# KOHLER

## ELECTRIC PLANTS

Instructions

*for*

Operation, Care and Maintenance

*of*

5 KVA and 10 KVA, A.C. Models

*and*

List of Parts

KOHLER OF KOHLER

# INTRODUCTION

## Purpose Of Book

An Instruction Book 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 prepaid to Kohler Co., Kohler, Wisconsin, 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 authorized representative 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 anyone to assume for us, any other 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 Book and give the plant the attention which these instructions 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.

## Check The Installation

The operation of any gasoline engine, as well as a gasoline engine driven generator is affected considerably by the installation.

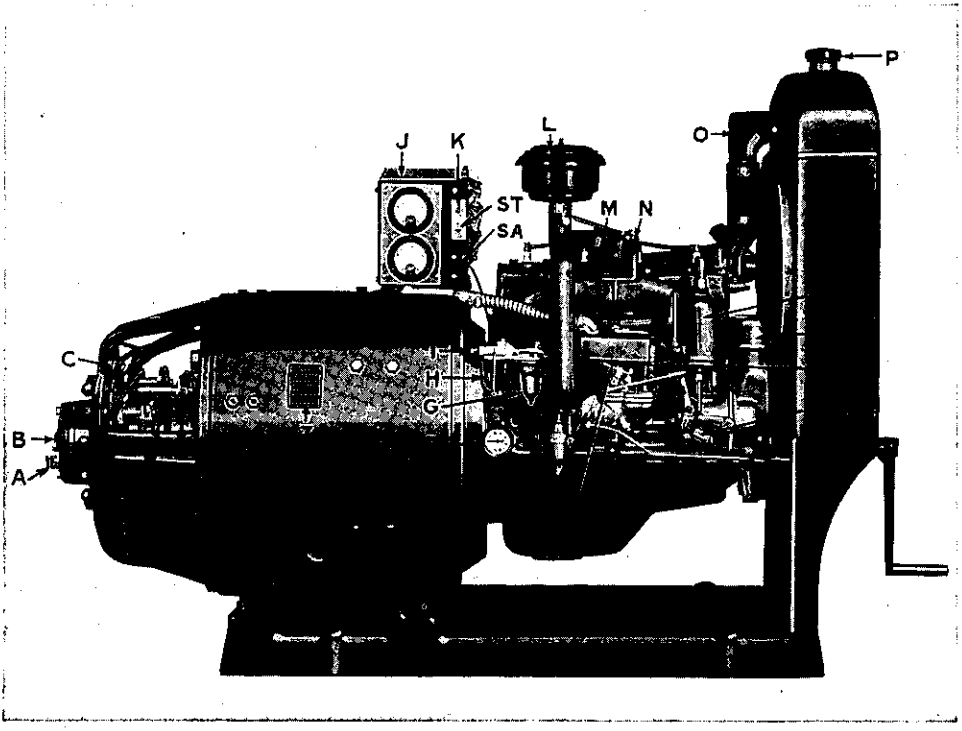



Figure 1.
Carburetor Side of Plant.

A—Oil cup for generator bearing
B—Cap—Remove to check speed
C—Radio condenser
D—Collector ring
E—Commutator
F—Oil gauge
G—Fuel pump priming lever
H—Fuel pump sediment bowl
I—Fuel pump inlet
J—Control switch
K—Battery charging switch
L—Air cleaner
M—Thermostat
N—Exhaust outlet
O—Water outlet manifold
P—Radiator cap
R—Vacuum compensator
S—Crankcase breather
SA—Safety switch
ST—Start and stop switch
T—Fume eliminator
U—Governor spring
V—Oil pressure valve
W—Governor switch
X—Carburetor
Y—Electric choke
Z—Name plate

The factors involved in the installation which should be considered are ventilation, temperature, moisture and cleanliness. All gasoline engines are heat engines and require a certain amount of clean, fresh air. To obtain maximum power and efficiency, they must be operated under a temperature which is not too hot nor too cold. The equipment is designed to operate satisfactorily in an ambient temperature range of 0 to 104° F. The electrical generator must not be subjected to excessive moisture, oil or dust. Although the plant may be permanently located when this Instruction Book is received, the various factors which affect the operation of the plant from an installation standpoint should be carefully checked over to avoid the possibility of future trouble.

### Installation Book

An installation book has been prepared which contains detailed suggestions for installing all models. One of these books will be mailed free upon request.

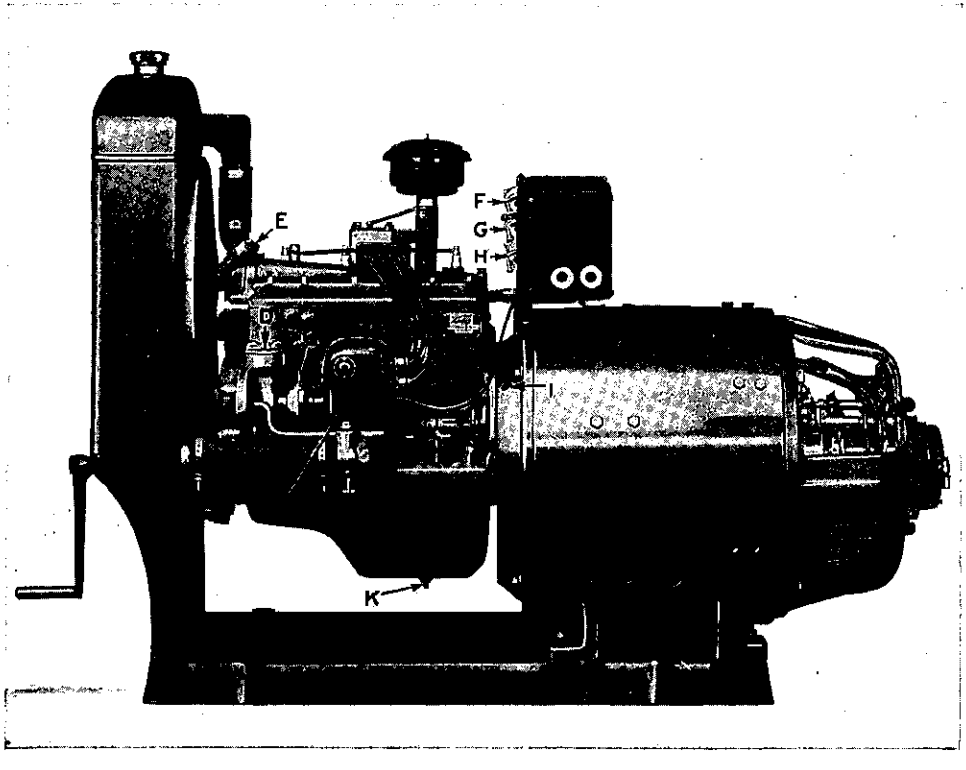



Figure 2.
Magneto Side of Plant.

A—Water valve
B—Magneto
C—Magneto coupling
D—Oil filler cap
E—Fan grease cup
F—Charging resistance
G—Line resistance
H—Field resistance
I—Opening to check timing
J—Oil gauge
K—Crankcase drain plug

# PREPARING AND STARTING THE PLANT

## Preparing Plant for Operation

OIL—Fill oil base up to high level mark on oil gauge. Use S.A.E. 30 for summer and 20W for winter, if temperatures drop below 15° F. use 10W. — gas plants use one grade lighter. 4 quarts are required.

WATER—Fill cooling system with water. Approximately five gallons are required.

OILING—Oil fan, generator bearing, and magneto in accordance with instructions.

CONNECTIONS—Make necessary connections for exhaust line, gasoline lines, and starting battery. All joints must be tight. Connect service switch to main lines.

GASOLINE—Fill gasoline supply tank. Be sure line to carburetor is open.

INSPECTIONS—Turn the engine over slowly with the hand crank to make certain all parts move freely. Examine governor operating lever, generator brushes, and fan while rotating engine.

## Starting the Plant — Automatic Type

Turn on a lamp or appliance of 100 watts or more for the 5 KVA and 250 watts or more for the 10 KVA and plant should start automatically.

## Manual Type

Before starting a manual plant for the first time, check the foregoing instructions to make sure no items have been omitted. Remove the ignition or magneto ground, pull choker wire out and turn hand crank. Manual plants are equipped with impulse starters on magneto and it is not necessary to spin the engine. Give crank a quarter turn at moderately slow speed. The engine is timed to avoid a kick-back, but the thumb should be placed on the same side as the fingers when grasping the crank to avoid injury to the wrist. An engine should start with the third or fourth pull-up of the crank.

COLD WEATHER STARTING—To start the plant easily in cold weather, use a better grade of fuel, leave ignition switch off, and with the choker rod pulled out, crank the engine two or three times, release the ignition switch and choker rod and crank as in preceding paragraph.

STARTING A HOT ENGINE—When starting a hot engine, it is not necessary to pull out the choker rod. Choking a hot engine will cause it to flood and make starting difficult.

## Remote Control Type

Close the control circuit and plant should start same as the automatic type.

## Oil Pressure

After the plant is running normally, observe the oil pressure gauge to ascertain if oil is circulating. If oil is not circulating, hold the throttle closed so as to operate the plant at slow speed until oil begins to flow. The oil pressure gauge should register not less than 15 pounds pressure when the plant is operating at rated speed of 1200 R.P.M.

The oil pressure can be adjusted by the relief valve (K, Figure 1) located on the side of the engine below the carburetor.

## Load

When the plant is running satisfactorily, the load can be connected to the external circuit. As the plant attains normal operating temperatures, the load may be increased to the rated capacity. Although these plants are tested to carry an overload, excessive overloads for continuous operation will cause overheating which should be avoided as much as possible.

## Voltage

The voltage of a cold generator will be higher than the voltage of a generator which has reached normal operating temperatures. As the temperature of the generator increases the voltage drops to approximately rated voltage with a slight variation on increasing and decreasing loads.

## Control

The plant is designed to operate at constant speed of approximately 1200 R.P.M. However, the speed will vary slightly depending upon the load. The variation in speed will, perhaps; not exceed 5%, i. e. on a small load or a 150 watt light the speed may be 1260 R.P.M. and if the plant is carrying its rated capacity, the speed will drop to approximately 1200 R.P.M. The carburetor operating control lever, mechanical governor and the resistance in the shunt field must be adjusted to obtain the correct voltage and control on all loads and at all temperatures.

The above adjustments are correctly made at the factory when the plant is tested before shipment. Under normal operating conditions, these adjustments need not be changed. If it becomes necessary to adjust the voltage and speed of the plant the instructions on Page 30 should be followed.

## General Operation

After the plant has been prepared for operation and started in accordance with the preceding paragraphs, the general operation should be observed for a few minutes. The plant has been operated for approximately 36 hours at the factory and should function perfectly, but minor troubles may occur during the interval between the time the plant is tested and the time it is again placed in service. A broken spark plug for instance would cause the plant to misfire and voltage and speed would be irregular.

# OPERATION AND CARE

## Lubrication

THE OILING SYSTEM—The engine is equipped with an oiling system which will insure positive lubrication to all necessary parts. The system includes an oil reservoir, a full pressure pump, a pressure gauge, and relief valve for regulating the pressure.

CHANGING OIL—The oil level should be maintained to the high mark on the oil gauge and a complete change should be made every fifty hours of service when the engine is new. After the first 1000 hours of service, the oil should be changed every 100 hours of operation.

The oil should be carefully examined after it is drained to determine whether it is necessary to drain more often or if a different grade of oil should be purchased. It is usually necessary to drain oil after a smaller number of hours of service when the plant is exposed to cold temperatures, because excessive use of the choker and condensation will cause crankcase dilution.

GRADE OF OIL TO USE—If the plant is operated at starting temperatures above 50° F. medium oil should be used or S.A.E. 30. For temperatures 15° F. to 50° F. use S.A.E. 20W, if temperatures drop below 15° F., use S.A.E. 10W. Gas plants use one grade lighter.

OIL PRESSURE The oil pressure is registered by an oil gauge on the side of the cylinder block. A constant pressure of 15 pounds should be maintained after the plant has reached normal operating temperatures. The oil pressure can be changed by adjusting the oil relief valve on the side of the crankcase. Adjustments of this valve are made at the factory and they should be changed only after the plant has attained normal operating speeds and temperatures.

A change in the grade of oil used or a change in the speed of the plant will affect the oil pressure. If the pressure drops suddenly, the plant should be stopped immediately and the probable cause determined.

FAN—The fan should be oiled with heavy oil, or light grease, at regular intervals depending upon the number of hours of service.

WATER PUMP—The water pump grease cups should be kept filled and given a turn a day while the plant is in service. Use No. 2 Water Repellent Fluid grease, or Alemite water pump lubricant. Too much grease will work into cooling system. Avoid excessive grease and dirt.

MAGNETO—The magneto must be oiled strictly in accordance with instructions furnished with it.

GENERATOR BALL BEARING—Oil the generator ball bearing with the same oil used in crankcase, monthly or after every 200 hours of operation. Be careful to keep all oil off of commutator and electrical windings.

## Inspections

IMPORTANT—The importance of regular inspections at predetermined intervals based on hours of operation cannot be over emphasized. Regular inspections will keep the plant in better operating condition and tend to avoid extensive repairs.

DAILY INSPECTIONS OR AFTER SEVEN HOURS OF OPERATION
Plants which are operated daily should be checked for oil, water and fuel in the same manner that an automobile would be inspected under similar operating conditions.

Observe oil pressure. Inspect plant generally for loose connections, oil or water leaks.

Inspect fan belt.

WEEKLY INSPECTIONS OR AFTER 50 HOURS OF OPERATION—
Remove any accumulation of excessive dirt, water or grease from plant.

Test compression of cylinders by turning engine with hand crank. It may be necessary to adjust valve clearance.

Remove spark plugs, clean and adjust spark gap. Examine for broken porcelains. Tighten securely when replacing them.

Examine the brush contact on commutator. If brushes are arcing, sand brushes and commutator with fine sand paper. Surface of brush should conform to surface of commutator. Spring tension of all brushes must be uniform.

Check starting battery. Add distilled water if necessary.

MONTHLY INSPECTIONS OR AFTER 200 HOURS OF OPERATION
Check plant generally for unusual noises or poor control.

Inspect valve clearance and adjust if necessary.

Tighten all connections and fan belt.

Change oil in accordance with second paragraph on Page 6 under lubrication.

Fill generator ball bearing with grease if necessary.

Inspect the plant to determine when complete overhaul will be necessary.

Check voltage control and speed of plant. Adjust according to specifications.

## Cooling System

GENERAL DESCRIPTION—The cooling system consists of a radiator, pump for circulating the cooling water and a fan for circulation of air through radiator and over plant. With plants covered by housing this system provides adequate cooling although the metal housing remains closed, except door in front of radiator, while the plant is in operation.

The cooling system is of the pump circulating type.

OVERHEATING—Under normal operating conditions the cooling system is adequate and will prevent overheating. However, if the plant overheats the trouble may be due to a lack of oil or water, fan belt slipping, choker closed, leaky valves or piston rings, improper timing, a clogged exhaust, lack of ventilation or operating the plant under an overload.

The oil and water level should always be checked first when the plant apparently overheats. The temperature of the water in the cooling system should be approximately 180° F. to secure the greatest efficiency, insofar as temperature of operation is concerned.

A lack of circulation caused by an obstruction in the cooling system will also cause overheating and it is advisable to flush the cooling system occasionally to prevent any part of it from becoming clogged.

The tension of the fan belt should be checked frequently to avoid slipping which causes overheating.

A closed choker will cause too rich a mixture which in turn will cause the engine to overheat.

METAL HOUSING PLANTS—While a lack of sufficient ventilation will cause overheating the design of the metal housing plants is such that when the various sections of the housing are in place, the cooling is better than if the housing is partially removed. The construction of the housing causes the air to be drawn over the entire engine and cooling system.

COLD WEATHER OPERATION—For cold weather operation, if possible, the radiator should be covered until the plant attains a running temperature. This will increase the efficiency of the plant and insure quicker normal operation after the plant is started.

A plant that is exposed to extreme cold weather must be especially prepared for this class of service. All connections in the cooling system must be carefully checked over and if defective, replaced before anti-freeze solutions are added.

The following table gives the quantities of anti-freeze solutions recommended for various temperatures:

| Percent of Alcohol | Freezing Temperature (Fah.) |
|---|---|
| 20 | + 19° |
| 30 | + 10° |
| 40 | + 2° |
| 50 | − 18° |

As alcohol evaporates, alcohol should be added occasionally to replace the amount lost through evaporation in order to maintain the solution in the proper proportions.

If an anti-freeze solution other than alcohol is used, the percentage of solution used should conform to the recommendations of the manufacturer.

If the plant is not operated when exposed to freezing temperatures and it is decided to have the engine continue to remain out of service, the cooling system should be thoroughly drained and alcohol added to prevent freezing of any water which has failed to properly drain away.

**Fuel System**

DESCRIPTION—The fuel system consists of a storage tank, carburetor, fuel pump, choker, and air cleaner. The latter accessory while not strictly a part of the carburetion system may be called a part of the fuel system since air and fuel are necessary for combustion. The function of the fuel system is to provide an adequate mixture of air and gasoline or similar fuel to the combustion chamber through the intake manifold and valves. If this mixture is in the proper proportions, the plant will function with the highest efficiency and with a lesser amount of starting trouble.

CARBURETOR—To obtain maximum efficiency from all carburetors, it is necessary to keep them free of dirt, water and other foreign substances usually deposited therein by the gasoline. Care should be exercised when replenishing the fuel supply by straining it through a suitable medium. Any straining device, however, must be cleaned at intervals to function properly. This type carburetor can be completely disassembled for cleaning purposes. Various passages and holes should be cleaned by using compressed air. Never use a wire, pin or similar instruments as by so doing the size of the hole is often changed effecting an improper metering of the gasoline.

FUEL PUMP—The fuel pump is used to draw the gasoline from the storage tank to the carburetor. Under normal conditions it will require no special care or attention. If fuel pump does not lift gasoline when plant is started, prime pump by filling carburetor bowl.

CHOKER—The purpose of the choker is to close the air intake to the carburetor and cause a richer mixture of fuel for starting purposes. Through the operation of the choker valve, it is possible to determine whether the fuel mixture is in proper proportions when the plant is not operating satisfactorily. The choker valve on manual plants should be used as little as possible as overchoking will cause crankcase dilution, excessive carbon, leaky valves and a waste of fuel. The automatic choker requires practically no attention and should it fail to operate, the coil should be tested.

THE STORAGE TANK—The storage tank may be located under ground and under ordinary circumstances it will require no care and attention.

PRIMER—When the plant is started under extreme cold temperatures, a gasoline primer can be installed to improve starting conditions. The intake manifold is drilled and tapped for a primer and it will not be difficult to install one.

The illustration on following page, particularly the sectional view on the left, shows the relation of the various parts in the carburetor assembly. Note the gasoline level in the carburetor barrel. The main nozzle is so located in relation to the float bowl that variances of fuel flow is minimized when carburetor is subjected to angular running positions. The adjustment of the carburetor is set at the factory and under normal operating conditions it will not be necessary to change this setting.

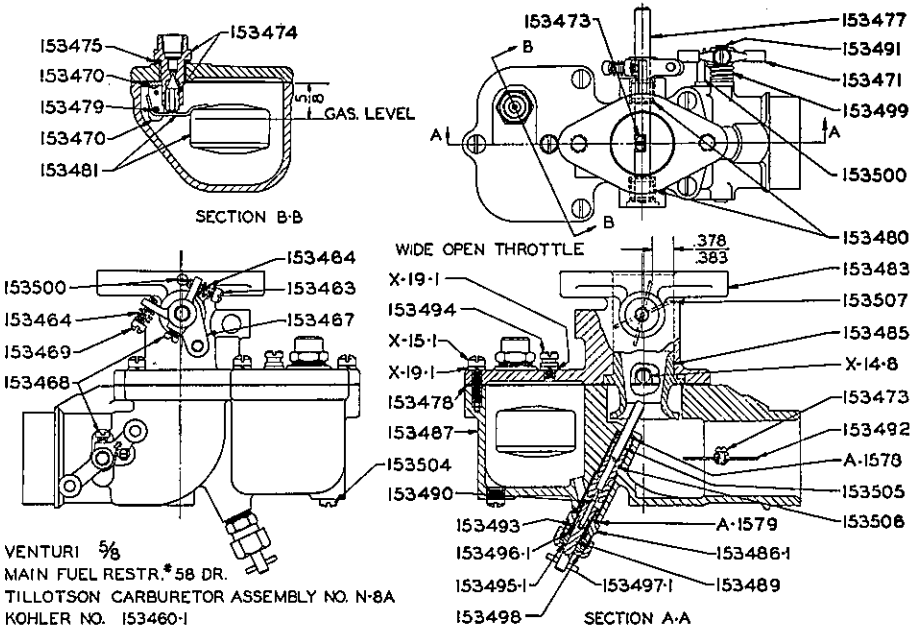



Figure 3.

Refer to list of parts in back of book for description of above parts.

If it is desired to readjust carburetor the following rules should be followed:

1. Close main adjustment screw (pictured as 153497-1 above) by turning to the right, or in, to its seat (never force against seat or injury to nozzle will result) then open to the left, or out, three (3) full turns.

2. Choke carburetor in usual manner; start motor and run until thoroughly warm.

3. With engine running at governed speed or its normal operating speed, slowly close the main adjustment screw 153497-1 by turning to the right, or in, until the engine speed decreases, or does not run smoothly. Open main adjustment screw approximately one-fourth (¼) turn from this position which will be found to be the proper adjustment.

AIR CLEANER AND BACK-FIRE TRAP—The air cleaner and back-fire trap requires no detailed explanation. The air required for combustion is drawn through this cleaner which prevents foreign particles from getting into the carburetor and intake valves. Excessive dust will cause greater wear of cylinder walls and consequently an air cleaner should lengthen the life of cylinder parts especially. The unit which has been installed on these plants has been approved by the National Board of Fire Underwriters.

## Ignition System

DESCRIPTION—The ignition system consists of a high tension magneto with impulse starter on manual plants, magneto cables or wiring system and spark plugs. It is of utmost importance, since the satisfactory performance of the elctric plant depends on a strong ignition system, which requires a minimum amount of care and attention.

MAGNETO—The magneto used is of improved design and carefully tested before installation on the electric plant and also on the plant when the final tests are made.

The magneto will require very little care and attention, but is is very essential that the necessary attention be given in ample time to avoid costly repairs and unnecessary delays. The instructions in the magneto booklet should be carefully followed and complied with. The instructions vary somewhat with the type of magneto used, naturally the instructions in this book can be only general.

CARE OF MAGNETO—The breaker points should be examined frequently and the spark gap adjusted with the gauge provided. The correct gap between the points is .012″ to .014″. The gap should be adjusted after approximately every 1000 hours of operation.

IMPULSE STARTER—All magnetos installed on manually cranked plants are equipped with impulse starters for quicker starting and to prevent kick-backs of the engine. Ordinarily, the impulse starter will require no care or attention. If trouble is experienced, the entire unit can be replaced or individual parts purchased. The impulse starter makes it possible to crank the plant without spinning the engine. Only a ¼ turn of the crank is necessary at moderately slow speed.

FIRING ORDER—The firing order of this engine is one, three, four, two. This should be kept in mind when the magneto cables are replaced or if they are disconnected. The numbers on the magneto correspond to the firing order of the magneto—cable number 1 should be connected to cylinder number 1, cable 2 must be connected to cylinder 3, etc.

TIMING THE ENGINE—*Flange Mounted Magneto.*

When mounting the magneto, the engine must be turned until the SPK mark is in the proper position for No. 1 cylinder. The gear on the impulse coupling of the magneto is then turned until a spark is obtained for the No. 1 spark plug lead, and then turned backwards until the mark at the center of one of the drive dogs coincides with the mark on the flange. This is the firing position, or the position at which the breaker points start to open. Before putting the magneto in place it is necessary to turn the gear approximately one tooth backwards which is equal to the spiral angle. When the gears are meshed it will turn forward to the proper position.

To be sure the magneto is properly timed it should be rechecked by turning the engine two complete turns. When the impulse coupling trips, note the position of timing marks on the generator fan. If properly timed, the impulse will trip approximately 2° or ¼″ past the DC mark on the generator fan. The impulse coupling will have a 15° lag angle and the SPK mark on the generator fan is 13° before the DC mark.

If the magneto timing is one tooth or more out of location it will be readily noticed because one tooth is equal to 12° or approximately 1-⅝″ on the generator fan.

Final accurate timing is accomplished by turning the complete magneto through an angle of 10° either side of center before tightening the two supporting screws or nuts.

SPARK PLUGS—If any trouble is experienced with the ignition system, the spark plugs should always be examined first, as the spark plugs are most liable to cause trouble. Defective or fouled spark plugs are the most common cause of misfiring.

When a spark plug proves defective, it should be cleaned or replaced. They can be tested by short circuiting them while the plant is in operation. The spark plug which is short circuited and apparently causes no change in the operation of the plant is defective and should be replaced.

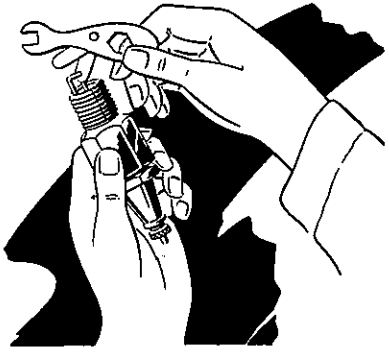


Figure 4.
Adjusting Spark Plug Gap
Adjust Gap to .040 for Gasoline, for Propane .030, for Artificial Gas .016.

The correct spark plug gap is very important and should be adjusted every 50 to 100 hours of operation. The electrodes should be adjusted with a gauge (see Figure 4). An excessive spark plug gap will cause an excessive strain on the magneto winding.

It is very important that the outside, as well as the inside, of the spark plug be kept clean of oil, dust and moisture.

WIRING—If trouble is experienced with the ignition system and the spark plugs are found to be in satisfactory condition, the wiring or cables should be carefully inspected. Poor insulation caused by excessive oil or moisture may cause the spark to leak through and cause misfiring.

## EXCITER - ALTERNATOR
### All Models

The complete generator consists of a one-piece field frame with two sets of field poles and armature with provisions for furnishing direct current for purposes of field excitation and battery charging, and an insulated alternating current winding properly connected to the collector rings.

The two sets of armature windings are wound in such a manner as to raise the exciter voltage as lamps and appliances are connected to the alternator. The exciter voltage is approximately 32 volts on small alternator loads and more than 50 volts on heavy alternator loads. This wide variation in exciter voltages maintains a reasonably constant alternator voltage at all times with results very similar to that of a compound field on a direct current dynamo.

The exciter field coils consist of a shunt and a cranking series while the alternator field coils consist of only a single winding. There is no need for any brush shifting mechanism. The exciter is used as an electric motor while cranking the plant, and becomes a direct current dynamo during normal operation supplying direct current to recharge the battery and to magnetize all field poles. Exactly the same exciter is used on all machines. The section of the armature

windings supplying alternating current is wound for the proper voltage and phase corresponding to the different models. Exciter brushes should be well fitted with plenty of spring tension. The collector ring brushes do not require much attention except to keep the holders securely locked in position with brush centered on the collector ring. Increase the tension of the collector ring brushes frequently to avoid burning of collector ring. All wire terminals are properly marked to correspond with the brass studs on terminal panel of the automatic switch.

