KOHLER OF KOHLER

Electric Plants

Instructions

for

Operation and Care

and

Price List of Parts

for

1½ KVA Model 1E21H

110 Volt A. C.

Navy Model	Contract No.	Contract Date	Navy Type No.	Cycles
ER	NOs-3244A	4-14-42	CKC-73006	60
ER	NXs-3244	6-22-42	CKC-73006	60
ER-2	NXs-5802	5-22-42	CKC-73010	60
ES	NXs-5802	5-22-42	CKC-73008	25

KOHLER CO.

KOHLER, WISCONSIN, U. S. A.

KOHLER OF KOHLER

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Instruction and Parts List

for

1½ KVA Model 1E21H

110 Volt A. C.

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MOUNTAIN STATES SUPPLY CO. . *824 So. Main St., Salt Lake City, Utah*

3M-7-42

Kohler Co., Kohler, Wis.

STARTING A NEW PLANT

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

Fill the Crankcase

The engine base holds approximately seven quarts of oil and is filled through the cylinder head cover marked "OIL FILL HERE." Use SAE 20 in winter and SAE 30 in summer. Keep the oil level between the marks H and L on the oil level gauge. *Plant must set level.*

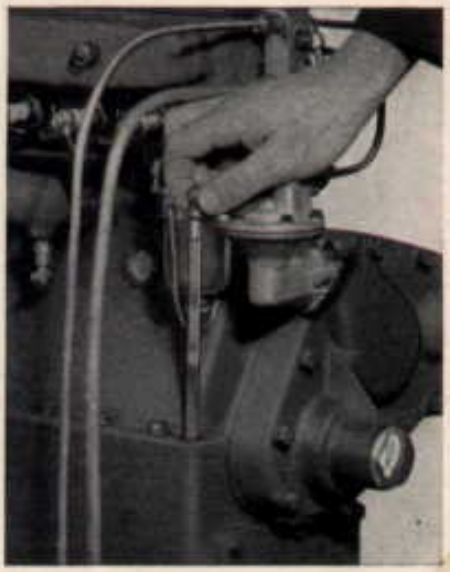


Figure 1

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

Fill Radiator

With pure soft water.

Fill Gasoline Supply Tank

Be sure the main line switch is open before filling supply tank. Do not over-fill tank. Examine plant for leakage.

Exhaust Line

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

Fuel Lines

Check all fuel line connections from plant to tank. Connections must be tight.

Fuel Pump

Operate priming lever of fuel pump until bowl is full.

Connect Starting Battery

The instructions for placing the battery in service should be followed; then battery should be connected to plant as covered by wiring diagram, Figure 13.

Start Plant

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

Oil Circulation

After starting a new plant or after changing oil, look through the small hole in the cylinder head cover (E, Figure 3) and observe whether the oil pump is delivering oil. Oil will be discharged from the copper tubing visible in this opening. In the event the oil is not visible, hold the butterfly valve of the carburetor almost closed so that the plant operates at very slow speed. Do not operate the plant if the oil does not circulate.

OPERATION AND CARE

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

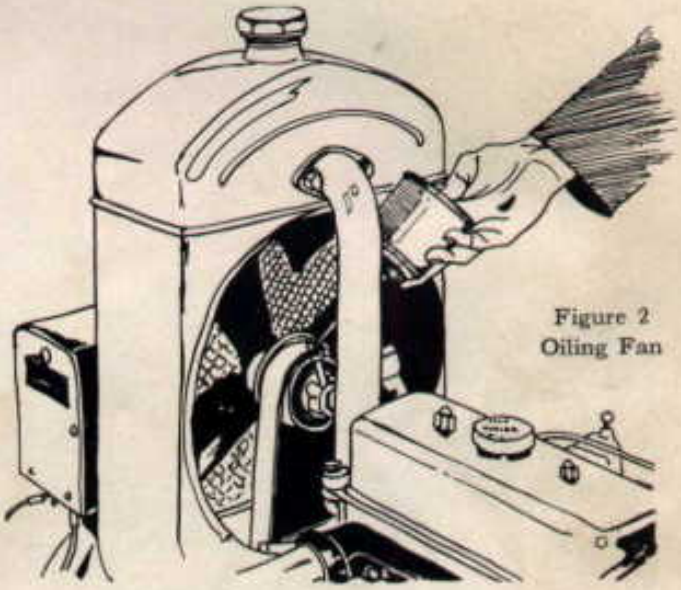


Figure 2
Oiling Fan

AFTER 50 HOURS OF OPERATION

Cooling System

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

Fan Belt

Examine the fan belt, oil the fan with medium oil.

Oil

Check oil level in crankcase.

Battery

Test the battery, adjust charging rate if necessary and add distilled water.

AFTER 200 HOURS OF OPERATION

Drain Oil and Refill Oil Base

See article on lubrication for viscosity of oil to be used.

Muffler

If muffler is used clean if necessary.

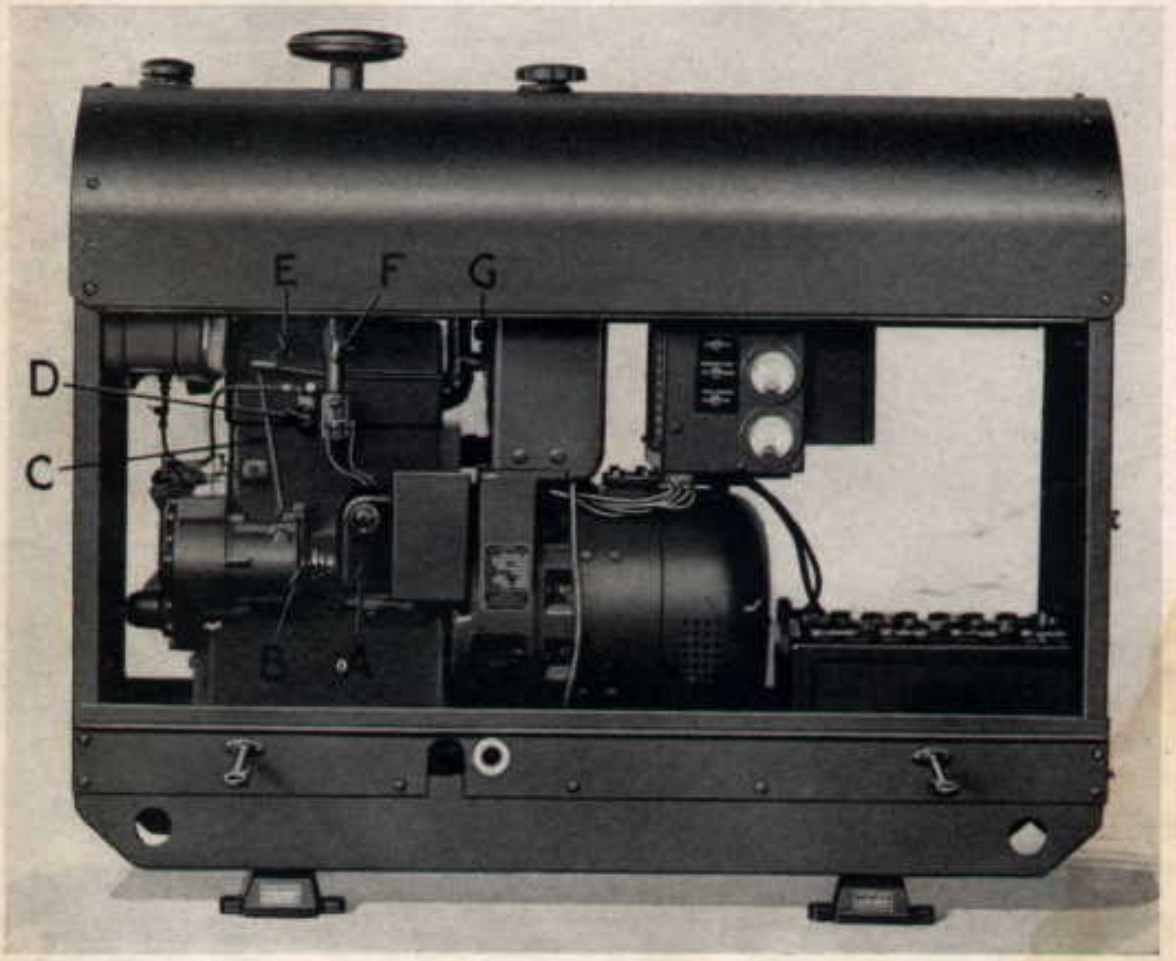


Figure 3

Carburetor Side of Plant (Door Removed)

A—Magneto
B—Governor stop
C—Governor lever
D—Carburetor
E—Oil sight hole
F—Choker
G—Fan oil cup

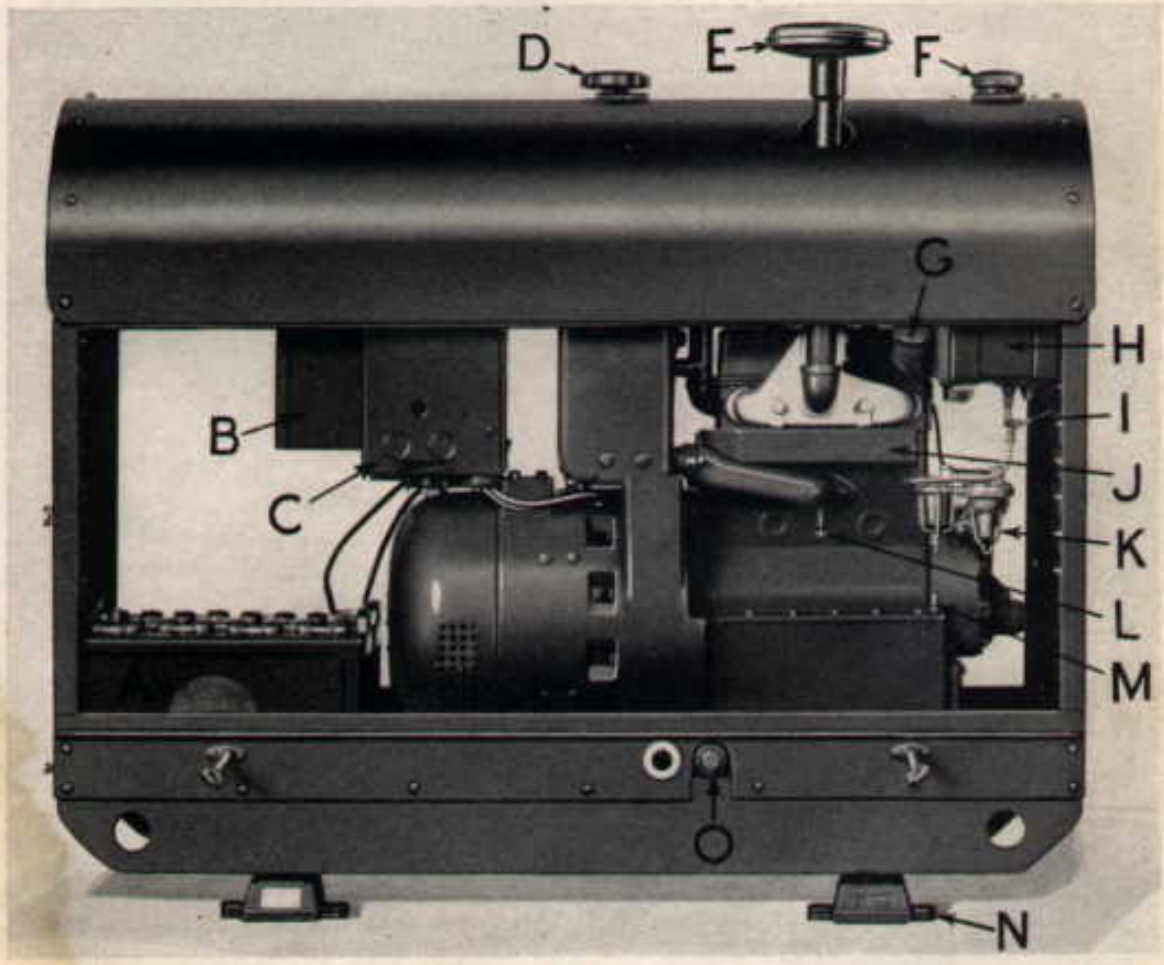


Figure 4

Exhaust Side of Plant (Door Removed)

A—Battery
B—Time delay relay
C—Control switch
D—Radiator cap
E—Exhaust muffler
F—Gasoline filler cap
G—Oil filler cap
H—Gasoline tank
I—Shut off valve
J—Spark plug shield
K—Fuel pump
L—Water drain
M—Oil gauge
N—Vibration damper
O—Oil drain

Valve Clearance

Check valve clearances and if necessary adjust clearance, when plant is hot, between .006" and .008".

Spark Plugs

Remove, clean and adjust. Plugs with small electrodes should be adjusted to .025" and plugs with heavy electrodes should be adjusted from .030 to .035".

Generator Ball Bearing

Lubricate by applying a good grade of cup grease. Do not permit grease to get on commutator.

Compression

Try the engine for compression and if valves leak regrind them.

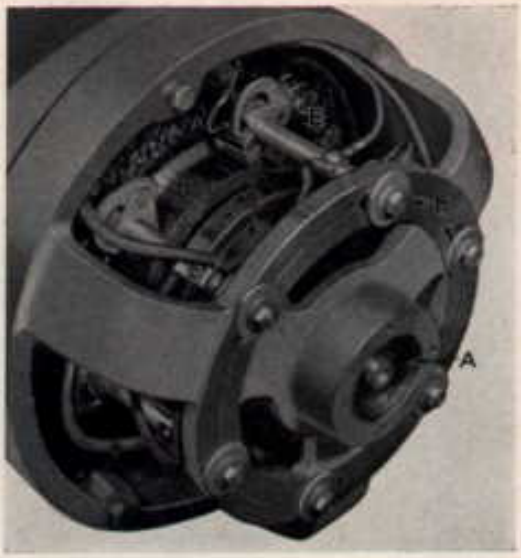


Figure 5

A—Generator Ball Bearing
B—Brush Holder Studs
C—Collector Rings
D—Commutator
E—Field Coils

Fuel Strainers

Check strainers in fuel line and clean if necessary.

Figure 6
Filling Oil Base
(Capacity 7 Quarts.)

Commutator and Collector Rings

Clean commutator and collector rings. If necessary sand brushes, commutator and collector rings with fine sandpaper. Adjust spring tension of brushes evenly.

Magneto Coupling

Lubricate magneto coupling with cup grease.

Magneto

Check the magneto according to instructions in magneto booklet.

LUBRICATION SYSTEM

The lubrication system provides for forced lubrication to main bearings and rocker arms, and splash to connecting rods, pistons and pins.

Changing Oil

The crankcase holds seven quarts of oil and this should be changed every 200 hours.

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

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

Oil Filter

An oil filter can be installed on these models and we will be pleased to mail information.

Figure 7
Draining Oil Base

IGNITION SYSTEM

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

Magneto

Follow the instructions in the magneto folder. The attention the magneto requires will depend upon the type used.

Timing Magneto to Engine

To time the magneto first remove the cylinder head cover and tighten down the cylinder head and rocker arm bolt nuts securely. Next adjust the valve clearance as previously described.

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

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

Removing and Replacing Magneto

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

Cleaning Breaker Points

A film of oil or dirt may at times collect on the contact points, which will prevent perfect short circuiting of the low tension winding. The points are best cleaned with a fine file or with a hone, taking care not to round off the edges. The points must face up SQUARELY OVER THE ENTIRE AREA.

Attaching Cables

The firing order is 1-3-4-2. Attach cables accordingly. If insulation on cables is worn or oil soaked, they should be replaced.

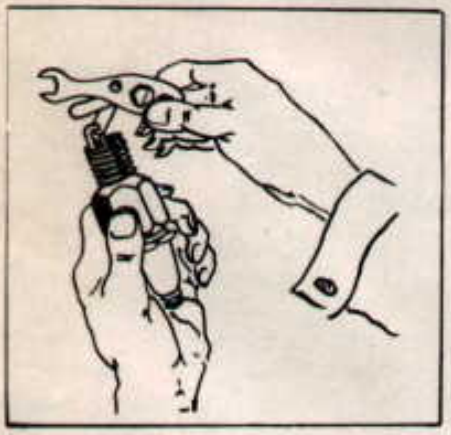


Figure 8
Adjust Gay to ½ Inch

Testing Magneto for Sparks

The magneto may be tested when engine is in operation. To do this, disconnect one cable from the spark plug. Start the engine under its own power and hold the end of detached cable within 1/16" of engine frame. The spark for each cylinder may be tested one at a time in this manner. Pliers with insulated handles should be used for holding the cable when making tests with plant in operation, or a slight shock or burn may result.

For further information see pamphlet on magneto.

Spark Plugs

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

The distance between points should be .025" for plugs having 1/32" wire electrodes. Heavy duty plugs, having 1/16" wire electrodes should have a gap adjustment of .030" to .035". This is equivalent to 1/32".

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

How to Test for Spark

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

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

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

COOLING SYSTEM

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

Radiator

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

If the plant is exposed to freezing temperatures add anti-freeze accordingly. The cooling system holds approximately 8½ quarts.

Fan

Oil the fan at regular intervals and make sure that it turns freely. Also, check the fan belt tension and condition of the belt. Replace if necessary. See instructions on installing fan belt.

FUEL SYSTEM

The fuel system consists of the gasoline storage tank, fuel pump, carburetor, choker and connecting tubing.

Carburetor

The carburetor is not adjustable, except that the mixture can be changed by changing the jets. The jets used are correct for sea level installations and should not be changed unless the plant is installed at a high altitude.

Dirt or Water in the Carburetor

When gasoline is dirty, a tiny speck of dirt may clog the aperture of a jet, and though the engine may continue to work, it does so imperfectly, giving indications of defective carburization. The jets can be quickly cleaned out by holding the hand over the air intake for a few seconds when running the motor fast, or the jets can be taken out by removing the brass hexagon nuts under the carburetor. If the engine speed and voltage are unsteady, particularly on light loads, the jets need cleaning. The carburetor should be washed in gasoline and the jets should be blown clean with compressed air. Water may be removed from the carburetor jets in the same manner, namely, removing the brass hexagon nuts.

