaust Manifold Gasket Center	05
A-697	1	Exhaust Manifold Gasket-_-Rear	05
D-730	1	Generator Cover	1.60
A-735	1	Generator Ball Bearing	2.05
D-741-2	4	Generator Brush Holder D. C.	.55
D-742	4	Generator Brush D. C.	.35
A-752	5	Terminal Lugs	.03
A-758	3	Fillister Head Cap Screws	.03
A-774	1	Ball Joint	.20
D-781-1	1	Fan Blade	1.15
A-797	2	Camshaft Bearing Pin	03
A-798	1	Magneto Drive Shaft Bearing Pin	.03
K-804	2	Fuse--3OAmpere	.10
A-806	4	Cylinder Casting Plug, 1 inch	.03
A-806-A	1	Cylinder Casting Plug, 1⅛ inch	.05
A-812	1	Carburetor Butterfly Valve	1.20

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Part Number	No. Per Plant	DESCRIPTION	Price Each
E-816	1	Lead, Magneto Ground.	$ .10
A-822	4	Elbow Complete ¼ I. D..	.15
A-823	5	Connector Complete ¼ I. D.	.10
A-824	8	Compression Nut ¼ I. D..	.05
A-825	8	Compression Sleeve ¼ I. D..	.03
A-826	4	Piston Ring Standard.	.15
A-826-S	—	Piston Ring, .005 Oversize.	.15
A-826-10		Piston Ring. .010 Oversize.	.15
A-826-20		Piston Ring, .020 Oversize.	.15
A-826-25	—	Piston Ring, .025 Oversize.,	.15
A-826-30	—	Piston Ring, .030 Oversize.	1.5
B-826	8	Compression Ring, Standard.	.15
B-826-5		Compression Ring, .005	1.5
B-826-10	—	Compression Ring, .010	.15
B-826-20		Compression Ring, .020	.15
B-826-25		Compression Ring, .025	.15
B-826-30	—	Compression Ring, .030	1.5
A-827	1	**Socket Wrench**	.35
A-828	4	Washer, Plain.	.03
D-831	1	Spark Plug Wrench.	.30
K-833	1	Generator Fan	.95
A-837	1	Governor Lever Weight.	.25
A-838	1	"S" **Wrench**	.40
A-849	1	Double End Wrench.,	.35
A-851	2	Governor Flyweight Hub Link Pin,	.03
A-861	2.	Ball Joint Rod Nut.	.03
A-869	7	Generator Wire Terminal Lug,	.03
B-893	1	Nipple, Close.	.05
B-897	3	Stud $\frac{5}{16}$x2$\frac{5}{8}$—18 and 24 Thread,	.05
D-903	1	Generator Ball Bearing Gasket.,	03
B-909	1	"S" Wrench.	.30
B-1-913	1	Valve Feeler Gauge.	.03
B-920	1	Choker Valve Handle.	.05
B-930	1	Fan Shaft Nut Washer-Plain $\frac{5}{8}$	.05
B-936	1	Hexagon Nut-Galvanized ¼-20.	.03
D-950	6	Generator Brush Holder Set Screw.	.03
D-951	6	Generator Brush Holder Lock Nut,	.03
D-965-SP	1	Tool Set	10.00
D-966	8	Piston Pin Retainer.	.03
D-l-968	1	Magneto Ground Switch.	1.00
D-972	2	Copper Washer-Plain $\frac{3}{8}$	.05
D-973	1	Oil Base End Cover.	.25
D-974	1	Oil Base End Cover Gasket	05
D-979	1	Switch Support Bracket-R. H.	.30
D-980	1	Switch Support Bracket-L. H.	.30
D-99.5	1	Oil Pump Passage Plug	110
D-996	1	Retainer Washer	.03
D-997	6	Copper Washer $\frac{5}{16}$	.03
D-1012	1	Oil Strainer (See D-l-567)	.50
D-1192-1	1	Muffler	2.50
D-1199	1	Complete Set Gaskets,	1.35
c-1201	1	Starting Crank Support.	.35
C1202	1	Starting Crank Guide..	.10
C-1204	1	Starting Crank Spring Pin..	.03