The frequency is 60 cycles only when the speed is exactly 1200 R.P.M. Each 20 R.P.M. change in speed changes the frequency by 1 cycle.

The ampere rating is stamped on the name-plate. Alternating current motors require heavy starting and running currents so an alternating current ammeter may be used to determine overloads.

## THREE PHASE PLANTS

The appearance of these plants is identical, the only real difference being in final alternator armature connections and some parts in the automatic switch. Therefore, this description applies to all three phase models. The field coils and starting battery are the same for either type of plant, while the armature and automatic switch are not interchangeable. These are three phase plants from which only one voltage may be obtained between any pair of line terminals, hence there should be no confusion with the single phase 3-wire plant and its two voltages. The full capacity of any three phase plant can only be obtained with approximately equal currents in the three line wires (a balanced load).

### Minimum Load

A 100 watt load for the 5 KVA and 250 watt load for the 10 KVA is the minimum load which will automatically start the plant and keep it running. There may be exceptions to this at extreme generator temperature, as a cold plant may operate on 50 watts and a hot plant may require 150 watts. The capacity of the 5 KVA, 230 volt three phase plant is 13 amperes in each of the three wires, while the 115 volt plant will generate 26 amperes per terminal at full load. The 10 KVA has a capacity of 26 amperes and 52 amperes.

### Load Calculations

The volt-ampere load on these plants on a balanced load is calculated by the following formula: E×I×1.732=volt amperes when "E" equals voltage between any pair of line wires, and "I" equals amperes per terminal. Kilovolt amperes (KVA) is obtained by dividing the volt-amperes by 1000. For example:

$$\frac{115\text{ (volts)}\times 26\text{ (amps.)}\times 1.732 = 5\text{ KVA}}{1000}$$

$$\frac{115\text{ (volts)}\times 52\text{ (amps.)}\times 1.732 = 10\text{ KVA}}{1000}$$

Also:—

$$\frac{230 \text{ (volts)} \times 13 \text{ (amps.)} \times 1.732}{1000} = 5 \text{ KVA}$$

$$\frac{230 \text{ (volts)} \times 26 \text{ (amps.)} \times 1.732}{1000} = 10 \text{ KVA}$$

### The Balanced Load

These three phase plants may be used equally well on three phase or single phase (two-wire) equipment. Care must be used in the proper distribution of single phase loads if equal line voltages and currents are desired and if it is expected to carry full load without overheating generator.

### Motors

It is not possible to state the largest single phase motor which can be operated from a three phase plant. This is because of distances from the plant, types of motors and whether motor is easily started with its load. These limits are between one and two horsepower motors. In many cases a three phase motor may be operated up to five horsepower for the 5 KVA and larger for the 10 KVA when other requirements are small. Many motors require starting currents far beyond the capacity of this plant, which may be operated successfully if proper auxiliary motor starting equipment is installed.

## SINGLE PHASE PLANT

The 115/230 Volt, Single Phase Plant has a generator and automatic switch wired for 3 wire service. However, by using the 2 outside terminals only, (L1 and L3) 230 volts is available up to the full capacity of the plant. If 115 volts is required, the center terminal, or L2, must be used and either of the outside terminals or both. In the event that 115 volt service is used the load must be balanced in order to obtain the full capacity of the plant.

The alternator is wound for single phase 230 volts with a current capacity of 23 amperes for the 5 KVA and 32 amperes for the 7 KVA in each outside terminal (L1 and L3). There are two possible circuit combinations in which the above line amperes may be supplied. One condition is a 230 volt single phase load where the center terminal (L2) is not used. The other condition consists of two 115 volt circuits with the neutral wire (L2) used only to neutralize any unbalancing caused by unequal loads in these circuits.

### Load Calculations

The volt-amperes load on this plant when the neutral wire is carrying no current is calculated by the following formula: E×I=volt-amperes, when "E" equals voltage between wires and "I" equals amperes per terminal. Kilovolt amperes (KVA) is calculated by dividing the volt-amperes by 1000. For example:

$$\frac{230 \text{ (volts)} \times 32 \text{ (amps.)}}{1000} = 7 \text{ KVA}$$

A single phase plant with three line wires and three slip rings indicates that more than one voltage can be obtained.

### The Balanced Load

If the plant is used to supply 115 volt current, the circuits should be arranged to divide the load somewhat equally between both circuits. When a full load is taken from one 115 volt circuit, there will be some voltage rise on the unloaded side. This is only true when extreme unbalancing exists.

In some installations Voltage Regulators must be used to obtain satisfactory operation, particularly when large single phase motors are a part of the load.

## THE AUTOMATIC SWITCH

If the plant is installed under reasonably favorable conditions, there should be no trouble experienced with the automatic switch. If for some reason the automatic feature fails to function, the instructions should be carefully followed on the care and operation of the entire plant. Many of the automatic switch features are so interlinked with the exciter and alternator that the automatic switch should not be altered until further instructions are followed to prove the automatic switch at fault.

The switch box cover may be removed and the various contact points cleaned to obtain a good electrical connection. Disconnect battery leads before making any switch inspections. Do not alter the adjustments on any of the contacts, springs or relays unless absolutely sure that the trouble is definitely located. Later instructions attempt to cover all adjustments usually required; however, do not hesitate to write the nearest Kohler representative giving complete details of any unusual problems which may arise. (Do not use oil or any other lubricant on any part of the automatic switch).

The panel is of heavy, moisture-proof insulating material. All coils are well impregnated against moisture. All parts are well spaced or insulated from each other.

The automatic switch is positive in operation, but the circuits are rather complicated, even for those accustomed to electrical equipment. It is carefully designed and constructed of the best material and leaves the factory perfectly adjusted, still it remains a piece of electrical apparatus which will not bear any tampering or promiscuous adjustments.

A battery charging rate switch (BC) may be used to increase or decrease the charging rate. When this switch button is on high, the battery charges at approximately 2 amperes when alternator is fully loaded. The charging rate is about 1 ampere when this button is on low. The charging rate is also a function of the alternator load regardless of whether it is 115 or 230 volt model. On account of the variable exciter voltage at different alternator loads, the battery-charging-rate-switch must be used intelligently, because this high-charging-rate switch may become a high-discharge-rate-switch which must be considered if plant carries less than five hundred watts for many hours at a time. If the battery solution is about 1.250 and the average plant load is more than one thousand watts, then the battery charging rate switch should be on low as explained above.

The following pages explain the circuits in detail. 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. A satisfactory method is to check the circuits in the order of their performance. Familiarity with the automatic direct current models should simplify the correction of any trouble encountered in this automatic switch, for the alternating current plant is very similar in most operations and the same general plan is used in arranging the various parts.

## CIRCUIT DIAGRAM AND ADJUSTMENTS

The following details apply to all three-wire automatic switches used regardless of the voltage and number of phases. This does not mean that these switches are interchangeable, as there are certain parts which apply to one particular system. These details are shown in the List of Parts in Section II. The principle of operation is the same for all voltages.

### First Circuits

There are three possible circuit combinations on a three-wire plant, any one of which is fully automatic when a suitable lamp or other appliance is connected to the load line terminals.

The following explanation applies when a lamp is connected between line terminals L2 and L3. Battery current passes from the center battery terminal at P16 to terminal A2, then through a wire to line terminal L2 and the lamp. The return path is through terminal L3, generator relay terminals M3 and K4 through the normally closed contact at K4, main relay voltage coil and thence to N, the negative battery terminal.

If a similar two-wire circuit is completed between line terminals L1 and L2, the battery circuit may be traced from terminal P32 through coil of main relay B1, contact K2, terminal M1 through terminal L1 and the lamp. The return path is through L2 and A2 and battery terminal P16.

A third combination is a lamp connected from L1 to L3 which causes battery circuit to pass through both coils of main relay in series. Thus either or both coils of main relay are energized by the battery for the first circuit, dependent upon which load combination is used.

One lamp properly connected will energize main relay coil by battery current as already described. This in turn magnetizes the main relay armature E1, pulling it downward. The downward movement of armature E1 opens the magneto ground contact at C1 and closes the second circuit contact at D1. It will be noted that armature E3 may be energized and perform exactly the same circuit functions through contacts C3 and D3. Thus the operation of either or both of these relays will provide automatic operation of the plant.

If neither main relay armature moves when a load is turned on, check for the following:

1. Load too small.
2. Battery weak.
3. A loose or broken wire.
4. A defective lamp or appliance.
5. Coils of main relay.
6. Respective armature spring too tight.

### Second Circuit

The purpose of this circuit is to conduct the 32 volt battery current through coil T of the cranking relay at the right of the diagram. This current is less than one ampere and can thus be controlled by the small contacts. Assume contact D3 to be closed by the first circuit. The current for the second circuit passes from the positive battery terminal to P32, stationary cranking relay terminal R back through a small wire and normally closed contact F, cranking relay coil T, safety switch contact M, main relay contact D3 (or D1 if load circuit is from L1), across the panel to terminal No. 4, mercury type governor switch V, terminal No. 3 and No. 2, thence back to negative N terminal of battery.

Current passing through this circuit is to energize coil T of the cranking relay and its adjacent movable armature which carries the heavy contact RR.

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

1. Weak battery.
2. Coil T defective.
3. Poor contact at F, M, D3, (or D1) or V.

### Third Circuit

This is the cranking circuit from the battery through the exciter (also used as the cranking motor) with branch circuits through the engine choker Z and safety switch heater L. The cranking current now passes from battery terminal P32, relay contact R to RR (now closed), heavy flexible pigtail to terminal post and by heavy copper wire to terminal S1, through the series field coils of the exciter, the positive (+) exciter brushes through the commutator and exciter armature to the negative (−) brushes. The return path is by a heavy wire to the N terminal and battery negative.

This constitutes the cranking circuit which will continue as long as contact R and RR remain closed. Contact O closes simultaneously with RR which provides two branch circuits as follows:

> One circuit includes choker coil Z from which the return path may be traced back to battery negative without further control contacts. The other branch is from contact O through safety switch heater L and battery negative.

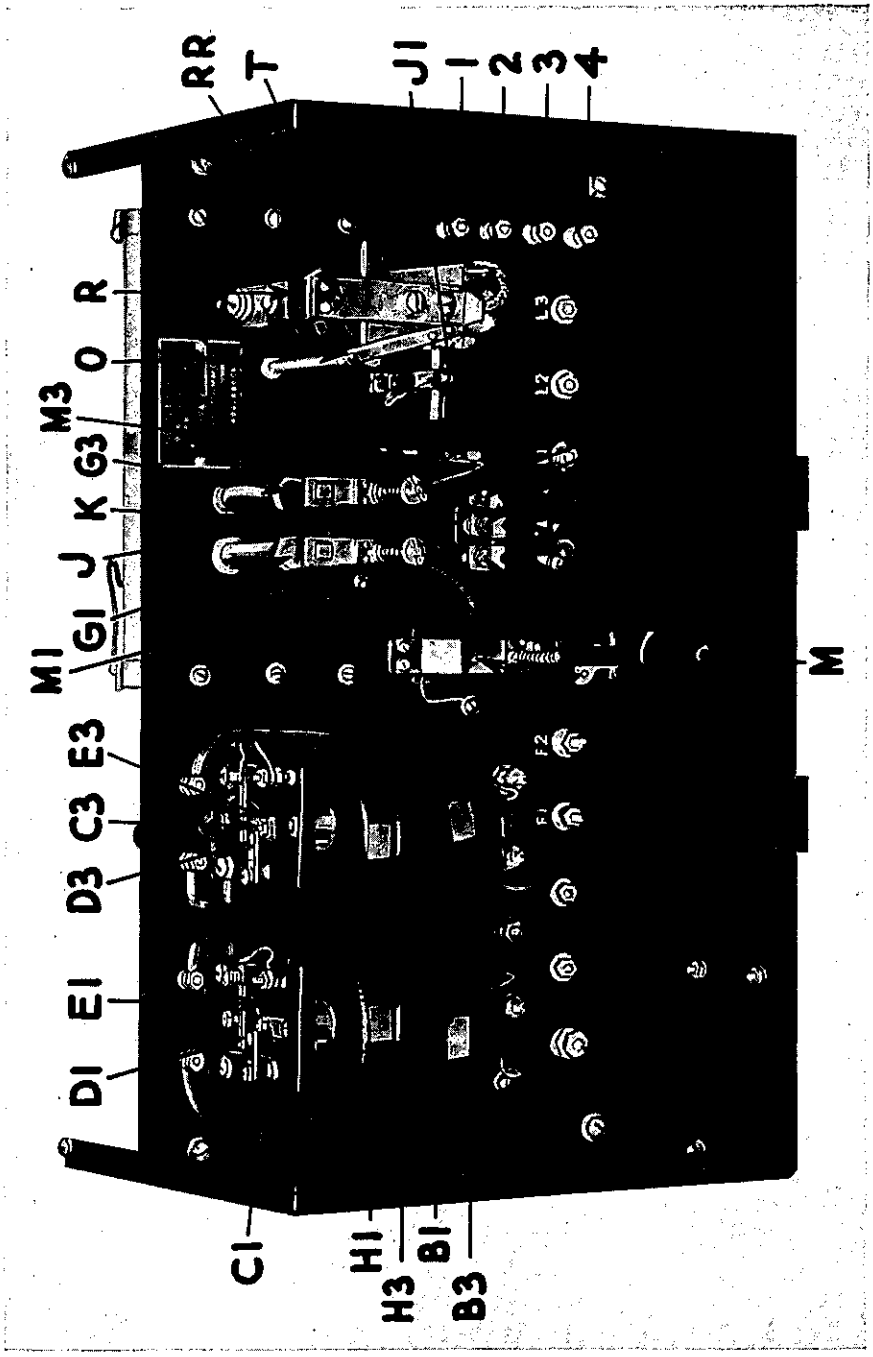



Figure 5.
Control Switch for Automatic Models

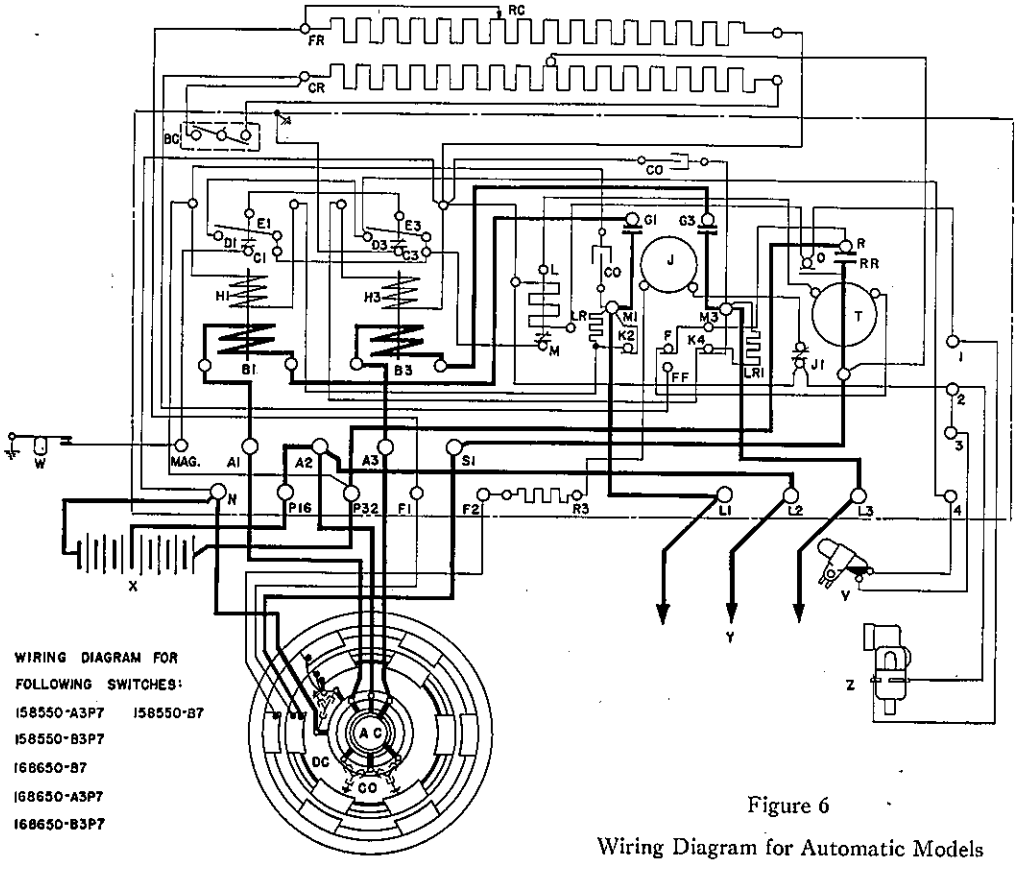



Figure 6

Wiring Diagram for Automatic Models

A1, A2, A3—Alternate terminals
A2—Not used on two-wire plants
AC—Alternator brushes
B1, B3—Series coils on main relays
BC—Battery charging rate switch
C1, C3—Magneto ground contacts
CR—Line resistance
D1, D3—Second circuit contacts
E1, E3—Armatures of main relays
F—Battery charging contact
FF—Auxiliary governor contact
F1—Exciter field terminal
F2—Alternator field terminal
FR—Exciter field resistance
G1, G3—Alternator line contacts
J—Generator relay coil
J1—Closed contact on cranking relay
K—Generator relay contact block
K1—Series contact to coil H1
K3—Series contact to coil H3
K2, K4—Auxiliary load contacts
L—Safety switch heater

L1, L2, L3—Line terminals
L2—Not used on two-wire plants
LR, LR1—Auxiliary load resistance
M—Safety switch button
M1, M3—Generator relay terminals
MAG—Mag. ignition control terminal
N—Negative terminal
O—Relay contact to choker
P-16—Center battery tap
P-32—Positive battery terminal
R, RR—Cranking relay contacts
RC—Field adjusting clip
R3—Fixed resistance
T—Cranking relay coil
V—Governor contact
W—Magneto breaker points
X—Starting battery
Y—Service lines
Z—Choker
1, 2—Choker terminals
3, 4—Governor switch terminals

If the engine fails to turn over while starting relay is closed, the following items should be checked:

1. The battery may be defective, weak or too cold.
2. Poor contact at R.
3. Poor exciter brush contact.
4. Cranking winding burned out.
5. Engine cold or bearings tight.
6. Safety switch open.

If the safety switch heater L does not heat properly or if choker Z does not operate, the trouble may be at contact O or it may be at the respective unit itself. Low battery voltage, a broken wire or a loose connection will prevent the choker from operating. The safety switch may require some adjustment at the contact screw if the cranking period exceeds two minutes, except in real cold locations when three minutes may be desirable.

### Fourth Circuit

The fourth circuit prevails for only a second which is after the cranking relay opens and before armature K of the generator relay moves to its running position. The cranking period as described in the third circuit normally continues until the engine begins to run under its own power and up to its governed speed. The movement of the engine governor to control the engine speed also tips the mercury tube (the governor contact) at V which breaks the second circuit through cranking relay coil T. This allows the third circuit to open at RR which stops the cranking process.

During the cranking period, contact J1 (insulated from, but operated by cranking relay armature) was held open. Now when the cranking relay is no longer energized by coil T, contact J1 now closes which closes a direct current circuit from the exciter through coil J of the generator relay. During this fourth circuit the exciter is supplying power to two shunt fields, one set is on the exciter field poles and the other on the alternator poles. Each field has an independent path and thus they are in parallel.

The exciter field current passes from the positive (+) brush direct into the six field coils in series thence to the panel terminal F1, field adjustable resistance FR and back to the common negative N terminal and negative (−) brushes and exciter armature.

The alternator field also is connected to the exciter (+) brush, passes through the six alternator field coils in series to panel terminal F2, fixed resistor R3, generator relay coil J, contacts J1, returning without other contacts to the negative exciter brushes. Up to this point the first circuit has not been disturbed and no relays have moved during the fourth circuit. The second and third circuits have both done their work and opened. Now this alternator field (and also the alternator voltage) builds up in magnetic strength together with coil J of the generator relay.

Relay armature K now moves to the running or fifth circuit position to be described later.

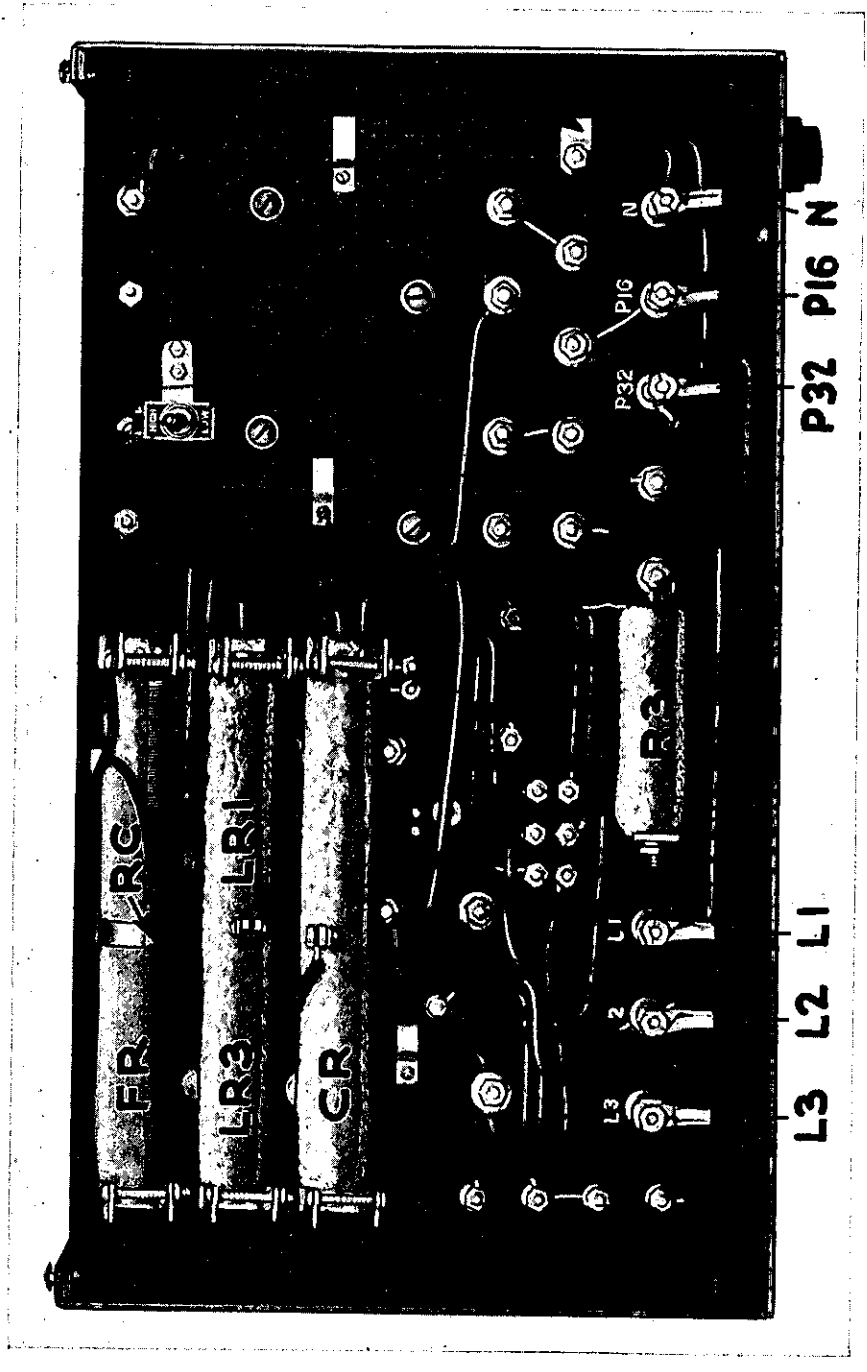



Figure 7.
Back of Automatic Control Switch. (Refer to Wiring Diagram, Figure 6, for description of parts.)

If generator relay does not move:

1. The exciter voltage may be below 32 volts.
2. Armature K may be locked or spring too tight.
3. Coil J burned out.
4. Contact J1 dirty or bent.
5. Resistance R3 burned out.
6. Loose terminals or broken wires.
7. Engine not up to speed.

Low exciter voltage may be adjusted with a screw driver by shifting clamp RC perhaps a quarter inch, so more of the resistance unit will be shorted out. However, the exciter brushes and engine speed should be checked before adjusting clip RC.

### Fifth Circuit

The purpose of the fifth circuit is to complete the alternator circuit to the load line through either or both of the main relay coils B1 and B3 to keep the plant running on a line load of 50 watts or more. This relay control also includes a direct current battery charging circuit from the exciter.

As generator relay armature K moves to the running position, contacts K1, FF and K3 are closed. Contacts K2 and K4 disconnect the battery from coils B1 and B3 respectively. Armatures E1 or E3 do not open because of some residual or permanent magnetism still in the iron caused by the previous magnetizing action of the battery current. Contact F also opens to prevent the cranking relay from recranking the plant if a heavy load and wide open throttle should reclose the governor switch V.

Further movement of the generator relay closes contacts G1, G3, K1, FF and K3.

Line terminals L1, L2 and L3 now have alternator voltages between them, even though a load may only be connected between two of them. One alternator circuit may be traced from A1, through series coil B1, relay contact G1, terminal and post M1 to L1. A similar circuit may be traced from alternator terminal A3, coil B3, contact G3, terminal M3 and line terminal L3. The third wire connects from A2 to L2 without contacts or control coils.

The actual load current passing through contacts G1 and G3 is determined by the load distribution as connected to L1, L2 and L3. In addition to any load combination in the external circuit, there are small alternating currents passing through resistors LR and LR1 to coils H1 and H3 respectively.

A similar load circuit may be followed from alternator terminal A3 through main relay series coil B3, generator relay contact G3, M3, line terminal L3 and alternator terminal A2 and thus through the respective alternator armature

brushes, collector rings and armature coils. The alternator circuits just described through resistances LR1 and LR do not carry sufficient wattage alone to keep the plant running, but they do aid coils B1 and B3 sufficiently that the regular load circuit of 50 watts or more will provide automatic operation.

These small alternating currents also provide a demagnetizing action to armatures E1 and E3, which prevents them from sticking in the running position after all loads are turned off.

In this fifth circuit, contact F is now carrying a trickle charge from the exciter to the storage battery. This path is from the positive (+) exciter brush through the series field winding to terminal S1 thence to a common connection below the cranking relay to the center tap of the battery charging resistance CR and through its left section to contact F, relay contact R and the positive (+) terminal of the battery through wire P32.

The battery and exciter have a common negative connection. The high rate battery charging switch BC may be reached from the back. When this switch is closed, a parallel charging circuit is added through the right section of resistance CR which doubles the battery charging rate. A weekly hydrometer test of the battery will suggest the proper use of this high rate battery charging feature, although either rate is not comparable to automobile battery charging except that the continuous running time of the plant is usually longer and the battery cells smaller.