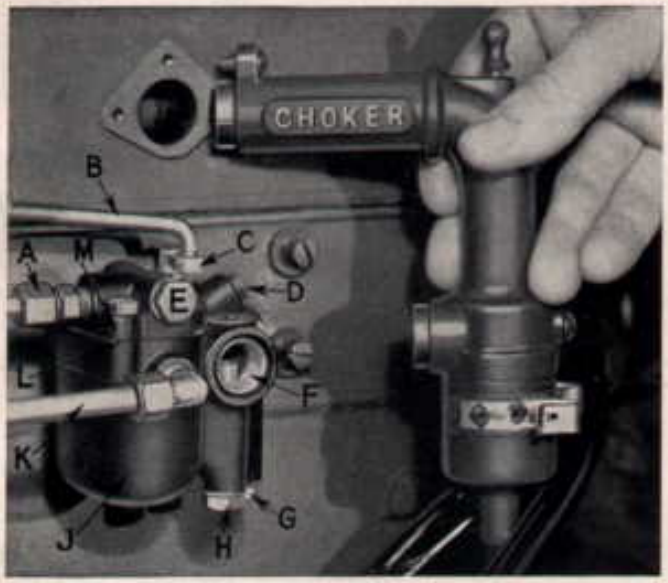


Figure 9
Carburetor

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

Fuel Pump

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

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

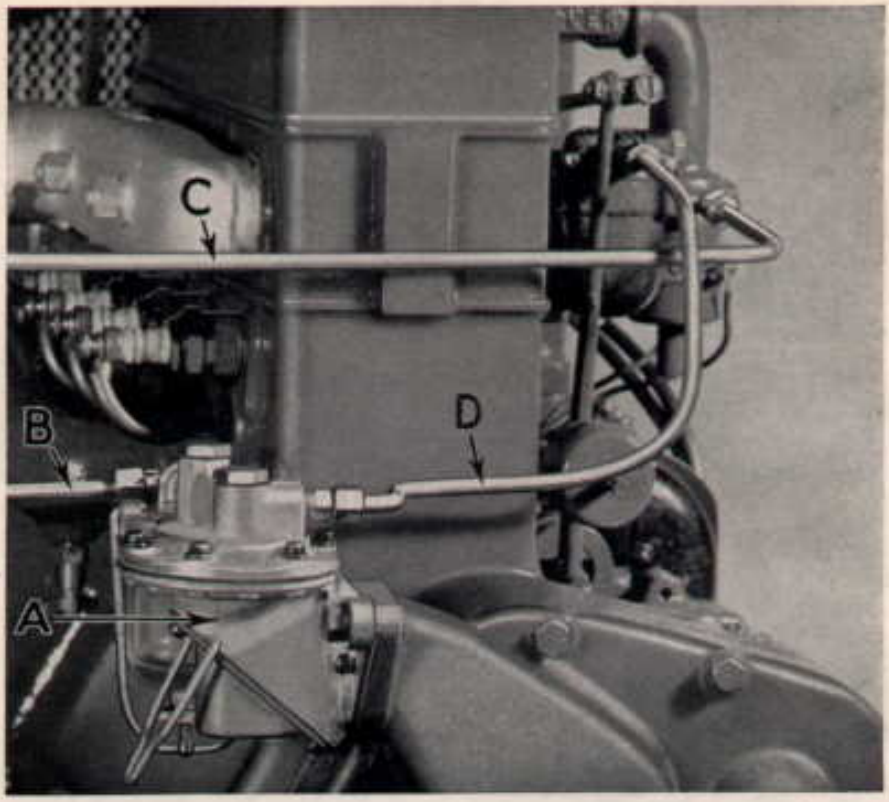


Figure 10

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

THERMOSTATIC CHOKE AND ELECTRIC CHOKE

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

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

Adjustment of Thermostat—See Figure 11

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

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

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

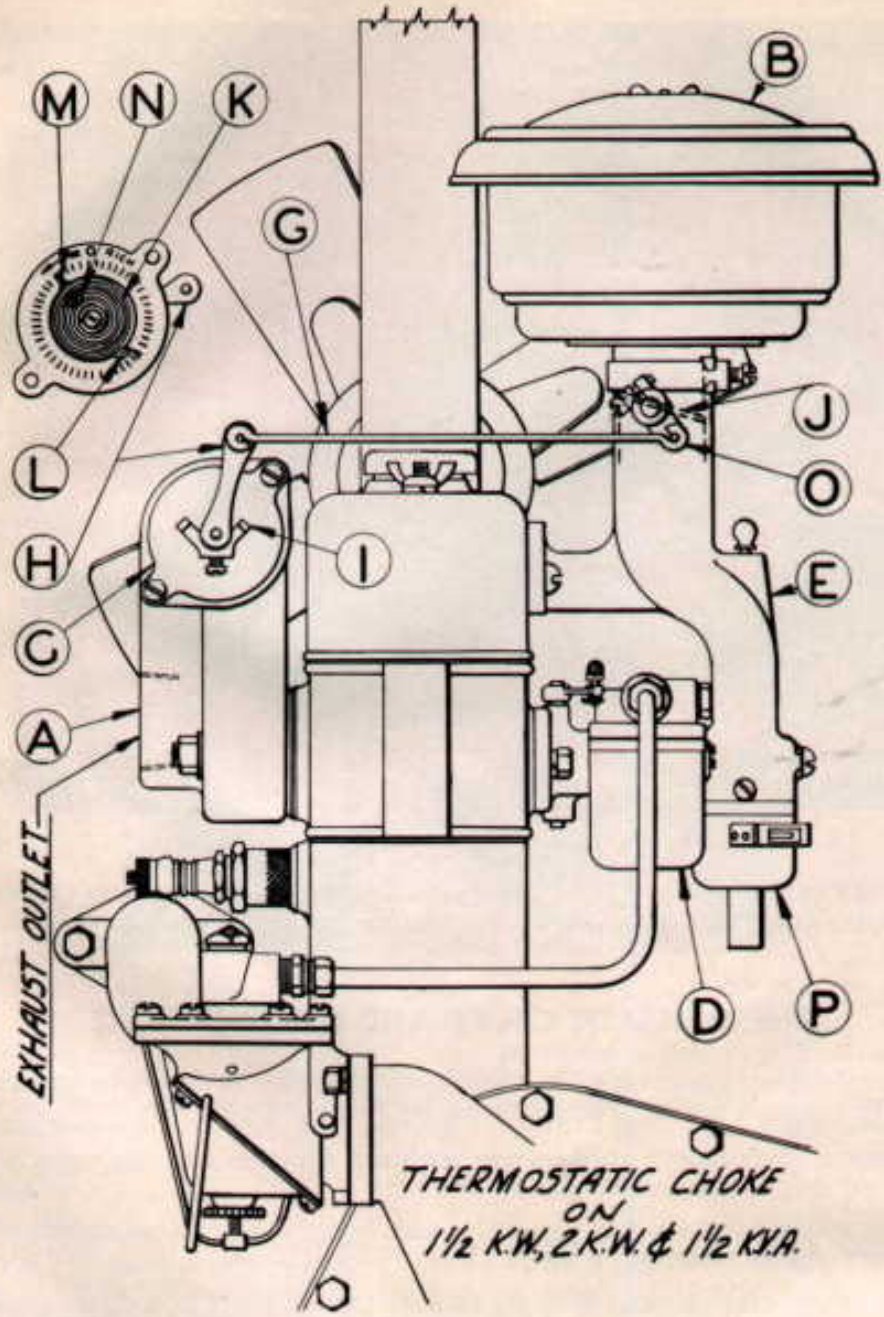


Figure 11

A—Exhaust Manifold No. 5451
B—Oil Bath Air Filter No. 4155
C—Thermostat No. AC-1970
D—Carburetor No. 5456
E—Choker Manifold No. 5520
G—Control Rod No. 5545
H—Thermostat Arm
I—Stop
J—Choker Valve
K—Thermostat Element
L—Adjustable Post
M—Indicator
N—Adjusting Screw
O—Choker Arm
P—Electric Choke No. D-699

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

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

Important

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

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

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

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

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

STARTING SYSTEM

The starting system consists of the starting battery and automatic switch.

Starting Battery

The starting battery is 32 volts and is kept charged automatically with a low trickle charger from the regular A.C. supply. The charging rate is adjustable and the high rate should be used if the low rate does not keep the battery charged.

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

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

How to Operate Plant Without Starting Battery

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

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

To Stop Plant After Battery is Disconnected

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

CONTROL SWITCH

Whenever the commercial line voltage drops sufficiently the emergency transfer relay operates to start the plant and transfer the load to the plant.

When the commercial line voltage returns to normal, the time delay relay prevents the load being transferred to the commercial line until the voltage has been without interruption for several minutes.

The control includes a transformer and rectifier for a trickle charge to the battery from whichever source of power is connected to the load circuit. The plant starts immediately on commercial line failure, regardless of the load requirements.

The complete operation of this control can best de described in seven major steps or positions.

Circuit No. 1

The first circuit prevails when the commercial line is supplying energy to the load circuit. One side of this line connects to terminal L-1, the connection G2, one terminal of transfer relay coil TC, through coil TC, Emergency Test switch ET, terminal No. 7, Time Delay relay TD terminal No. 1, the small enclosed switch or micro-switch MS to terminal L2 on this small panel to the combined L2-L3 terminal.

The circuit to the load line is completed when coil TC is energized by the commercial line current which has closed armature E of Emergency Relay ER against the stationary contact G2 which completes the load circuit to terminal L4 and the load, with the return to the L2-L3 terminal. Contact G1 is held open whenever G2 is closed.

Primary coil of Transformer TR is connected between relay armature E and terminal No. 2 and L2-L3, the battery charging transformer is energized from whichever source of power is being used on the load line.

The transformer secondary is electrically insulated from the primary and is connected to two terminals of the dry disc Rectifier RE with one side passing through the high rate HR resistance unit and LR the low rate resistance unit. The toggle switch BC by-passes the resistance LR to increase the trickle charge rate. The high or low rate may be selected at will. The ammeter AM indicates the actual trickle charge.

The battery must **always** be connected with + terminal to the Positive P terminal on the switch. If the battery is disconnected, the plant may be used as a manual plant, but if the battery is later connected with reversed polarity, the ammeter will burn out instantly and the transformer and rectifier may be damaged by the heavy reverse current.

The Time Delay relay TD has a magnet coil MC which is continuously energized from the commercial line as shown by the connections at L1 and L2-L3.

When coil TC is energized the contact bar C is held to the right which completes the "ground" circuit to the magneto terminal No. 5. This is the circuit which automatically stops the engine after the commercial line is restored and emergency power no longer required.

Circuit No. 2

The second circuit exists for an instant after a power line failure. The circuit to coil TC is open which releases armature from contact G2 and immediately closes against contact G1.

Current flows from battery terminal P to the stationary terminal of contact R1, coil T, then through the normally closed contact I, the recently closed contact C on Emergency Relay ER through the ON terminals of toggle switch SW, to terminal S2 to + brush on the generator, then through the commutator and armature windings to the minus − brush and the common generator and battery negative terminal at N. The magnet coil MC of the time delay relay is now also released since there is now no commercial or power line voltage to energize it. This moves the micro-switch MS to the position shown.

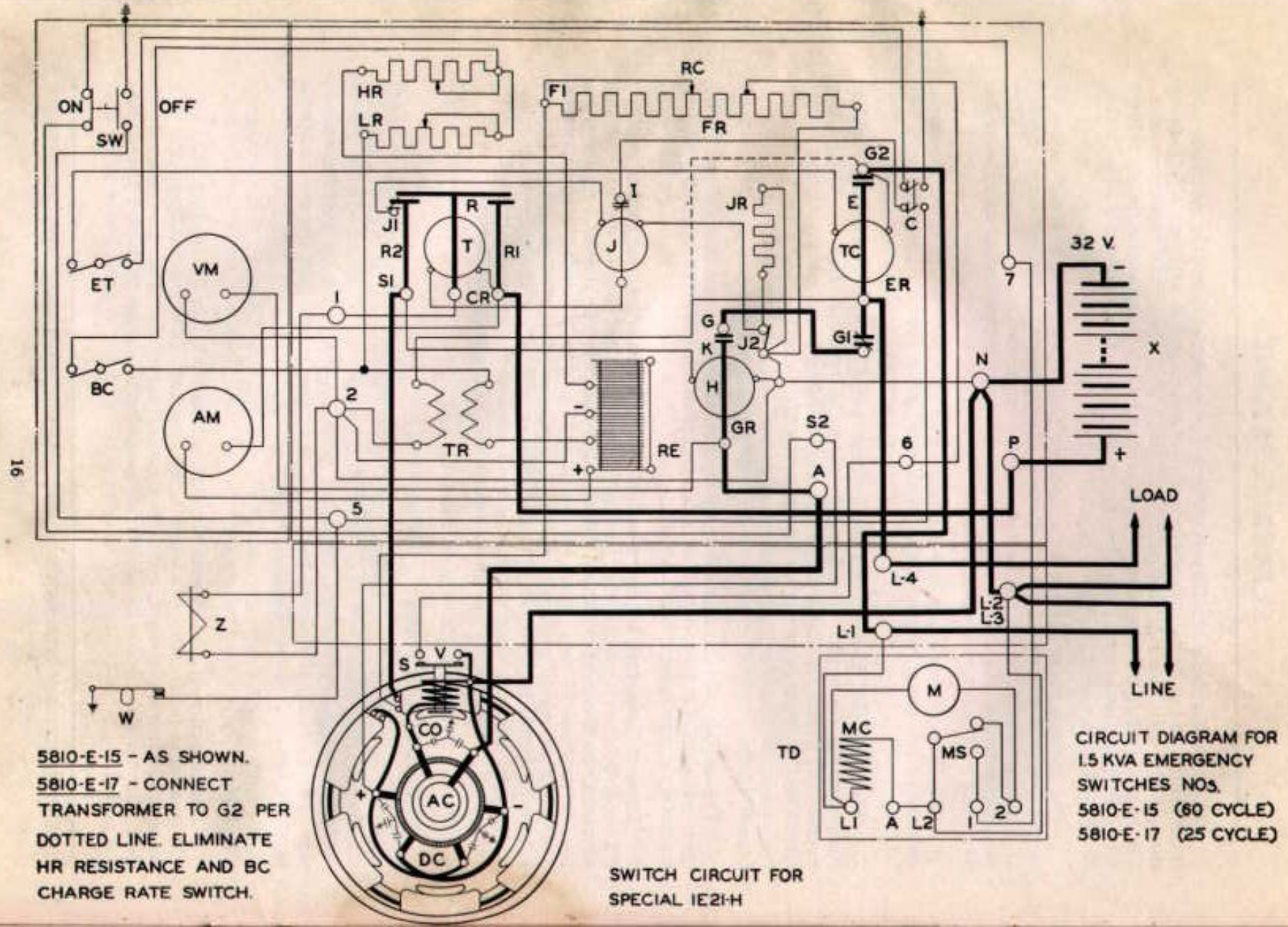
Failure of this circuit may be due to:

1. Switch SW is not in the ON position.
2. Contact C may not close with sufficient pressure.
3. Battery may be low or disconnected.

The emergency test switch ET is provided for an occasional inspection test by which only the circuit to coil TC is broken to see that the engine starts properly but without disturbing the time delay coil MC.

Circuit No. 3

Battery current now passes through contact R1, bar R, contact R2, wire S1, generator field coils, + exciter brush, exciter armature windings and the common return to generator and battery negative N. The generator shunt field is a parallel circuit which carries some battery current during the cranking period.



5810-E-15 - AS SHOWN.
5810-E-17 - CONNECT TRANSFORMER TO G2 PER DOTTED LINE. ELIMINATE HR RESISTANCE AND BC CHARGE RATE SWITCH.

SWITCH CIRCUIT FOR SPECIAL 1E21-H

CIRCUIT DIAGRAM FOR 1.5 KVA EMERGENCY SWITCHES NOS.
5810-E-15 (60 CYCLE)
5810-E-17 (25 CYCLE)

Figure 22

Wiring Diagram

A—Alternator Terminal
A—Unused Terminal on Time Delay Relay
AC—Alternator Collector Rings
AM—0-1 Battery Charge Ammeter
BC—Battery Charging Rate Switch
C—Magneto Ground Contact
CO—Condensers
CR—Cranking Relay
E—Emergency Relay Armature
ER—Emergency Relay Assembly
ET—Emergency Test Switch
F1—Shunt Field Terminal
FR—Field Resistance
G—Generator Relay Contact
G1—Emergency Relay Bottom Contact
G2—Emergency Relay Top Contact
GR—Generator Relay Assembly
H—Generator Relay Coil
HR—High Rate Battery Charge Resistance
I—Normally Closed Relay Contact
J—Relay Coil to Open Contact I
J1—Back Contact on Cranking Relay
J2—Normally Closed Contact on Generator Relay
JR—Series Resistance to Coil J
K—Generator Relay Armature
L1—Line Terminal
L1—Terminal in Time Delay Relay
L2-L3—Common AC Line and Load Terminal
L2—Terminal in Time Delay Relay
L4—Load Terminal
LR—Low Rate Battery Charging Resistance
M—Timing Motor
MC—Magnet Coil on Time Delay
MS—Micro Switch on Time Delay
N—Negative Battery and Generator Terminal
ON—Control Switch Position
OFF—Control Switch Position
P—Positive Battery Terminal
R—Cranking Relay Armature Contact
RE—Dry Disc Rectifier
RC—Exciter Field Adjusting Clip
R1—Cranking Relay Stationary Contact
R2—Cranking Relay Stationary Contact
S—Generator Voltage Booster Relay
S1—Cranking Series Wire
S2—Exciter Positive Wire
SW—Control Switch
T—Cranking Relay Coil
TD—Time Delay Relay Assembly
TR—Battery Charging Transformer
TC—Emergency Relay Transfer Coil
V—Generator Booster Relay Contact
VM—AC Voltmeter
W—Magneto
X—Starting Battery
Z—Engine Choker
+ —Positive Battery Terminal
+ —Positive Exciter Brushes
– —Negative Battery Terminal
– —Negative Exciter Terminal
1—Engine Choker Terminal
1—Control Terminal in Relay Delay
2—Choker and Voltmeter Terminal
2—Blank Terminal on Delay Relay
5—Magneto Terminal
6—Field Relay Terminal
7—Panel Terminal to Delay Relay

Failure of the engine to crank may be because of:

1. A weak battery.
2. Engine too tight.
3. Engine oil may be too heavy.
4. If cranking relay chatters, the battery is probably weak or is of too small capacity for local starting conditions. Engine choker Z is connected to terminals No. 1 and No. 2 and is energized only during the cranking period.

Circuit No. 4

After the engine starts running, the exciter (which is also the cranking motor) builds up a voltage equal and opposite to that of the battery. At this point Coil T is at zero voltage and releases armature R which disconnects the battery from the cranking circuit. Contact J1 closes when this armature is released which permits exciter current to pass from S1, through I1, coil J, the normally closed contact J2 and the common return N. Failure of the fourth circuit may be caused by:

1. The engine does not run at normal speed.
2. Relay contact R fails to open at the right time.

Circuit No. 5

The fifth circuit is almost simultaneous with the fourth circuit, as coil J is energized instantly when contact J1 closes. Coil J opens contact I when energized as explained in the fourth circuit. Contact I must open almost instantly after J1 closes to prevent the exciter current from recharging the battery from terminal S2 through the ON switch, contact C, contact I and coil T which might be sufficient to keep contact R closed and the cranking relay could not release. Therefore, relay J should not be adjusted except by one who is very familiar with this complete control switch.

Circuit No. 6

Coil H is energized by direct current from the exciter as there is a circuit from S1 through coil H to the common N terminal which is not effective during the cranking period with only 32 volts but does close contact K against G when exciter reaches about 40 volts. The movement of armature K also opens contact J2 which adds resistance JR into the circuit of coil J to prevent coil J from overheating during long periods of use. The AC output circuit from the inner AC collector ring through the brush goes to terminal A, armature K of generator relay GR, contact G1 to line terminal L4 and the load. The return path is through L2-L3, common terminal N through the series coil on the small relay S mounted on the generator end bracket and collector ring.

The voltmeter VM indicates only the AC voltage of the emergency generator. The exciter shunt field circuit is from the – exciter brush through the shunt field, terminal F1, field adjustable resistance FR to the common negative N return. At approximately half load, the series coil on relay S is sufficiently energized to close the contacts at V which short-circuits the right hand portion of the field resistance FR which causes a definite voltage increase above half load. Usually any small motor will cause relay S to close and may only release when motor is turned off. This relay may close on any current surge above 8 amperes and may not release until line current drops below 5 amperes. This relay has no adjustment and usually needs no attention.

Circuit No. 7

After the commercial or power line voltage has been restored, when the AC voltage returns to terminals L1 and L2-L3, the time delay relay TD is connected as shown with the timing Motor M in the circuit. The time of delay is determined by the dial setting. The magnet coil MC is also energized during this delay period which holds the dog in position for the timing motor to trip the micro-switch MS at the end of the delay period. Finally switch MS snaps to the new position which disconnects the motor M and connects terminal No. 1 of the time delay device which closes the line circuit through coil TC which transfers relay ER from the G1 to the G2 position. Any interruption in the commercial line voltage will cause the time delay device to re-set and start a new timing interval.

The plant continues to supply power to the load circuit until armature E closes against terminal G2 which also moves contact C to ground the magneto.

The emergency transfer switch ET should always be in NORMAL position except for a daily or weekly test run as desired. Then this switch should be turned to the TEST position for such test run. If there has been no interruption in the commercial line, the time delay relay does not operate when switch ET is returned to the NORMAL position.

If the battery terminals are connected in reversed polarity, the ammeter will burn out almost instantly, even without engine running or without any connection to the commercial line.

Switch SW may be left in the OFF position during times when no emergency power is required, or if a mechanic wishes to work around the engine or generator without fear of injury when engine may start because of power line failure. However, the switch must be turned to the ON position after engine repairs are made and when the emergency protection is desired.