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ELECTRIC PLANTS

Part Number	NO. Per Plant	DESCRIPTION	Price Each
E-1206	1	Knife Switch Complete	$ 2.25
c-1209	1	Starting Crank Spring	.03
C-1217	4	Conduit Bushing	03
C-1218	4	Conduit Bushing Lock Nut	.03
D-1301	1	Governor Housing	1.50
D-1302	1	Governor Housing Cover	1.00
D-1306	1	Governor Housing Cover Gasket	.03
D-1307	1	Governor Housing Plug	.03
D-1308	1	Ball Joint Rod	.15
D-1312-1	1	Governor Fork and Lever Assembly	2.00
D-1320	1	Filter, Gasoline-Assembly	1.00
D-1337	1	Gasket, Filter Bowl	.05
D-1338	1	Bowl, Gasoline Filter	15
D-1339	1	Screen, Filter	.20
D-1340	1	Bail-Assembly,	.15
D-1342	1	Wheel, Thumb	.05
D-1343	1	Cover, Gasoline Filter	.50
D-1344	1	Valve, Gasoline Filter Shut-off	25
D-1351'		Oil Filter (Purolator)	6.50
D-1352		Oil Filter Element	1.15
E-1400-1	1	Drip Pan Assembly	2.75
E-1402-1	1	Drip Pan Tube	.10
D-1507	1	Insulating Bushing	.05
D-1508	2	Insulating Washer	.05
D-1509	13	Plain Washers 1/4"	.03
AC-1538-2'	1	Condenser, .75 Mfd	.75
AC-1539	3	Order D-242	.50
A-1567	2	Butterfly Retaining Screw	.05
A-1568	1	Main Jet No. 9	.60
A-1569	1	Compensating Jet No. 11	.55
A-1571	2	Lower Plug	35
A-1578	2	Carburetor Jet Washer	.05
A-1579	4	Lower Plug Washer	.05
D-1706	1	Resistance, Head Switch	2.50
D-1711	1	Armature-With Contacts	3.05
D-1715	1	Core-Assembly	3.40
D-1716	1	Base, Core	.50
D-1737	1	Pin, Hinge	.15
D-1739	4	Bracket, Support	.20
D-1742	1	Spring, Armature	.10
D-1744	1	Contact, Carbon	.60
D-1746	1	Post, Contact	.45
D-1752	1	Body, Heat Switch	55
D-1753	1	Arm, Heat Switch	.65
D-1755	1	Spring, Heat Switch	.35
D-1758	1	Screw, Adjusting	.15
D-1776	1	Coil, Cranking Relay	4.65
D-1777	1	Washer, Insulating	20
AC-1778	1	Bowl, Air Cleaner	3.50
AC-1779	1	Filter and Cover	6.50
AC-1782	1	Nut, Wing	.05
D-1786	1	Spacer, Resistance	.20
AC-l 788	1	Filter, Air-Assembly	10.00
AC-l 789	1	Clamp, Air Filter	.35

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Part Number	No. Per Plant	DESCRIPTION	Price Each
D-1820	1	Post, Contact..	$ .50
AC-18.50	1	Collector Ring Assembly.	2.90
AC-1852	2	Collector Ring Holding Screw..	.10
D-1868	1	Washer, Insulating.	.05
AC-1882		Rubber Bushing.	.10
EH-2200-2	1	Housing, Weather-Assembly..	81.00
EH-2201-l	1	Skid, Housing.	11.95
EH-2224-l	1	Pipe, Exhaust.	.45
EH-2226	1	Ell, Street.	.35
EH-2229	1	Cover. Cylinder Head,	1.90
EH-2230	1	Nipple, Pipe.	.15
EH-2231	1	Elbow, Pipe.	.30
EH-2236	1	Rod, Choker- Short	.05
EH-2237-l	1	Rod, Choker--- Long.	.05
EH-2247.2	1	Line, Fuel.	.25
EH-2.252	1	Drain, Oil Assembly	1.90
EH-2255	4	Washer, Rubber.	.05
EH-2259	7	Nut, Wing.	.03
EH-2260	2	Doors, Side (includes EH-2262 and EH-2263j	4.95
EH-2261	4	Latch, Door	.75
EH-2262	4	Handle, Housing Door.	1.60
EH-2263	4	Bracket, Door Latch.	30
EH-2264	1	Tank, Gasoline (includes D-188).	22.30
EH-2265	2 sets	Bracket, Gasoline Tank.	
EH-2266	1	Roof, (includes EII-2265).	25.00
EH-2267	1	Panel-- Rear (generat or end).	19.00
EH-2268	1	Panel-- Front (crank end).	18.00
EH-2269	1	Door, Rear Panel.	9.00
EH-2270	1	Panel, Left Side (includes 2 EH-2261).	11.00
EH-2271	1	Panel, Right Side (includes 2 EH-2261).	11.00
EH-2273	1	Cover. Radiator Outlet Neck	1.70
D-2302	1	Nipple Pipe, 1½ x 4 L.P.	.15
D-2448	4	Ring, Oil—Standard.	.20
D-2448-5		Ring, Oil—.005 0. S..	.20
D-2448-10		Ring, Oil—.010 0. S..	.20
D-2448-20		Ring, Oil—.026 0. S..	.20
D-2448-30		Ring, Oil—.030 0. S..	.20
D-2516	1	Tee, Oil Line-Assembly.	.60
D-2517	1	Cross, Oil Line--Assembly	70
D-3000	1	Magneto---Assembly..	35:oo
D-3011-1	1	Cables, Magneto No. 1.	.20
D-3011-2	1	Cables, Magneto No. 2.	.20
D-3011-3	1	Cables, Magneto No. 3.	.20
D-3011-4	1	Cables, Magneto No. 4.	.20
D-3031	1	Window, Observation.	.05
D-3032	1	Ring, Window	.05
D-3033	1	Gasket, Distributor Plate,	.10
D-3034	4	Screw, Distributor Plate.	.05
D-3035	4	Washer, Fastening Screw.	.05
D-3036	5	Washer, Lock.	.05
D-3037	1	Plate, Circular Name.	.10
D-3052	1	Washer, Rotor Gear Spacing.	.05
D-3054	1	Washer, Distributor Gear Spacing..	.05
D-3058	2	Washer, Interrupter Bracket Lock.	.05