### Stopping the Plant

When the load is reduced to zero or below 50 watts, series coils B-1 or B-3 are now able to magnetize relay armatures E-1 or E-3 sufficiently to keep the magneto ground contacts C-1 or C-3 open, therefore, the vertical compression spring at the back of these armatures forces the front end upward to ground the magneto to stop the plant.

If the plant fails to stop when the load is supposed to be all disconnected, it may be that some distant lamp is still operating. It is, therefore, well to have a line switch near the plant which can be opened for such tests.

Other troubles might be a dirty contact at C-1 or C-3 or something wrong with the magneto ground wire or brush. An unusually high plant voltage may keep the plant running even after all loads are disconnected. A short piece of wire may be used to ground the magneto to stop the plant, as it is well not to make adjustments while the plant is running.

A high voltage may be caused by a cold plant, a high engine speed or a wrong setting of resistance clip RC. If the high voltage is from a cold plant, then no other adjustments should be made unless some installations may require adjustments to compensate for the seasonal temperature changes.

### Adjustments in Automatic Switch

There are only four adjustments provided in this switch. Of first importance is the adjusting clip RC which changes the exciter voltage and alternator voltage in one operation.

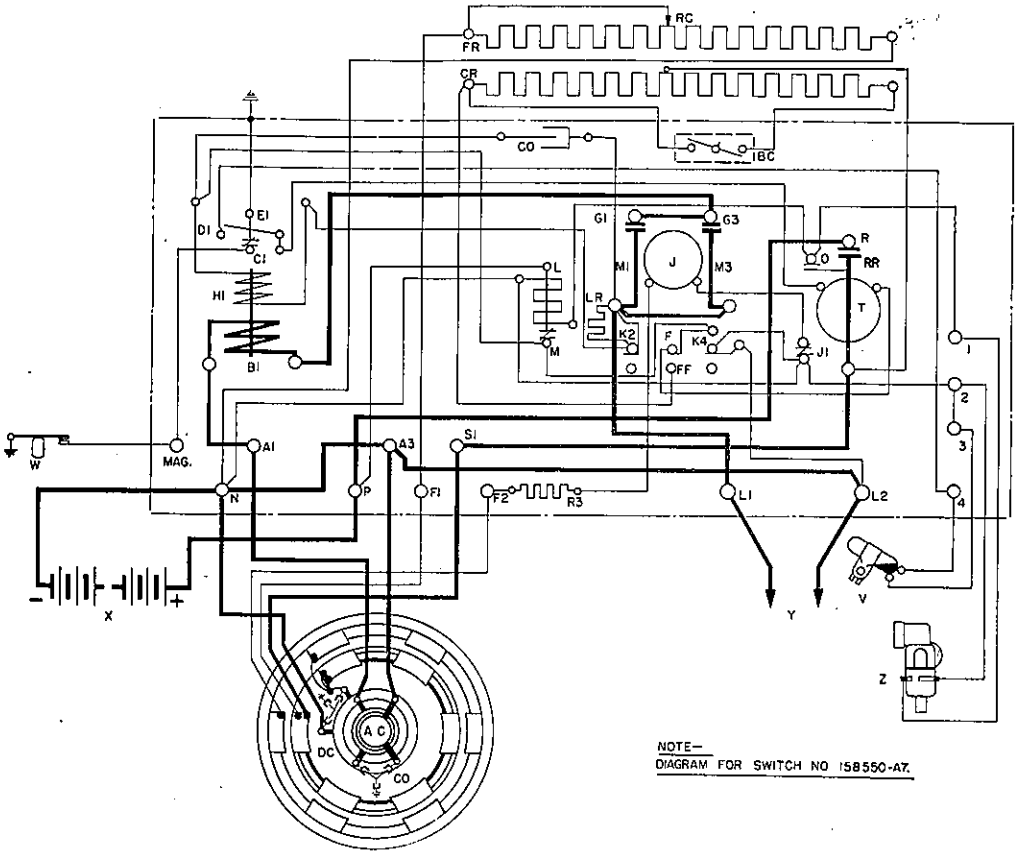



Figure 8.

Wiring Diagram for Two Wire Automatic Plants
Model 5A21

A1, A3—Alternator terminals
B1—Main relay
BC—Battery charging switch
C1—Magneto ground
CO—Condenser
CR—Charging resistance
D1—Second circuit contact
E1—Relay armature
F, FF—Generator relay contacts
F1, F2—Alternator terminals
FR—Field reistance
G1, G3—Line contacts
J—Generator relay coil
J1—Auxiliary contacts
K1, K2, K3—Generator relay contacts
L—Safety switch resistance
L1, L2—Line terminals
LR—Line resistance
M—Safety switch
M1, M3—Generator relay armature
MAG—Magneto ground terminal
N—Negative battery terminal
O—Choker contacts
P—Positive battery terminal
R, RR—Starting relay contacts
RC—Movable clip
R3—Resistance
S1—Cranking lead
T—Cranking relay coil
V—Governor switch
W—Magneto
X—Battery
Y—Service lines
Z—Choker

Relay armatures E-1 and E-3 each have respective adjustments with a hexagon nut which is kept from turning by a flat spring. These should not be turned unless such action is the only solution of poor operation.

The fourth adjustment is that of the contact screw of the cranking safety switch and is not likely to require attention. This is to change the cranking time before tripping.

If contacts C-1 and C-3 do not positively ground the magneto to stop the plant, perhaps the plant is not securely mounted which causes undue vibration.

The generator and cranking relays perform no critical functions and are not likely to give trouble unless some operator carelessly bends or twists the springs or contacts. The cranking relay contacts may become burned after continued use, but these may be replaced by new parts.

The battery cables and the load line wire terminals are at the rear and well marked. There is no need for removing the switch cover unless relay adjustments are necessary. The switch cover should always be replaced to keep out dirt and insects.

## REMOTE CONTROL PLANTS

All A.C. Kohler electric plants, which use the remote control method of starting are designated by the letter "R" following the numeral covering the capacity of the plant. For example: the 10 KVA, 120 volt, 60 cycle, 3 phase plant is a Model 10R31.

The remote control operated plants differ from the automatic plants in that a special control circuit must be provided for starting and stopping the plant and the alternator leads extend from the alternator for connecting to the load; whereas, the fully automatic plant may be started and stopped by switches on the regular service line, and the load lines are connected at the switch.

### Description

**The Remote Control Panel** consists of relays, a safety switch and terminals for connecting to the control circuit. The relays are operated by battery current during the cranking period and from the exciter during the running period. They are positive in operation and require no critical adjustment.

**The Control Circuit** is not a part of the load circuit and no lights can be operated from it. The alternator output is supplied directly from the leads, which project from the alternator. The current does not pass through the control panel. No. 14 wire can be used if the point of control is within several hundred feet of the plant. If greater distances are involved, larger wire may be necessary.

**The Control Switches** may be located near the plant or away from it as required. Three-way and four-way switches may be used if necessary to control the plant from more than one point. Ordinary S.P.S.T. switches may be used of 2 ampere capacity, since the circuit carries only a small amount of battery current.

### Operation

To start the plant and keep it running, the control circuit must be closed. Since the control circuit is independent of the load circuit, the plant may be started or stopped without operating any of the line switches. This method of operation makes it possible to use this plant for emergency installations or with time switches or automatic appliances in the same manner in which automatic plants are used since the relays which would ordinarily close the main service lines may be connected to the control circuits of the plant.

## SWITCH CIRCUITS

The following description of the various circuits will assist the operator if any difficulty is experienced. Description of the circuits should be studied in connection with the wiring diagram.

### First Circuit

When the control circuit is closed between terminals 5 and 6 located at the end of the switch box or the switch SW, at the opposite end of the switch box, current from the 32 volt starting battery flows from the battery through the coil A.

The path of the current is from the positive side of the battery terminal marked P, through the coil A, terminal 6, remote control line circuit or switch SW and back to terminal 5. Thence, through the wire to the opposite end of the switch and junction with the auxiliary control terminal. From this point, the path may be traced through the safety switch M, terminal 2 and junction J1 and back to the negative side of the battery N.

The purpose of the first circuit is to energize the coil A, which in turn magnetizes the adjacent armature. An auxiliary function of this circuit is to complete the second circuit by the action of this armature and also to remove the ignition ground at contact C. The safety switch M protects the battery in case the plant fails to start within two or three minutes.

If the plant fails to crank automatically, the following parts of this circuit should be checked:

1. Starting battery must be charged.
2. Coil A must not be open or short circuited.
3. Safety switch M must be pushed in.
4. The control circuit must be closed.

### Second Circuit

The second circuit is completed through the contact D and cranking relay coil T, which is completed when the armature BR is magnetized by coil A of the first circuit.

In addition to the battery current flowing through the first circuit, as previously described, the battery current now passes from relay armature BR through contact D, contacts I, 4, governor switch contacts Z, terminal 3 and 1, cranking relay coil T, terminal 2 and back to battery negative N.

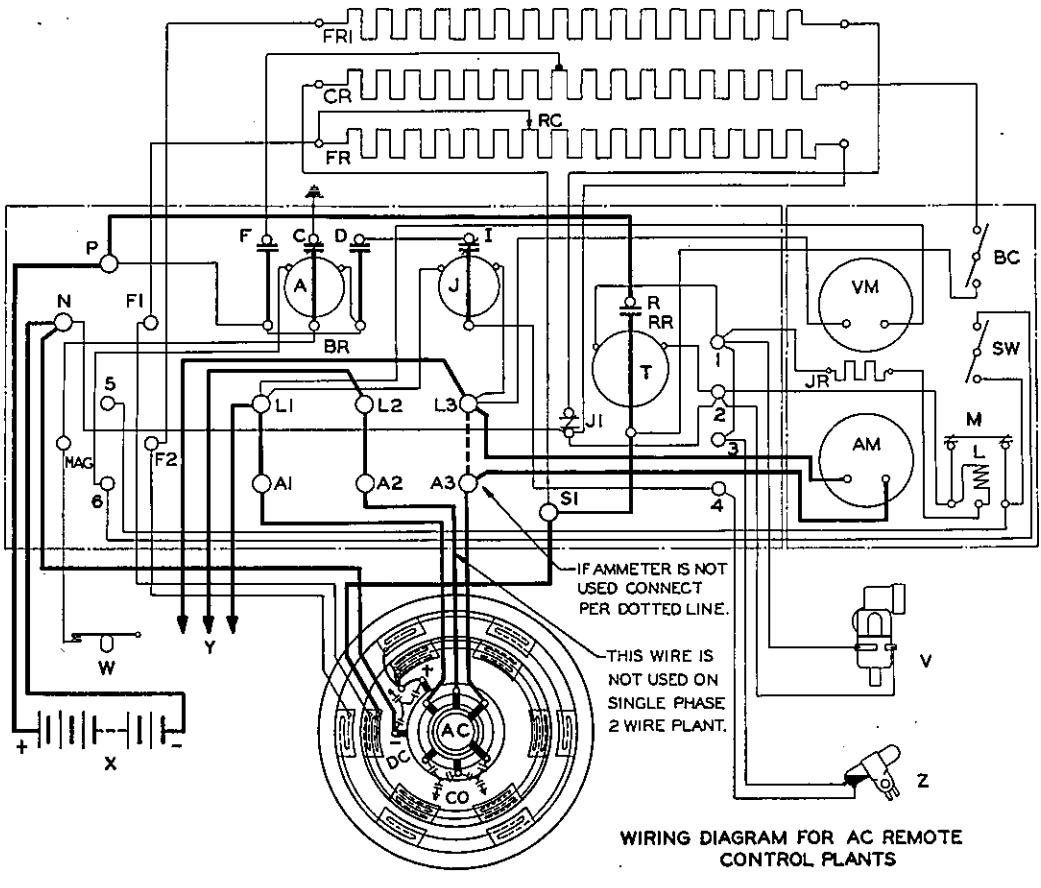



Figure 9.

Remote Control Switch Parts.

A—Main relay coil
A1, A2, A3—Alternator terminals
AM—Ammeter
BC—Battery charging resistance
BR—Main relay
C—Magneto ground contact
CR—Charging resistance
CS—Cranking series
D—Second circuit contact
F—Main relay contact
F1—Exciter field terminal
F2—Alternator field terminal
FR—Exciter field resistance
FR1—Load resistance
J—Generator relay coil
J1—Auxiliary contacts
JR—Fixed resistance
L—Safety switch element
L1, L2, L3—Line terminals
M—Safety switch button
MAG—Magneto terminal
N—Negative battery terminal
P—Positive battery terminal
R—Cranking relay contact
RR—Cranking relay armature
S1—Cranking terminal
SW—Start and stop switch
T—Cranking relay coil
V—Choker
VM—Voltmeter
W—Magneto
X—Battery
Y—Service lines
Z—Governor switch

The heating resistance L of the safety switch M is in parallel with coil T, also with choker coil V, which is connected between terminals 1 and 2. Current through these three branches of the second circuit unite at terminal 2 and to battery negative N as long an engine is at cranking speeds.

The purpose of the second circuit is to energize cranking relay armature RR, provide electric choking of engine and to heat the resistor L of the safety switch M.

### Third Circuit

This is the cranking circuit which carries the heavy starting current which cranks the engine for starting purposes. The first and second circuits are still complete. The cranking current from battery positive terminal P goes through cranking relay stationary terminal R, movable contact RR, terminal S1, motor generator series field, generator armature and returns to the common negative N terminal of generator and battery. The cranking circuit remains closed through contact R as long as coil T of the second circuit is energized.

The purpose of the third circuit is to provide a low resistance path for the battery current through the exciter series field and armature for rotating the engine at proper cranking speed. During the cranking period there is also some battery current passing through the exciter. shunt field through shunt field lead, switch terminal F1, adjustable resistance FR and the common negative return N.

### Fourth Circuit

After the plant is running under its own power, current is generated by the exciter. This current goes to terminal S1, through resistance CR, contact F to P, and positive of battery.

### Fifth Circuit

In the fifth circuit, the alternator field current passes from the exciter brush through the alternator field, terminal F2, resistance FR1, contact J1, terminal N, returning through the negative exciter brush and armature.

### Generator Thermostat

A generator thermostat may not be required on all plants. It has been developed for those users desiring a minimum change in voltage between cold and normal running temperatures. This thermostat and a pair of contacts are fully enclosed and mounted with the temperature tube extending into the generator frame. At a frame temperature of about 100° F. these contacts close and remain closed until again cooled to about 90° F. The voltage of any generator drops approximately ten per cent between starting and running temperatures. The thermostat short-circuits a portion of the adjustable field resistance FR to compensate for the heating of the shunt field copper wire. The adjustable contact FTC determines the voltage change as generator thermostat closes. This adjustment is carefully set at the factory and should not require adjustment after installation. Adjustment RC represents a clamp ring, which may be loosened by a screw driver for required voltage adjustment. Move to the right for raising the voltage and to the left for lowering the voltage. This adjustment is rather critical. A quarter inch movement of this clamp will usually be more than is required.

## Line Circuits

The alternator wires leading from the brushes and collector rings are insulated from the rest of the plant and may be wired through some separately mounted line switch and fuses as desired.

## Safety Switch M

If, for any reason, the engine does not start to fire after two or three minutes of cranking, the safety switch element MM curls sufficiently to trip the contact M, thus breaking the first circuit and stopping the cranking process. After the engine trouble has been remedied and this safety switch has cooled a few minutes, then the button M may be snapped into position to complete the first circuit.

## Care of Electrical System

Any instructions pertaining to the care of direct current generators will also apply to the alternators except that no provision for shifting the brushes is necessary. The exciter is the heart of the electrical system. Any trouble experienced with the alternator may require attention to the exciter rather than the alternator.

The remote control switch is mounted securely to the plant. Undue switch or plant vibration may wear some of the relay hinges; however, these are not to be oiled. Usually the contacts are self cleaning due to a sliding motion while opening and closing. There may be instances where cleaning of the relay contacts is necessary. Care must be used not to bend the relay fingers as they may not make proper contact. The nuts holding the wires or terminals on all studs or bolts should be kept tight by regular inspection.

The minimum alternator voltage on these plants must be approximately that on the Name Plate or the voltage may be unstable on light loads. A voltage of ten per cent higher than that on the Name Plate is satisfactory for the generator, but may be objectionable for the electrical appliances for continuous operation. The carbon or graphite brushes on the commutator and collector rings should fit the rubbing surface well and should be free in the holders. The engine speed should be at 1200 R.P.M. (therefore 60 cycles at the alternator) at approximately half load. This does not usually get out of adjustment unless some change is made on the governor arm or spring adjusting screw. The speed may be checked with a revolution counter on the generator shaft or a frequency meter in the alternator circuit.

## Voltage Regulation

These plants have a patented inherent voltage regulation system incorporated in the armature which is sufficient for most uses. Alternating current motors having a low power factor may cause the voltage to drop appreciably. The total voltage may be raised by the adjustment of clamp RC, but care should be taken to avoid excess voltages on small loads after motors are switched off. Three phase motors should be used with three phase plants except those of one-quarter horsepower or less, which may be of the single phase type, largely because of that being standard equipment.

# MANUAL, WATER PUMP, AND GAS BURNING MODELS

The instructions in the foregoing pages apply to all A.C. plants with but few exceptions. Additional instructions, which apply only to manual, water pump, and gas burning models, are included on this and following pages.

## MANUAL MODELS

### Description

The manual type plant is the same capacity, voltage, and has almost all the principal features of the automatic except that the automatic switch and starting battery are not included.

### Manual Type Switch

The main line switch and fuse panel is entirely enclosed, and the knife switch opens with the cover of the box. A control switch is provided on the end of the switch box for stopping the plant. There are two extra wires leading from this control switch which can be led to any remote place, away from the installation, so that the plant may be stopped without necessitating a trip to it.

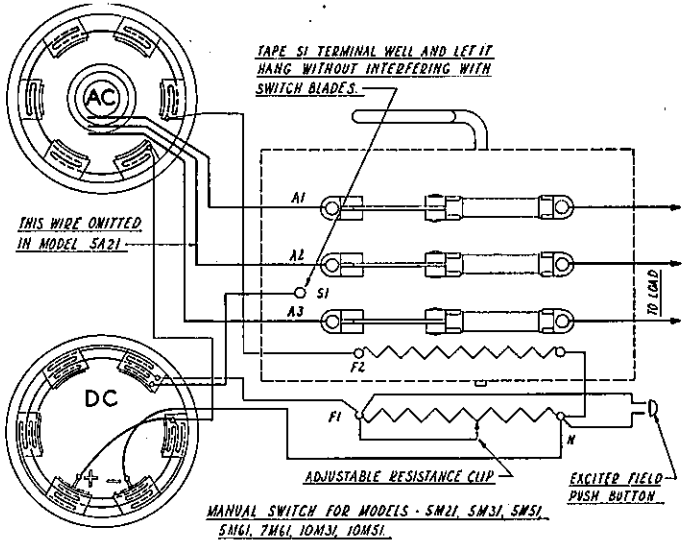



Figure 10.

Wiring Diagram

### Starting the Plant

When starting the plant, see that the control button is pushed IN, and then crank the gas engine by means of a hand crank and pull the choker wire until the plant has commenced to fire. Then release the choker and allow the plant to function.

### Stopping a Manual Plant

Pull out the button on switch or remote control switch located away from the installation, this will ground the magneto and stop the plant. The control switch is provided with a catch and the ignition will remain grounded until the button is again pushed to the IN position.

### Failure to Generate

If, when first starting plant, it fails to generate current at a normal speed, push in the exciter field push button (Figure 9) until plant starts to generate.

## WATER PUMP MODELS

The plants equipped with a water pump are practically identical with other models except that instead of using the radiator and thermo-syphon system, a water pump is used.

An Instruction Booklet will be mailed upon request, which contains detailed instructions and illustrations applying especially to water pump models.

## GAS BURNING PLANTS

Plants which are equipped with the necessary attachments for using artificial, natural, propane, or butane gas for fuel instead of gasoline have separate instructions for this fuel system.

One fuel system is used for butane and another for natural and artificial gas, therefore specify the fuel which is to be used when writing or ordering a gas fuel system.

## MAINTENANCE

### General

If the Kohler Electric Plant has been given a reasonable amount of care and attention, it will not require extensive repairs or adjustments until after a long period of service. There are, however, always minor repairs and adjustments necessary because of grades of fuel used, hard continuous service or neglect. The mechanical adjustments necessary to the gas engine in particular will compare with those which are necessary for keeping an automobile engine in first class operating condition. The electrical part of the plant, such as the generator and control circuits will require practically little maintenance attention.

As the maintenance of a gasoline engine which would also apply to the Kohler Electric Plant engine is quite generally understood by first class automotive mechanics, no attempt will be made in this book to cover these repairs and adjustments in detail.

## Carbon

Low grades of fuel, excessive choking, weak ignition, low starting temperatures, high oil level or too rich a mixture are liable to cause the formation of excessive carbon in the combustion chamber. The correct way to remove this carbon is to remove the cylinder head.

## Valves and Their Care

After the cylinder head has been removed to clean carbon from the combustion chamber, the valves should be examined and ground, if necessary.

WHEN TO GRIND VALVES—It is necessary to grind the valves whenever they start to leak. However, it is also good practice to grind the valves when the cylinder head has been removed for cleaning out the carbon. Leaky valves are liable to cause oil pumping, excessive carbon and loss of power.

TESTING THE VALVES—It is possible to test the valves by turning the engine with the hand crank. If the engine will rock back when pistons are turned against compression, it is the usual indication that the valves are well seated. If the valves leak, however, there will be little resistance to the crank on the compression stroke.

REMOVING THE VALVES—The valve mechanism which includes the valve springs, valve spring retainers, and spring retainer keys is similar in construction to other valves of this type and no difficulty should be experienced in removing the valves for grinding.

GRINDING VALVES—The valve seats should be carefully examined and ground in so that the valves form a good seat. The amount of grinding necessary will depend on the condition of the valve and the valve seat. Grinding, however, must not be overdone.

REPLACING THE VALVES—After the valves have been properly ground to fit their respective seats, they should be replaced and the valve springs, spring retainers and pins placed into position.

VALVE CLEARANCE—After valves have been ground in and replaced in their respective positions, the valve clearance should be adjusted. This should be .005″—.007″ for intake valves and .007″—.011″ for exhaust valves for liquid fuels; for gaseous fuels increase .002″.

## Bearings

BEARING ADJUSTMENTS—An inexperienced person should not attempt to adjust the bearings of a gas engine of this type. It is very important that the mechanic who handles repairs of this kind be able to adjust bearings to the proper clearances and tolerances which are required.

LOOSE BEARINGS—In general, it is not difficult to ascertain whether bearings have become loose and when the operator is of the opinion that this trouble is present, an experienced mechanic should be called to locate and remedy the condition.

INSPECTING BEARINGS AND CAPS—Whenever the plant is disassembled for the repair of a loose bearing or a bearing which requires replacement, all bearings and caps should be carefully inspected.

### Pistons and Rings

A loss of compression or a lack of power may indicate that it is necessary to install new piston rings and in extreme cases new pistons. Worn cylinders or loose pistons and piston rings may cause oil pumping or the use of an excessive amount of oil and noise due to what is known as piston slap.

REPLACING PISTON RINGS—When a gasoline engine has started to pump oil or lacks compression due to pistons and rings, it is the usual practice to install new oversize piston rings to correct the trouble. The old piston rings are removed, together with the carbon which usually collects beneath them. The new rings when first installed will, perhaps, take up the space covered by the carbon and wear of the cylinder and old rings, but in a short time the new piston rings will probably lose their tension and the oil pumping condition will be more severe than before the new rings were installed. New piston rings only should be installed when there is practically no wear on pistons or cylinder walls. It is usually advisable when an engine has started to pump oil to replace both pistons and rings and have the cylinders rehoned to place the engines in first class operating condition.

INSTALLING PISTONS—New pistons should be installed when cylinders have become worn. The cylinders should be honed and the new pistons ground to fit the size of the bore. When installing new pistons, it is also necessary to install new piston pins fitted to the piston and connecting rod bushings.

The above repairs should only be undertaken by an experienced mechanic. There is no particular difficulty involved for anyone who is reasonably familiar with this class of work. Common automotive practices should be followed. For that reason we do not consider it essential that complete details relative to these repairs be contained in this Instruction Book.

### Generator and Control

The generator and mechanical governor will require no special maintenance attention unless the parts have been repaired or replaced and in case they must be adjusted, a regular procedure should be followed. All adjustments must be made while the engine and generator are at normal operating temperatures.

Connect a small load of 100 watts to the external circuit, adjust the governor operating lever which controls the carburetor valve so the speed is approximately 1250 R.P.M., the voltage should be approximately 115 volts. If the voltage is too high or low the clip on the shunt field resistance should be adjusted to obtain the correct voltage. Increase the load to one-fourth, one-half and full load and check the speed and voltage on each load. The speed will drop to approximately 1200 R.P.M. on the full load and the voltage to 115. It will be necessary to readjust carburetor lever and resistance clip to obtain the best performance on all loads.

### Testing Generator for Ground

The Kohler Plant is parallel wound, neither side of the circuit is grounded to the frame, and it is an easy matter to ascertain if a ground exists by alternately connecting a lamp between the positive brush holder and generator frame and between the negative brush and generator frame while plant is in operation. If a ground exists, the lamp would glow and its location can be found by testing the field coils separately.

### To Test Field Coils for Grounds

Remove all wiring from coil terminals; then ground to the generator one end of a test wire having a battery and a bell or light in circuit, and apply the other end to coil terminal. If current flows, one or more of the coils are grounded. To determine which, disconnect the coils from each other and try each coil separately. Coils will often show grounds when hot that are not in evidence when the coils are cold; this is due to the expansion of the coil when heated.

### To Test for Open Circuits

Remove all wiring from field coil terminals. Attach test wire to one of the coil terminals and attach other end of test wire to other end of coil terminal. If current flows, the circuit is complete. If current does not flow, there is an open circuit in one or more of the coils; to determine which, unsolder the pig tails and test out the winding of each coil separately. An open circuit is something that rarely occurs within the coil itself, unless the coil has been burned out as a result of a bad ground or a short circuit; they are more likely to occur where the pig-tail connections between coils are soldered together.

## USEFUL INFORMATION

### Fuel Consumption

The fuel consumption of any engine for a given period on a specified load depends on several important factors. This is true regardless of the type of fuel used. The gas engine is technically known as an internal combustion engine. Since internal combustion consists of burning of fuel mixed with oxygen of the air, the mixture is very important. The factors which affect the volume of fuel used by a Kohler Electric Plant are the load carried in watts, efficiency of the appliance used, quality of the fuel, temperature under which the plant operates, the use of the choke, number of times plant is started and mechanical condition of the engine.

THE LOAD—The load connected to the generator directly affects the amount of fuel used. As the load increases, the amount of fuel consumed also increases, but not in direct proportion. Although the fuel consumption increases with the load, the cost per K.W.H. decreases as the load is increased.