Special Switch 5810E17—25 Cycle

This switch has a special 25 cycle coil at TC when the commercial line is 25 cycle and the emergency generator 60 cycle. The battery charging transformer is also 25 cycle and only one trickle charge rate provided, with no trickle charge when the emergency plant is running. The time delay relay also has a 25 cycle magnet coil and clock movement which must only be used on 25 cycle service.

REPAIRS AND ADJUSTMENTS

Caution

If the plant does not operate properly and the owner feels that the plant is at fault, he can test it by using the test switch ET. If plant operates properly it is an indication that the fault lies outside of the machine. However, if the plant does not function as it should repairs or adjustments are necessary.

Always disconnect the battery before making an adjustment or doing repair work of any kind on the plant. This will prevent all possibility of electric shocks and sparks. The latter might be the cause of fires or explosions if they come in contact with gasoline from the carburetor or fuel lines.

Overloading

If properly installed and cared for, the plant can be depended upon to furnish 110 volt current up to its rated capacity. There is a tendency on the part of some owners to put a far greater load on the plant than it was ever designed to carry. This should not be done. While the Kohler Plant is a very rugged and substantially built machine, continued overloading is certain to cause trouble and expense.

Short Circuits or Grounds

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

Stop the Plant Immediately and Make an Investigation

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

Open Circuits

The engine will not start automatically if there is an open circuit in the line between the engine and the light or appliance that is turned on. An open circuit in the external wiring will not affect the operation of the plant except that no light will be obtained beyond the point where the circuit is broken.

Grounded Circuit

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

Short Circuit

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

Tracing Defects in Wiring System

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

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

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

Testing Generator for Ground

In testing for "grounds", it is necessary to find some approximate location of the trouble before starting. Perhaps the trouble may be from the starting battery case on a wet concrete floor. If it is certain the trouble is at the plant, put a strip of dry paper under each brush so the brushes do not touch the commutator or the copper collector rings. This isolates the armature so it may be tested separately. Use a telephone, magneto ringer, or other test device.

The two collector rings are connected together by proper armature coils so one "ground" would show trouble on both rings. The commutator is thoroughly insulated from the collector rings only when all brushes are supported by dry paper or otherwise raised, as already suggested. Thus two sections of the armature may be individually tested.

If no armature trouble is found, then the automatic switch may be disconnected including the electric choker and the governor switch. Then tests can be made of the separate circuits to get closer to the fault. Sometimes a stray wire or some terminal twisted against the frame may be the trouble and easily remedied or some terminal twisted against the frame may be the trouble and easily remedied.

If it is necessary to remove the automatic switch for further investigation, the marking of each terminal should be carefully noted so everything can be properly assembled.

Removal of Armature

If it is necessary to remove the armature, the following general procedure should be taken: After end cover has been removed, lift all brushes from their holders and let them hang by the flexible leads. Next remove the cap screws from the heavy brass brush studs and thus disconnect the wires which go from the brushes to the field coils and generator frame. Where there are two wires under one screw, these should be tied together so no error will be made on assembly from the heavy brass brush studs and thus disconnect the wires which go from the brushes to the field coils and generator frame. Where there are two wires under one screw, these should be tied together so no error will be made on assembly.

Now the generator end bracket may be removed after removing the three cap screws which hold it in place. This should be properly marked before removal. This bracket holds the armature ball bearing so must be removed evenly and may be tapped with a light hammer, if the bearing race sticks. Great care should be taken that the copper armature rings are not damaged on the polished outer surface.

The armature may be removed with a special puller after ball bearing has been removed. The armature has a keyway and the shaft has a key which must be properly lined up when replacing. The armature should not be driven in place but should be pressed on with a special threaded tool.

Removal of Generator Frame

The generator frame and field coil assembly may be removed as a unit without disturbing the armature. All generator brushes are removed from the holders as already described for armature removal. The flexible brush leads are not unfastened as this is not easy with an ordinary wrench and the brushes should not be mixed after having been properly fitted.

It is not necessary to remove the automatic switch although probably advisable to reduce weight and avoid damage. The end bracket supporting the armature and wires to the brush studs are not disturbed as this is a part of the frame assembly.

Remove eight cap acrews which hold the generator frame to engine housing. Now an iron bar may be used between the end of the armature and the end bracket to force the generator frame from the engine about one inch. At this point the frame lies on the armature and should be supported and removed easily to prevent damage to the armature.

This process is to be reversed during assembly. There is a counter-bore where the generator frame bolts to engine housing which centers the two frames. A bar under the generator frame may be used while bolts are being tightened. The end bracket may also be tapped lightly near armature ball bearing so it will enter properly. This should be tapped again after frame has been tightened to the engine, so this ball bearing will properly align itself.

Any repairs or renewals may be made to the generator field coils after frame is removed. Each field pole is held in place by two bolts through generator frame. The field poles are built-up with thin sheets of soft iron in which the threads can be "stripped" if too much strength is used when putting field poles in place.

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 other end to coil terminals; 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 in Field Coils

The exciter field coils consist of two insulated coils taped as a single coil. Put a piece of dry paper under each brush as already described before testing armature for "grounds." Now remove cable "S1" from its terminal post on back of automatic switch. Also remove cable "F" from its post. Now test for a complete circuit from plus exciter brush to the "S1" cable terminal. A single dry cell may be used for this test as the resistance is very low and a spark should be seen when touching and removing the test wire. Now test the exciter shunt field circuit by putting one of the test wires on "plus" exciter brush stud and the other on wire terminal "F" which has already been disconnected from the automatic switch. A part or all of which has already been disconnected from the automatic switch. A part or all of the starting battery may be used to test this shunt field circuit. If a 32 volt lamp is used in the circuit from the starting to the circuit under test, then all tests can be made with the same equipment. On short circuits, the lamp will burn brightly. On other circuits a dull glow will indicate that there are no broken wires.

The alternator field is connected to the exciter brush studs with a single terminal on each end. It is only necessary to disconnect one end of the exciter field from the brush stud in order to apply the test equipment to locate any open alternator field connection. The joints are usually the first and easiest places to look for open circuits. With generator frame removed, each joint between field coils may be untaped and examined, however all terminals should first be examined as some unusual strain may have pulled off a terminal which may be still held in position by tape or other insulation. Many troubles here mentioned will never happen, however, this is only a guide to a systematic procedure which should be of help when an expert is not available.

Care of Commutator and Collector Rings

The commutator, collector rings and brushes are the only parts of the generator which are subject to wear. Under proper conditions of cleanliness and adjustment, the commutator and collector rings takes on a mahogany-colored polish, which is highly desirable for satisfactory operation.

It is very necessary that the plant be protected from flying dirt or dust, which would be drawn into the machine, collect on the commutator, collector rings and brushes, and cause them to wear rapidly. Dirt, oil and water are very injurious to any kind of electrical machinery.

The only care that the commutator and collector rings should have, is to keep them clean. Do not put oil or other lubricant on them. Wipe them off with a clean cloth occasionally. If the commutator gets gummy or sticky, it may be cleaned with a cloth dipped in gasoline or alcohol. Do not operate after cleaning with gasoline or alcohol until parts are dry, as a spark may ignite the volatile gases. Keep slots clean or sparking will result.

Under-cut the mica to a depth of about 1/32" below the surface of the bars when the bars wear down to the mica.

Brushes

The brushes must fit in their holders so that they are free to move without sticking or binding, yet not so loose that they will chatter or get out of alignment.

The end of the brush must be sand-papered until it fits the radius of the commutator and collector rings on which it rests. After a period of use, a gummy substance will collect on the brushes; this comes from the brushes, and also from dirt and dust drawn into the generator. The brushes may be withdrawn from their holder and cleaned with gasoline or alcohol.

The spring tension should be sufficient to press each brush against the commutator with a **uniform tension.** It is very important that each brush have an equal pressure. If one of the springs is too weak, the opposite brush will have to take more than its share of the load, and sparking and damage to the commutator will result.

Compression

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

Following are the causes for poor compression:

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

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

Removing Cylinder Head

Drain all water from cooling system, after which remove all water and gasoline connections. The nuts holding rocker arm brackets to head should then be removed and the entire assembly lifted off. Remove the eight push rods and lay them out carefully, so they can be replaced in their original position. Unscrew the nine nuts holding cylinder head and lift head, and carburetor assembly off the engine. Be sure not to injure the copper asbestos cylinder head gasket. Do not pry the head up with a screwdriver. Use a block of wood, tapping gently until the head is loosened. (See Fig. 17.)

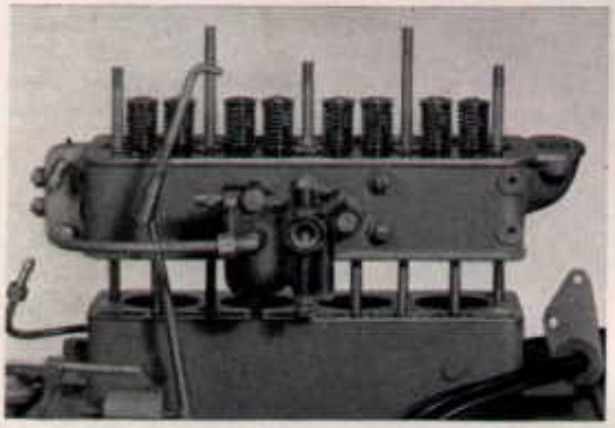


Figure 17
Removing Cylinder Head

Grinding Valves

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

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

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

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

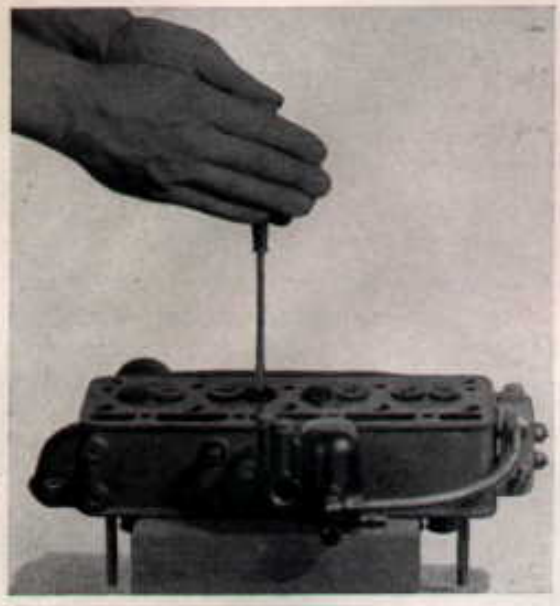


Figure 18

Grinding Valves

Clean the valve seat in the cylinder head and the face of the valve with gasoline occasionally to see how the grinding is progressing. To have a good seat it is necessary for both to be free of all pits and grooves and for both seat and valve to show a uniform light gray band all the way around. It is not necessary to have the valve seating across its entire width. If the band is 1/32" wide it will make a good seat. When finally replacing the valve, oil the valve stem and clean out all vestiges of the grinding compound from the valve chamber. (See Fig. 18.)

Replacing the Cylinder Head

To replace the cylinder head, reverse the method given for removing. Carefully clean the joint surfaces and the gasket, and coat both sides of copper asbestos gasket with shellac, being careful not to get too much around the openings for cylinders. Replace the push rods in their original positions, being certain they center in the socket in tappet. When replacing the nuts holding head to cylinder, tighten down evenly, as there is a danger of wrinkling the gasket, causing a water leak. Replace all water and gasoline connections. Coat gaskets with grease or vaseline, and be careful to get connections water and air tight.

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

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

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

In making the adjustment necessary to secure the proper clearance, first loosen the upper lock nut on the rocker arm. Then by turning the adjusting screw to the right or left, the clearance can be decreased or increased. Be sure to lock the adjustment securely with the lock nut after adjustment is made. To do this, hold the screw tight with a screw driver while the top nut is tightened. (See Fig. 19.) **Valve clearance adjustment should be made while the engine is warm.**

Figure 19
Adjusting Valve Clearance

Installing Fan Belt

To install the fan belt observe the following instructions: (See Fig. 20.)

1. Disconnect battery leads.
2. Remove the 5 wires from terminal block of automatic switch.
3. Remove generator brushes from brush holders.
4. Remove cap screws which join generator housing to engine.
5. Lift off switch and generator assembly as illustrated.
6. Lower fan and remove old belt.
7. Place endless belt over armature, then on flywheel pulley.
8. Lower fan and slip belt on fan pulley.
9. Tighten fan in position with proper tension on belt.
10. Replace generator and automatic switch assembly, being careful that the outer race of the generator bearing enters squarely into the hole in the armature support bracket.
11. Replace the generator cap screws, but before tightening them, take a small block of wood and hammer and tap lightly against the armature support bracket above and below the generator ball bearing hole. This, together with tightening the cap screws, will force the generator frame tightly against the engine bell housing, close up the joint and align the generator ball bearing in armature support bracket.
12. Replace terminal wires, generator brushes and battery leads.

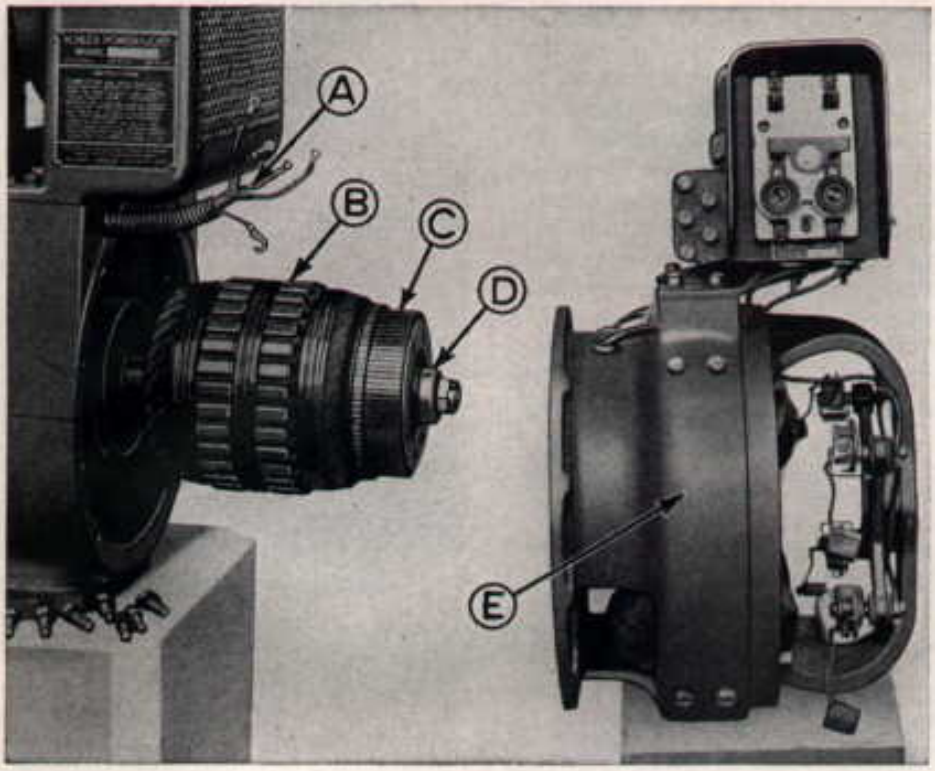


Figure 20

Generator and Switch Removed

A—Wire Accessory
B—Armature
C—Commutator
D—Generator Ball Bearing
E—Generator

13. After generator is completely assembled start the plant and listen closely to the generator ball bearing. If it is quiet the bearing is in alignment. If it is noisy the bearing is out of alignment. Use a block of wood and hammer and tap lightly above and below the bearing until it runs quietly. If the support bracket is driven in too far the bearing will be out of alignment the other way. The remedy is to insert a screw driver between the end of armature and pry the bracket out slightly.

GENERAL INFORMATION

Fuel Consumption

The following factors determine the fuel consumption:

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—Lamps and appliances may be rated to carry a certain specified load, but 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. 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 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 and Appliances

Since the current generated by a Kohler Electric Plant compares favorably with current generated by city or high line service stations, it is possible to connect motors and appliances to the line supplied by a Kohler Electric Plant providing such motors and appliances are of the same voltage and type of current as supplied by the plant. Accordingly, the alternating current, 115 volt plant will operate alternating current, 115 volt motors of various capacities up to the rated output of the plant.

Special Installations

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

Radio Interference

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

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

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

DIAGNOSIS OF TROUBLES AND THEIR REMEDIES

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

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

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

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

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

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

I. Engine Fails To Crank Automatically When A Light Is Turned On

1. 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.
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. Generator not functioning properly. The following are causes for non-functioning of the generator: (1) dirty commutator; (2) worn, broken or sticking brushes; (3) broken brush springs; (4) broken or loose wires; (5) ground, short circuit or open circuit in armature. Grounds and short circuits in the armature are caused by rough handling, water or oil soaking insulation, defective insulation in coils, crushed lead wire or foreign substance lodging between commutator bars. An open circuit may be caused by wires being burned, due to short circuit, leads not soldered properly or solder broken away.
7. 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. (1) sticking of needle valve in the carburetor; (2) excessive choking, due to sticking, rusted or bent valve or stem; (3) clogged main or compensating jet, due to foreign substances in fuel. **Avoid use of varnish or paint cans as fuel containers.**
3. Fuel pump at fault.
4. Defective magneto due to: (1) over-oiling, which causes dirty distributor brushes; (2) dirty rotating disc; (3) dirty collector ring; (4) worn or improperly adjusted breaker points; (5) loose or defective cables; (6) short circuit between brushes, caused by crack in distributor plate; (7) burnt out armature or condenser.
5. Defective, cracked or fouled spark plugs. Points not adjsuted 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 7. 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 cylinder due to: (1) leaky cylinder head gasket; (2) cracked cylinder block or head; (3) condensation from a long exhaust not fitted with a water drain.

III. Engine Cranks Slowly Under Battery Current

This may be due to the following causes: (1) weak battery; (2) use of too heavy motor oil (use only light oil in cold weather); (3) partial short circuit in the armature; (4) open or short circuit in armature or field coils; (5) short circuit in third circuit of automatic switch. If plant has been repaired, this may indicate tight bearings or generator not in alignment.

IV. Engine Starts But Misfires

Caused by the following: (1) 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 cylinder. (6) tappets out of adjustment, giving too much or too little clearance for the valves; (7) weak or broken valve springs; (8) bent, worn, or sticking valve stems; (9) air leak between intake manifold and carburetor; (10) water in gasoline; (11) excessive lubrication; (12) mixture too lean (main compensating jet or spray nozzle should be set in center of venturi tube); (13) choker valve caught up, causing too rich mixture; (14) water in cylinder.

V. Engine 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 matters, frozen or condensed water, or exhausting of gas into closed area; (11) spray nozzle not in center of venturi tube of carburetor; (12) air leak from push rod clearance passage into intake manifold, due to crack or sand hole in casting.

VI. Engine Kicks Back When Being Cranked By Hand

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

VII. Engine Knocks

Knocking in engine may be due to the following causes: (1) excessive carbon in cylinder 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.

VIII. 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.

IX. 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.

X. Engine Runs But Fails To Generate

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

XI. 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) clogged muffler; (7) valves out of adjustment; (8) not enough ventilation; (9) irregular load.

XII. Engine Fails To Stop

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

XIII. 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.

XIV. Engine Runs Too Fast

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

XV. 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.

XVI. 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.

XVII. Engine Runs At Slow Speed

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.

XVIII. 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) fuel pump defective.

REPAIR PARTS

How to Order Repair Parts

Follow these instructions carefully so as to avoid errors and consequent delay:

1. Use order blank in this book.

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

3. Give MODEL and SERIAL NUMBER of your plant, as K-3352 (see instruction plate on radiator shell of plant.)

4. Write plainly the following data:
   a. Quantity of each part desired.
   b. Part number—such as D-504.
   c. Description of part—such as Oil Base Baffle Plate.

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

6. 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 own 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 rerurn 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.