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ELECTRIC PLANTS

Part Number	NO. Per Plant	DESCRIPTION	Price Each
D-3062	1	Plate, Name-Type	$ .10
D-3063	2	Screw, Interrupter Bracket	.05
D-3064	1	Gear, Rotor.	.85
D-3065	3	Washer, Rotor Felt	.05
D-3068	2	Strip, Packing-Ball Bearing	.05
D-3069	1	Washer, Ball Bearing Paper	05
D-3070	req'd	Shim, Bearing .0126	.05
D-3071	req'd	Shim, Bearing .0071	.05
D-3072	req'd	Shim, Bearing .0040	.05
D-3073	req'd	Shim, Bearing .0197	.05
D-3074	1	Washer, Rotor Felt Retaining	.05
D-3075	2	Washer, Bearing Spacing	.05
D-3076	2	Washer, Contact Bracket Lock	.05
D-3077	1	Washer, Fastening Screw Lock	.05
D-3078	2	Screw, Mounting Coil Lock	.05
D-3082	1	Nipple, Rubber Insulating	.05
D-3084	1	Cable, Coil-Specify Length	.05
D-3085	1	Screw, Magneto Grounding	.05
D-3089	1	Housing, Magneto	8.29
D-3090	1	Cover, Ventilator	.15
D-3092	1	Plate, Name—Ventilator Cover	.10
D-3093	1	Gasket, Ventilator Cover	.05
D-3096	1	Washer, Ventilator Cover	.05
D-3103	1	Clip, Coil Cable Terminal	.05
D-3104	4	Clip, Distributor Plate Cable	.05
D-3106	2	Screw, Name Plate	.05
D-3110	1	Plate, Distributor	3.50
D-3111	4	Washer, Sealing	.05
D-3 114	1	Shaft, Rotor Gear	.10
D-3116	1	Ring, Shaft Spring	.05
D-3117	1	Ring, Shaft Spring,	.05
D-3124	1	Gear, Distributor	2.40
D-3126	1	Brush, Carbon and Spring	.20
D-3128	2	Pin, Distributor Gear	.05
D-3135	2	Screw, Ventilator Cover	.05
D-3137	1	Rotor, Magnet	11.75
D-3141	2	Plate, Locking	.05
D-3142	1	Interrupter-with Points	3.50
D-3143	1	Bracket, Interrupter-Assembly	1.30
D-3144	1	Condenser	.70
D-3145	3	Screw, Contact Bracket	.05
D-3146	1	Washer, Lock	.05
D-3147	1	Bracket, Contact-with Point	.85
D-3148	1	Lever, Interrupter	.60
D-3149	1	Washer, interrupter lever stud	.05
D-3150	1	Pin, Interrupter Lever Stud,	.05
D-3151	1	Screw, Conducting Lead	.05
D-3154	1	Clip, Terminal	.05
D-3 160	1	Coil, High Tension	5.15
D-3179	1	Gauge, Point Setting	.05
D-3189	2	Bearing, Ball	1.55
D-3190	2	Washer, Lock	.05
D-3196	1	Wick, Cam Oiler	.05
D-3197	1	Bracket, Wick Retaining	.10

