



INSTRUCTION MANUAL

GENERATOR SET, PORTABLE, ELECTRIC, GASOLINE ENGINE
DRIVEN, SKID-MOUNTED, ALTERNATING CURRENT
15 KW, 0.8PF, 120/208 - 240/416 VOLTS, 3 PHASE
60 CYCLE, 1800 R.P.M., WYE CONNECTED
CONTRACT NO. GS-00S-14625

MODEL G-15C18D
SERIAL NO. M-1000-1 THRU M-1000-1004 INC.

WINPOWER MFG. CO.
NEWTON, IOWA

INSTRUCTION & MAINTENANCE MANUAL

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Winpower Mfg. Company

Newton, Iowa, U.S.A.

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GENERAL DESCRIPTION

This manual includes maintenance and operating instructions for 18.75 KVA, 15KW, 0.8 Power Factor, 120/208 and 240/416 volt 60 cycle, 3 phase WYE connected Gasoline engine-driven Electric Plant, Model G-15C18D, procured under Contract GS-OOS-14625 by The General Services Administration under Item CD-III-10 of FCDA Specification No. 1200 dated Oct. 15, 1956, as amended.

This set includes the following components:

Engine: A four-cylinder, water cooled, 36 Horsepower, 1800 RPM gasoline engine of 162 cubic inch displacement adequately powers this plant.

Generator: A four-pole revolving field type generator with direct connected exciter, operating at 1800 r.p.m. is provided. This generator is designed to conform to NEMA MG-1 1955 specifications for synchronous generators.

Control Panel: The generator and engine control panel is located in the generator end of the housing and provides metering of AC line voltage and current frequency, battery charge-rate, running time, engine lubricating oil pressure, engine water jacket temperature. These last two devices are equipped with contacts to shut down the engine in the event of excessive water temperature or dangerously low oil pressure. Engine controls are grouped at the right-hand side of the panel and include Start-Stop switch, choke and throttle controls. The throttle control will be manipulated only when the unit is being synchronized preparatory to operating the set in parallel with other units. In normal service the engine governor will maintain close output frequency control.

The control equipment includes automatic voltage regulation with associated cross current compensation. Synchronizing lamps and switch are provided for parallel operation using the "Dark Lamp" method of synchronizing. This method will be discussed later.

Housing: A sheet metal housing is provided to protect the unit from adverse weather. The side doors of this housing must be removed prior to operating in order to assure adequate ventilation for cooling the equipment.

Accessories: Furnished with the units are the following:

1. Four power cables each 100 ft. long with terminals. These cables are stored in a compartment under the generator exciter. Access to this compartment is afforded thru a door immediately below the generator control panel.
2. Tool Box. This item is permanently attached to the base of the set and contains the instruction manual and spare parts. Aside from the spark plug wrench provided, no special tools are required to service this equipment. Space is provided however, for small hand tools that may be desired by the operator.
3. Battery. A 6-volt battery is supplied mounted near the engine. This battery is supplied charged and dry.
4. Fire Extinguisher. A bracket is provided for mounting this unit inside the housing on the cable compartment.
5. Starting crank, muffler tail pipe, battery electrolyte, starting battery and fire extinguisher for shipped loose in the packing crate and must be installed prior to initial operation.

I N S T R U C T I O N S
FOR INSTALLATION, CARE AND OPERATION OF
GENERATORS & ELECTRIC GENERATING PLANTS

THE AIM OF THE MANUFACTURER:

It is the aim of the manufacturer to deliver to the customer a correctly designed, well built, dependable electric generator, free from unnecessary and trouble-making complications.

IMPORTANCE OF FOLLOWING INSTRUCTIONS:

This generator is built to operate with a minimum of care and attention but like any other piece of high-grade machinery, it is essential that it be given proper attention and must not be abused if best results are to be obtained. If the instructions which follow are carefully carried out, long and efficient service will be received from this unit.

IMPORTANT: READ INSTRUCTIONS CAREFULLY BEFORE PUTTING UNIT INTO OPERATION.

RECEIVING AND UNCRATING:

This generator has been carefully tested and packed before leaving the factory. Upon receipt, unpack it carefully and check thoroughly for any damage that may have occurred in shipping. If damage is noticed, report to the transportation company immediately.

The windings and other parts should be protected from damage when unpacking and handling. Under no circumstances should lifting hooks be attached to ventilating holes in the end bells. Since the windings and other internal parts of the machine are close, there is a possibility of injuring them. It is preferable to use eyebelts instead of slings.

WARRANTY:

Each plant or generator is warranted to produce its rated output as stamped on the nameplate when installed and operated in accordance with instruction manual.

They are warranted to be in good condition, electrically and mechanically, when leaving the factory.

They are warranted against electrical and mechanical defects in workmanship for a period of one year after shipment from the factory; any parts found to be defective by factory inspectors after return to the factory, transportation charges prepaid, will be replaced or repaired free of charge. This does not include, however, any component part or standard accessory, such as engines, meters, relays, regulators, etc. fabricated by other manufacturers, as these are subject to the warranties of those manufacturers.

INSTALLATION:

The successful operation of any electrical machine particularly

STARTING AND OPERATING INSTRUCTIONS

The following outline is prepared for use by the operator in starting and operating and shutting down the plant after its use.

Preparation:

Service the engine with lubricating oil and fuel and fill the dry-charged battery with electrolyte included in the shipment of the set. Check the Ignition wires (at plug and magnet) for tightness. Fill the radiator with appropriate coolant (water or ethylene-glycol solution) after having made certain that the drain cocks on the radiator and engine block have been tightly closed.