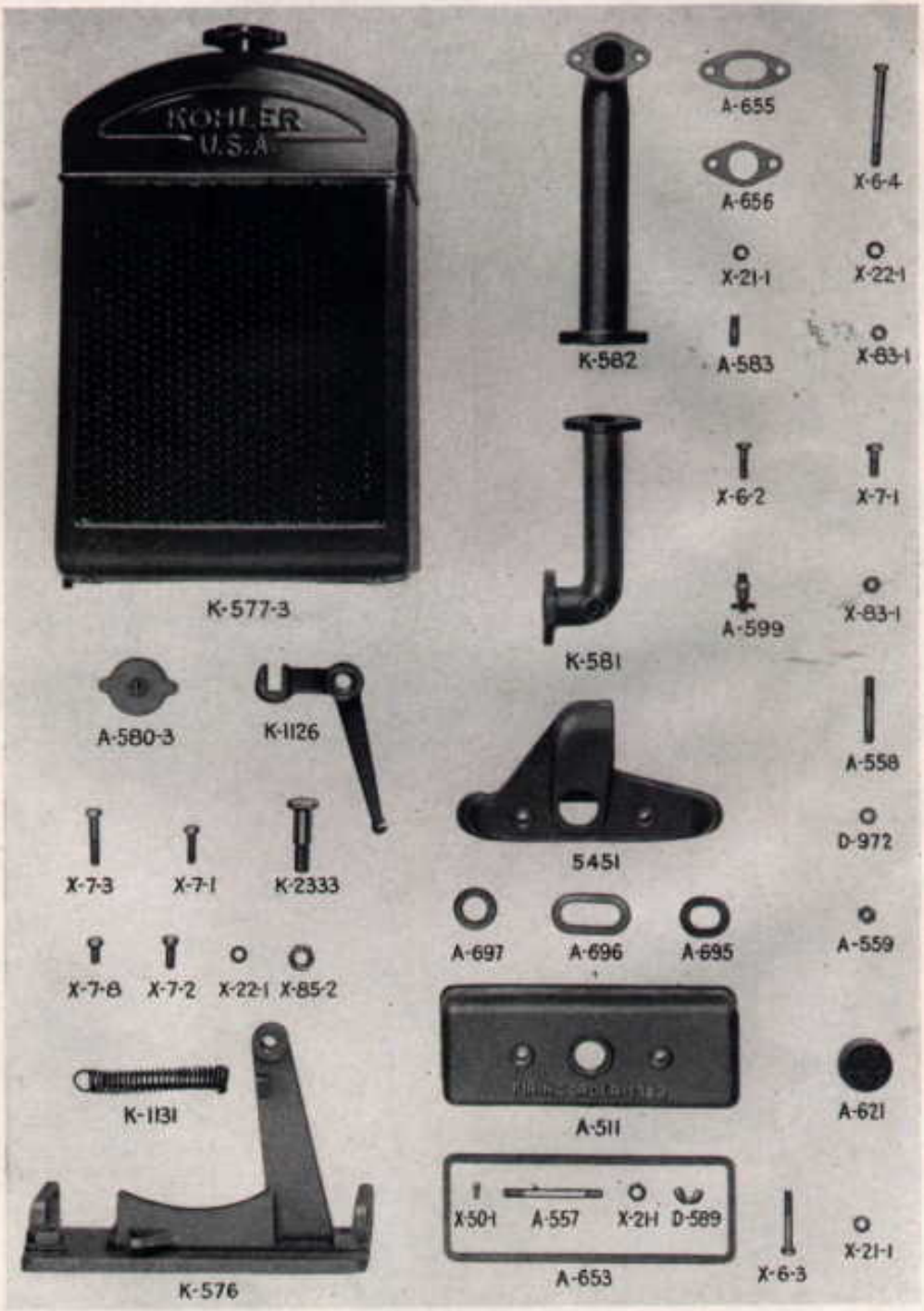
CLAIMS FOR SHORTAGE

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

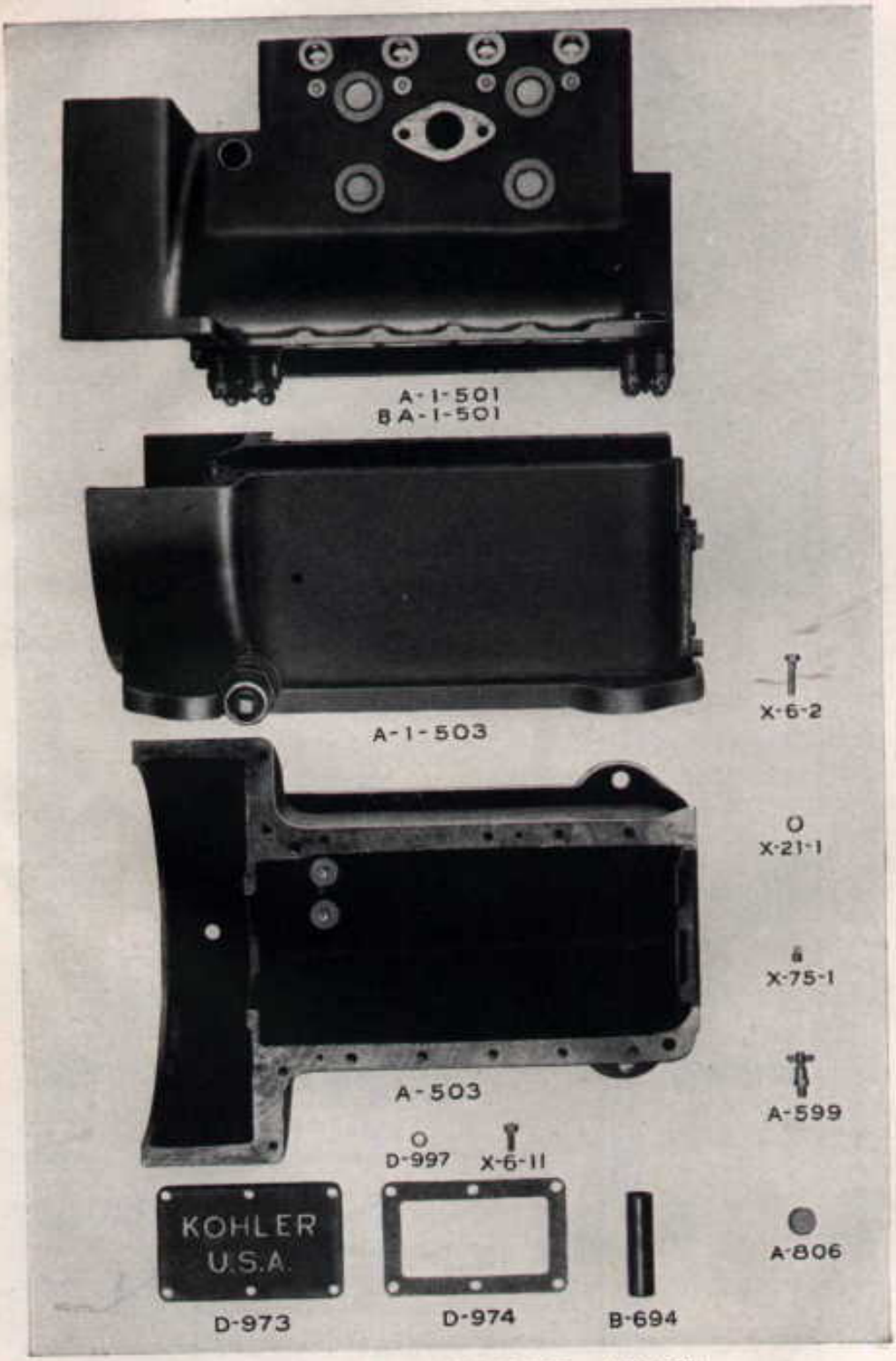
PRICES

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.

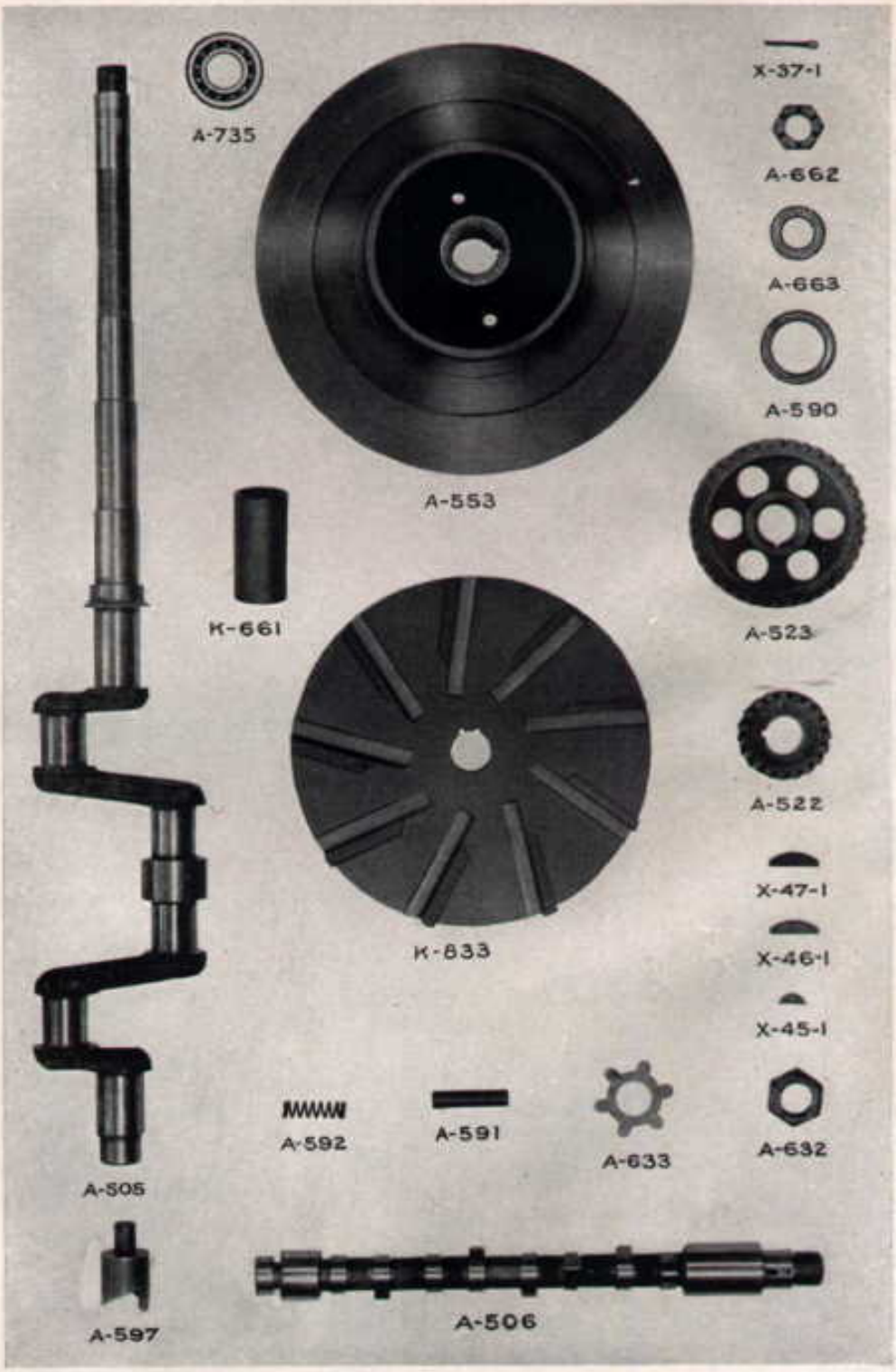
Due to changes in cost of materials, prices are subject to change without notice.



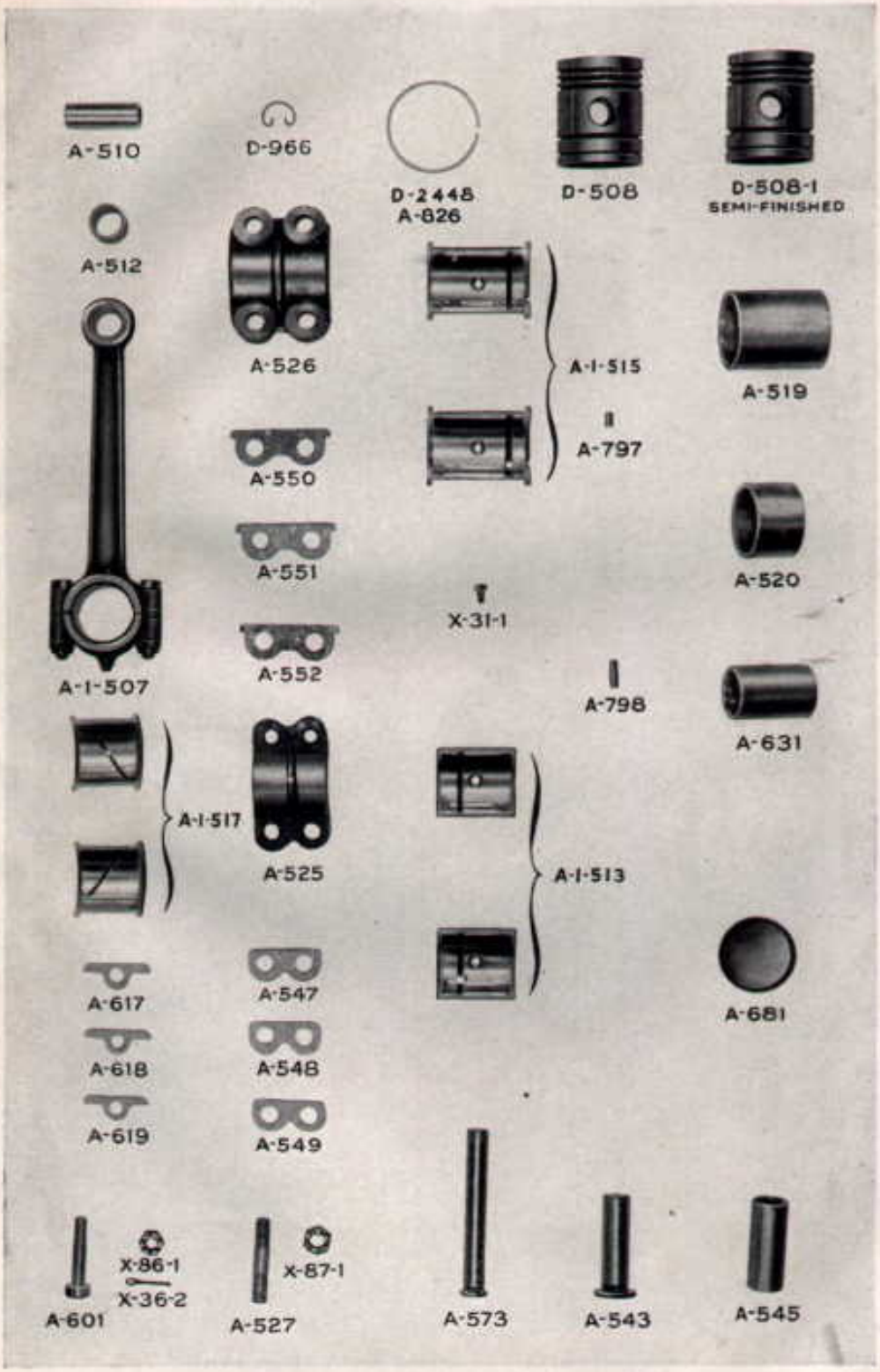
RADIATOR, RADIATOR SUPPORT, and MANIFOLDS