APPLIANCES—Although lamps and appliances may be rated to carry a certain specified load, the fuel consumption cannot be based on this rating as efficiency of these lamps and motors may vary considerably.

QUALITY OF FUEL—Good fuel means quicker and better starting especially under cold temperatures. Consequently, less fuel will be used.

TEMPERATURES—An internal combustion engine or gasoline engine is in reality a heat engine. Consequently, the temperature of the installation, as well as the temperature under which the plant operates will have a direct bearing on the fuel consumption.

FREQUENT STARTING—If the choke is used each time the plant is started, an excessive amount of fuel will be used, especially if the engine is flooded and part of the fuel expelled without being burned or converted into power.

MECHANICAL CONDITION OF ENGINE—The engine must be in absolutely good, mechanical condition in its entirety if a minimum amount of fuel is to be consumed under all operating conditions.

If the fuel consumption of a plant does not compare favorably with the average fuel consumption of a similar group of plants as covered by the fuel consumption charts available, the plant should be carefully examined and the above factors carefully considered before any definite action is taken.

## Electrical Wiring

While the electrical wiring independent of the Kohler Electric Plant may not be considered a part of the electric plant proper and essentially a part of this instruction manual, it bears considerable influence upon the operation of the plant and for that reason it is covered briefly.

WIRE SIZES—The size of the wire used is important since the size of the wire depends upon the load to be carried, the distance between the plant and the load and the voltage drop permissible at the end of the line. There are wiring charts available which indicate the various sizes of wire to be used for specified loads at various distances from the plant allowing for a maximum voltage drop. Anyone who is interested in obtaining these wiring charts should write for an Installation Book which contains this information.

SAFE CARRYING CAPACITIES OF WIRE—The wire should be sufficiently large to carry the maximum amount of current connected to the particular circuit involved. The current capacity of wire will depend on the size, as well as insulation. Motors require heavy current for starting and wire should be sufficiently large to carry this current. If motors are started with a load, larger wire will be required. The Underwriters' Code and local regulations should be observed when planning the wiring installation.

## MOTORS

We recommend the use of three phase motors with three phase plants except the quarter horsepower size which is usually single phase. The single phase plants can only operate motors of the single phase type. Such motors should be of low starting current and high power factor to avoid line surges and lamp flicker when starting. Single phase motors larger than one horse power require starting currents far above the capacity of the plant so are not recommended. Installations having power motors should be checked by an electrician with a reliable ammeter under various load conditions to see that no line wire is far exceeding the alternator Name Plate amperes except when a motor is starting. This plant is not designed to furnish the large horsepower usually required to start motors from a commercial power line, so the larger motors should be started with special starting equipment or a clutch arrangement installed on the motor shaft to apply the load after motor is started.

## TRANSFORMERS

Alternating current is widely used because of the efficient transformer which steps up the voltage for long distance transmission or steps down the voltage for door bells or toy trains. Transformers find many uses with the alternating current type of Kohler Electric Plant. Transformers must not be permanently connected across any of the service lines as they will either prevent the plant from stopping or cause it to repeat the cranking cycle several times per minute. There are many ways in which transformers can be used with Kohler plants, some of which are fully automatic. In writing for such information, do not fail to give all details of your requirements.

## 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, the causes that are responsible for them, and the remedies 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.

## I. 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 box projects outward about ½". 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 one 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.

   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 cranking circuit.

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. 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) loose or broken governor switch; (3) broken or improperly connected governor switch wires.

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 soaked 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, leads not soldered properly or solder broken away.

8. Automatic switch inoperative. The following might cause failure of switch to operate: (1) relay coil burnt out (this coil draws in armature "E" when plant is started); (2) contact point "D" in switch making poor contact with armature "E"; (3) contact point "I" has poor connection; (4) magneto ground plate inoperative, due to binding, dirt, foreign substances, or from being bent. (5) open circuit in 3rd circuit.

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 main fuel tank is not properly vented, fuel will not be drawn freely.**

2. Clogged carburetor. **Avoid use of varnish or paint cans as fuel containers.**

3. Fuel pump inoperative.

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 due to: (1) bent or unadjusted choker valve stem; (2) body of choker out of alignment; (3) screw in hot air manifold not removed in hot weather; (4) choker manifold out of alignment.

7. Improper timing. Instructions for timing are given on Page 11. 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 rocker arms; (5) loose cylinder head. Check valve clearance in accordance with instructions given elsewhere in this book.
9. Engine too cold, combined with use of low grade of fuel.
10. Water in cylinders, 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 ground 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. Engine must crank about 1000 R.P.M. or faster.

### IV. Engine Starts, but Misfires

Caused by the following: (1) 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; (13) choker valve caught up, causing too rich mixture; (14) water in cylinder.

### V. Engine Alternately Cranks and Starts

Caused by (1) small arm marked "battery charging contact" (F) in automatic switch not making proper contact. This should make contact $\frac{1}{8}$" prior to time (contact marked K) generator relay switch closes.

### VI. Engine Backfires through Carburetor

The following are some causes for backfiring: (1) cold motor; (2) mixture too lean, due 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; (7) improper timing (See article on timing); (8) water in gasoline; (9) choker not functioning properly: (10) obstruction in exhaust line due to collection of carbon or foreign matter, frozen or condensed water, or exhausting of gas into closed area.

### 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 the 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 to obstructions of needle valve, leaky float or bent or worn needle valve or axle; (2) mixture 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; (8) 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"; (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 due to defective spark plugs or defective magneto; (5) high or low commutator bars; (6) hole in ell intake of vacuum tank too large; (7) clogged muffler; (8) valves out of adjustment; (9) not enough ventilation; (10) 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. 6) not making contact with magneto ground plate; (5) magneto ground wire disconnected or broken; (6) armature "E" does not drop out when last lamp or appliance is turned off, due to the fact that the hinged pin is bent or residual magnetism remaining in the coil holds up the plate; (7) contact "F" is not complete, due to being burnt off or bent; (8) short circuit in the external wiring system, due to worn insulation.

### 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, More than 1275 R.P.M.

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

### XVI. Engine Continues to Crank with Service Switch Out

Points "C" and "D" in the automatic switch making contact with armature "E", cause the plant to crank until the safety switch disengages.

### 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 fit 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; (11) oil leak around intake valve guides.

### XIX. Engine Runs at Slow Speed, Less than 980 R.P.M.

This condition may be due to: (1) misadjustment of throttle arm to carburetor feeding insufficient gas; (2) poor compression; (3) retarded spark; (4) defective ignition; (5) obstruction 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; (4) overloading beyond rated capacity; (5) heavy load on cold engine.

# REPAIR PARTS

**How to Order Repair Parts:** Follow these instructions carefully so as to avoid errors and consequent delay:

1. Write plainly the name of person or firm to receive parts. Give street address, name of city, county and state.

2. Give MODEL and SERIAL NUMBER of your plant, as 5A1-40500 (see instruction plate on plant.)

3. Write plainly the following data:
   a. Quantity of each part desired.
   b. Part number.
   c. Description of part.

4. State clearly whether you wish shipment to be made by mail (parcel post), express, or freight.

5. Send cash to cover cost of parts, plus transportation charges. Money may be sent by money order, express order, or draft. This will eliminate C.O.D. shipments which consume time and are more expensive. Currency sent will be at your risk. We will refund any excess charges paid.

## RETURN OF PARTS

We make no allowance for parts claimed to be defective unless they are returned to the factory. Order and pay for the new parts, and return old parts promptly to the factory, charges prepaid. They will be given consideration, and just allowance will be made upon arrival at the factory.

Tag all parts to be returned plainly with your name and address. When shipment is made, write us, giving the date, how parts are being shipped, and in detail why they are returned. Give Model Letter and Serial Number of plant from which parts are taken. If package is returned by parcel post, send it to KOHLER CO., Service Dept., Kohler, Wis. If sent by express or freight, it must be addressed to KOHLER CO., Service Dept., Sheboygan, Wis.

## CLAIMS FOR SHORTAGE

Our responsibility ends with safe delivery to the carrier. All claims for shortage, breakage, delay or damage should be made against the carrier.

## PRICES

All prices are F.O.B. factory, or Kohler branch offices. Cash must accompany order, otherwise parts are sent C.O.D. by express, or parcel post or sight draft attached to bill of lading.

Due to changes in cost of materials, prices are subject to change without notice.

### IMPORTANT TAX NOTICE

ANY MANUFACTURERS' OR SALES TAX WILL BE ADDED TO THESE PRICES AT THE OPTION OF THE KOHLER CO.

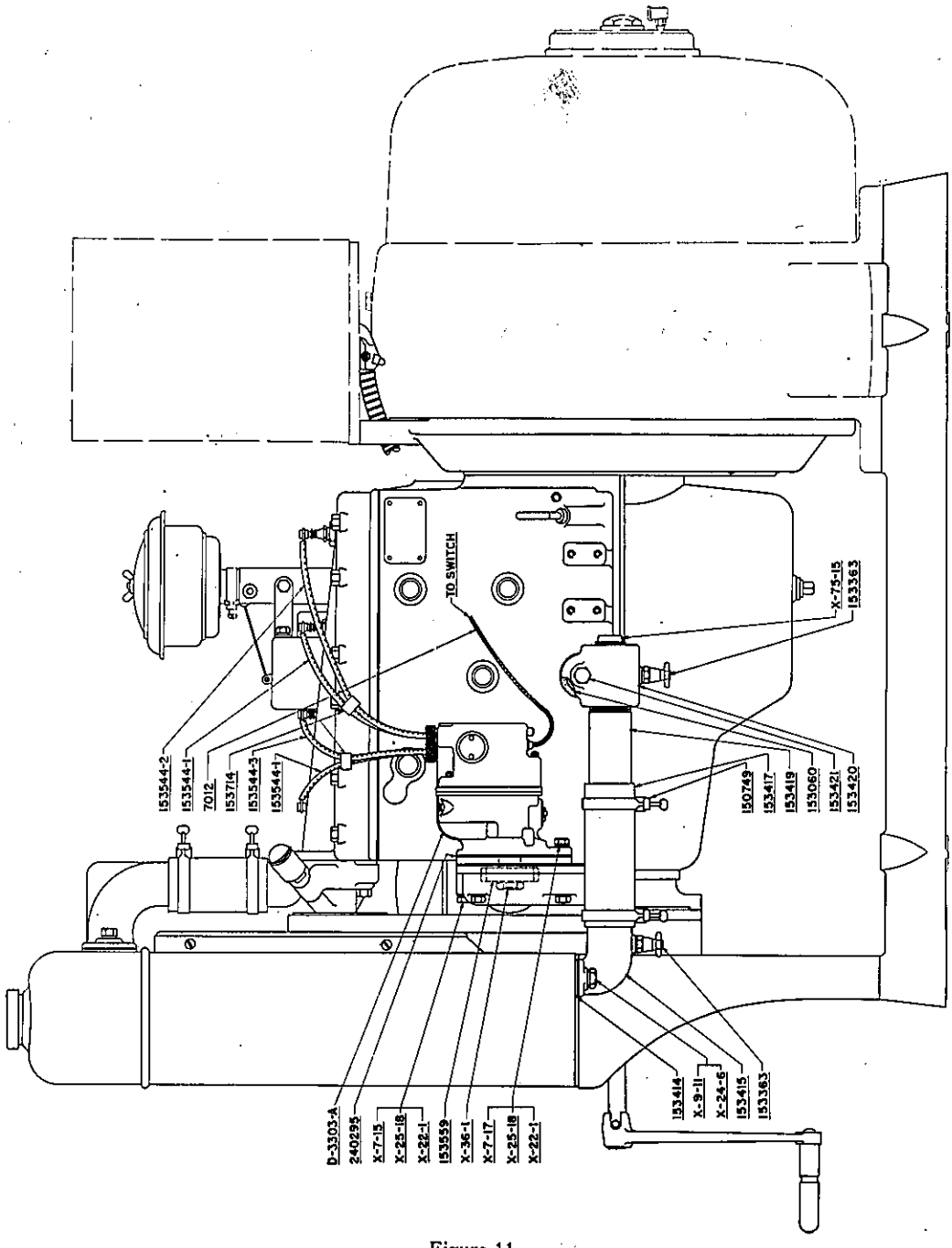



Figure 11

MAGNETO SIDE OF PLANT

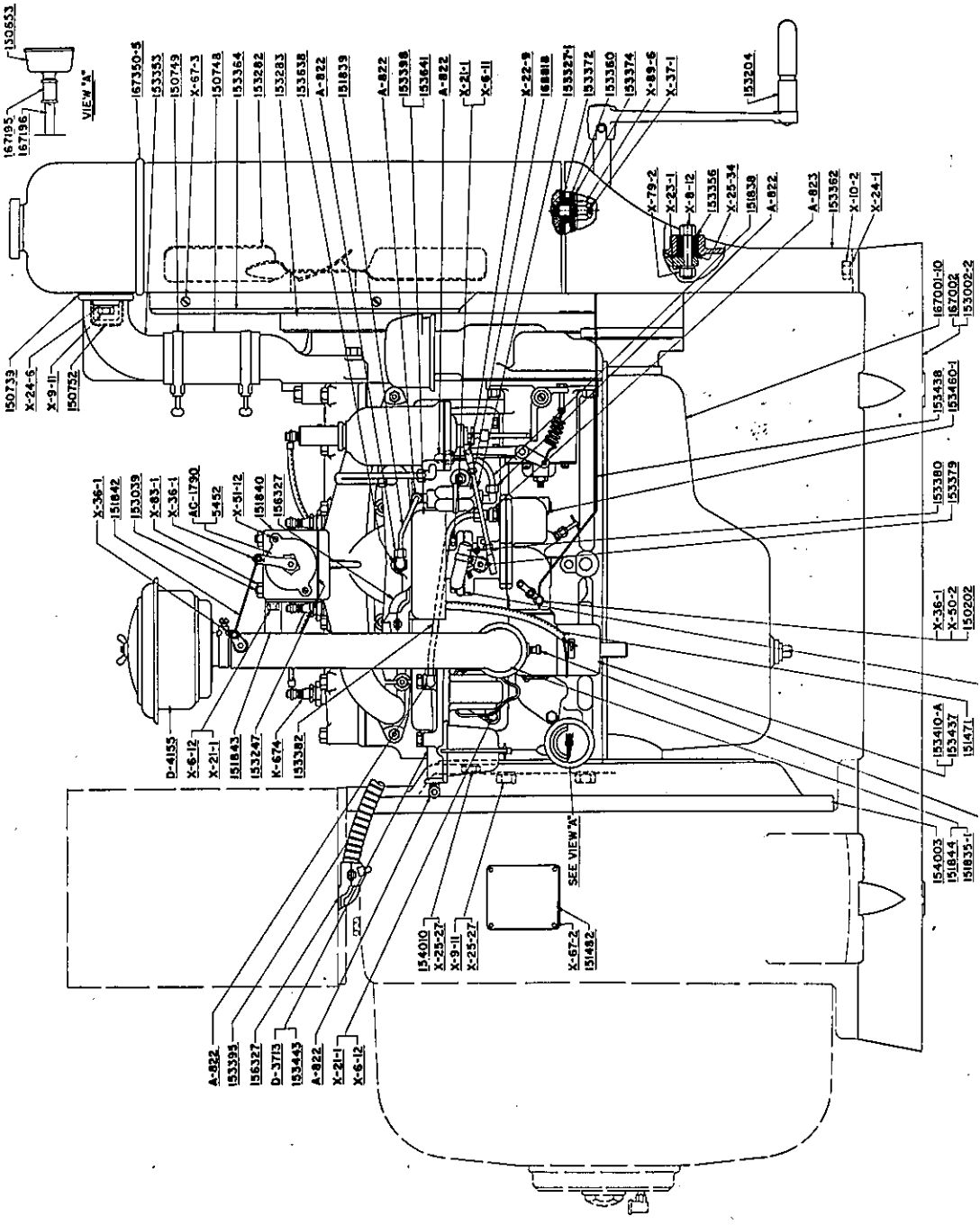



Figure 12

CARBURETOR SIDE OF PLANT

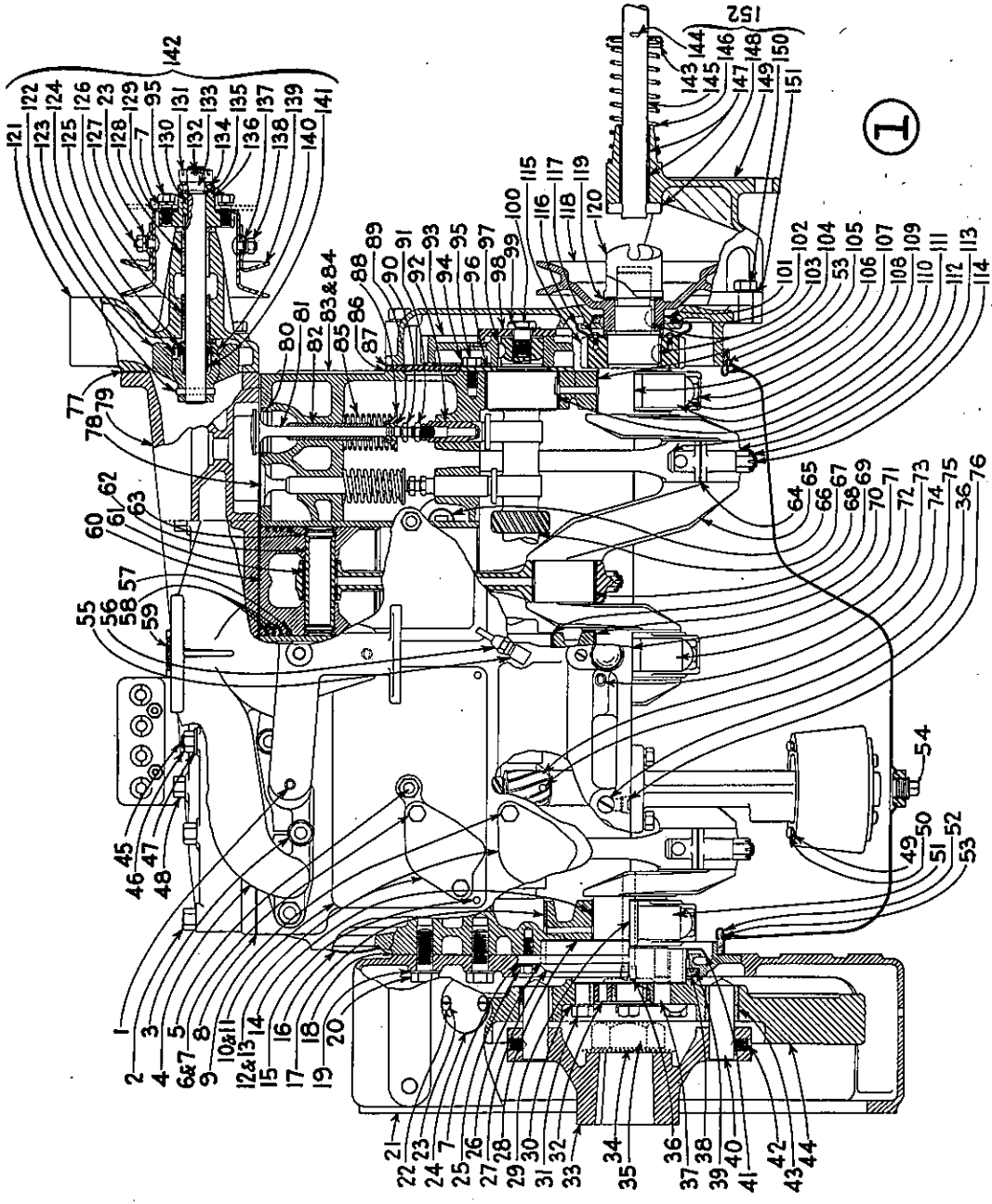



Figure 13

**Sectional View of Engine**

Refer to Opposite Page for Part Number and Description.

Refer to Numerical parts list in back of book for description and price.
Order by part number, not reference number.

## ASSEMBLY DETAILS OF ENGINE—167001-4

**Figure 13**

| Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | X-75-1 | 32 | 167234 | 63 | 153024 | 94 | 153160 | 125 | 153286 |
| 2 | 167032 | 33 | 167230 | 64 | 167022 | 95 | X-6-12 | 126 | 153253 |
| 3 | X-25-18 | 34 | 167240 | 65 | 153082 | 96 | 153158 | 127 | 153264 |
| 4 | 153240 | 35 | 167239 | 66 | X-75-3 | 97 | 153161 | 128 | 153252 |
| 5 | 153039-1 | 36 | X-75-14 | 67 | 167100 | 98 | 150155 | 129 | 153262 |
| 6 | X-6-1 | 37 | 167089 | 68 | 167023 | 99 | 150163 | 130 | 153267 |
| 7 | X-21-1 | 38 | 153092 | 69 | 167102 | 100 | 150154 | 131 | 151322 |
| 8 | 167031 | 39 | 153091 | 70 | 167082 | 101 | 153213 | 132 | X-35-1 |
| 9 | 167062 | 40 | 167232 | 71 | 167085 | 102 | 153212 | 133 | 167159 |
| 10 | 153037 | 41 | 153085 | 72 | 167053 | 103 | X-45-1 | 134 | 151311 |
| 11 | 153038 | 42 | 167233 | 73 | 153339 | 104 | 167081 | 135 | 153268 |
| 12 | 167061 | 43 | 167238 | 74 | 167179 | 105 | 153176 | 136 | 153260 |
| 13 | D-3713 | 44 | 167242 | 75 | 150680 | 106 | 167084 | 137 | 153265 |
| 14 | 167083 | 45 | 153034 | 76 | X-75-20 | 107 | 153056 | 138 | X-81-1 |
| 15 | 167212 | 46 | X-88-2 | 77 | 153271 | 108 | 153057 | 139 | 153263 |
| 16 | 167057 | 47 | 153035 | 78 | 167070 | 109 | 167052 | 140 | 167150 |
| 17 | 167103 | 48 | 167033 | 79 | 167030 | 110 | 167101 | 141 | 167144 |
| 18 | 167042 | 49 | X-19-1 | 80 | 153048 | 111 | 153021 | 142 | 167125 |
| 19 | X-22-4 | 50 | X-15-3 | 81 | 167071 | 112 | 167021 | 143 | 153193 |
| 20 | 167246 | 51 | 167054 | 82 | 167072 | 113 | 153022 | 144 | X-38-1 |
| 21 | 167241 | 52 | 153177 | 83 | 167050-1 | 114 | X-35-1 | 145 | 153200 |
| 22 | X-73-1 | 53 | 153180-1 | 84 | 167051-1 | 115 | 167087 | 146 | 153192 |
| 23 | X-20-1 | 54 | X-75-10 | 85 | 167073 | 116 | 167088 | 147 | 153206 |
| 24 | 167244 | 55 | 167217 | 86 | 153205 | 117 | 167090 | 148 | 153198 |
| 25 | X-6-11 | 56 | 167218 | 87 | 153211 | 118 | 153280 | 149 | 153197 |
| 26 | 167094 | 57 | 167028 | 88 | 167074 | 119 | 153196 | 150 | X-7-2 |
| 27 | 167093 | 58 | 167027 | 89 | 167075 | 120 | 153195 | 151 | X-22-1 |
| 28 | 153087 | 59 | 167058 | 90 | 153068 | 121 | 153251 | 152 | 153189 |
| 29 | 167086 | 60 | 167025 | 91 | 153071 | 122 | X-94-28 | | |
| 30 | 153171 | 61 | 153023 | 92 | 153067 | 123 | 167132 | | |
| 31 | 167245 | 62 | 167026 | 93 | 167104 | 124 | 153258 | | |

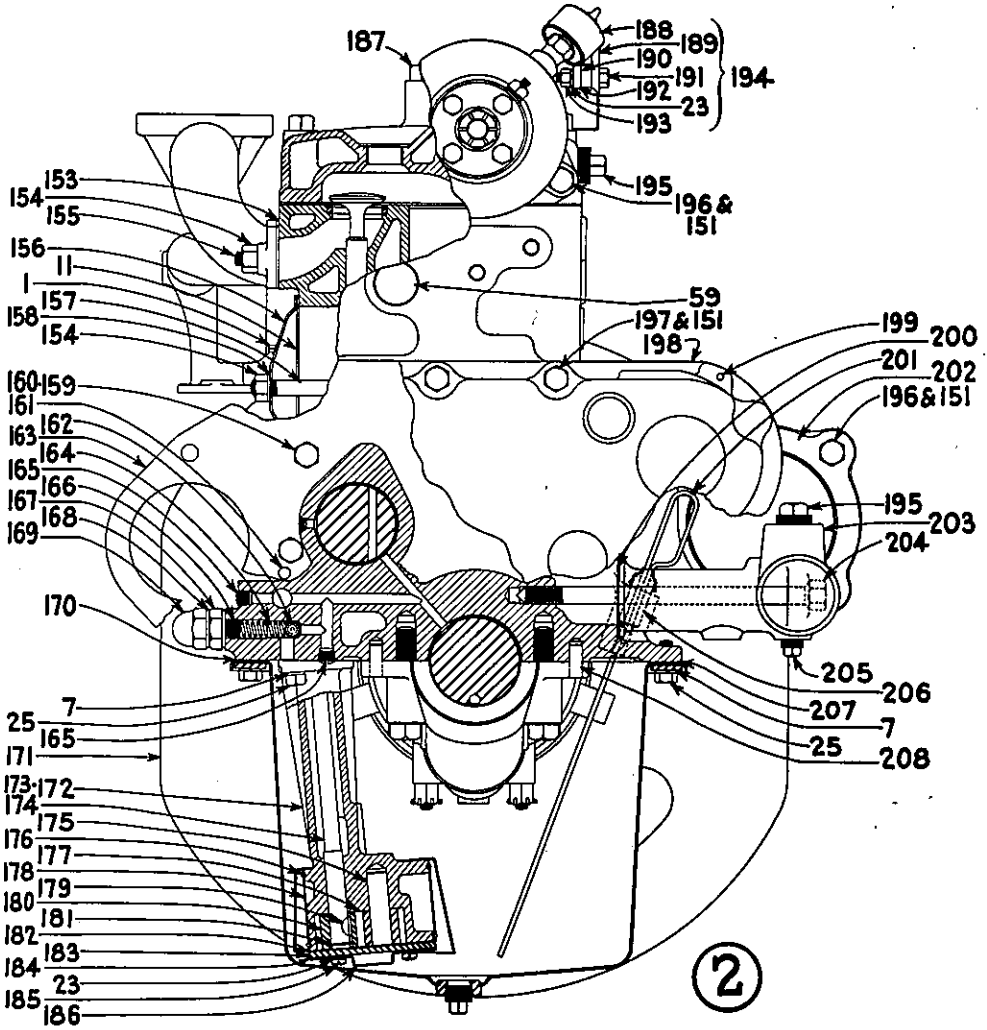



Figure 14

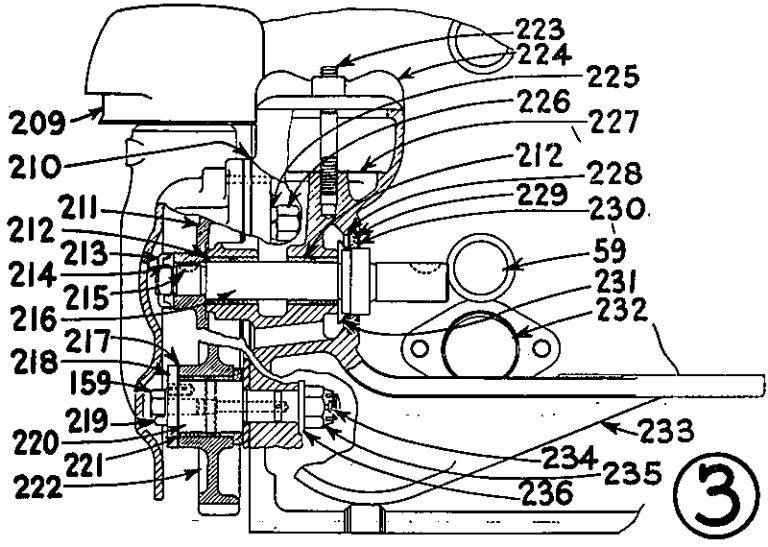
**End View of Engine**

Refer to Opposite Page for Part Number and Description.