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-3200	1	Magnet.0 (Bosch Shielded)	$ 40.25
D-3575	1	Pump, Fuel-Assembly	2.95
D-3576	1	Nut, Cam	.60
D-3581	1	Lever, Priming	.35
D-3582	1	Cover, Fuel Pump Pad	.15
D-3583	1	Slinger, Oil	.05
D-3586	1	Bail, with Screw	.20
D-3587	1	Bowl, Glass	.15
D-3588	1	Gasket, Bowl	.05
D-3589	1	Nut, Bail-Thumb	.10
D-3590	1	Screen	.10
D-3591	1	Seat, bowl	.10
D-3592	2	Gasket, Valve Plug	.03
D-3593	2	Plug, Valve	.20
D-3594	1	Diaphragm	.25
D-3595	2	Valve	.03
D-3596	3	Spring, Valve	.03
D-3597	3	Spring, Rocker Arm	.05
D-3633	1	Retainer, Fuel Valve	.05
D-3634	1	Body, Carburetor-Assembly	7.50
D-3635	1	Cover, Valve Seat-Assembly	3.15
D-3636	1	Cover, Carburetor-Assembly	3.15
D-3637	1	Gasket, Cover	.05
D-3638	2	Screw Assembly	.05
D-3639	2	Washer, Screw Assembly Lock	.03
D-3640	1	Float Assembly	.65
D-3641	1	Axle, Float	.10
D-3642	1	Screen, Filter Assembly	.30
D-3643	1	Seat, Fuel Valve Assembly	.75
D-3710	1	Line, Fuel	.20
D-3713	1	Gasket, Fuel Pump	.05
D-3716	1	Pin, Rocker Arm.,	.05
D-3717	1	Washer, Rocker Arm Pin	.03
D-3718	1	Washer, Diaphragm Alignment	.05
D-3719	1	Arm, Rocker	1.85
D-3721	1	Gasket, Bottom Cover	.03
D-3962	4	Cable Outlet Nut	.20
D-3964	4	Rubber Glands	.15
D-4130		Set Piston Rings	4.95
D-4155	1	Air Filter,	3.00
5271-1		Crankshaft, Single	18.00
5272	1	Flywheel	5.10
5418-3	1	Radiator Overflow Extension	.45
5422	1	Fan Guard	1.50
5423	1	Fan Adjusting Screw	10
5424	1	Fan Support Bracket	l:oo
5446	1	V Fan Belt	.85
5451	1	Exhaust Manifold	1.40
5452	1	Exhaust Manifold Plate	.05
5456	1	Order D-673-8	
5519		Manual Choker	3.40
5520	1	Choker Assembly	4.00
5521-1	1	Choker Manifold Assembly---Manual	2.45
5525	1	Choker Valve Assembly	.25