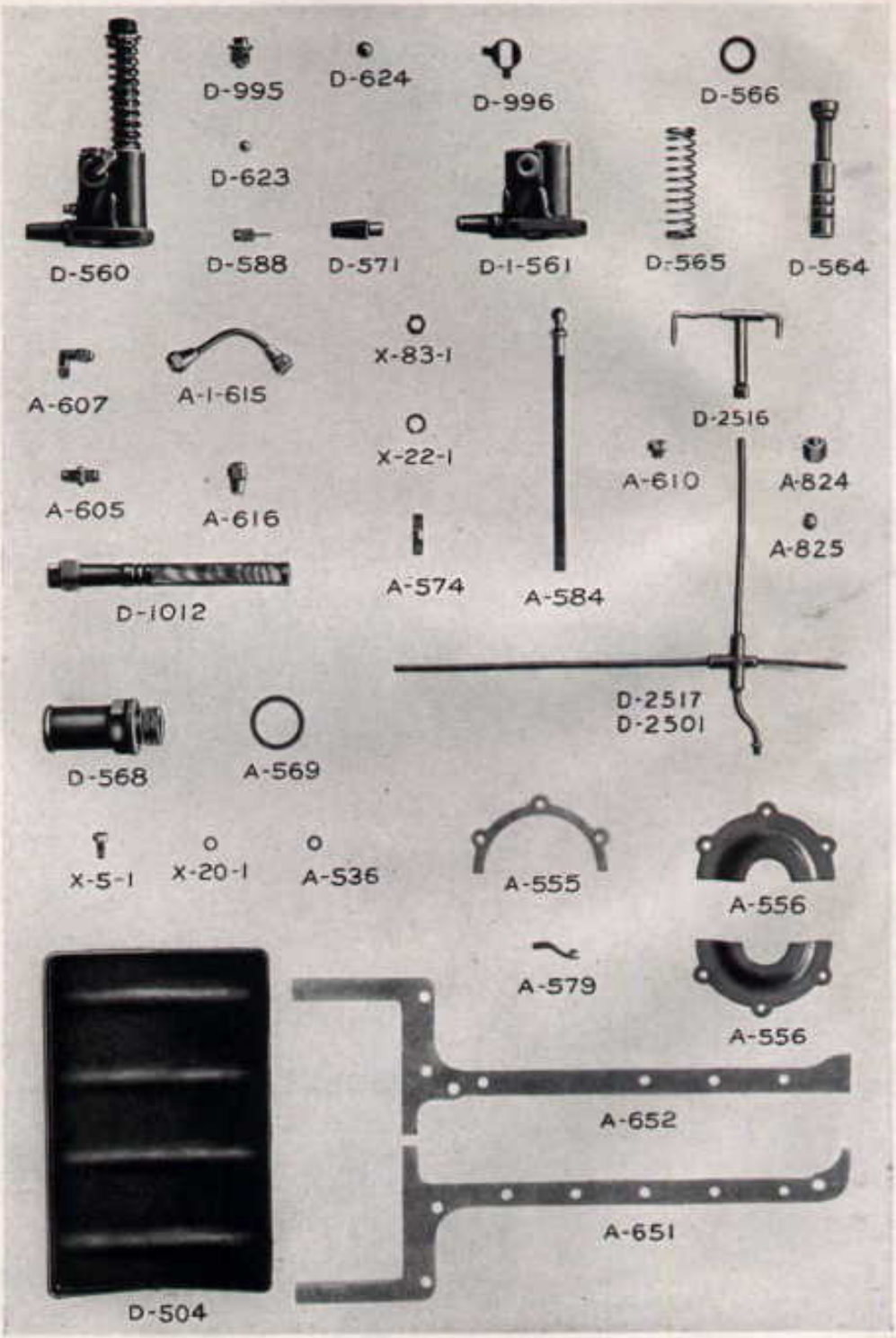
CYLINDER BLOCK, OIL BASE and PARTS



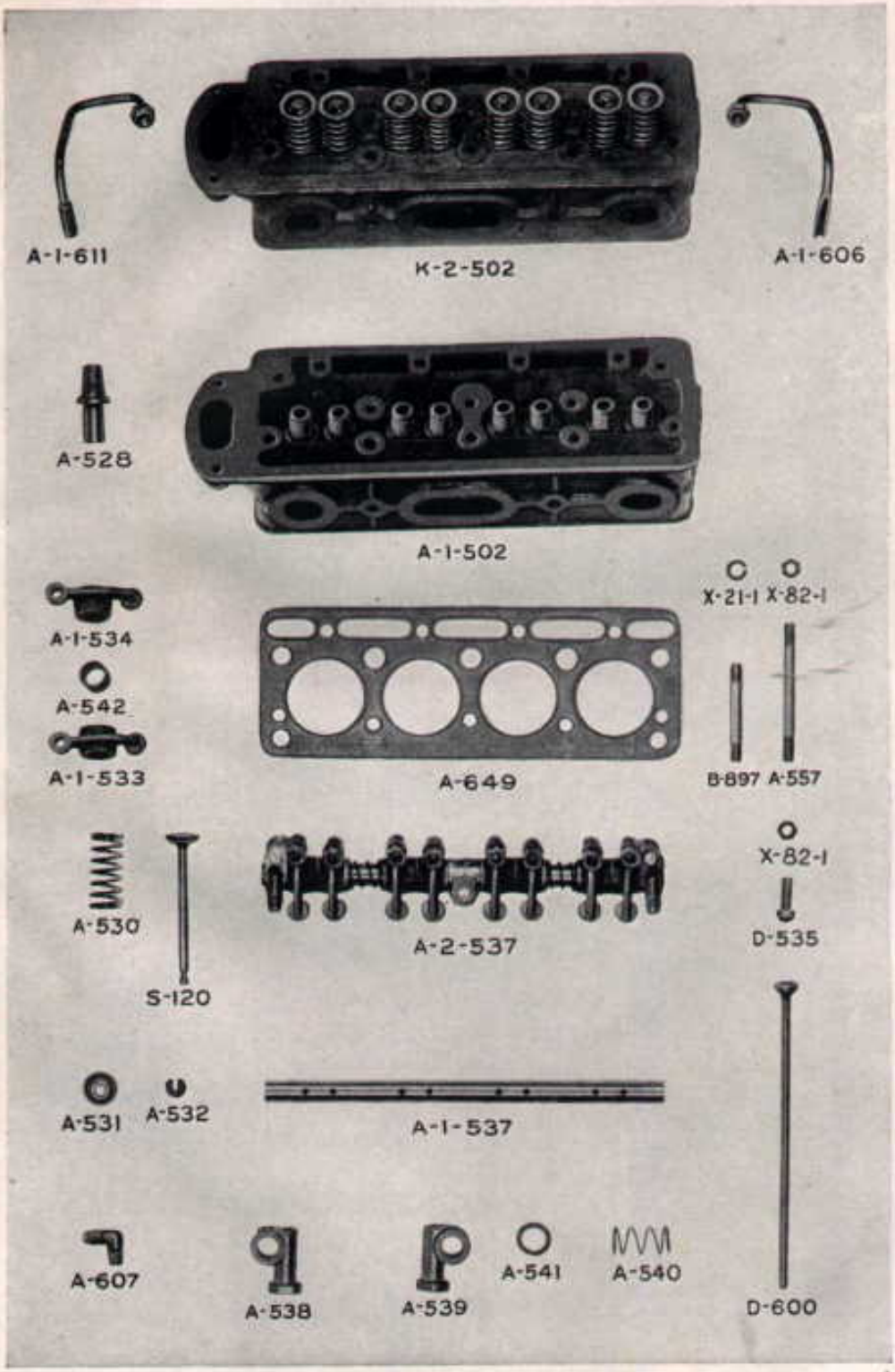
CRANKSHAFT, CAMSHAFT and PARTS



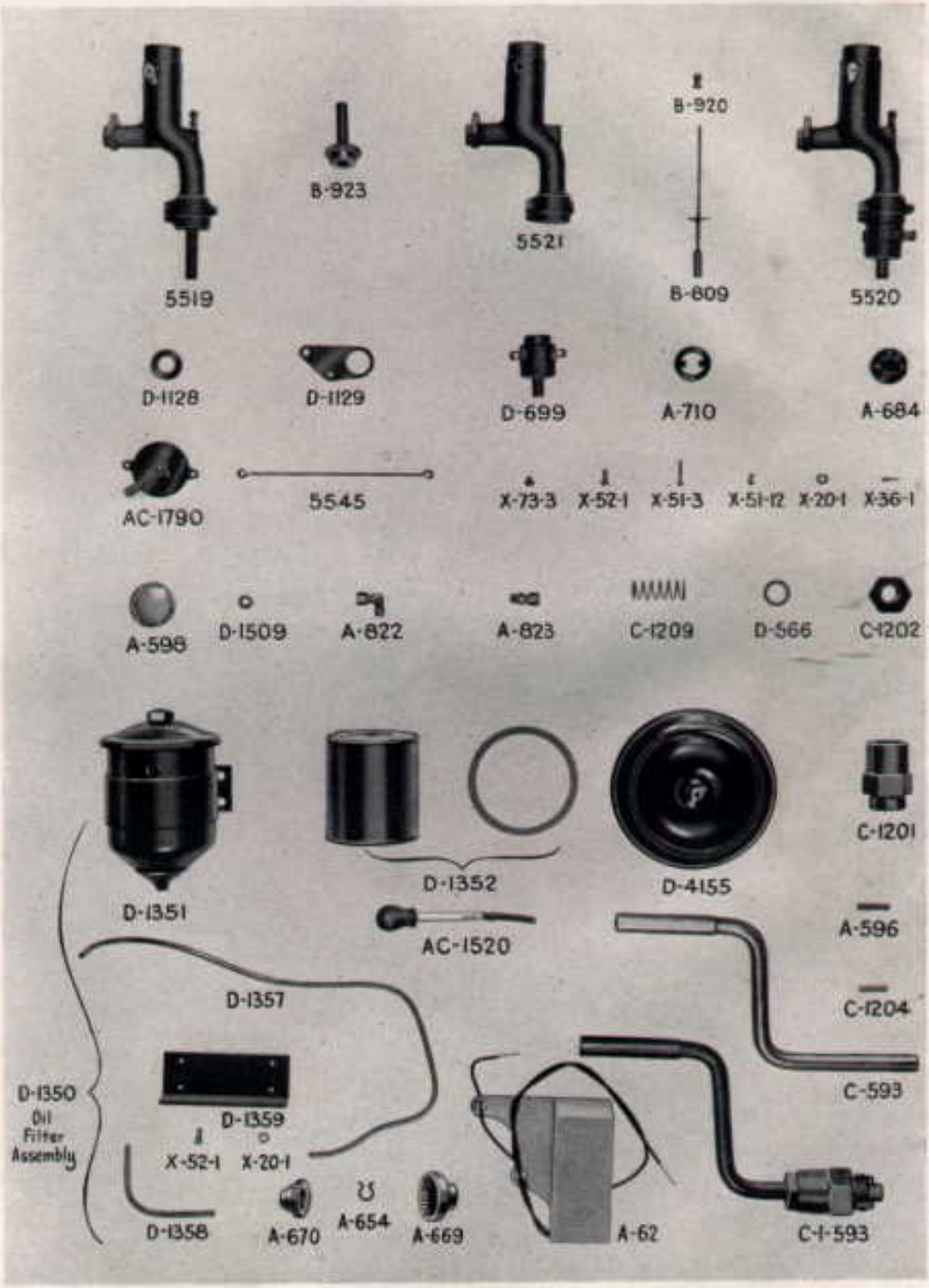
CRANKSHAFT and CAMSHAFT PARTS



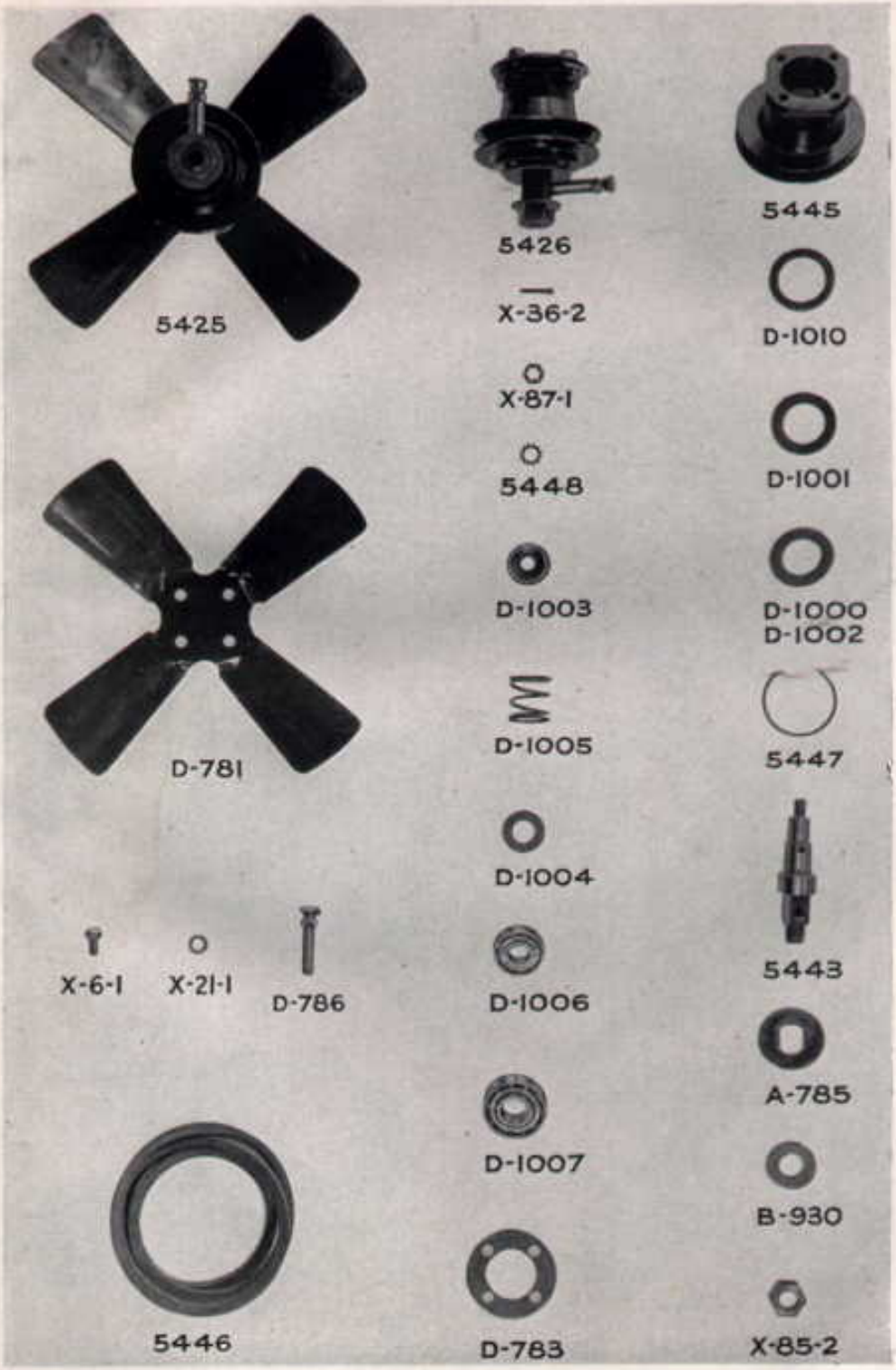
OIL PUMP and OIL BASE PARTS



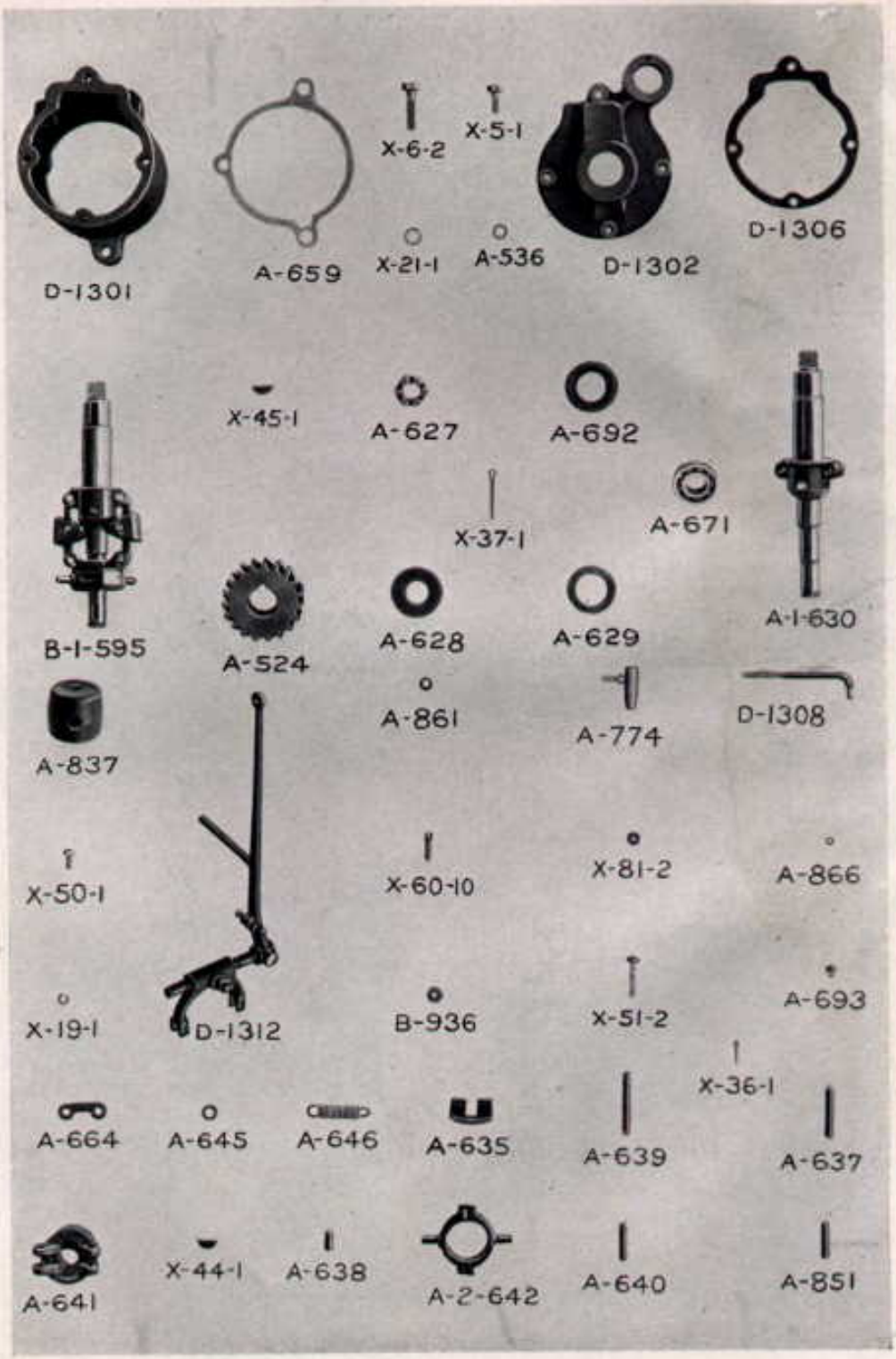
CYLINDER HEAD and PARTS



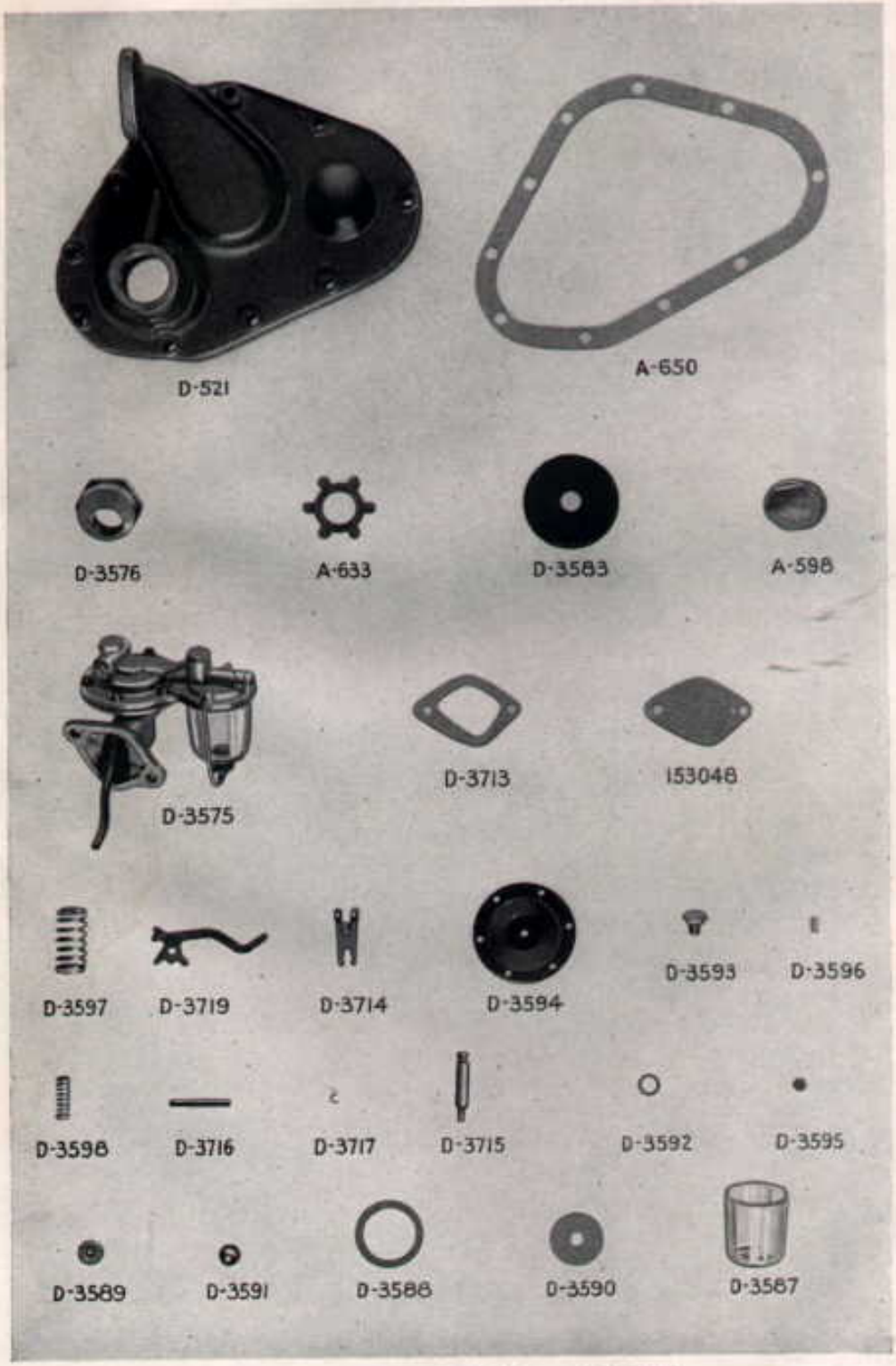
CHOKER, GOVERNOR SWITCH, and FITTINGS



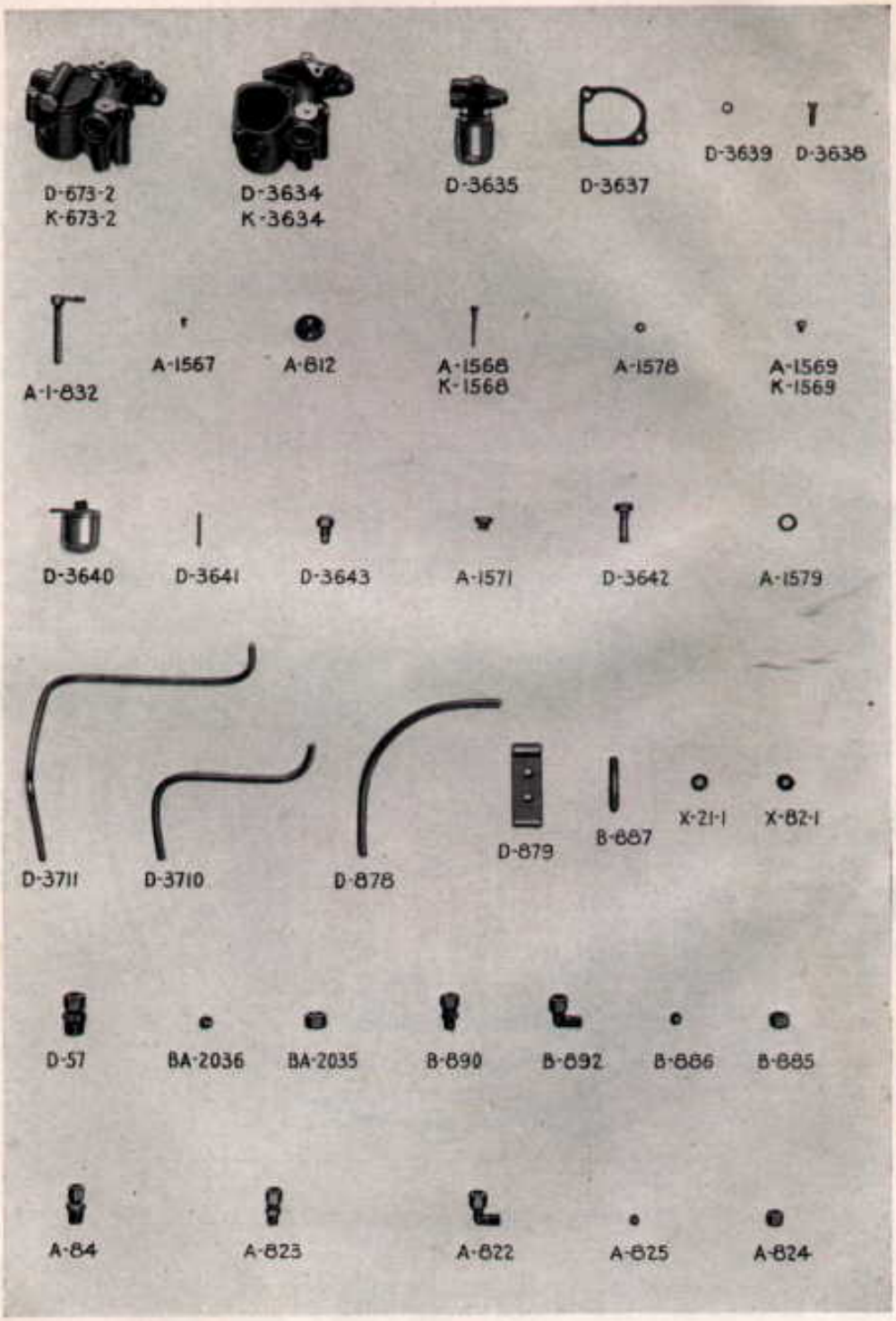
FAN and PARTS



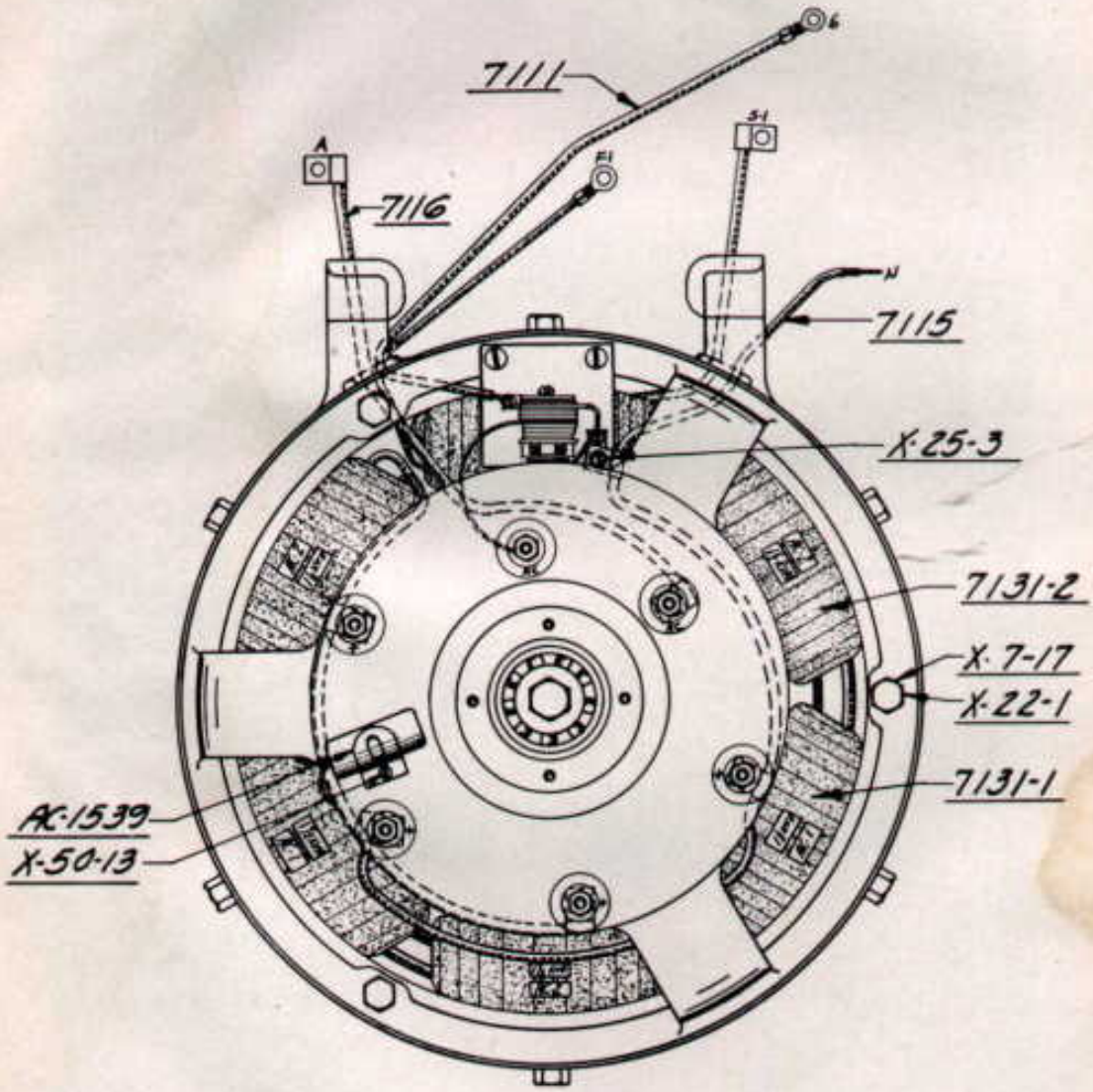
GOVERNOR and PARTS



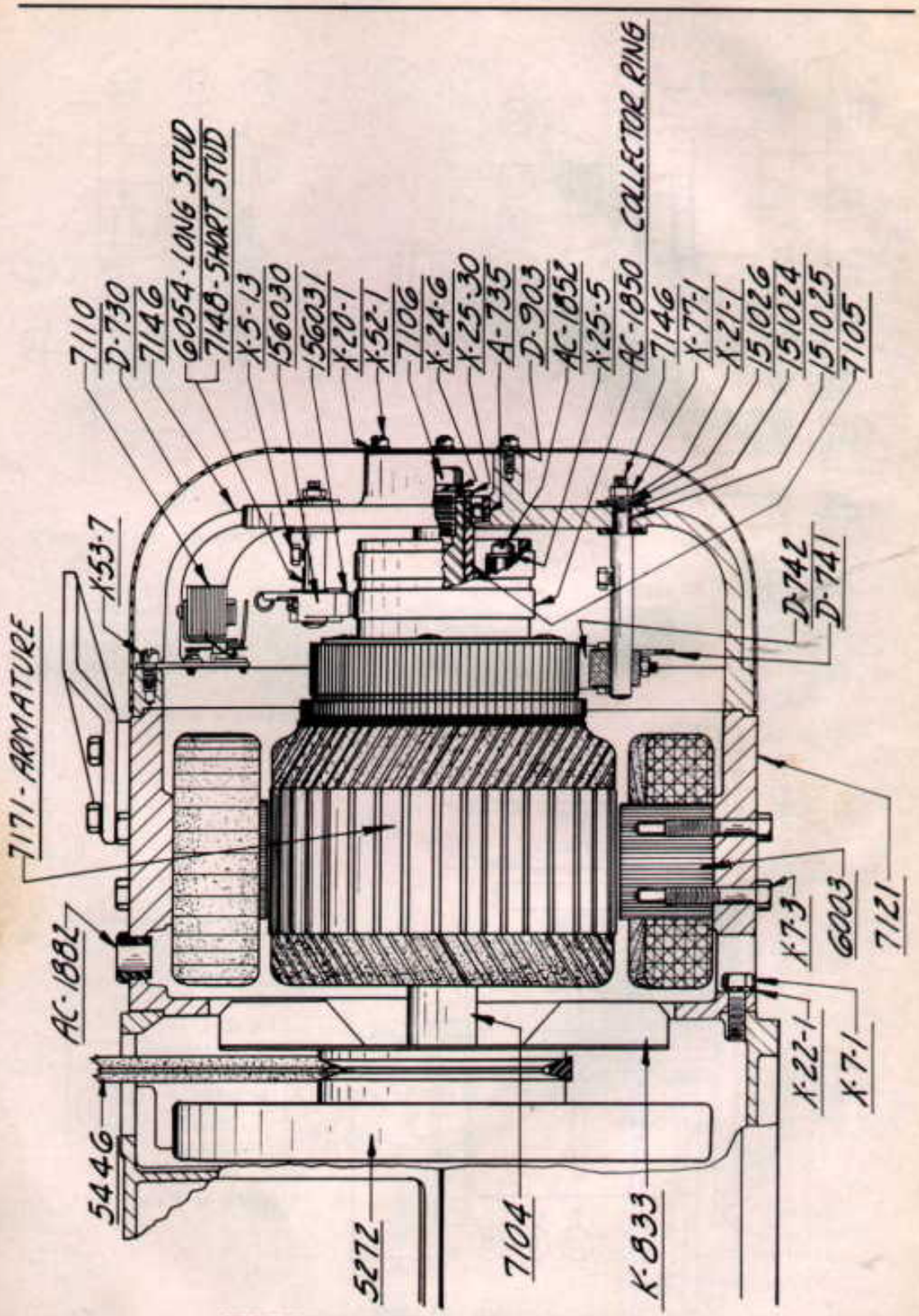
GEAR COVER FUEL PUMP and PARTS



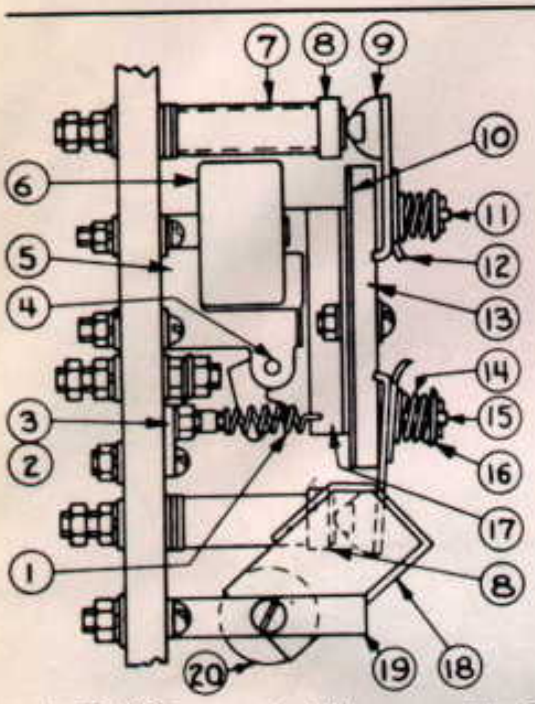
KH3 CARBURETOR and PARTS

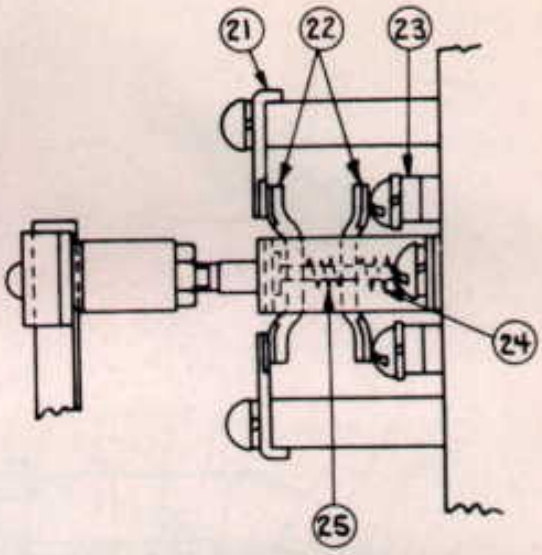


1½ KVA SINGLE ARMATURE FIELD