## ASSEMBLY DETAILS OF ENGINE—167001-4

**Figure 14**

| Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | X-75-1 | 160 | X-22-10 | 174 | 167178 | 188 | 153565 | 202 | 167243 |
| 7 | X-21-1 | 161 | 167277 | 175 | 167177 | 189 | 150077 | 203 | 153058 |
| 11 | 153038 | 162 | 167209 | 176 | 153138 | 190 | 150076 | 204 | 153059 |
| 23 | X-20-1 | 163 | 153214 | 177 | 167175 | 191 | X-5-10 | 205 | |
| 25 | X-6-11 | 164 | 167210 | 178 | 153137 | 192 | 150081 | 206 | 167207 |
| 59 | 167058 | 165 | X-75-17 | 179 | X-42-3 | 193 | X-81-2 | 207 | 153178 |
| 151 | X-22-1 | 166 | 167208 | 180 | 167176 | 194 | 150075 | 208 | 167055 |
| 153 | 153241 | 167 | 150697 | 181 | 167181 | 195 | X-75-5 | 294 | 153134 |
| 154 | X-83-1 | 168 | 167211 | 182 | 153126 | 196 | X-7-8 | 295 | 153133 |
| 155 | 153242 | 169 | 153188 | 183 | 153125 | 197 | X-7-3 | 298 | X-7-18 |
| 156 | 153036-1 | 170 | 153179 | 184 | | 198 | 167270-1 | | |
| 157 | 153039 | 171 | 153175 | 185 | X-25-1 | 199 | X-94-20 | | |
| 158 | 153040 | 172 | 167171 | 186 | | 200 | 153060 | | |
| 159 | X-7-16 | 173 | 167172 | 187 | 167035 | 201 | 167205 | | |




SECTION THRU MAGNETO BRACKET AND IDLER GEAR

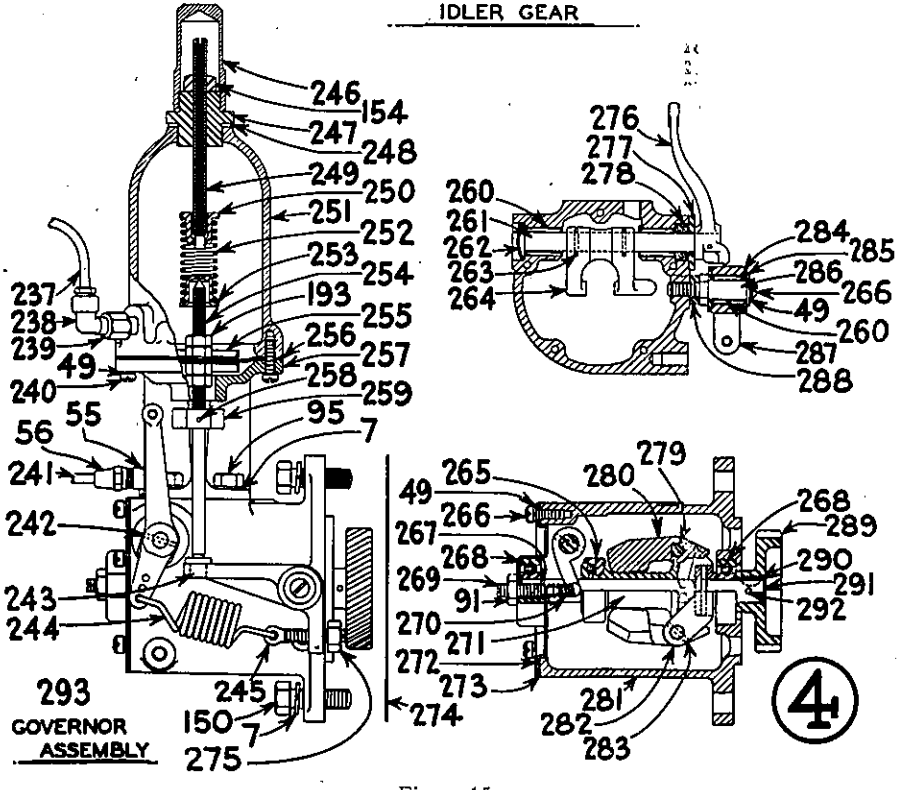



Figure 15

**Section through Magneto Bracket and Governor Assembly**

Refer to Opposite Page for Part Number and Description.

## ASSEMBLY DETAILS OF ENGINE—167001-4

**Figure 15**

| Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. |
|---|---|---|---|---|---|---|---|---|---|
| 59 | 167058 | 227 | 153231 | 193 | X-81-2 | 256 | D-3594 | 276 | 153306-1 |
| 159 | X-7-16 | 228 | 153222 | 237 | 151283 | 257 | 151254-1 | 277 | 153331 |
| 209 | 167276 | 229 | 153220 | 238 | 151284 | 258 | 151280 | 278 | 153341 |
| 210 | 153218 | 230 | 153221 | 239 | 151286 | 259 | 151279 | 279 | 153301 |
| 211 | 153569 | 231 | 153235 | 240 | X-15-1 | 260 | 151275 | 280 | 153299-1 |
| 212 | 153219 | 232 | 167060 | 241 | 167220 | 261 | 153305-1 | 281 | 153291 |
| 213 | 153234 | 233 | 153217 | 242 | X-94-7 | 262 | 153340 | 282 | 153298 |
| 214 | 153224 | 234 | X-37-1 | 243 | 151259 | 263 | 153308 | 283 | 153302 |
| 215 | X-44-2 | 235 | X-89-1 | 244 | 153318 | 264 | 153304 | 284 | 151276 |
| 216 | 153233 | 236 | 150631 | 245 | 153319 | 265 | 153297 | 285 | 151258 |
| 217 | 150458 | 297 | X-82-2 | 246 | 151274 | 266 | X-15-3 | 286 | 151253 |
| 218 | 150459 | 7 | X-21-1 | 247 | 151271 | 267 | 153328 | 287 | 151257 |
| 219 | 150453 | 49 | X-19-1 | 248 | 151272 | 268 | 153296 | 288 | 151281 |
| 220 | 153098 | 55 | 167217 | 249 | 151270 | 269 | 153310 | 289 | 153321 |
| 221 | 153102 | 56 | 167218 | 250 | 151268 | 270 | 153311 | 290 | X-43-1 |
| 222 | 153097 | 91 | 153071 | 251 | 151255 | 271 | 153300 | 291 | 153295 |
| 223 | 153232 | 95 | X-6-12 | 252 | 151269-1 | 272 | 153293 | 292 | 153323 |
| 224 | 153230 | 150 | X-7-2 | 253 | 151267 | 273 | 153294 | 293 | 151250-D1 |
| 225 | X-23-1 | 151 | X-22-1 | 254 | 151260-A | 274 | 153292 | 296 | X-7-1 |
| 226 | X-8-7 | 154 | X-83-1 | 255 | 153456 | 275 | 151273 | | |

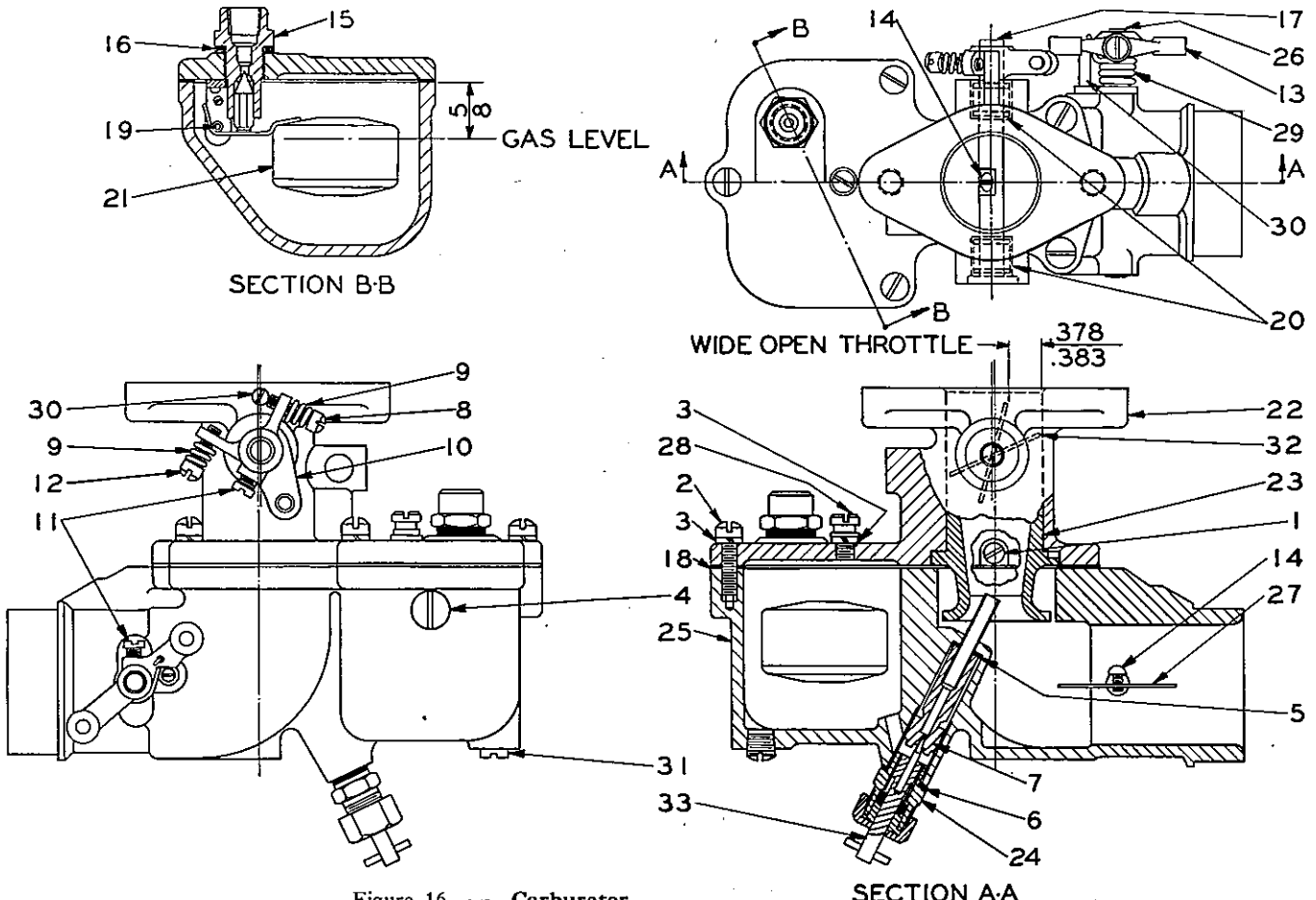



Figure 16 — **Carburetor**
Refer to Opposite Page for Part Number and Description.

## ASSEMBLY DETAILS OF CARBURETOR—153460-2

Figure 16

| Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. | Ref. No. | Part No. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | X-14-8 | 8 | 153463 | 15 | 153474 | 22 | 153483 | 29 | 153499 |
| 2 | X-15-1 | 9 | 153464 | 16 | 153475 | 23 | 153485 | 30 | 153500 |
| 3 | X-19-1 | 10 | 153467 | 17 | 153477 | 24 | 153486-1 | 31 | 153504 |
| 4 | X-75-17 | 11 | 153468 | 18 | 153478 | 25 | 153487 | 32 | 153507 |
| 5 | A-1578 | 12 | 153469 | 19 | 153479 | 26 | 153491 | 33 | 153508 |
| 6 | A-1579 | 13 | 153471 | 20 | 153480 | 27 | 153492 | | |
| 7 | 153458 | 14 | 153473 | 21 | 153481 | 28 | 153494 | | |