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Part Number	NO. Per Plant	DESCRIPTION	Price Each
5650	2	Governor Flyweight	$ .35
5680	1	**Governor** Assembly	6.15
5810-A-1	1	Automatic Switch	71.15
5815	1	Coil, Generator Relay	3.95
5820	1	Switch, Heat	6.55
5822	1	Button, Heat Switch	.75
5824	1	Post, contact	1.94
5828	1	Resistor (AB)	3.50
5834	1	Frame, Magnet	3.15
5837	1	Spring, Armature Lever	.15
5840-l	1	Resistor, Exciter Field	3.30
5841	1	Resistor, Battery Charging	2.50
5842	1	Resistor (CD)	2.00
5843	1	Coil, Load Relay	5.00
5847	1	Finger, Contact-Assembly	5.00
5849	1	Core—DC	2.65
5850	1	Relay, Generator—Less Coil	13.30
5851	1	Bracket, Contact-Assembly	1.50
5852	1	Board, Contact-Assembly	3.15
5853	1	Lever, Armature	3.10
5854	1	Insulator	.15
5950	1	Manual Switch Assembly	7.80
5952	1	Flexible Lead	.10
5955	1	Resistance Coil	3.40
5956	1	Snap Switch	.35
5964	1	Relay, Cranking-Less Coil	14.00
5965	2	Clamp, Support	
5967	1	Shim---l-11/32" Long	.30
5968	1	Shim—15/16" Long	.15
6003	6	Field Poles	1.40
6054	1	Brush Holder Stud-Short	.20
7004	1	Fan Assembly	7.15
7012	1	Magneto Ground Wire Assembly	.65
7031	1	Fan Hub	1.45
7032	1	Fan Shaft	2.00
7033	2	Fan Bearing	1.50
7034	1	Fan Bearing Spacer	.30
7035	2	Fan Bearing Snap Rings	.10
7104	1	Bearing Spacer-Small	.20
7105	1	Bearing Spacer-Large	.45
7106	1	Hexagon Cap Screw ½-20x1	.15
7110-2	1	Voltage Control Relay,	5.60
7111	1	Voltage Control Relay Lead No. 6	.10
7115	1	Exciter Brush Lead No. N	.35
7116	1	AC Brush Lead No. A	.20
7120-M	1	Generator Assembly-Manual	46.90
7121	1	Generator Frame	12.30
7130-M	1	Field Coil Assembly	20.70
7131-M-1	3	Field Coil No. 1	3.45
7131-M-2	3	Field Coil No. 2	3.45
7135	1	Shunt Field Lead No. F1	.15
7137	1	Exciter Brush Lead	.15
7145	1	End Bracket Assembly	19.10
7146	1	End Bracket	7.70

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Part Number	No. Per Plant	DESCRIPTION	Price Each
7147	4	Brush Holder Stud DC	$ .15
7148	1	Brush Holder Stud AC.	.15
7150	2	AC Generator Brush.	.50
7170	1	Armature.	69.75
150202	1	connector.	.20
151024	12	Insulating Washer..	.05
151025	6	Insulating Bushing	.05
151026	6	Plain Washer.	.03
151193	1	Socket Wrench Set	.90
151194	1	Ball Pein Hammer	.25
151195	1	6″ Pliers.	.20
151196	1	Screw Driver. ..	.15
151482	1	Name Plate. ...	.30
151541	1	Spring, Coil Thrust.	.10
151928	2	Bushing, Lead.	.30
153009-3	1	Exhaust Tube Assembly	2.85
153010-2		Exhaust Pipe. .	.95
153446	1	Fuel Pump Body. . .	1.35
153447	1	Fuel Pump Link. . .	.10
153448	1	Fuel Pump Link Pin.,	.05
153449	1	Fuel Pump Link Pin Clip.	.50
153450	2	Rocker Arm and Spring Clip .	.03
153452	1	Fuel Pump Bottom Cover.. . . .	.50
153453	1	Fuel Pump Pull Rod.	.15
153454	1	Fuel Pump Pull Rod Gasket, .	.50
153455	1	Lower Diaphragm Protector.	.03
153456	1	Upper Diaphragm Protector.	.03
153657	1	Thermometer. ...	2.00
153730	1	Muffler, Exhaust.	3.35
153880	3	Ventilator Screen.. . ..	.08
153881	6	Ventilator Screen Washer.	.05
153882	1	Primary Ground Insulating Washer . 1	Dz. .05
153883	1	Stat. Contact Bracket Washer. .	Dz. .05
153884	3	Ventilator Screen Rivet. ...	.05
153885	1	Rotor Pinion.	.30
153886	1	Distributor Sleeve Bearing.	20
153887	1	Rotor Sleeve Bearing.	.25
153888	1	Rotor Ball Bearing.	1.15
153889	1	Distributor Shaft and Gear Assembly.	1.25
153890	1	Bearing Seal Rubber Washer.	.12
153891	1	Rotor Bearing Insulating Strip..	Dz. .10
153892	1	Distributor Rotor.	.50
153893	1	Primary Lead Wire Tube.	.09
153894	2	Rotor Shaft Thrust Bearing Shim. . .	Dz. .15
153895	2	Distributor Shaft Flat Washer.	Dz. .15
153901-FN	1	Magneto Complete.	38.50
153904	1	Magneto Point Gauge.	.05
153920	1	Stat. Contact Point Adjusting Screw .	.09
153922	1 pr.	Coil Lead Brush.	.22
153926	1	Bearing Insulating Washer.	Dz. .15
153937	3	Coil Lead Wire Terminal.....	Dz. .25
153967	1	Coil Assembly.	5.00
153968	1	Magneto Condenser	.90
153969	1	Ground Cable Terminal.....	28

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