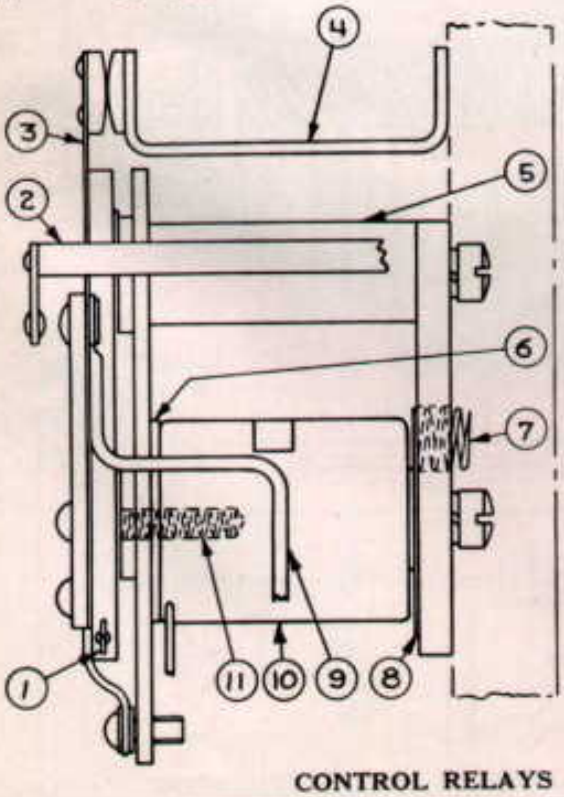
SECTIONAL VIEW 1½ KVA ALTERNATOR





ELECTRICAL INTERLOCK

1—D-1867	6—5932	11—5933	16—L-2558	21—5943
2—5935	7—5936	12—5938	17—158653	22—5944
3—151544	8—158652	13—5939	18—5940	23—5945
4—5936	9—158650	14—158651	19—5941	24—5946
5—158654	10—5937	15—5934	20—5942	25—5947

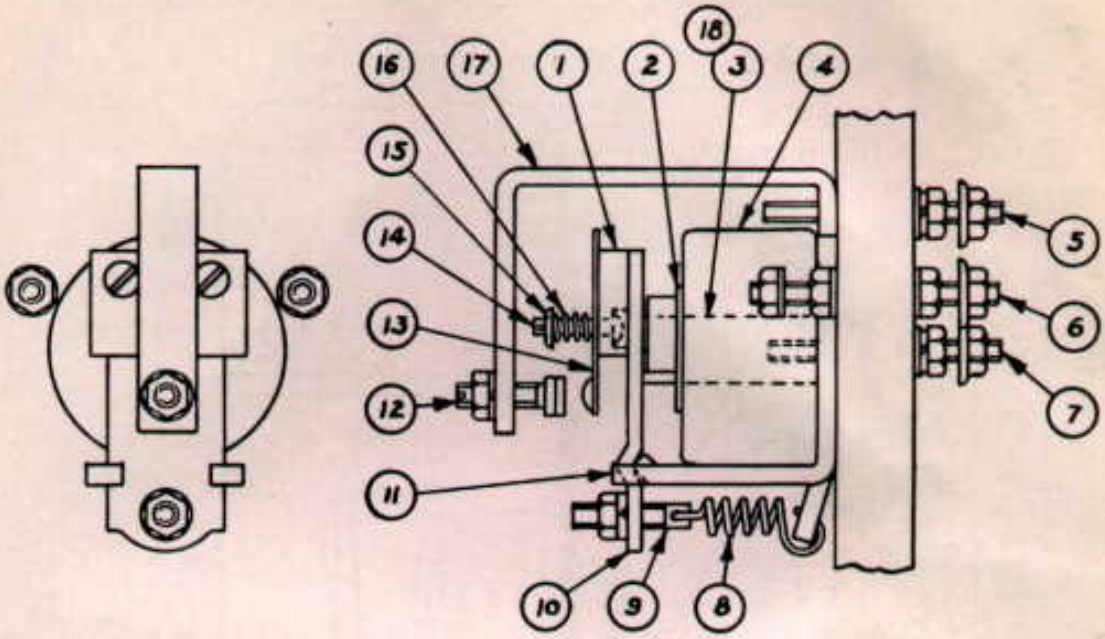


Transfer Relay 5896

1—D-1737
2—D-1822
3—D-1711
4—D-1824
5—D-1714
6—D-1777
7—151591
8—D-1868
9—5931
10—5930
11—D-1742

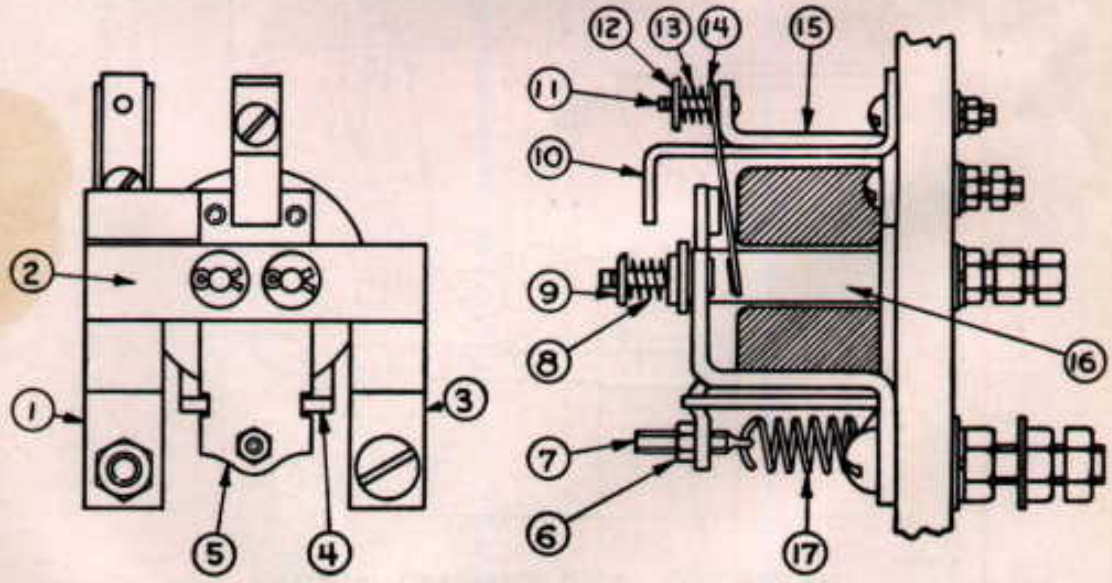
Generator Relay 5897

CONTROL RELAYS



1—5948
2—5949
3—5920
4—5924
5—5923
—X-71-1
—5925
—X-17-2
—5922
—5923
—X-71-1
—5925
—X-17-2
—5922
—5921
7—X-70-1
—A-847
—5916
—X-25-7
8—AC-1899
9—L-2563
—L-2564
10—5915
11—5914
12—158675
—5913
—5912
13—5911
14—5910
15—5917
16—5918
17—5919
18—5920