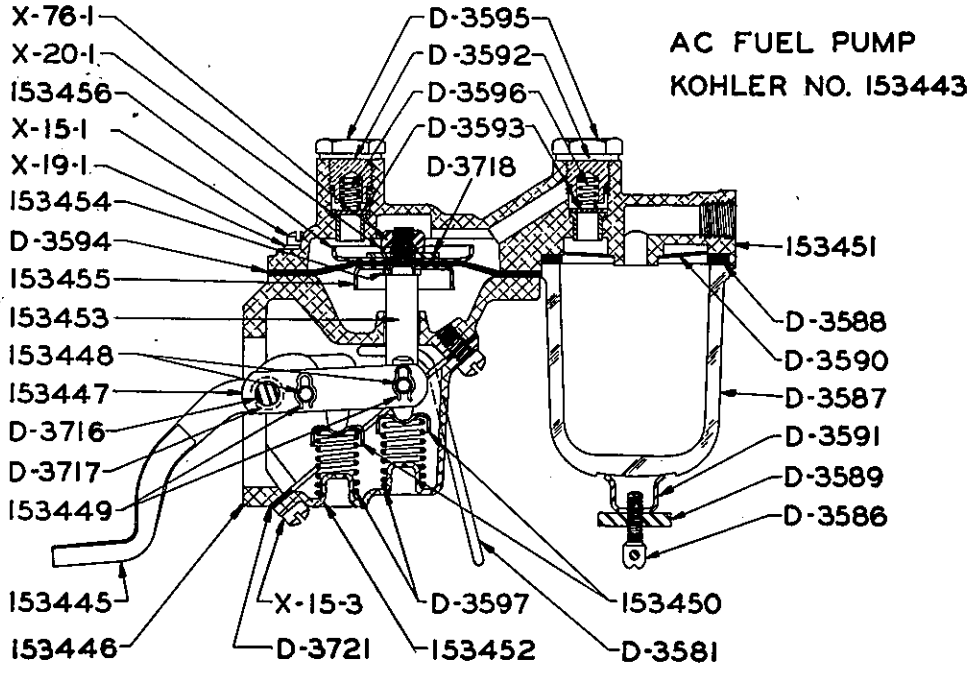



Figure 17

**Fuel Pump**

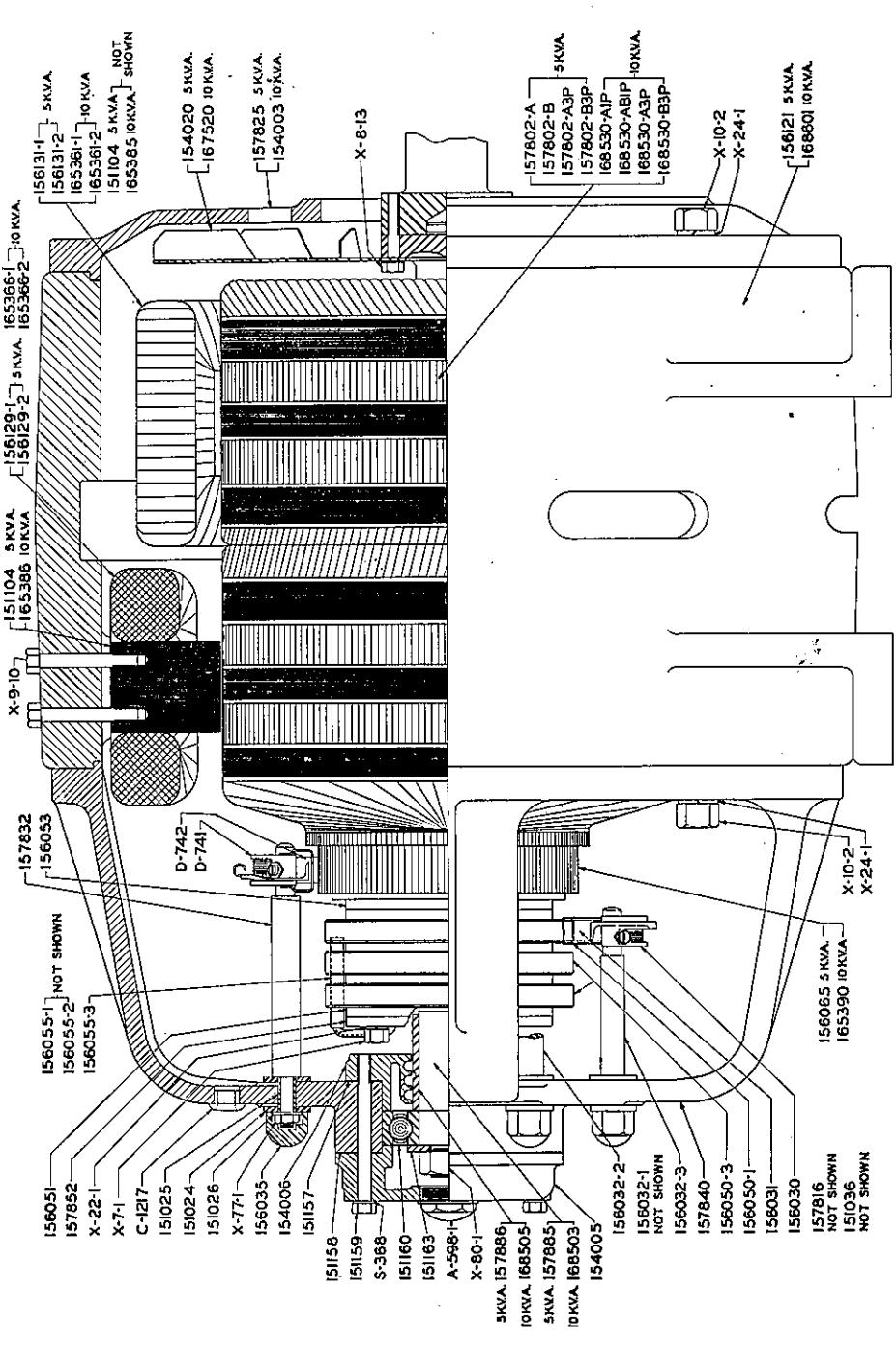



Figure 18

GENERATOR PARTS

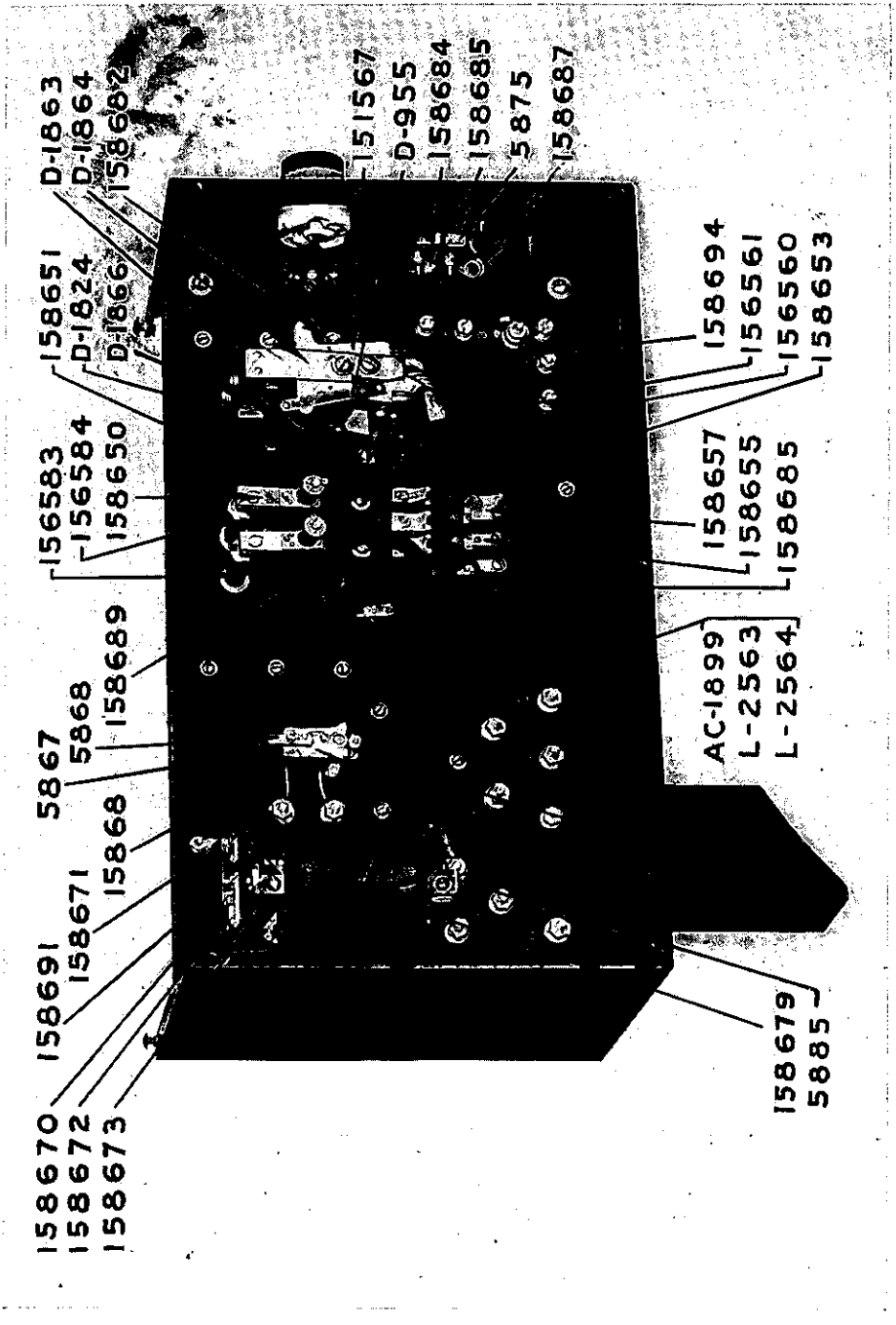



Figure 19

AUTOMATIC SWITCH

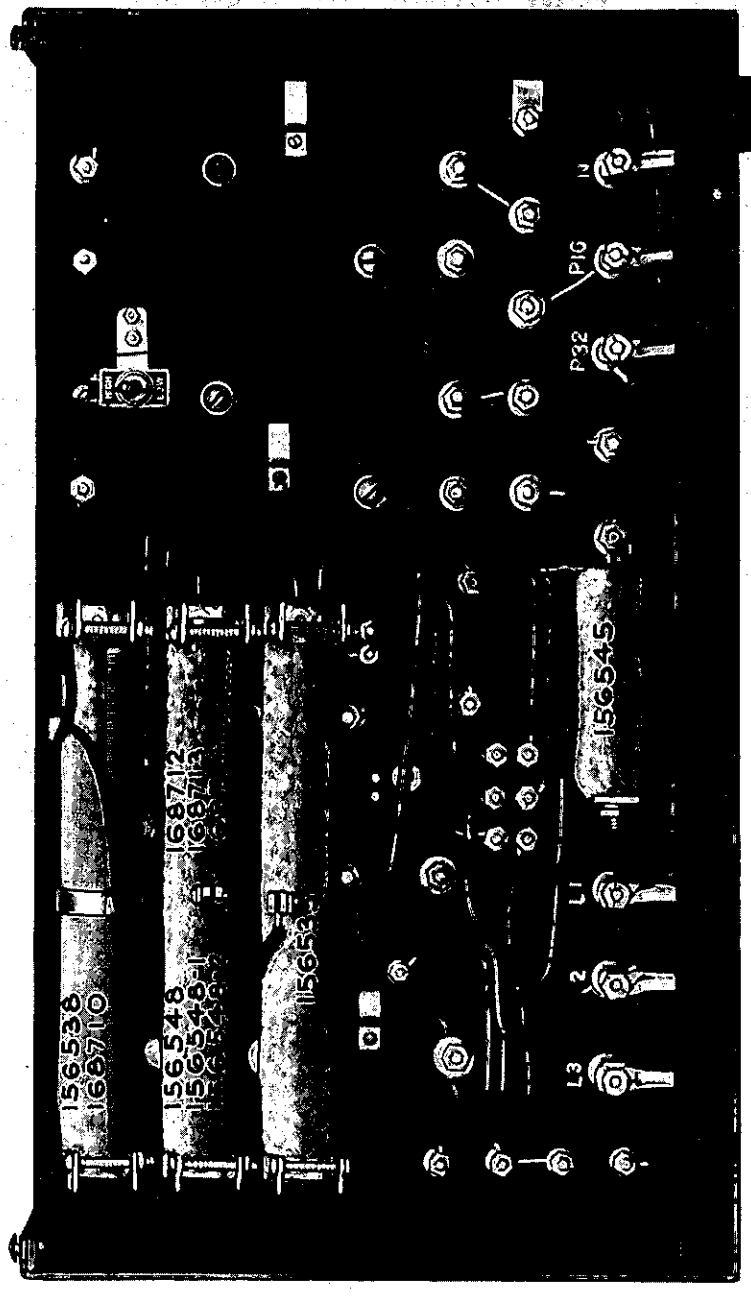



Figure 20

AUTOMATIC SWITCH PARTS

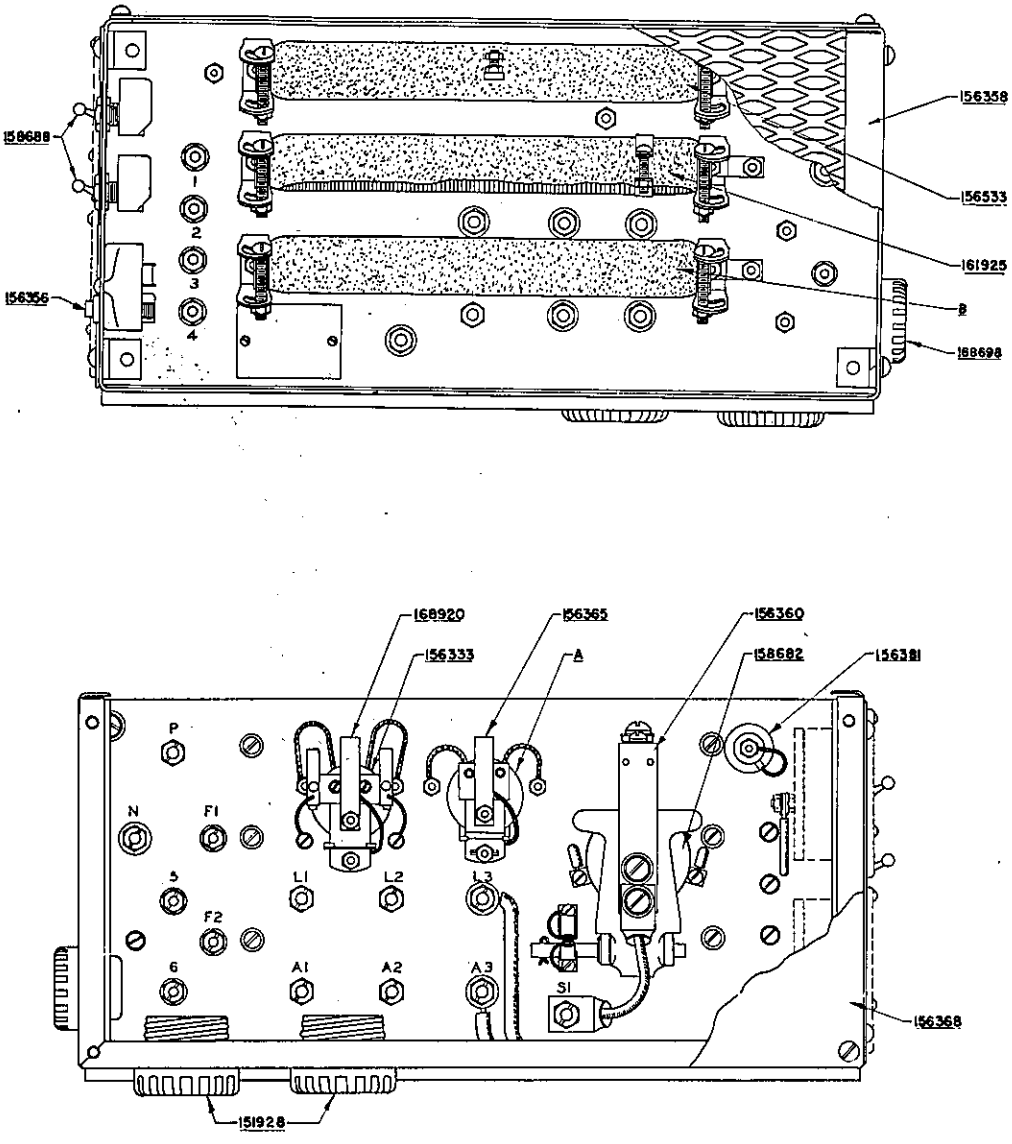



Figure 21

REMOTE CONTROL SWITCH

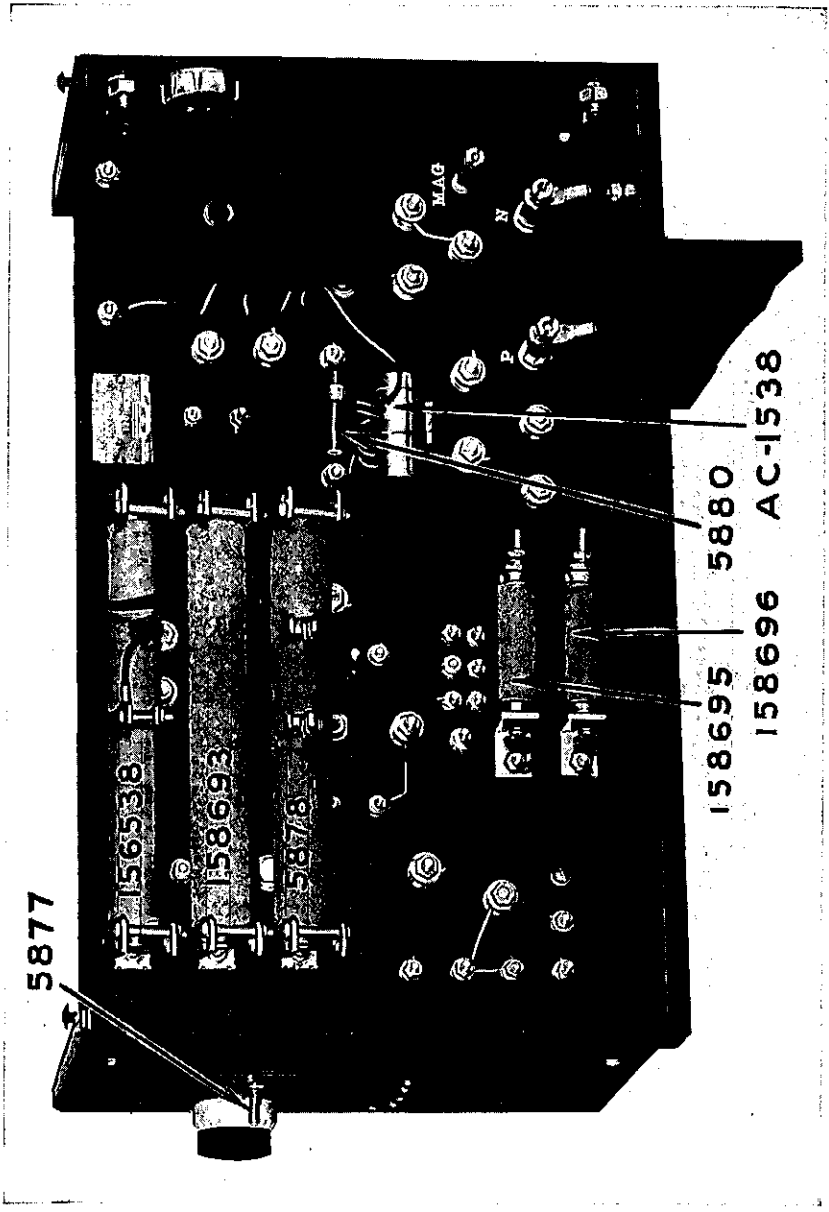



Figure 22
AUTOMATIC SWITCH

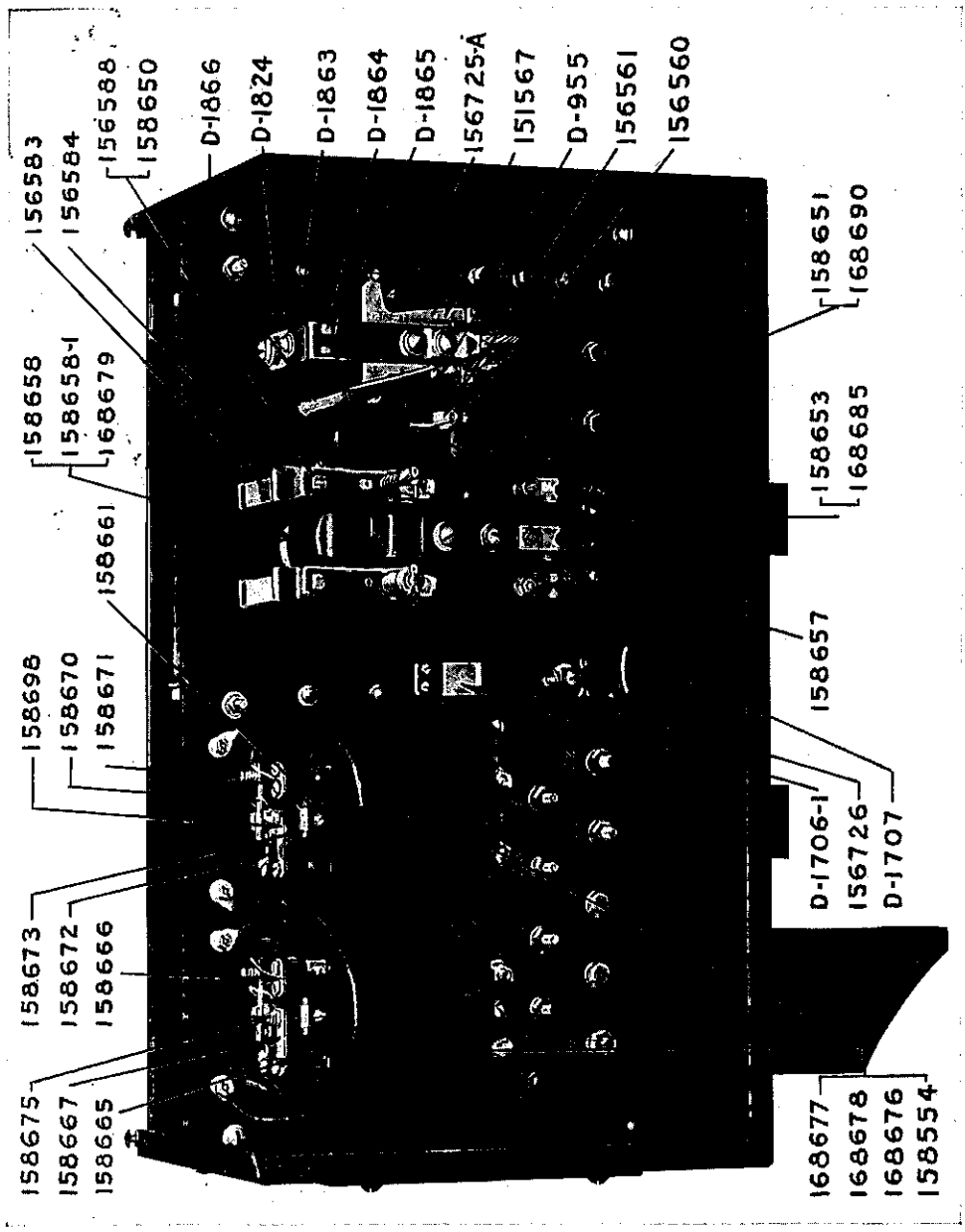



Figure 23
AUTOMATIC SWITCH

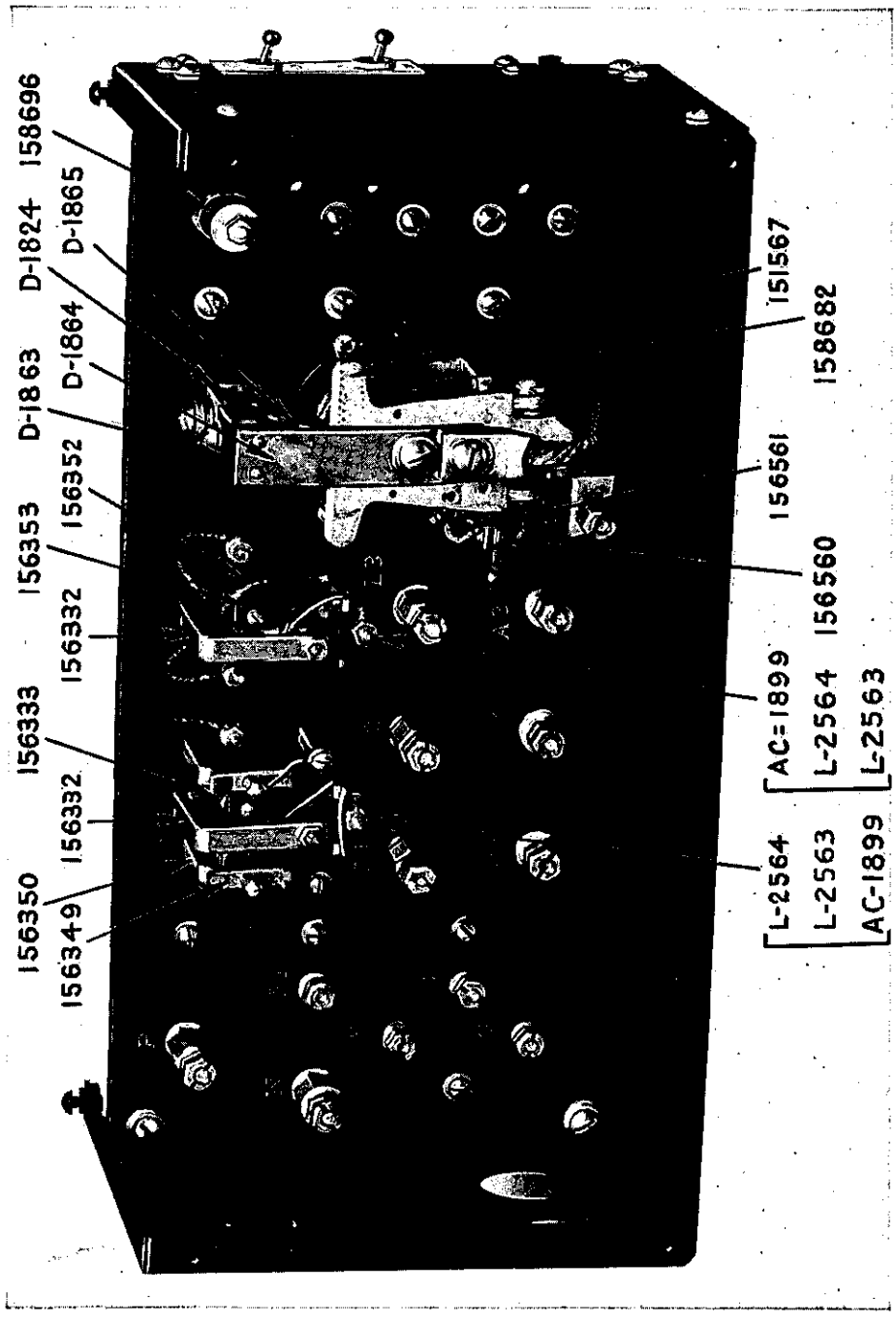



Figure 24

REMOTE CONTROL SWITCH

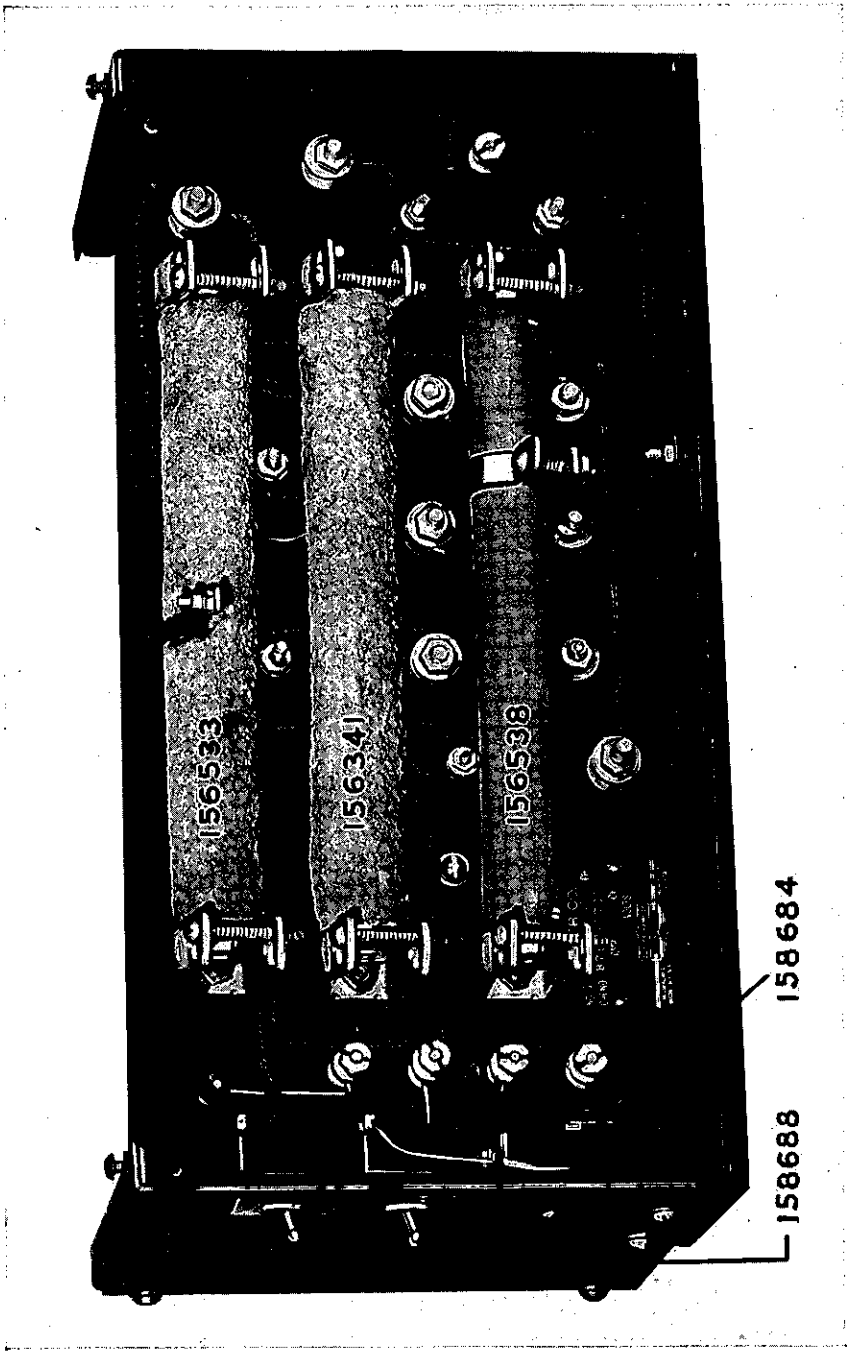
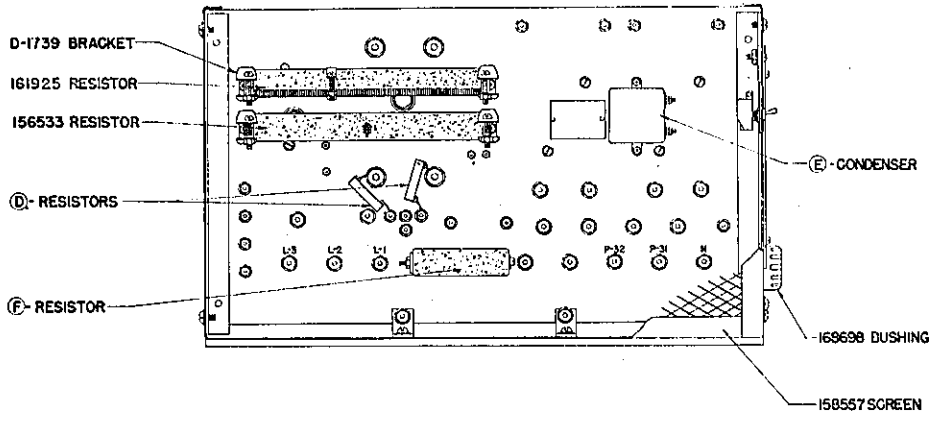
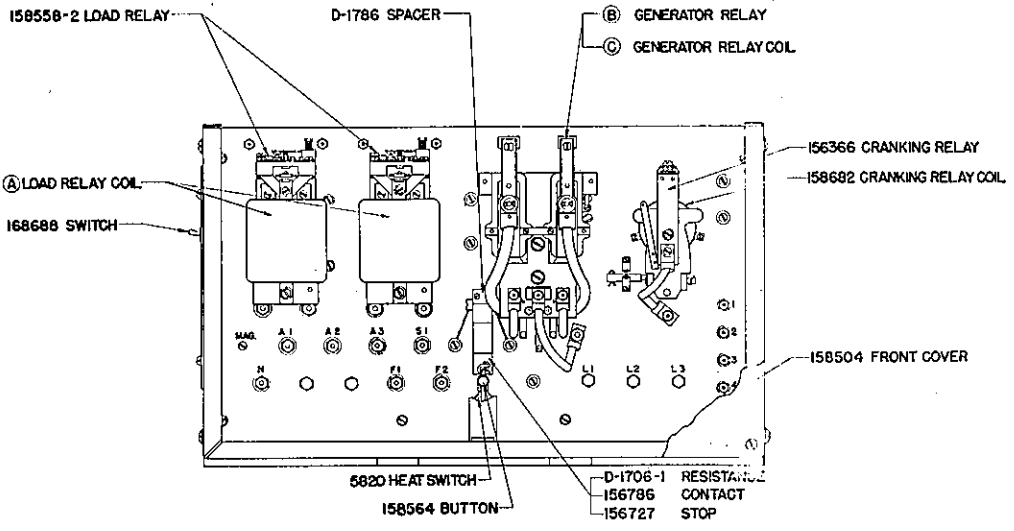



Figure 25

REMOTE CONTROL SWITCH

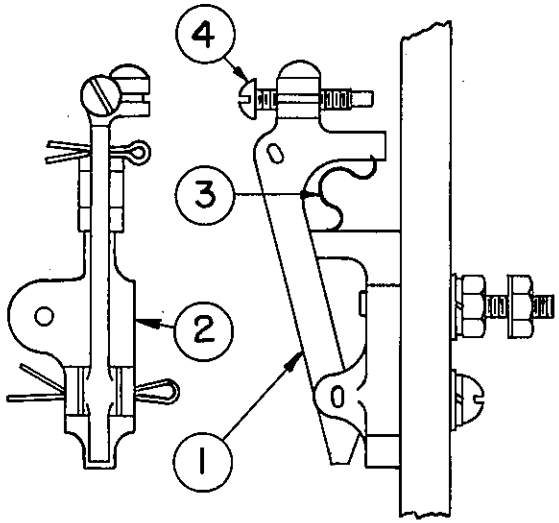



| CONTROLLER | PLANT MODEL | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| 158550 - A7 | 5A21 | 168678 | 158647 | 1586583 | 5791 | AC-1538-2 | 156545 |
| 158550-A3P7 | 5A31 | 158692 | 159647 | 158658-2 | 5791 | AC-1538-2 | 156545-3 |
| 158550-B3P7 | 5A51 | 158554 | 158647 | 158658-2 | 5786 | D-206 | 156545-3 |
| 158550-B7 | 5A61 | 158692 | 159647 | 159658-3 | 5791 | AC-1538-2 | 156545 |
| 168650-A3P7 | 10A31 | 168677 | 168700 | 156571 | 5791 | AC-1538-2 | 156545-2 |
| 168650-B3P7 | 10A51 | 158692 | 168700 | 156571 | 5786 | D-206 | 156545-2 |
| 168650-B7 | 10A61 | 168678 | 168700 | 156571 | 5791 | AC-1538-2 | 156545 |

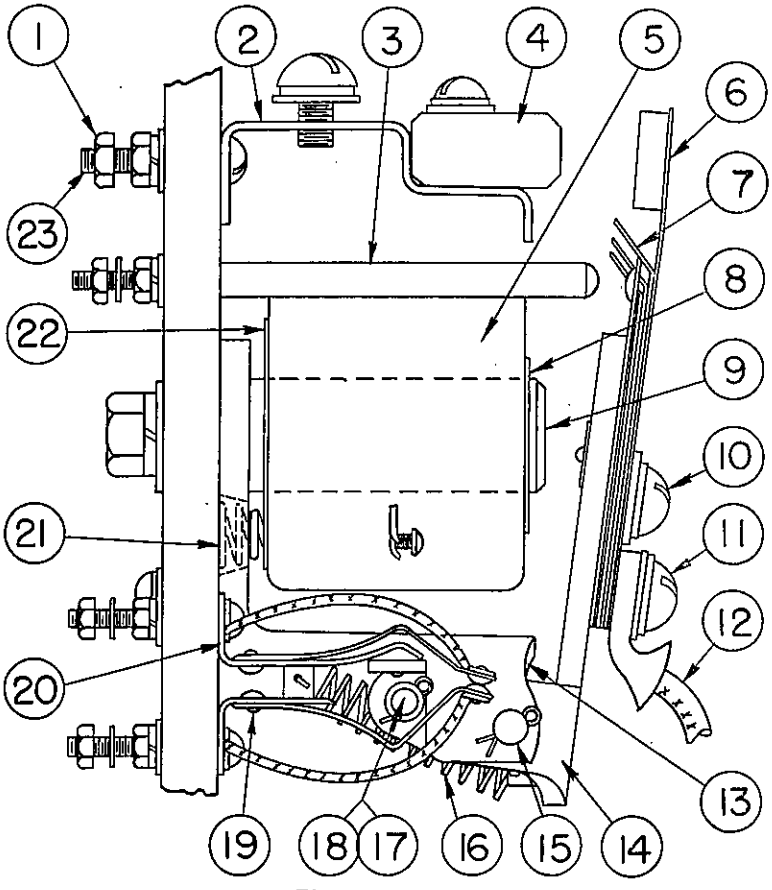
Figure 26

AUTOMATIC SWITCHES




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

Figure 27 HEAT SWITCH 5820




| Item No. | Part No. |
|---|---|
| 1 | X-70-2 |
| 2 | 151570 |
| 3 | D-1866 |
| 4 | D-1863 |
| 5 | 158682 |
| 6 | D-1865 |
| 7 | D-1864 |
| 8 | D-1876 |
| 9 | 163895 |
| 10 | X-73-5 |
| 11 | X-73-10 |
| 12 | 151574 |
| 13 | 156740 |
| 14 | 156367 |
| 15 | D-1862 |
| 16 | 151578 |
| 17 | 156610 |
| 18 | 156611 |
| 19 | 156612 |
| 20 | D-1887 |
| 21 | 151541 |
| 22 | D-1868 |
| 23 | X-50-14 |

Figure 28 CRANKING RELAY 156366

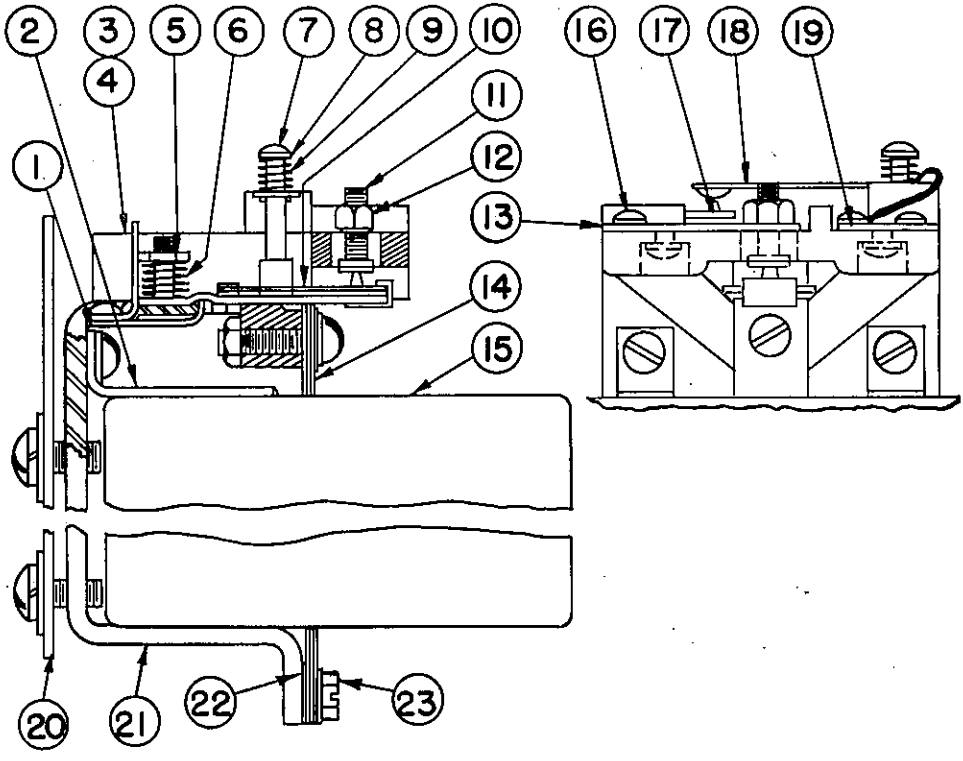



Figure 29

LOAD RELAY ASSEMBLY 158558

AUTOMATIC MODELS

| Item No. | Part No. | Item No. | Part No. | Model |
|---|---|---|---|---|
| 1 | 158701 | 14 | 158661-1 | |
| 2 | 158702 | 15 | 158554 | 5A51 |
| 3 | 158665 | | 158692 | 5A31 - 5A61 - 10A51 |
| 4 | 158660-2 | | 168677 | 10A31 |
| 5 | 158691 | | 168678 | 5A21 - 10A61 |
| 6 | 158674 | 16 | 158662 | |
| 7 | 158664 | 17 | 158672-1 | |
| 8 | 158668 | 18 | 158670-1 | |
| 9 | 158671 | 19 | 158666 | |
| 10 | 158673-2 | 20 | 158703 | |
| 11 | 158675 | 21 | 158704 | |
| 12 | X-72-3 | 22 | 5781 | |
| 13 | 158667 | 23 | 5782 | |

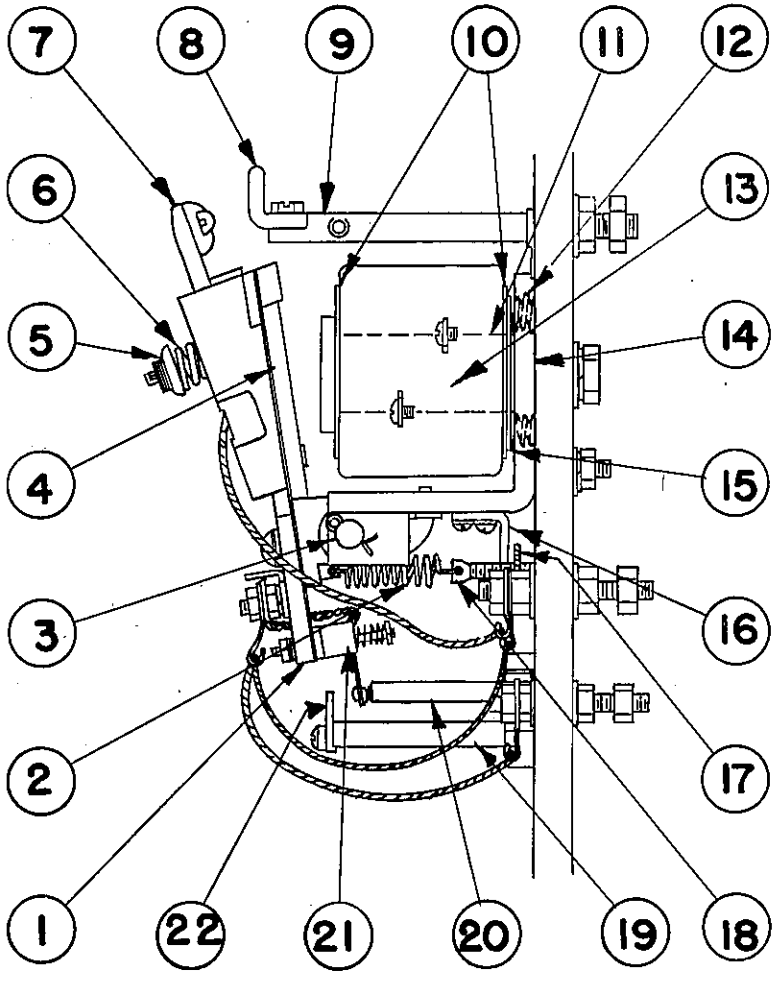



Figure 30 GENERATOR RELAY ASSEMBLY 168700 AUTOMATIC

| Item No. | Part No. | Item No. | Part No. |
|---|---|---|---|
| 1 | 168704 | 12 | 168702 |
| 2 | 151542 | 13 | 156571 |
| 3 | 151547 | 14 | 151537 |
| 4 | 168705 | 15 | 151551 |
| 5 | 168707 | 16 | 151648 |
| 6 | 168690 | 17 | 151553 |
| 7 | 156588 | 18 | 151544 |
| 8 | 156584 | 19 | 168703 |
| 9 | 156583 | 20 | 168695 |
| 10 | 151550 | 21 | 158648 |
| 11 | 168701 | 22 | 158657 |

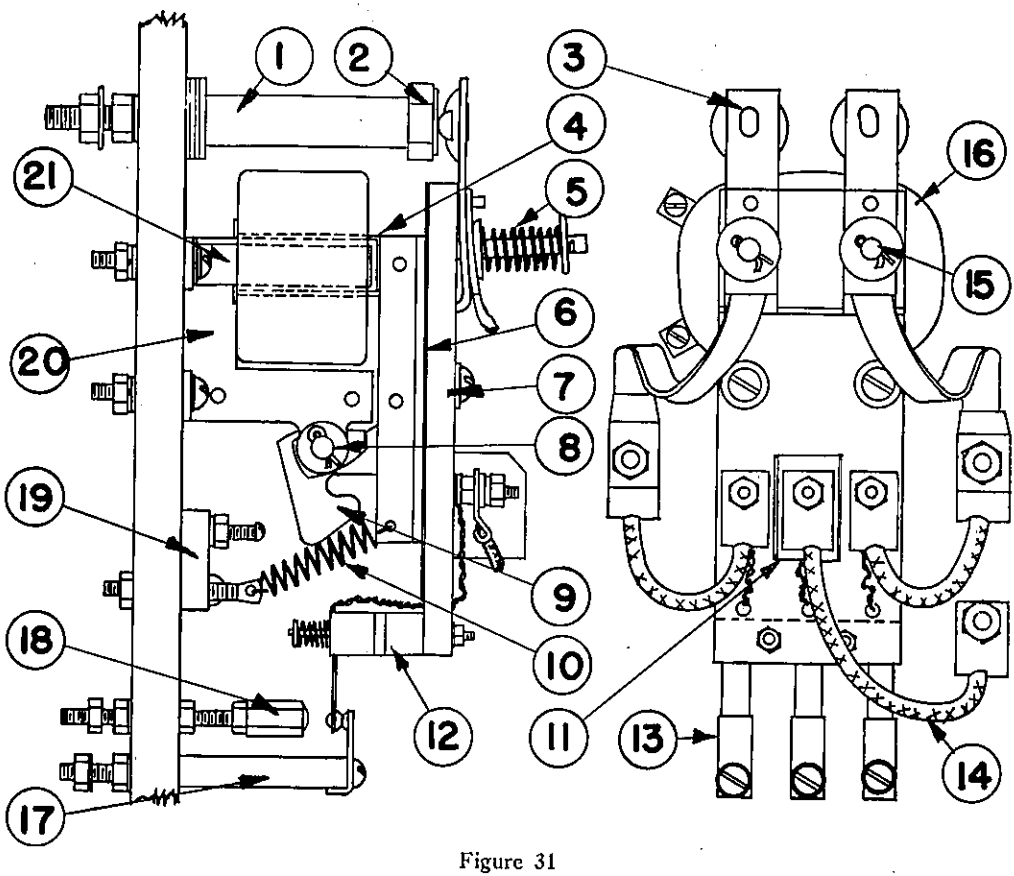



Figure 31

GENERATOR RELAY ASSEMBLY 158647 AUTOMATIC 5 KVA

| Item No. | Part No. | Model |
|---|---|---|
| 1 | 158559 | |
| 2 | 158652 | |
| 3 | 158650 | |
| 4 | 158617 | |
| 5 | 158651 | |
| 6 | 5937 | |
| 7 | 158618 | |
| 8 | 5966 | |
| 9 | 158653 | |
| 10 | D-1867 | |
| 11 | 158619 | |
| 12 | 158648 | |
| 13 | 158657 | |
| 14 | 158659 | |
| 15 | 5934 | |
| 16 | 158658-2 | 5A31 - 5A51 |
| | 158658 | 5A21 - 5A61 |
| 17 | 158616 | |
| 18 | 158683 | |
| 19 | 158568 | |
| 20 | 158567 | |
| 21 | 158566 | |

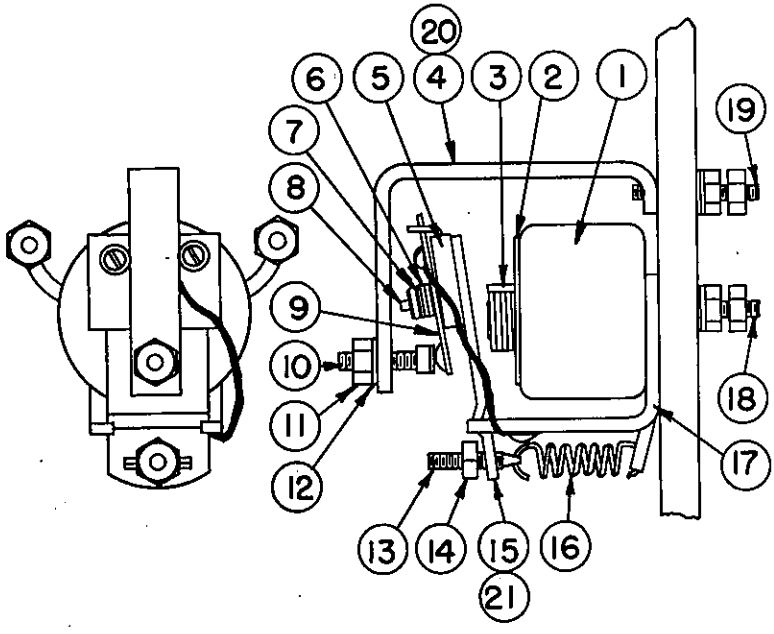
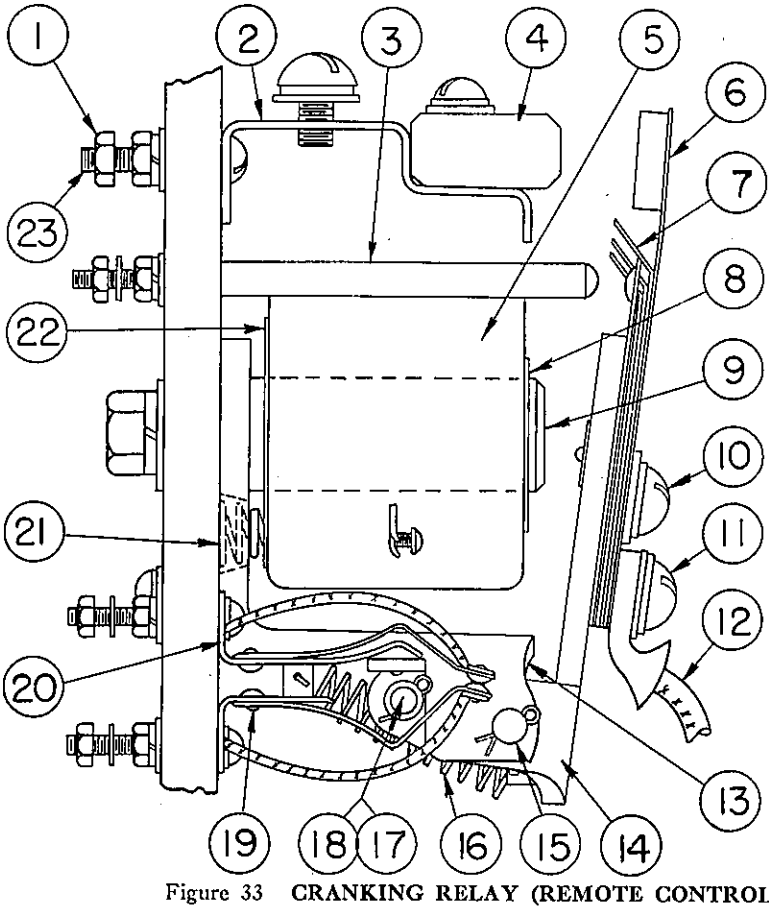


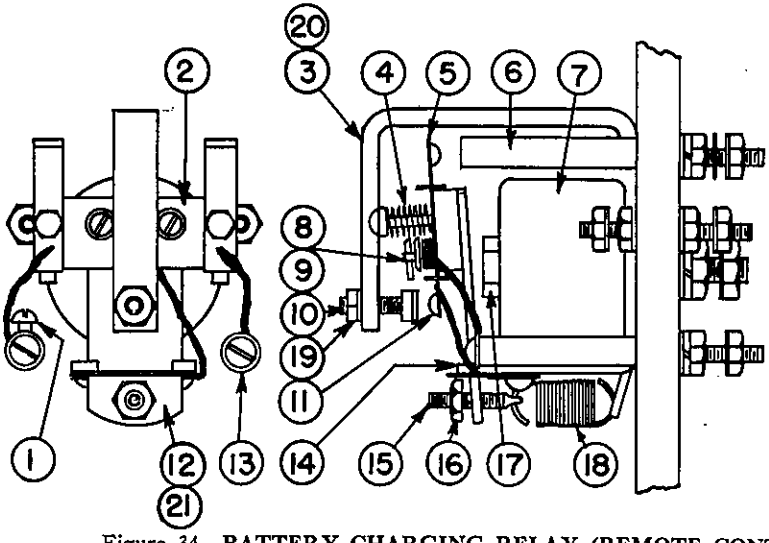

Figure 32 GENERATOR RELAY (REMOTE CONTROL) 156365

| Item No. | Part No. | Model |
|---|---|---|
| 1 | 156352 | 5R21 - 10R21 - 10R31 |
| | 156362 | 5R61 - 10R51 - 10R61 - 5R51 |
| 2 | 5949 | |
| 3 | 156364 | |
| 4 | 5919 | |
| 5 | 5948 | |
| 6 | 5918 | |
| 7 | 5917 | |
| 8 | 5910 | |
| 9 | 5911 | |
| 10 | 158675 | |
| 11 | X-72-2 | |
| 12 | X-22-7 | |
| 13 | L-2563 | |
| 14 | L-2564 | |
| 15 | 5915 | |
| 16 | AC-1899 | |
| 17 | 5914 | |
| 18 | 5969 | |
| 19 | 5923 | |
| 20 | 156332 | |
| 21 | 156353 | |




| Item No. | Part No. |
|---|---|
| 1 | X-70-2 |
| 2 | 151570 |
| 3 | Not Used |
| 4 | D-1863 |
| 5 | 158682 |
| 6 | D-1865 |
| 7 | D-1864 |
| 8 | D-1876 |
| 9 | 163895 |
| 10 | X-73-5 |
| 11 | X-73-10 |
| 12 | 151574 |
| 13 | 156740 |
| 14 | 156609 |
| 15 | D-1862 |
| 16 | 151578 |
| 17 | 156610 |
| 18 | 156611 |
| 19 | 156612 |
| 20 | D-1887 |
| 21 | 151541 |
| 22 | D-1868 |
| 23 | X-50-14 |

Figure 33 CRANKING RELAY (REMOTE CONTROL) 156360




| Item No. | Part No. |
|---|---|
| 1 | X-49-1 |
| 2 | 156613 |
| 3 | 5919 |
| 4 | 168694 |
| 5 | 156614 |
| 6 | 156616 |
| 7 | 156333 |
| 8 | 5917 |
| 9 | 5918 |
| 10 | 158675 |
| 11 | 5911 |
| 12 | 5915 |
| 13 | 156615 |
| 14 | 5914 |
| 15 | L-2563 |
| 16 | L-2564 |
| 17 | 5920 |
| 18 | AC-1899 |
| 19 | X-72-2 |
| 20 | 156332 |
| 21 | 156349 |

Figure 34 BATTERY CHARGING RELAY (REMOTE CONTROL) 168920

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| A-1-1 | Filler and Vent Pipe | |
| 2-RX | Pipe Plug—Headless 1/8" | |
| X-5-1 | Hexagon Cap Screw 1/4-20x5/8 | |
| X-5-9 | Cap Screw 1/4-28x1 | |
| X-5-10 | Hexagon Cap Screw 1/4-28x1 | |
| X-6-1 | Hexagon Cap Screw 5/16-18x1/2 | |
| X-6-2 | Hexagon Cap Screw 5/16x1 1/4 | |
| X-6-7 | Hexagon Cap Screw 5/16x1 | |
| X-6-11 | Hexagon Cap Screw 5/16-18x3/4 | |
| X-6-12 | Hexagon Cap Screw 5/16-18x5/8 | |
| X-7-1 | Hexagon Cap Screw 3/8-16x1 | |
| X-7-2 | Hexagon Cap Screw 3/8-16x1 1/4 | |
| X-7-3 | Hexagon Cap Screw 3/8-16x2 | |
| X-7-6 | Hexagon Cap Screw 3/8-16x7/8 | |
| X-7-8 | Hexagon Cap Screw 3/8x16x3/4 | |
| X-7-16 | Hexagon Cap Screw 3/8-16x5/8 | |
| X-7-18 | Hexagon Cap Screw 3/8-16x1 3/4 | |
| X-7-21 | Hexagon Cap Screw 3/8-16x3 1/2 | |
| X-8-7 | Hexagon Cap Screw 7/16-14x1 | |
| X-8-13 | Hexagon Cap Screw 7/16-20x1 1/4 | |
| X-9-5 | Hexagon Cap Screw 1/2x13x2 | |
| ‡ X-9-6 | Hexagon Cap Screw 1/2x13x3 1/2 | |
| X-9-8 | Hexagon Cap Screw 1/2x1 1/2 | |
| X-9-10 | Hexagon Cap Screw 1/2x13x3 | |
| X-9-11 | Hexagon Cap Screw 1/2-13x1 1/4 | |
| X-10-2 | Hexagon Cap Screw 5/8x11x1 3/4 | |
| X-10-5 | Hexagon Cap Screw 5/8-11x1 1/2 | |
| X-10-7 | Hexagon Cap Screw 5/8-11x2 1/4 | |
| A-1-13 | Supply Pipe Assembly | |
| A-2-13 | Supply Pipe Assembly | |
| ‡ X-14-4 | Fillister Head Machine Screw No. 8-32x1/2 | |
| X-14-8 | Fillister Head Machine Screw No. 8-32x5/8 | |
| X-15-1 | Fillister Head Machine Screw No. 10-32x5/8 | |
| X-15-3 | Fillister Head Cap Screw No. 10-32x3/8 | |
| X-15-12 | Fillister Head Cap Screw No. 10-32x1/2 | |
| ‡ X-18-2 | Lock Washer No. 8-3/64x1/16 | |
| X-19-1 | Lock Washer No. 3/16 | |
| X-20-1 | Lock Washer 1/4 | |
| X-21-1 | Lock Washer 5/16 | |
| X-22-1 | Lock Washer 3/8 | |
| X-22-10 | Lock Washer 3/8 | |
| X-23-1 | Lock Washer 7/16 | |
| X-24-1 | Lock Washer 5/8 | |
| X-24-6 | Lock Washer 1/2 | |
| X-25-5 | Plain Washer 5/16 | |
| X-25-8 | Plain Washer 1/4 | |
| X-25-14 | Plain Washer 1-3/8x3/32x9/16 | |
| X-25-16 | Plain Washer | |
| X-25-18 | Plain Washer 3/8x7/8 O.D. | |
| X-25-26 | Plain Washer 1/2x3/32x1 | |
| X-25-27 | Copper Washer 1/2" | |
| X-25-31 | Washer 7/16 | |
| D-31 | Supply Line 1/4 O.D. (12 feet) | |
| X-35-1 | Cotter Pin 3/32x1 | |
| X-36-1 | Cotter Pin 1/16x1/2 | |
| X-37-1 | Cotter Pin 1/2x1 1/4 | |
| X-42-1 | Woodruff Key No. 29 | |
| X-42-3 | Woodruff Key No. 2 | |
| X-43-1 | Woodruff Key No. 3 | |
| X-43-2 | Woodruff Key No. 4 | |
| X-44-2 | Woodruff Key No. 8 | |

‡ — 10 KVA Parts Only.

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| X-45-1 | Woodruff Key No. 9 | |
| X-50-1 | Round Head Machine Screw No. 10-32x½ | |
| X-50-2 | Round Head Machine Screw No. 10-32x⅜ | |
| X-50-4 | Round Head Machine Screw No. 10-32x⅝ | |
| X-50-15 | Round Head Machine Screw No. 10-24x½ | |
| X-51-12 | Round Head Machine Screw No. 8-32x⅜ | |
| X-52-1 | Oval Fillister Head Cap Screw ¼-20x½ | |
| X-52-5 | Oval Fillister Head Cap Screw ¼-20x⅝ | |
| X-53-3 | Oval Fillister Head Cap Screw 5/16-18x1 | |
| X-60-2 | Headless Set Screw ¼-20x1 | |
| X-60-9 | Square Head Screw ¼-20x¾ | |
| X-65-1 | Hexagon Nut ½x13 | |
| X-70-3 | Hexagon Nut Plain—No. 10-32 | |
| X-72-4 | Hexagon Nut—8/32 Z. Pl. | |
| X-75-1 | Pipe Plug ⅛ | |
| X-75-2 | Pipe Plug ¼ | |
| X-75-3 | Pipe Plug—Headless ½ | |
| X-75-5 | Pipe Plug—½ | |
| X-75-10 | Oil Pan Drain Plug Br. | |
| X-75-11 | Pipe Plug ⅜—Counter Sunk Head | |
| X-76-1 | Hexagon Nut ¼-28 | |
| X-76-2 | Hexagon Jam Nut ¼-20 | |
| X-77-1 | Order X-77-2 | |
| X-77-2 | Hex. nut .. NC | |
| X-80-1 | Hexagon Jam Nut 1-14 | |
| X-81-1 | Hexagon Nut ¼-20 U.S.S. | |
| X-81-2 | Hexagon Nut Plain ¼-28 | |
| X-82-1 | Hexagon Nut Plain—5/16-24 | |
| X-82-2 | Hexagon Nut Plain—5/16-18 | |
| X-83-1 | Hexagon Nut Plain —⅜x24 | |
| X-83-2 | Hexagon Nut ⅜-16 | |
| X-85-2 | Hexagon Nut ⅝-18 | |
| X-88-2 | Hexagon Nut 7/16-20 | |
| X-89-1 | Castle Nut ¼-20 | |
| X-89-6 | Plain Nut ½-13 | |
| A-93 | Elbow Complete ¼ I.D. | |
| X-94-7 | Taper Pin 1⅞ | |
| 111-BX | Name Plate Pin 3/32x¼ | |
| D-205-2 | Condensers | |
| 207-BX | Hexagon Nut ½-13 | |
| S-254 | Bell Crank Fork | |
| S-257 | Governor Pin | |
| 282-BX | Reducer Bushing ½x1¼ | |
| S-368 | Copper Washer ⅜ | |
| S-407 | Order D-3014-1 | |
| A-580 | Radiator Cap | |
| A-598-1 | End Bearing Plug | |
| K-674 | Spark Plug | |
| K-674-1 | Spark Plug | |
| D-741-2 | Generator Brush Holder | |
| D-742 | Generator Brush | |
| A-752 | Generator Wire Terminal Lug—Square | |
| E-816 | Magneto Ground Wire | |
| A-822 | Elbow Complete ¼ I.D. | |
| A-823 | Connector Complete ¼ I.D. | |
| A-824 | Compression Nut ¼ I.D. | |
| A-825 | Compression Sleeve ¼ I.D. | |
| D-831-1 | Spark Plug Wrench | |
| A-843 | Radiator Cap Gasket | |
| A-846 | Magneto Shaft Nut | |
| B-892 | Elbow Complete 5/16 I.D. | |
| B-893. | Close Nipple ⅛" | |
| B-912 | Restricted Ell | |
| B-1-913 | Valve Feeler Gauge Assembly | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| B-936 | Hexagon Nut ¼-20 | |
| D-950 | Generator Brush Holder Set Screw | |
| D-951 | Generator Brush Holder Lock Nut | |
| D-955 | Choker or Charging Contact Finger | |
| D-968 | Ground Switch | |
| D-972 | Copper Washer—Plain ⅜ | |
| C-1217 | Conduit Bushing | |
| D-1307 | Governor Fork Shaft Plug | |
| D-1320 | Gasoline Strainer Assembly | |
| A-1578 | Jet Washer | |
| A-1579 | Stuffing Box Gland Gasket—Lower Plug Washer | |
| D-1706-1 | Safety Switch Resistance—32 Volt | |
| D-1707 | Safety Switch Body Assembly | |
| AC-1790 | Choke Thermostat Assembly | |
| D-1824 | Contact and Support Assembly | |
| D-1863 | Relay Armature Contact | |
| D-1864 | Contact Brush | |
| D-1865 | Contact Finger | |
| D-1866 | Choker or Safety Switch Contact Post | |
| D-1887 | Interlock Finger—Long Support | |
| AC-1899 | Tail Spring | |
| L-2563 | Tail Spring Adjusting Stud | |
| L-2564 | Tail Spring Adjustment Nut | |
| D-3014-1 | Distributor Plate Cable Clip | |
| D-3015 | Adjustable Drive Member | |
| D-3202 | Magneto with Impulse Coupling | |
| D-3302 | Magneto Flange Mounted | |
| D-3581 | Priming Lever | |
| D-3582 | Order 167061 | |
| D-3586 | Wire Bail | |
| D-3587 | Glass Bowl | |
| D-3588 | Gasoline Strainer Gasket | |
| D-3589 | Thumb Nut | |
| D-3590 | Fuel Pump Screen | |
| D-3591 | Gasoline Strainer Bowl Seat | |
| D-3592 | Valve Plug Gasket | |
| D-3593 | Valve Plug | |
| D-3594 | Fuel Pump Diaphragm—4 Per Set | |
| D-3595 | Fuel Pump Valve | |
| D-3596 | Fuel Pump Valve Spring | |
| D-3597 | Diaphragm Spring | |
| D-3713 | Fuel Pump Gasket | |
| D-3715 | Pull Rod | |
| D-3716 | Rocker Arm Pin | |
| D-3717 | Rocker Arm Pin Retaining Ring | |
| D-3718 | Diaphragm Alignment Washer | |
| D-3721 | Bottom Cover Gasket | |
| D-4155 | Air Filter | |
| 5814 | Shunt Coil-0608-1 | |
| 5874-1 | Thermal Switch | |
| 150055 | Crankshaft Oil Thrower—Front FCL | |
| 150075 | Cable Support Bracket Assembly | |
| 150076 | Cable Support Block | |
| 150077 | Cable Support Bracket | |
| 150081 | Cable Support Clamp | |
| 150154 | Cam Gear Lock Screw | |
| 150155 | Cam Gear Lock Plate | |
| 150156 | Cam and Governor Gear Assembly | |
| 150163 | Cam Gear Lock Screw Lock | |
| 150171 | Choker Valve | |
| 150177-A | Choker Coil Assembly—115 Volt | |
| 150193 | Choker Rod | |
| 150201 | Muffler Complete | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 150202 | Choker Rod Connector | |
| 150296 | Reducer Bushing ¼-⅛ | |
| 150444 | Breather Cap (XAK) (ZA) (FC) | |
| 150453 | Idler Gear Nut Lock | |
| 150455 | Plain Washer 1-$\frac{3}{16}$x½x⅛ | |
| 150458 | Idler Gear Shim | |
| 150459 | Idler Stud Washer | |
| 150594 | Spark Plug Gasket FCL | |
| 150595 | Insulator | |
| 150653 | Oil Pressure Gauge | |
| 150680 | Oil Pump Drive Gear Pin | |
| 150697 | Half-Nuts ½-13 | |
| 150739 | Radiator Inlet Manifold Gasket | |
| 150748 | Radiator Hose Connection | |
| 150749 | Radiator Hose Clamp | |
| 151010 | Armature Disc Retaining Ring (C.I.) | |
| 151024 | Generator Brush Holder Washer | |
| 151025 | Generator Brush Holder Bushing | |
| 151026 | Generator Brush Holder Washer—Plain | |
| 151036 | Generator Bearing Oil Cup | |
| 151104 | Field Lamination Block | |
| 151157 | Generator Bearing Cap Gasket—Outer | |
| 151158 | Generator Bearing Cap Gasket—Inner | |
| 151159 | Generator Bearing Cap Bolt | |
| 151160 | Generator Bearing | |
| 151163 | Generator Shaft Washer | |
| 151181 | Push Rod Adjusting Wrench | |
| 151250-D1 | Vacuum Compensating Governor Assembly | |
| 151253 | Governor Spring Lever Spindle | |
| 151254-1 | Governor Vacuum Cylinder Base | |
| 151255 | Governor Vacuum Cylinder | |
| 151256 | Order X50-4 | |
| 151257 | Governor Spring Lever | |
| 151258 | Spindle Washer | |
| 151259 | Governor Spring Lever Button | |
| 151260-1 | Vacuum Cylinder Push Rod | |
| 151265 | Order D-3594 | |
| 151266 | Order 153456 | |
| 151267 | Vacuum Governor Spring Seat—Lower | |
| 151268 | Vacuum Governor Spring Seat—Upper | |
| 151269-1 | Vacuum Governor Cylinder Spring | |
| 151270 | Vacuum Governor Adjusting Screw | |
| 151271 | Vacuum Governor Cylinder Adjusting Screw Nut | |
| 151272 | Vacuum Governor Gasket | |
| 151273 | Adjusting Nut | |
| 151274 | Vacuum Governor Adjustment Screw Cap | |
| 151275 | Roller Bearings | |
| 151276 | Vacuum Governor Washer—Lower | |
| 151279 | Vacuum Push Rod Stop Collar | |
| 151280 | Stop Collar Pin | |
| 151281 | Governor Spring Lever Spindle Spacer | |
| 151282 | Oil Line Adapter | |
| 151283 | Vacuum Line Assembly | |
| 151471 | Choker Wire Assembly | |
| 151567 | Armature Lever Assembly | |
| 151751-2 | Magneto Coupling Assembly | |
| 151752 | Coupling Flange—Magneto End | |
| 151753 | Order 151751-2 | |
| 151754 | Coupling Flange—Drive End | |
| 151755 | Magneto Coupling Lock Washer | |
| 151756 | Magneto Coupling Nut | |
| 151838 | Metering Valve to Block Tube | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 151839 | Metering Valve to Manifold Tube | |
| 151840 | Choker Thermostat Housing | |
| 151842 | Choker Thermostat Control Rod | |
| 151843 | Air Cleaner Support Bracket | |
| 151844 | Air Intake Assembly | |
| 151850 | Order AC-1790 | |
| 151928 | Conduit Bushing Assembly | |
| 153001 | Order 167001-10 | |
| 153021 | Connecting Rod Bolt | |
| 153022 | Connecting Rod Bolt Nut | |
| 153023 | Connecting Rod Bushing | |
| 153024 | Piston Pin Retainer | |
| * 153025 | Piston—State size, Standard to .040 | |
| * 153025-1 | Piston—Semi-finished | |
| * 153026 | Piston Pin—State size, Standard to .010 | |
| * 153027 | Piston Ring—Compression. State size, standard to .040 | |
| * 153028 | Piston Ring—Oil. State size, Standard to .040 | |
| 153031 | Cylinder Head Gasket | |
| 153033 | Order 167033 | |
| 153034 | Cylinder Head Studs | |
| 153036 | Cylinder Door | |
| 153036-1 | Cylinder Door Front | |
| 153037 | Valve Cover | |
| 153038 | Cylinder Door Gasket | |
| 153039 | Cylinder Door Stud | |
| 153039-1 | Cylinder Door Stud | |
| 153040 | Order D-972 | |
| 153050 | Gasket Set—FC and FCL Engine | |
| * 153052-FCL | Crankcase Assembly with Bearings, Caps, Bushings and Guides only | |
| * 153052-2 | Order 167050-1 | |
| 153056 | Crankshaft Bearing Cap Screw | |
| 153057 | Crankshaft Bearing Cap Screw Lock | |
| 153058 | Water Inlet Elbow | |
| 153059 | Order 153421 | |
| 153060 | Water Inlet Elbow Gasket | |
| 153061 | Bell Housing Gasket | |
| 153067 | Valve Tappet | |
| 153068 | Push Rod Adjusting Screw | |
| 153071 | Order X-82-1 | |
| 153082 | Crankshaft | |
| 153085 | Crankshaft Oil Throw—Rear | |
| 153086 | Main Bearing Closure Plate | |
| 153087 | Main Bearing Plate Gasket | |
| 153090 | Restricting Plug | |
| 153091 | Rear Oil Seal | |
| 153092 | Rear Oil Seal Cup | |
| 153097 | Idler Gear—Bushed | |
| 153098 | Idler Gear—Spindle | |
| 153102 | Idler Gear Bushing | |
| 153125 | Oil Pump Cover | |
| 153126 | Oil Pump Cover Gasket | |
| 153132 | Oil Pump Cover Plate | |
| 153133 | Oil Pump Baffle | |
| 153134 | Oil Pump Baffle Gasket | |
| 153137 | Oil Pump Screen | |
| 153138 | Oil Pump Screen Wire | |
| 153139 | Oil Pump Cover Plate Gasket | |
| 153158 | Camshaft Thrust Plate | |
| 153160 | Camshaft Thrust Plate Screw Lock | |
| 153161 | Cam Gear Key | |
| 153172 | Order 150444 | |