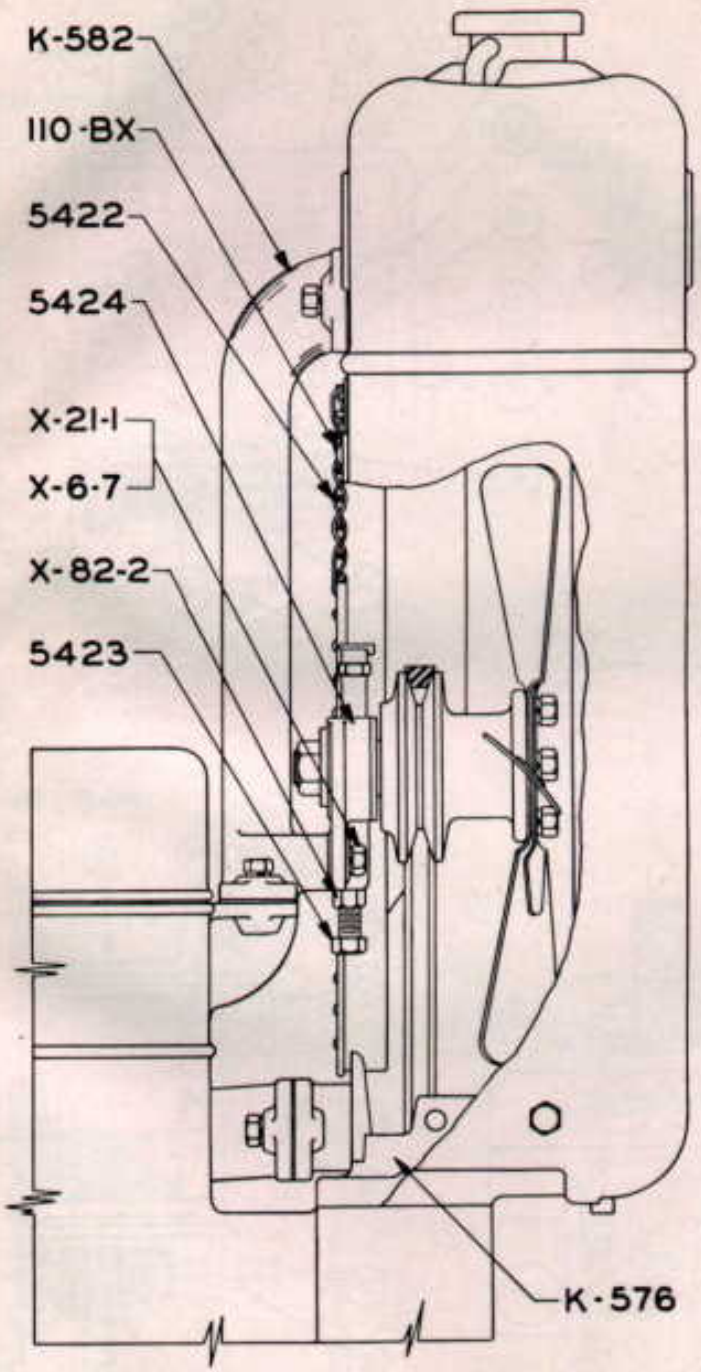
AC-DC Relay 5895



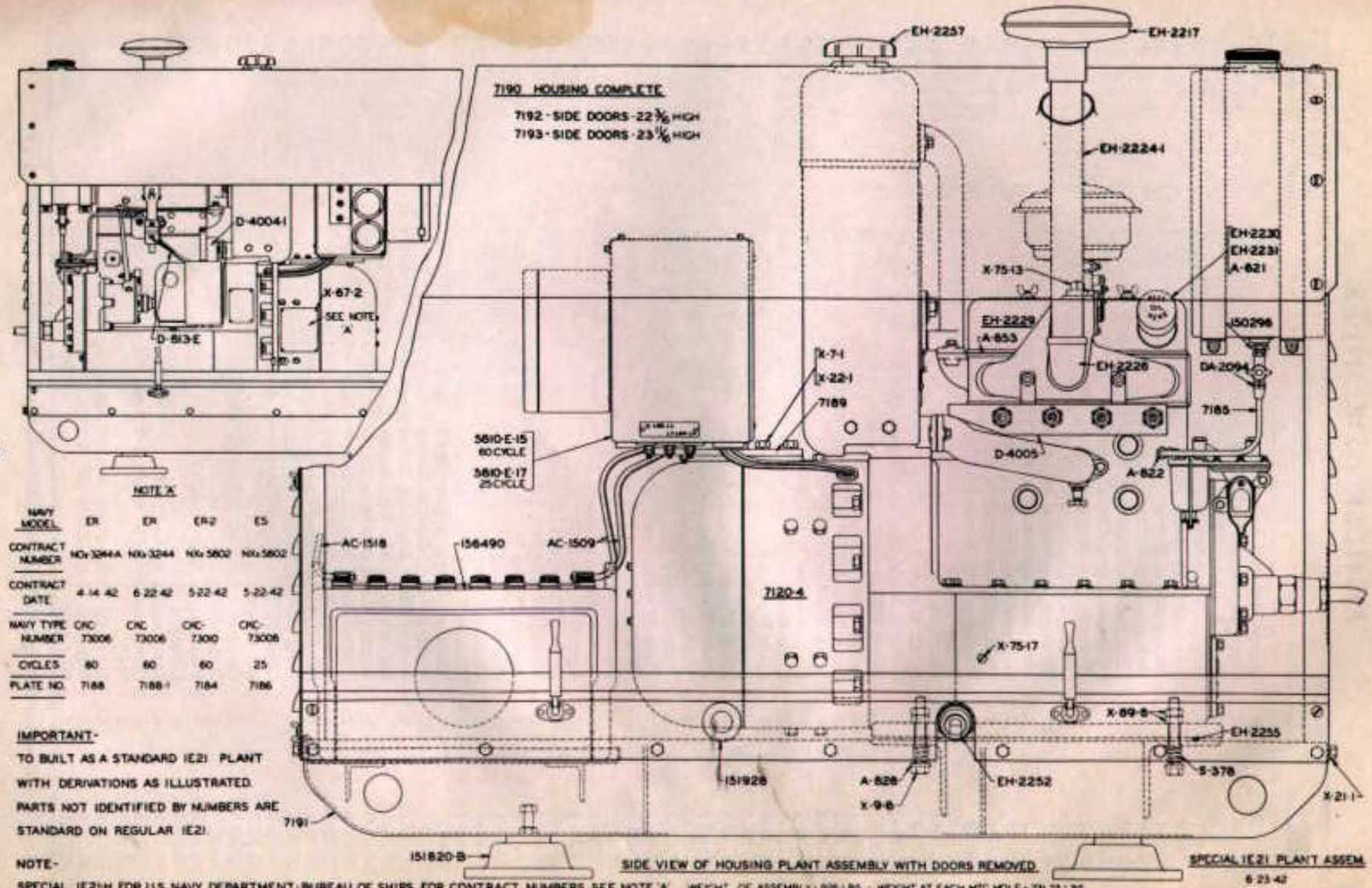
1—5859
2—AC-1885
3—AC-1887
4—5857
5—5861
6—L-2564
7—L-2563
8—5928
9—5925
10—AC-1928
11—5926
12—L-2572
13—5858
14—5862
15—5927
16—5856
17—AC-1929
Coil—5929

Starting Relay 5898

CONTROL RELAYS



RADIATOR AND FAN MOUNTING
1.5 KW-KVA, AND 2KW KOHLER
ELECTRIC PLANTS



NOTE 'A'

NAVY MODEL	ER	ER	ER-2	ES
CONTRACT NUMBER	NOa-3244-A	NOa-3244	NOa-5802	NOa-5802
CONTRACT DATE	4-14-42	6-22-42	5-22-42	5-22-42
NAVY TYPE NUMBER	CKC 73006	CKC 73006	CKC-7300	CKC-73008
CYCLES	60	60	60	25
PLATE NO.	7188	7188-1	7184	7186

IMPORTANT-

TO BUILT AS A STANDARD IE2I PLANT WITH DERIVATIONS AS ILLUSTRATED. PARTS NOT IDENTIFIED BY NUMBERS ARE STANDARD ON REGULAR IE2I.

NOTE-

SPECIAL IE2I-H FOR U.S. NAVY DEPARTMENT - BUREAU OF SHIPS. FOR CONTRACT NUMBERS SEE NOTE 'A'. WEIGHT OF ASSEMBLY - 925 LBS. - WEIGHT AT EACH MTG HOLE - 231.25 LBS.

SIDE VIEW OF HOUSING PLANT ASSEMBLY WITH DOORS REMOVED.

SPECIAL IE2I PLANT ASSEM.
6-23-42
H.M. NELSON
7195

Part Number	No. Per Plant	DESCRIPTION	Price Each
X-5-1	8	Hexagon Cap Screw 1/4-20x5/8	$ .03
X-5-3	2	Hexagon Cap Screw 1/4-20x7/8	.03
X-5-13	6	Order X-52-1	
X-6-1	4	Hexagon Cap Screw 5/16-18x1/2	.10
X-6-2	15	Hexagon Cap Screw 5/16-18x1 1/4	.03
X-6-3	8	Hexagon Cap Screw 5/16-18x2 1/4	.03
X-6-4	2	Hexagon Cap Screw 5/16-18x3 3/4	.05
X-6-8	1	Hexagon Cap Screw 5/16-18x2 3/8	.05
X-6-9		Hexagon Cap Screw 5/16-18x1 1/4	.05
X-6-11	9	Hexagon Cap Screw 5/16-18x3/4	.03
X-6-15	1	Order X-6-9	
X-7-1	12	Hexagon Cap Screw 3/8-16x1	.03
X-7-2	2	Hexagon Cap Screw 3/8-16x1 1/4	.03
X-7-3	1	Hexagon Cap Screw 3/8-16x2	.03
X-7-4	4	Hexagon Cap Screw 3/8-16x1 5/8	.03
X-7-8	2	Hexagon Cap Screw 3/8-16x3/4	.03
X-7-16	—	Order X-7-8	
X-7-17		Hexagon Cap Screw 3/8-16x1 1/2	.10
X-9-6	4	H. C. Screw	.05
X-14-6	1	Fillister Head Machine Screw No. 8—32x1/4	.10
A-17	—	Brass Union Complete 3/8 I.D.	.20
X-17-2	2	Lockwasher	.03
X-18-1	5	Lock Washer No. 6—5/64 x 1/32	.03
X-19-1	34	Lock Washer 5/16	.03
X-20-1	21	Lock Washer 1/4	.03
X-21-1	46	Lock Washer 5/16	.03
X-22-1	33	Lock Washer 3/8	.03
X-24-6		Lock Washer 1/2	.03
X-25-3		Lock Washer 1/8	.03
X-25-5		Plain Washer 5/16	.03
X-25-7	1	Washer	.03
X-25-8	6	Plain Washer 1/4	.03
X-25-18	1	Plain Washer 3/8x5/16 O. D.	.05
X-25-30		Washer 3-3/64 x 1 1/4 x 1/8	.03
X-31-1	4	Bearing Retaining Screw No. 8—32x3/8	.03
X-36-1	15	Cotter Pin—1/16x1/2	.03
X-36-2	11	Cotter Pin—1/16x3/4	.03
X-37-1	3	Cotter Pin—1/8x1 1/4	.03
X-43-1	2	Woodruff Key No. 3	.03
X-44-1	1	Woodruff Key No. 6	.03
X-45-1	3	Woodruff Key No. 9	.03
X-46-1	1	Woodruff Key No. 127	.05
X-47-1	1	Woodruff Key No. 128	.05
A-48	1	Exhaust Nipple 1 1/4x6 (See D-2302)	.25
X-50-1	14	Round Head Machine Screw No. 10—32x1/2	.03
X-50-12	4	Round Head Machine Screw No. 10—24x7/8	.03
X-50-13		Round Head Machine Screw No. 10—24x3/8	.03
X-51-2	1	Round Head Machine Screw No. 8—32x1 1/2	.03
X-51-3	2	Round Head Machine Screw No. 8—32x1	.03
X-51-12	2	Round Head Machine Screw No. 8—32x3/8	.03
X-52-1	4	Oval Fillister Head Cap Screw 1/4-20x1/2	.05
X-52-5	16	Oval Fillister Head Cap Screw 1/4-20x5/8	.03
X-53-7		Oval Fillister Head Cap Screw 5/16-18x5/8	.03
X-60-2	1	Set Screw 1/4-20x5/16	.03
X-60-10	1	Governor Arm Set Screw 1/4-20x3/4	.05
A-62	1	Order 7000	.05
X-64-1	4	Foundation Bolt 1/2-13x7	.05
X-65-1	4	Hexagon Nut 1/2-13	.03
X-67-1	4	Instruction Plate Rivet	.03
X-68-1	4	Governor Switch Terminal Screw	.03
X-70-1	2	Nut	.03
X-70-2	18	Hexagon Nut—Plain No. 10-24	.03
X-70-3	23	Hexagon Nut—Plain No. 10-32	.03
X-71-1	4	Nut	.03

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
X-71-1	8	Nut	$ .03
X-72-2	1	Hexagon Nut—Special No. 8-32	.03
X-73-3	1	Round Head Machine Screw ¼-20x¼	.03
X-75-1	1	Pipe Plug ⅛	.03
X-75-4	1	Pipe Plug—Brass ⅛	.05
X-75-8	1	Pipe Plug—Brass ½	.20
X-75-13	1	Pipe Plug	.05
X-77-1	6	Hexagon Jam Nut $\frac{5}{16}$-18	.05
X-81-2	1	Hexagon Nut—Plain ¼-28	.03
X-82-1	26	Hexagon Nut—Plain $\frac{5}{16}$-24	.03
X-83-1	4	Hexagon Nut—Plain ⅜x24	.03
X-83-3	1	Hexagon Jam Nut ⅜-16	.03
A-84	1	Connector Complete—Special ¼ I. D.	.10
X-85-2	1	Hexagon Check Nut $\frac{5}{16}$-18	.03
X-86-1	8	Castle Nut $\frac{5}{16}$-24	.03
X-87-1	8	Castle Nut ⅜-24	.03
X-87-2	1	Castle Nut ⅜-16	.03
X-89-8	8	Hexagon Nuts	.03
A-95	—	Brass Union Complete ¼ I. D.	.15
A-100	—	Brass Tee Complete ⅜ I. D.	.35
S-120	8	Exhaust Valve	.60
S-378	4	Spring	.05
A-1-501	1	Cylinder Block Assembly (See A-3-501)	52.00
A-3-501	1	Cylinder Assembly with Pistons, Rings, Pins and Retainers	58.00
BA-1-501	1	Cylinder Block Assembly—for Gas Plants only (See BA-3-501)	52.00
BA-3-501	1	Cylinder Assembly with Pistons, Rings, Pins and Retainer—For Gas Plants only	58.00
A-1-502	1	Cylinder Head less Valves	13.65
K-2-502	1	Cylinder Head with Valves	17.25
A-503-1	1	Oil Base	11.40
A-1-503	1	Oil Base Assembly	17.75
D-504	1	Oil Base Baffle Plate	.25
A-505	—	Order 5271 or 5271-1	
A-506	1	Camshaft	6.25
A-1-507	4	Connecting Rod Assembly	2.40
D-508	4	Piston (Specify Size)	
D-508-1	4	Piston (Semi-finished)	
A-510	4	Piston Pin—Standard	.15
A-510-3	—	Piston Pin—.003 Oversize	.15
A-510-5	—	Piston Pin—.005 Oversize	.15
A-510-10	—	Piston Pin—.010 Oversize	.15
A-511	1	Cylinder Head Cover	1.50
A-512	4	Connecting Rod Bushing	.15
A-1-513	1	Crankshaft Bearing—Front	.75
A-1-515	1	Crankshaft Bearing—Rear	.80
A-1-517	4	Connecting Rod Bearing	.90
A-519	1	Camshaft Bearing—Front	1.10
A-520	1	Camshaft Bearing—Rear	.80
D-521	1	Gear Cover	4.20
A-522	1	Crankshaft Gear	1.15
A-523	1	Camshaft Gear	2.20
A-524	1	Magneto Drive Gear	1.15
A-525	1	Crankshaft Bearing Cap—Front	.30
A-526	1	Crankshaft Bearing Cap—Rear	.25
A-527	8	Crankshaft Bearing Stud	.05
A-528	8	Valve Stem Guide	.15
D-529	8	Valve	.30
A-530	8	Valve Spring	.05
A-531	8	Valve Spring Retainer	.03
A-532	8	Valve Spring Retainer Key	.03
A-1-533	4	Rocker Arm with Bushing—Right	.45
A-1-534	4	Rocker Arm with Bushing—Left	.45
D-535	8	Rocker Arm Adjusting Screw	.10
A-536	18	Packing Washer ¼	.03

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
A-1-537	1	Rocker Arm Shaft	$ 1.45
A-2-537	1	Rocker Arm Shaft Assembly	8.25
A-538	2	Rocker Arm Shaft Bracket—F and R	.80
A-539	1	Rocker Arm Shaft Bracket—Center	.85
A-540	2	Rocker Arm Spacing Spring	.03
A-541	6	Rocker Arm Spacing Washer	.03
A-542	8	Rocker Arm Bushing	.05
A-543	8	Valve Tappet	.30
A-545	8	Valve Tappet Bushing	.15
A-547	2	Crankshaft Front Bearing Shim .094	.03
A-548	6	Crankshaft Front Bearing Shim .008	.03
A-549	8	Crankshaft Front Bearing Shim .002	.03
A-550	2	Crankshaft Rear Bearing Shim .094	.03
A-551	6	Crankshaft Rear Bearing Shim .008	.03
A-552	8	Crankshaft Rear Bearing Shim .002	.03
A-533	1	Flywheel	4.45
A-555	2	Rear Split Cover Gasket	Set .05
A-556	2	Rear Split Cover—Upper and Lower	Set .85
A-557	11	Cylinder Head and Cover Stud	.03
A-558	2	Exhaust Manifold Stud	.03
A-559	2	Exhaust Manifold Stud Nut	.05
D-560	1	Oil Pump	2.30
D-1-561	1	Oil Pump Body	1.40
D-564	1	Oil Pump Plunger	.40
D-565	1	Oil Pump Plunger Spring	.05
D-566	1	Oil Pump Spring Washer	.03
D-1-567	1	Oil Drain Plug and Strainer	.60
D-568	1	Oil Drain Plug (See D-1-567)	.20
A-569	1	Oil Drain Plug Washer	.03
D-571	1	Oil Pump Nipple	.10
A-573	1	Oil Pump Tappet	.35
A-574	2	Oil Pump Stud	.03
K-576	1	Radiator Hose	3.10
K-577-3	1	Radiator	21.70
A-579	2	Rear Split Cover Joint Gasket	Set .03
A-580-2	1	Radiator Cap W/2" Spring	1.50
A-580-3	1	Radiator Cap W/4" Spring	1.50
K-581	1	Water Inlet Manifold	1.05
K-582	1	Water Outlet Manifold	1.00
A-583	2	Water Inlet Stud	.03
A-584	1	Oil Gauge	.10
D-588	1	Oil Pump Lead Plug	.15
A-589	2	Cylinder Head Cover Stud Nut	.03
A-590	1	Camshaft Thrust Washer	.15
A-591	1	Camshaft Thrust Plug	.10
A-592	1	Camshaft Thrust Plug Spring	.03
C-593	1	Starting Crank	.90
C-1-593	1	Starting Crank and Support	1.55
B-1-595	1	Order 5680	
A-596	1	Starting Crank Pin	.03
A-597	1	Order D-597	
D-597	1	Starting Crank Jaw	.80
A-598	1	Starting Crank Hole Cap	.20
A-599	1	Pet Cock	.20
D-600	8	Push Rod	.20
A-601	8	Connecting Rod Bolt	.05
A-602	1	Order 5521	
A-605	1	Oil Line Connector	.10
A-1-606	1	Oil Return Tube Assembly	.15
A-607	3	Oil Line Ell	.10
A-610	1	Oil Line Split Nut	.10
A-1-611	1	Oil Tube to Rocker Arm Shaft Assembly	.30
A-1-615	1	Oil Pump Tube Assembly	.15
A-616	2	Oil Line Nut	.05