* — FCL Engine Parts.

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 153175 | Oil Pan | |
| 153176 | Cork Retainer Clip—Front | |
| 153177 | Cork Retainer Clip—Rear | |
| 153178 | Oil Pan Gasket—Right | |
| 153179 | Oil Pan Gasket—Left | |
| 153180-1 | Oil Pan Gasket—End | |
| 153181 | Order 153180-1 | |
| 153184 | Oil Pan to Gear Cover Stud | |
| 153187 | Oil Level Gauge Hole Plug | |
| 153192 | Starting Crank Spring | |
| 153193 | Starting Crank Spring Washer | |
| 153195 | Starting Crank Jaw | |
| 153196 | Starting Jaw Shim | |
| 153197 | Front Support Bracket | |
| 153198 | Starting Crank Pin | |
| 153199 | Starting Coil Shaft Assembly | |
| 153205 | Timing Gear Cover Plate Gasket | |
| 153210-FL | Gear Cover | |
| * 153210-FCL | Gear Cover | |
| 153211 | Gear Cover Gasket | |
| 153212 | Gear Cover Oil Seal | |
| 153213 | Gear Cover Oil Seal Cup | |
| 153214 | Timing Gear Plate | |
| 153216 | Magneto Bracket | |
| 153218 | Magneto Bracket Gasket | |
| 153219 | Magneto Bracket Assembly | |
| 153220 | Magneto Drive Oil Shaft Seal | |
| 153221 | Magneto Drive Shaft Oil Seal Cup | |
| 153222 | Magneto Drive Shaft Oil Seal Washer | |
| 153223 | Order 153569 | |
| 153224 | Magneto Gear Nut Lock | |
| 153225 | Magneto Gear—Marine Plants | |
| 153230 | Oil Filler Cap | |
| 153231 | Oil Filler Screen | |
| 153232 | Oil Filler Cap Stud | |
| 153233 | Magneto Drive Shaft | |
| 153234 | Magneto Drive Shaft Collar | |
| 153235 | Magneto Drive Shaft Collar | |
| 153240 | Manifold—Exhaust and Intake | |
| 153241 | Manifold Gasket | |
| 153242 | Manifold Stud | |
| 153246 | Exhaust Pipe Flange | |
| 153247 | Exhaust Pipe Flange Gasket | |
| 153248 | Exhaust Pipe Flange Stud | |
| 153251-1 | Water Pump Body | |
| 153252 | Water Pump Bushing—Front | |
| 153253 | Water Pump Bushing—Rear | |
| 153256 | Groove Pin | |
| 153258 | Pin | |
| 153260 | Fan Hub | |
| 153262 | Fan Hub Pulley | |
| 153263 | Fan Hub Adjusting Collar | |
| 153264 | Fan Pulley Lock Screw | |
| 153265 | Fan Pulley Lock Screw Washer | |
| 153266 | Fan Hub Assembly | |
| 153267 | Fan Hub Key | |
| 153268 | Spacer Shim | |
| 153271 | Water Pump Flange Gasket | |
| 153276 | Water Outlet Flange Gasket | |
| 153277 | Water Pump Stud | |
| 153280 | Fan Pulley | |

* — FCL Engine Parts

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 153282 | Fan Blade Assembly | |
| 153283 | Fan Belt | |
| 153286 | Water Pump Seal | |
| 153290 | Governor Assembly | |
| 153291 | Governor Housing | |
| 153292 | Governor Housing Gasket | |
| 153293 | Governor Housing Cover | |
| 153294 | Governor Housing Cover Gasket | |
| 153296 | Governor Bearing | |
| 153297 | Governor Thrust Bearing | |
| 153299 | Governor Weight | |
| 153300-1 | Governor Shifter and Thrust Bearing | |
| 153301 | Governor Weight Shaft | |
| 153302 | Groove Pin 3/32x½ | |
| 153303 | Groove Pin ⅛x1 | |
| 153304 | Governor Shifter Lever | |
| 153305 | Governor Lever Shaft | |
| 153306 | Governor Lever | |
| 153306-1 | Governor Lever | |
| 153307 | Groove Pin ⅛x¾ | |
| 153308 | Groove Pin 3/32x⅝ | |
| 153310 | Bumper Screws | |
| 153311 | Bumper Screw Spring | |
| 153312 | Order 153581 | |
| 153314 | Governor Spring Bracket | |
| 153315 | Stud $\frac{5}{16}$x$\frac{13}{16}$ | |
| 153318 | Governor Spring | |
| 153319 | Adjusting Screw | |
| 153320 | Adjusting Nut | |
| 153321 | Governor Gear | |
| 153323 | Groove Pin ⅛x⅞ | |
| 153324 | Governor Rod | |
| 153328 | Snap Ring | |
| 153332 | Cork Packing | |
| 153333 | Cork Retainer | |
| 153334 | Order D-1307 | |
| 153338 | Governor Shaft and Weight Carrier Assembly | |
| 153352-1 | Order 153362-1 | |
| 153353 | Radiator Inlet Manifold | |
| 153354 | Inlet Manifold | |
| 153357 | Outlet Manifold | |
| 153358 | Radiator Hose | |
| 153359 | Order 153358 | |
| 153360 | Rubber Gasket | |
| 153362-1 | Radiator Support | |
| 153363 | Radiator and Water Pump Drain Cock | |
| 153364 | Order 153809 | |
| 153372 | Radiator Support Bushing | |
| 153374 | Radiator Steel Washer | |
| 153380 | Governor Switch | |
| 153382 | Carburetor Feed Tube | |
| 153390 | Order 153380 | |
| 153394-1 | Conduit Assembly | |
| 153395 | Flexible Conduit | |
| 153410-A | Choker Assembly, 115 Volt | |
| 153410-B | Choker Assembly—230 Volt | |
| 153411 | Choker Manifold | |
| 153421 | Screw | |
| 153437 | Backfire Trap Elbow | |
| 153438 | Choker Rod—Long | |
| 153443 | Fuel Pump | |
| 153445 | Rocker Arm—New Type | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 153446 | Body | |
| 153447 | Link | |
| 153448 | Link Pin | |
| 153449 | Link Pin Clip | |
| 153450 | Rocker and Diaphragm Spring Cap | |
| 153451 | Top Cover and Valve Seat Assembly | |
| 153452 | Bottom Cover | |
| 153453 | Order D-3715 | |
| 153454 | Pull Rod Gasket | |
| 153455 | Order 153456 | |
| 153456 | Fuel Pump Diaphragm Protector (FC) | |
| 153458 | Nozzle Assembly | |
| 153460-1 | Carburetor Complete | |
| 153463 | Idle Regulating Screw | |
| 153464 | Idle Regulating Screw Spring | |
| 153467 | Throttle Lever | |
| 153468 | Choker and Throttle Lever Set Screw | |
| 153469 | Throttle Lever Set Screw | |
| 153470 | Parker-Kalon Drive Screw | |
| 153471 | Choker Lever | |
| 153473 | Choke and Throttle Shutter Retaining Screw | |
| 153474 | Inlet Needle and Seat Assembly | |
| 153475 | Inlet Seat Gasket | |
| 153477 | Throttle Shaft | |
| 153478 | Body Gasket | |
| 153479 | Float Lever Pin | |
| 153480 | Needle—Bearing | |
| 153481 | Float | |
| 153483 | Body—Upper Half | |
| 153485 | Venturi | |
| 153486-1 | Stuffing Box Gland | |
| 153487 | Body—Lower Half | |
| 153489 | Order 153508 | |
| 153490 | Order 153508 | |
| 153491 | Choke Shaft | |
| 153492 | Choker Shutter | |
| 153493 | Order 153508 | |
| 153494 | Float Bowl Vent Screw | |
| 153495 | Stuffing Box Nut | |
| 153496 | Stuffing Box Packing | |
| 153497-1 | Order 153508 | |
| 153498 | Order 153508 | |
| 153499 | Choke Lever Return Spring | |
| 153500 | Choke Lever Stop Pin | |
| 153501 | Throttle Lever Assembly | |
| 153502 | Upper Body Assembly | |
| 153503 | Lower Body Assembly | |
| 153504 | Plug Screw | |
| 153505 | Order 153458 | |
| 153506 | Order 153458 | |
| 153507 | Throttle Shutter | |
| 153508 | Needle Valve Complete and Packing Nut | |
| 153539 | Magneto Ground Wire | |
| 153541 | Impulse Coupling | |
| 153542 | Drive Disc | |
| 153543 | Order D-3015 | |
| 153565 | Grease Cup | |
| 153569 | Magneto Gear | |
| 153581 | Water Vent Elbow | |
| 153809 | Fan Guard | |
| 154003 | Generator Bracket and Motor Support | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 154005 | Generator Bearing Cap—Outer | |
| 154006 | Generator Bearing Cap—Inner | |
| 154020 | Generator Fan | |
| 156030-2 | Alternator Brush Holder | |
| 156031 | Alternator Brush | |
| 156032-1 | Brush Holder Stud—Short | |
| 156032-2 | Brush Holder Stud—Medium | |
| 156032-3 | Brush Holder Stud—Long | |
| 156034 | Alternator Brush Holder Bushing | |
| 156035 | Alternator Brush Stud Nut | |
| 156050-1 | Slip Ring | |
| 156050-2 | Slip Ring | |
| 156050-3 | Slip Ring | |
| 156051 | Slip Ring Spacer | |
| 156053 | Slip Ring Lock Washer | |
| 156054 | Slip Ring Bushing | |
| 156055-1 | Slip Ring Tube | |
| 156055-2 | Slip Ring Tube | |
| 156055-3 | Slip Ring Tube | |
| * 156065-2 | Commutator Assembly | |
| * 156121 | Generator Frame | |
| * 156129-1 | Exciter Field Coil | |
| * 156129-2 | Exciter Field Coil | |
| * 156131-1 | Alternator Field Coil | |
| * 156131-2 | Alternator Field Coil | |
| ‡ 156137 | Exciter Brush Lead | |
| 156141 | Generator Frame Insulating Bushing | |
| 156300-R5-A | Remote Control Switch, 115 Volt A. C. | |
| 156300-R5-B | Remote Control Switch, 115-230 Volt A. C. | |
| * 156300-R5-A3P | Remote Control Switch, 115 Volt—3 P. A. C. | |
| * 156300-R5-B3P | Remote Control Switch, 230 Volt—3 P. A. C. | |
| 156327 | Connector | |
| 156332 | Stationary Back Contact | |
| 156333 | Control Relay Armature | |
| 156341 | Alternator Field Fixed Resistance Coil—3.2 Ohm, Three Phase | |
| 156349 | Armature Assembly | |
| 156350 | Stationary Contact | |
| 156352 | Voltage Relay Coil | |
| 156353 | Armature Assembly | |
| 156490 | Battery—32 Volt with Cables | |
| 156533 | Battery Charging Resistance Coil, 24 Ohm | |
| * 156538 | Exciter Field Resistance Coil—25 Ohm | |
| * 156545 | Extra Field Resistance—7 Ohm | |
| * 156545-2 | Alternate Field Resistance, 1.5 Ohm | |
| * 156548 | ABC Resistor, 115-230 Volt B | |
| * 156548-1 | ABCX Resistor, 115 Volt A3P | |
| * 156548-2 | ABCX Resistor, 230 Volt B3P | |
| * 156548-3 | Load Resistor, 115 Volt A | |
| 156560 | Alternator Field Contact—Short Support | |
| 156561 | Order D-1887 | |
| ‡ 156583 | Generator Relay Main Contact Support Assembly | |
| ‡ 156584 | Generator Relay Main Contact | |
| ‡ 156588 | Generator Relay Main Contact Finger | |
| 156725-A | Order 158682 | |
| 156726 | Thermostat Contact Spring | |
| 156801 | Plant Base | |
| * 157802-A | Armature Complete, 115 Volt, 1 Phase | |
| * 157802-A | Armature Rewinding, 115 Volt, 1 Phase | |
| * 157802-B | Armature Complete, 115-230 Volt, 1 Phase | |
| 157802-B | Armature Rewinding, 115-230 Volt, 1 Phase | |
| * 157802-A-3P | Armature Complete, 115 Volt, 3 Phase | |

* — 5 KVA Parts Only.

‡ — 10 KVA Parts Only.

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| * 157802-A-3P | Armature Rewinding, 115 Volt, 3 Phase | |
| * 157802-B-3P | Armature Complete, 230 Volt, 3 Phase | |
| * 157802-B-3P | Armature Rewinding, 230 Volt, 3 Phase | |
| 157816 | Generator End Cover - Lower | |
| 157816-1 | Generator Cover - Upper | |
| * 157825 | Generator End Bracket | |
| 157832 | Exciter Brush Holder Stud | |
| 157840 | Generator Support Bracket | |
| 157852 | Slip Ring Clamping Washer | |
| 157870 | Oval Head Counter-sunk Screw | |
| * 157885 | Generator Shaft | |
| * 157886 | Generator Shaft Thrust Ring | |
| * 158550-A7 | Automatic Switch Complete, 115 Volt Single Phase | |
| * 158550-A-3P7 | Automatic Switch Complete, 115 Volt 3 Phase | |
| * 158550-B7 | Automatic Switch Complete, 115-230 Volt, Single Phase | |
| * 158550-B-3P7 | Automatic Switch Complete, 230 Volt 3 Phase | |
| 158554 | Load Relay Coil, B3P | |
| * 158650 | Contact Finger | |
| * 158651 | Contact Finger Spring | |
| * 158653 | Armature Lever Assembly | |
| 158655 | Movable Contact Assembly | |
| 158657 | Contact Fingers | |
| * 158658 | Generator Relay Coil | |
| * 158658-1 | Order 158658-2 | |
| 158658-2 | Generator Relay Coil | |
| 158661-1 | Laminated Core Assembly | |
| 158665 | Molded Base | |
| 158666 | Terminal Plate | |
| 158667 | Contact Plate | |
| 158670-1 | Contact Finger | |
| 158671 | Contact Finger Spring | |
| 158672-1 | Stationary Contact Plate | |
| 158673-2 | Armature Lever Assembly | |
| 158675 | Contact Stud | |
| 158677 | Order 5814 | |
| 158682 | Cranking Relay Coil | |
| 158684 | Order 5874-1 | |
| 158688 | Toggle Switch | |
| 158692 | Main Relay Coil | |
| 158696 | Resistor—28 Ohm | |
| 158698 | Hexagon Nut | |
| 161925 | Field Resistance Coil - 16 Ohm | |
| 162103 | Air Cleaner | |
| ‡ 165361-1 | Alternator Field Coil | |
| ‡ 165361-2 | Alternator Field Coil | |
| ‡ 165366-1 | Exciter Field Coil | |
| ‡ 165366-2 | Exciter Field Coil | |
| ‡ 165385 | Field Lamination Block (Alternator) | |
| ‡ 165386 | Field Lamination Block (Exciter) | |
| ‡ 165390 | Commutator Assembly | |
| 167001-10 | Engine Assembly 3¼x4 | |
| 167002 | Plant Base | |
| 167015-2 | Gasket Set | |
| 167021 | Connecting Rod Complete | |
| 167022 | Connecting Rod Shim | |
| 167023 | Connecting Rod Bearing | |
| 167024 | Piston—Semi-finished | |
| 167025 | Piston—State Size, Standard to .030 | |
| 167026 | Piston Pin—State Size .003 to .010 | |
| 167027 | Compression Ring—State Size .010 to .040 | |
| 167028 | Oil Control Ring—State Size .010 to .040 | |
| 167030 | Cylinder Head | |

* — 5 KVA Parts Only.
‡ — 10 KVA Parts Only.

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 167030-G | Cylinder Head | |
| 167031 | Cylinder Head Gasket | |
| 167032 | Cylinder Head Cap Screw | |
| 167033 | Cylinder Head Cap Screw | |
| 167035 | Cylinder Head Cap Screw | |
| 167040 | Order 153037 | |
| 167041 | Crankcase Stud | |
| 167050-1 | Crankcase Assembly (FC) | |
| 167051 | Crankcase Assembly with Guides and Bearings Reamed | |
| 167052 | Main Bearing Cap—Front | |
| 167053 | Main Bearing Cap—Center | |
| 167054 | Main Bearing Cap—Rear | |
| 167055 | Main Bearing Dowel | |
| 167056 | Order X-75-3 | |
| 167057 | Expansion Plug | |
| 167058 | Expansion Plug | |
| 167059 | Distributor Shaft Bushing | |
| 167060 | Cup Plug (Distributor Hole) | |
| 167061 | Fuel pump cover (FC) | |
| 167070 | Intake Valve | |
| 167071 | Exhaust Valve | |
| 167071-1 | Exhaust Valve | |
| 167072 | Valve Guide | |
| 167073 | Valve Spring | |
| 167074 | Valve Spring Retainer | |
| 167075 | Valve Spring Taper ..... Per Pair | |
| 167076 | Order 151181 | |
| 167081 | Main Bearing Bushing—Front | |
| 167082 | Main Bearing Bushing—Center | |
| 167083 | Main Bearing Bushing—Rear | |
| 167084 | Main Bearing Shim—Front | |
| 167085 | Main Bearing Shim—Center | |
| 167086 | Main Bearing Shim—Rear | |
| 167087 | Crankshaft Gear | |
| 167088 | Crankshaft Oil Thrower—Front | |
| 167089 | Dowel Pin—Shaft to Flywheel | |
| 167090 | Drive Screw | |
| 167091 | Order 153090 | |
| 167092 | Dowel Pin | |
| 167093 | Main Bearing Closure Plate | |
| 167100 | Camshaft | |
| 167101 | Camshaft Bushing—Front | |
| 167102 | Camshaft Bushing—Center | |
| 167103 | Camshaft Bushing—Rear | |
| 167104 | Camshaft Gear | |
| 167125 | Water Pump Assembly | |
| 167129 | Order 167159 | |
| 167131 | Water Pump Thrust Washer Assembly | |
| 167132 | Water Pump Vane | |
| 167150 | Water Pump Thrust Washer | |
| 167151 | Order 153286 | |
| 167159 | Water Pump Shaft (FC) | |
| 167170 | Oil Pump Complete with Screen and Baffle | |
| 167171 | Oil Pump less Screen and Baffle | |
| 167172 | Oil Pump Body | |
| 167175 | Oil Pump Gear Driver | |
| 167176 | Oil Pump Gear Driver | |
| 167177 | Oil Pump Shaft—Idler | |
| 167178 | Drive Shaft - FC | |
| 167179 | Oil Pump Drive—Gear | |
| 167181 | Snap Ring | |
| 167195 | Pipe Coupling—Standard ⅛" | |

**When ordering parts give Model and Serial Number of your Plant.**

| Part Number | DESCRIPTION | Price Each |
|---|---|---|
| 167196 | Pipe Nipple ⅛x2" | |
| 167205 | Oil Level Gauge | |
| 167207 | Oil Gauge Bushing | |
| 167208 | Relief Valve Adjusting Screw | |
| 167209 | Oil Relief Valve Ball | |
| 167210 | Oil Relief Valve Spring | |
| 167217 | Elbow | |
| 167270 | Gear Cover | |
| 167276 | Breather Cap | |
| 167277 | Dowel Pin | |
| 167330 | Order 153362-1 | |
| 167350-3 | Radiator Assembly | |
| ‡ 167520 | Generator Fan | |
| ‡ 168002 | Plant Base | |
| ‡ 168503 | Armature Shaft | |
| ‡ 168505 | Generator Shaft Thrust Ring | |
| ‡ 168530-A-3P | Armature 115 Volt, 3 Phase | |
| ‡ 168530-A-3P | Armature Rewinding 115 Volt, 3 Phase | |
| ‡ 168530-AB-1P | Armature 115/230 Volt, 1 Phase | |
| ‡ 168530-B3P | Armature 230 Volt, 3 Phase | |
| ‡ 168530-B3P | Armature Rewinding 230 Volt, 3 Phase | |
| ‡ 168601 | Generator Frame | |
| ‡ 168650-B-7 | Automatic Switch 115/230 Volt, Single Phase | |
| ‡ 168650-A-3P-7 | Automatic Switch 115 Volt, 3 Phase | |
| ‡ 168650-B-3P-7 | Automatic Switch 230 Volt, 3 Phase | |
| 168676 | Order 158692 | |
| 168678 | Main Relay Coil 948-5 | |
| 168679 | Generator Relay Coil | |
| ‡ 168685 | Armature Lever with Brackets Only | |
| ‡ 168690 | Contact Finger Spring | |
| ‡ 168693 | Order 158655 | |
| ‡ 168710 | Order 161925 | |
| ‡ 168712 | ABC Resistor 120/240 Volt | |
| ‡ 168713 | Auxiliary Load Resistance | |
| ‡ 168714 | ABC Resistor 240 Volt | |
| 168818 | Metering Valve | |

‡ — 10 KVA Parts Only.

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SHIPPING POINT, SHEBOYGAN, WIS.

2M-6-59

PRINTED IN U. S. A.