When ordering parts give Model and Serial Number of your Plant

ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
A-617	8	Connecting Rod Bearing Shim .063	$ .03
A-618	24	Connecting Rod Bearing Shim .008	.03
A-619	24	Connecting Rod Bearing Shim .002	.03
A-621	1	Oil Filler Cap	.15
D-623	1	Oil Pump Inlet Ball ¾	.03
D-624	1	Oil Pump Outlet Ball ½	.03
A-627	1	Magneto Drive Shaft Nut	.10
A-628	1	Magneto Drive Shaft Washer	.03
A-629	1	Magneto Drive Shaft Thrust Washer	.20
A-1-630	1	Magneto Drive Shaft Assembly	3.05
A-631	1	Magneto Drive Shaft Bushing	.70
A-632	1	Camshaft Lock Nut	.10
A-633	1	Camshaft Lock Washer	.03
A-635	2	Order 5650	
A-637	1	Governor Flyweight Hub Pin	.03
A-638	2	Governor Sliding Sleeve Stud	.03
A-639	2	Governor Flyweight Pin	.03
A-640	2	Governor Sliding Sleeve Link Pin	.03
A-641	1	Governor Sliding Sleeve	.70
A-2-642	1	Governor Sliding Sleeve Collar Assembly	1.05
A-645	4	Governor Link Plate Washer	.03
A-646	2	Governor Spring	.10
A-649	1	Cylinder Head Gasket	.40
A-650	1	Gear Cover Gasket	.05
A-651	1	Oil Base Gasket—Right	.05
A-652	1	Oil Base Gasket—Left	.05
A-653	1	Cylinder Head Cover Gasket	.05
A-654	1	Magneto Coupling Lock Ring	.05
A-655	1	Water Outlet Gasket	.05
A-656	4	Water Outlet and Inlet Gasket	.05
A-657	1	Carburetor Flange Gasket	.05
A-659	1	Governor Housing Gasket	.05
K-661	1	Order 6070 or 6071	
A-662	1	Generator Lock Nut	.15
A-663	1	Generator Lock Nut Washer	.05
A-664	8	Governor Link Plate	.03
A-669	1	Magneto Coupling—Female	.75
A-670	1	Magneto Coupling—Male	.75
A-671	1	Drive Shaft Bearing	1.15
D-673-2	1	Carburetor Complete	12.50
K-673-2	1	Carburetor Complete	12.50
K-674	4	Spark Plug	.65
A-675	4	Spark Plug Gasket	.03
A-681	1	Cylinder Casting Plug—Large	.05
A-684	1	Governor Switch	.95
A-692	1	Governor Flyweight Hub Washer	.70
A-693	1	Governor Switch Contact Plug	.05
B-694	1	Accessory Wire Conduit	.15
A-695	1	Exhaust Manifold Gasket—Front	.05
A-696	1	Exhaust Manifold Gasket—Center	.05
A-697	1	Exhaust Manifold Gasket—Rear	.05
D-699	1	Choker Coil	1.85
A-710	1	Governor Switch Washer	.03
A-712	1	Order 5955	
D-730	1	Generator Cover	1.60
A-735	1	Generator Ball Bearing	2.05
D-741	4	Generator Brush Holder D. C.	.55
D-742	4	Generator Brush D. C.	.35
A-774	1	Ball Joint	.20
D-781	1	Fan Blade	1.15
D-783	1	Fan Hub Gasket	.10
A-785	1	Fan Shaft Clamp Washer	.20
D-786	1	Fan Shaft Oil Cup	.15
A-797	2	Camshaft Bearing Pin	.03

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
A-798	1	Magneto Drive Shaft Bearing Pin	$ .03
A-804	2	Fuse—25 Ampere	.10
S-805	—	Top Oiler Assembly	3.15
A-806	4	Cylinder Casting Plug, 1-inch	.03
A-806-A	—	Cylinder Casting Plug, 1⅛-inch	.05
B-809	1	Choker Valve	.40
A-812	1	Carburetor Butterfly Valve	1.20
D-813	1	Accessory Wire Assembly	.70
E-816	1	Magneto Ground Wire	.10
A-822	2	Elbow Complete ¼ I. D.	.15
A-823	2	Connector Complete ¼ I. D.	.10
A-824	4	Compression Nut ¼ I.D.	.05
A-825	4	Compression Sleeve ¼ I. D.	.03
A-826	12	Piston Ring, Standard	.15
A-826-5	—	Piston Ring, .005 Oversize	.15
A-826-10	—	Piston Ring, .010 Oversize	.15
A-826-15	—	Piston Ring, .015 Oversize	.15
A-826-20	—	Piston Ring, .020 Oversize	.15
A-826-25	—	Piston Ring, .025 Oversize	.15
A-826-30	—	Piston Ring, .030 Oversize	.15
A-827	1	Socket Wrench for Cylinder Head Nut, 33/64 Opening	.35
A-828	4	Foundation Bolt Washer	.03
D-831	1	Spark Plug Wrench—1-1/32 and 1-5/32 Opening	.30
A-1-832	1	Shaft and Arm	1.40
K-833	1	Generator Fan	.95
A-837	1	Governor Lever Weight	.25
A-838	1	S Wrench 33/64 and 41/64 Openings	.40
A-847	1	Cup Washer	.03
D-848	1	Double End Wrench ⅜ and 7/16" Openings	.05
A-849	1	Double End Wrench 9/16 and 1" Openings	.35
A-851	2	Governor Flyweight Hub Link Pin	.03
A-861	1	Ball Joint Rod Nut	.03
A 864	2	Field Resistance Adjusting Clip	.15
A-866	1	Governor Contact Plug Nut	.03
A-869	5	Generator Wire Terminal Lug	.03
D-870	1	Magneto Wrench with Gauge .012 and .025—9/32 Opening	.40
D-878	1	Order D-891	
D-879	1	Fuel Pipe Support Bracket	.95
B-885	2	Compression Nut 3/16 I. D.	.05
B-886	2	Compression Sleeve 3/16 I. D.	.03
B-887	2	Fuel Pipe Bracket Stud	.05
B-890	1	Connector Complete 3/16 I. D.	.10
D-891	1	Carburetor Overflow Tube 5/16 O. D.	.15
B-892	1	Elbow Complete, 3/16 I. D.	.15
B-894	1	Governor Switch Wrench 13/32 Openings	.20
B-897	4	Stud 5/16x2 5/8—18 and 24 Thread	.05
D-903	1	Generator Ball Bearing Gasket	.03
B-909	1	S Wrench 29/64 and 37/64 Openings	.30
B-911	1	Screw Driver 3/16	.10
B-913	1	Valve Feeler Gauge .006	.05
B-920	1	Choker Valve Handle	.05
B-923	1	Choker Cover Assembly	.50
B-930	1	Fan Shaft Nut Washer—Plain ⅝	.05
B-936	12	Hexagon Nut—Galvanized ¼-20	.03
D-950	4	Generator Brush Holder Set Screw	.03
D-951	4	Generator Brush Holder Lock Nut	.03
D-965	1	Set of Tools—Order Individually	
D-966	8	Piston Pin Retainer	.03
D-1-968	1	Magneto Ground Switch	1.00
D-972	2	Copper Washer—Plain ⅜	.05
D-973	1	Oil Base End Cover	.25
D-974	1	Oil Base End Cover Gasket	.05
D-979	1	Switch Support Bracket—R. H.	.30
D-980	1	Switch Support Bracket—L. H.	.30

When ordering parts give Model and Serial Number of your Plant

ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-995	1	Oil Pump Passage Plug	$ .10
D-996	1	Retainer Washer	.03
D-997	6	Copper Washer $\frac{5}{16}$	.03
D-1000	1	Fan Hub Felt Retainer	.40
D-1001	1	Fan Hub Felt Retainer Washer	.15
D-1002	1	Fan Hub Cork Washer	.15
D-1003	1	Fan Shaft Spring Retainer	.30
D-1004	1	Fan Shaft Cone Clamp Washer	.15
D-1005	1	Fan Shaft Cone Adjusting Spring	.15
D-1006	1	Fan Shaft Bearing Complete—Small	2.65
D-1007	1	Fan Shaft Bearing Complete—Large	2.65
D-1009	—	Fan Shaft	2.40
D-1010	1	Fan Shaft Felt Retainer Gasket	.10
D-1012	1	Oil Strainer (See D-1-567)	.50
K-1126	1	Fan Bracket Arm	1.50
D-1128	1	Magneto Cable Bracket Insulator	.05
D-1129	1	Magneto Cable Bracket	.05
D-1-1129	1	Order D-1128 and D-1129	
K-1131	1	Fan Bracket Arm Spring	.10
C-1201	1	Starting Crank Support	.35
C-1202	1	Starting Crank Guide	.10
C-1204	1	Starting Crank Spring Pin	.03
C-1209	1	Starting Crank Spring	.03
D-1301	1	Governor Housing	1.50
D-1302	1	Governor Housing Cover	1.00
D-1306	1	Governor Housing Cover Gasket	.03
D-1308	1	Ball Joint Rod	.15
D-1312	1	Governor Fork and Lever Assembly	2.00
D-1313	1	Single End Wrench $\frac{3}{8}$	.25
D-1350		Oil Filter Assembly	6.50
D-1351		Oil Filter	6.50
D-1352		Oil Filter Element	1.15
D-1357		Inlet Tube	1.15
D-1358		Outlet Tube	1.15
D-1359		Oil Filter Bucket	.50
AC-1508	1	Cable Assembly	1.95
D-1509	1	Plain Washers $\frac{1}{4}$"	.03
AC-1515		Battery, 12 Volt wp Cables	17.95
AC-1539		Radio Condenser Assembly	.50
A-1567	2	Butterfly Retaining Screw	.05
A-1568	1	Main Jet No. 9	.60
K-1568	—	Used on 2000 Watt Plants only	
A-1569	1	Compensating Jet No. 11	.55
K-1569	—	Used on 2000 Watt Plants only	
A-1571	2	Lower Plug	.35
A-1578	2	Carburetor Jet Washer	.05
A-1579	2	Lower Plug Washer	.05
D-1706	1	Thermostat Element—24 Volt	2.50
D-1711	1	Contact Arm	3.05
D-1714	1	Core	3.50
D-1737	1	Hinge Pin	.15
D-1739	1	Resistor Support	.20
D-1742	1	Spring	.10
D-1744	1	Carbon Contact	.60
D-1746	1	Carbon Contact Support	.45
D-1776	1	Starting Relay Coil 426-2	4.65
D-1777	1	Washer	.20
AC-1790	1	Thermostat	2.25
D-1822	1	Contact with Post	.75
D-1824	1	Contact with Support	.70
AC-1850		Collector Ring Assembly	2.90
AC-1852		Collector Ring Holding Screw	.10
E-1859-S-3	1	Contact Stop Post Assembly	1.95
AC-1867	1	Spring	.15

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-1868	1	Washer	$ .05
AC-1882		Rubber Bushing	.10
AC-1885	1	Contact	1.05
AC-1887	1	Contact Post	1.70
AC-1899	1	Spring	.25
AC-1928	1	Stop Bracket	1.85
AC-1929	1	Spring	.10
BA-2032	2	Elbow Complete ⅜ I. D.	.20
BA-2033	2	Connector Complete ⅜ I. D.	.20
BA-2035	6	Compression Nut ⅜ I. D.	.05
BA-2036	6	Compression Sleeve ⅜ I. D.	.03
DA-2094	1	Shut-off Cock	.60
EH-2217	1	Muffler	3.25
EH-2224-1	1	Exhaust Pipe	.80
EH-2226	1	Str. Elbow	.35
EH-2229	1	Cylinder Head Cover	1.90
EH-2230	1	Pipe 1x5"	.15
EH-2231	1	45 Degree Elbow	.30
EH-2236	1	Choker Rod	.05
EH-2238	1	Choker Valve Handle	.05
EH-2242	1	Choker Rod Assembly	.40
EH-2252	1	Oil Drain Assembly	1.90
EH-2255	4	Rubber Gaskets	.05
EH-2257	1	Radiator Cap	.75
D-2302	1	Exhaust Nipple 1¼x4 inches	.15
D-2448-5	4	Piston Ring—Oil Control .005 Oversize	.20
D-2448-10	—	Piston Ring—Oil Control .010 Oversize	.20
D-2448-20	—	Piston Ring—Oil Control .020 Oversize	.20
D-2448-30	—	Piston Ring—Oil Control .030 Oversize	.20
D-2473	1	Order AC-1515	
D-2474	1	Order 156490	
D-2501	1	Order D-2516—D-2517	
D-2516	1	Oil Line Tee Assembly	.60
D-2517	1	Oil Line Cross Assembly	.70
L-2558	4	Cup Washer	.03
L-2563	1	Stud	.20
L-2564	1	Nut	.10
L-2572	1	Cup Washer	.03
D-3575	1	Fuel Pump Complete	2.95
D-3576	1	Cam Nut	.60
D-3582	1	Cover for Fuel Pump Opening	.15
D-3583	1	Oil Thrower	.05
D-3584	6	Fuel Pump Cover Screw	.03
D-3587	1	Glass Bowl	.15
D-3588	1	Gasoline Strainer Gasket	.05
D-3589	1	Thumb Nut	.10
D-3590	1	Fuel Pump Screen	.10
D-3591	1	Gasoline Strainer Bowl Seat	.10
D-3592	2	Valve Plug Gasket	.03
D-3593	2	Valve Plug	.20
D-3594	1	Fuel Pump Diaphragm	Set .25
D-3595	2	Fuel Pump Valve	.03
D-3596	2	Fuel Pump Valve Spring	.03
D-3597	1	Spring—Large	.05
D-3598	1	Spring—Small	.05
D-3634	1	Carburetor Body Assembly	7.50
K-3634	—	Used on 2 K. W. Plants only	
D-3635	1	Cover and Float Assembly	3.15
D-3637	1	Cover Gasket	.05
D-3638	2	Cover Screw	.05
D-3639	2	Cover Screw Lock Washer	.03
D-3640	1	Float Assembly	.65
D-3641	1	Float Axle	.10
D-3642	1	Filter Screen Assembly	.30

When ordering parts give Model and Serial Number of your Plant

ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
D-3643	1	Fuel Valve Seat Assembly	$ .75
D-3710	1	Fuel Pipe, ¼"—Fuel Pump to Carburetor	.20
D-3711	1	Fuel Pipe, ¼"—Fuel Block to Pump	.20
D-3713	1	Fuel Pump Gasket	.05
D-3714	1	Link	.25
D-3715	1	Pull Rod	.25
D-3716	1	Rocker Arm Pin	.05
D-3717	1	Rocker Arm Pin Retaining Ring	.03
D-3719	1	Rocker Arm	.60
D-4004-1		Magneto and Cable Shield	
D-4005		Spark Plug and Cable Shield	
4155	1	Air Filter	3.00
5271	1	Crankshaft, Double	20.25
5271-1		Crankshaft, Single	18.60
5272	1	Flywheel	5.10
5425	1	Fan Assembly	7.15
5426	1	Order 5425	
5443	1	Fan Shaft	2.50
5445	1	Fan Hub	2.50
5446	1	V Fan Belt	.85
5447	1	Lock Wire	.05
5448	1	Lock Washer	.05
5451	1	Exhaust Manifold	1.40
5456	1	Carburetor Complete	12.50
5519		Manual Choker	3.40
5520	1	Choker Manifold	4.00
5521		Choker Manifold	2.45
5545	1	Thermostat Rod	.10
5650	2	Governor Flyweight	.35
5680	1	Governor Assembly	6.15
5802	1	Armature Lever	10.50
5810-E-15	1	Emergency Switch—60 Cycle	200.00
5810-E-17	1	Emergency Switch—25 Cycle	200.00
5856	1	Core	.40
5857	1	Frame	.85
5858	1	Spring	.20
5859	1	Contact Post	1.75
5861	1	Armature Lever	4.20
5862	1	Finger	2.80
5883	1	Transformer	10.50
5884	1	Rectifier	16.95
5890	1	Time Delay Relay	45.00
5893	1	Time Delay Relay	45.00
5906	1	High Rate Resistor	1.40
5907	1	Low Rate Resistor	1.40
5908	1	AB Resistor	1.40
5909	1	Field Resistor	2.50
5910	1	Pin	2.30
5911	1	Contact Finger	9.45
5912	1	Shakeproof Washer	.20
5913	1	Nut	.03
5914	1	Frame	.60
5915	1	Armature Lever	4.20
5916	1	Lock Washer	.35
5917	1	Cup Washer	.03
5918	1	Spring	.25
5919	1	Contact Post	6.30
5920	1	Core—D.C.	2.80
5921	2	Shakeproof Washer	.03
5922	2	Washer	.03
5923	2	Stud	.15
5924	1	Coil	4.20
5925	2	Cup Washer	1.20
5926	1	Pin	3 50

When ordering parts give Model and Serial Number of your Plant

Part Number	No. Per Plant	DESCRIPTION	Price Each
5927	1	Support	$ 1.00
5928	2	Spring	.35
5929	1	Coil	3.85
5930	1	Coil	5.05
5931	1	Sleeving	.25
5932	1	Coil	3.50
5933	1	Pin	.05
5934	1	Pin	.05
5935	1	Plate	.80
5936	1	Tube	.35
5936	1	Shaft	.50
5937	1	Insulator	.15
5938	2	Connector	4.90
5939	1	Finger Board	2.80
5940	1	Blowout Chute	2.80
5941	2	Bracket	.35
5942	1	Coil	3.50
5943	2	Contact Plate	.80
5944	2	Contact	.65
5945	2	Contact Plate	.65
5946	1	Spring	.15
5947	1	Spring	.15
5948	1	Finger Board	2.65
5949	2	Washer	.03
5956	1	Push Button—Manual Switch	.35
6002	1	Generator Frame	34.30
6003	12	Field Lamination Block Assembly	1.40
6054	1	Brush Holder Stud—Short A. C.	.20
6070	1	Generator Spacer—Small	.20
6071	1	Generator Spacer—Large	.20
6090	1	Negative Brush Connector	.25
6092	1	Negative Exciter Brush Lead	.25
6093	1	Alternator Brush Lead	.20
7000	1	Radio Condenser Assembly	8.00
7104		Bearing Spacer—Small	.20
7105		Bearing Spacer—Large	.45
7106		1/4-20x1 Hexagon Cap Screw	.15
7110		Voltage Control Relay	5.60
7111		Voltage Control Relay Lead	.10
7115		Exciter Brush Lead	.35
7116		AC Brush Lead	.20
7120-4	1	Special Generator Assembly Reg.	46.90
7121		Generator Frame	12.30
7131-1		Field Coil No. 1	3.45
7131-2		Field Coil No. 2	3.45
7146		Generator End Bracket	7.70
7148		Brush Holder Stud AC—Short	.15
7170		Armature—Single	69.75
7185	1	Fuel Line	.30
7189	2	Switch Brackets	.30
7190	1	Weatherproof Housing	81.00
7191	1	Weatherproof Housing Base	19.50
7192		Side Doors—22 3/16" High	
7193		Side Doors—23 1/16" High	
7194		110 Volt, 50-60 Cycle Coil	
7196		110 Volt, 25 Cycle Coil	
7197		110 Volt, 60 Cycle Motor	
7198		110 Volt, 25 Cycle Motor	
7199		Load Switch—S.P.D.T.	
122521		Field Resistance Coil 6.3 Ohm	2.40
150296	1	Reducer Bushing	.10
150890	—	Order D-2337	
150892	2	Pipe Nipple 1/2x2	.20
150897	1	Reducer Bushing 3/8x1/2	.15

When ordering parts give Model and Serial Number of your Plant

ELECTRIC PLANTS

Part Number	No. Per Plant	DESCRIPTION	Price Each
151024	12	Brush Holder Insulating Washer	$ .05
151025	6	Brush Holder Insulating Bushing	.05
151026	12	Generator Brush Holder Washer	.03
151541	1	Spring	.10
151544	1	Spring Stud	.15
151928	1	Porcelain Bushing	.30
152555	1	Emergency Test Switch	.70
152555	1	Emergency Battery Charge Switch	.70
152556	1	Complete Disconnect Switch	1.40
153048	1	Order D-3582	
156030	2	Brush Holder AC	.75
156031	2	Alternator Brush	.50
156490	1	Battery 32 Volt wp Cables	58.90
158621-F	1	Voltmeter 0-150	17.15
158631-F	1	Ammeter 0-1	13.80
158650	2	Finger	2.20
158651	2	Spring	.10
158652	2	Contact	1.20
158653	1	Armature Lever	3.65
158654	1	Magnet Frame	2.70
158675	1	Contact Stud	.40

All Prices F.O.B. Kohler, Wisconsin. Prices subject to change without notice.

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