Starting:

All engine controls as well as generator and synchronizing controls are located on the unit control panel.

1. Place generator controls in the following positions.
 - a. Ammeter switch OFF
 - b. Unit Circuit Breaker OFF
 - c. Voltage Regulator OFF MANUAL
 - d. Manual Rheostat EXTREME COUNTERCLOCKWISEManipulation of the PANEL LAMP Switch will light panel lamp if required.

2. Press RELEASE button on Oil Pressure Gauge located at upper right hand of control panel. This release button is located on the gauge immediately below the meter terminal screw. When properly depressed the hand on the Oil Pressure Gauge will be held AWAY from the shutdown contact thus permitting the remainder of the starting procedure to be accomplished.

3. Place left thumb on Engine Switch and press to LEFT while holding the CHOKE control knob in the right hand. As unit cranks, open and close choke lever by pulling and pushing on control. As engine starts slowly return choke control to "at rest" position (fully depressed against panel). Care should be exercised in the manipulation of the manual choke so that flooding of the engine does not occur.

4. As engine starts RELEASE thumb from start switch. The RUN position for this switch is in the center position. To stop plant press this switch to the "Stop" side where it is mechanically held.

5. With engine running, allow a few moments for the engine to warm up. With Unit Circuit Breaker OFF, switch Voltage Regulator Automatic-Manual Switch to AUTOMATIC position, and adjust output voltage (as indicated on voltmeter) by manipulation of the Voltage regulator control rheostat raising voltage by turning this rheostat clockwise, and reducing it by adjusting the rheostat counterclockwise.

6. Apply Load to set by closing in (ON) unit Circuit Breaker. Readjust output voltage if required. (see step 5).

7. To shutdown plant, remove load by throwing Circuit Breaker OFF.

8. If period of operation has been appreciable (engine water temperature near 210°), ALLOW THE ENGINE TO RUN FOR A FEW MINUTES AFTER LOAD HAS BEEN REMOVED. Since engine is equipped with thermostat, the minimum temperature is about 170° F. When engine has cooled out for about 3 minutes (depending on the ambient operating temperature) the unit may be stopped safely by placing Engine Switch in STOP position.

an electric generator, depends upon its being installed under conditions that are favorable to its economical and efficient operation. For this purpose, a plentiful supply of clean, cool, fresh, dry air is necessary, with sufficient space on all sides of the generator in order that the air may circulate freely. This location should be such as to protect the generator from moisture, escaping steam, dripping pipes, oil, acid, alcohol, chlorine or other corrosive gases.

GENERAL INSTRUCTIONS FOR THE CARE AND OPERATION OF ELECTRICAL GENERATORS

KEEP THE GENERATOR CLEAN: Do not allow the generator to become covered with grease and dirt. Wash occasionally with gasoline or carbon tetrachloride.

This generator must be operated at the speed, as stated on the nameplate, in order to generate the proper voltage and frequency.

This generator is equipped with double-shielded ball bearings. These shields are closely fitted and sealed on both sides so as to prevent entrance of dirt or escape of lubricant.

These bearings when leaving the factory are packed with the correct amount and grade of grease to last the life of the bearing with proper care and at a normal temperature (10° to 60° Fahrenheit above room temperature). Ordinary greases in the bearing will soften and flow at a temperature above 125° F. If the grease runs out of the bearing, it should be returned to the factory to be repacked or it may be replaced with a new bearing of like size.

The average life of this bearing under normal loading conditions is approximately 3800 to 4000 running hours.

The commutator, collector rings, brushes and bearings are the only parts of the generator subject to wear. It is important to protect the generator as much as possible, from flying dirt and dust which will collect on the commutator, collector rings and brushes and will increase the rate of wear.

If dirt or oil collects on the commutator or collector rings, it should be removed by washing off with gasoline or carbon tetrachloride. If gasoline is used, allow to dry thoroughly before putting the plant back in operation, since a spark might ignite the gasoline vapors and cause considerable damage.

IF THE COMMUTATOR OR SLIP RINGS BECOME DIRTY OR ROUGH they should be polished. A very effective polisher may be constructed by folding several layers of canvas and placing it over the end of a strong piece of wood and tacking in place. The canvas pad may then be held over the commutator or collector rings as they are rotated resulting in a high polish without cutting the surface. However, if the commutator or collector rings are pitted it will be necessary to first polish with a very fine grade of sandpaper, Number 00, following up with the canvas polisher. NEVER USE EMERY CLOTH WHEN POLISHING COMMUTATORS OR COLLECTOR RINGS.

If all commutator bars are slightly blackened, this indicates an overload or possibly wrong brush setting. If only one or two

bars are blackened, this may indicate shorted or open coils. Any sparking should be investigated and analyzed. Excessive sparking will cause very rapid wearing away of either the collector rings, commutator and brushes.

Servicing Precautions:

When in use over extended periods, the collector rings will wear gradually. In this event, it may become necessary to machine these worn surfaces. When doing so, a competent machinist must be employed. Make absolutely certain that the armature is centered concentric with the bearing surfaces. When a minimum of material has been removed to restore a clean bright surface, repolish the rings using the canvas polisher as noted above.

CAUTION: UNLESS EXTREME CARE IS TAKEN IN MACHINING OPERATIONS AND TECHNIQUES EMPLOYED TO RESURFACE COMMUTATOR AND COLLECTOR RINGS, IT IS QUITE POSSIBLE THAT THE EFFICIENCY OF OPERATION OF THE MACHINE MAY BE SERIOUSLY IMPAIRED.

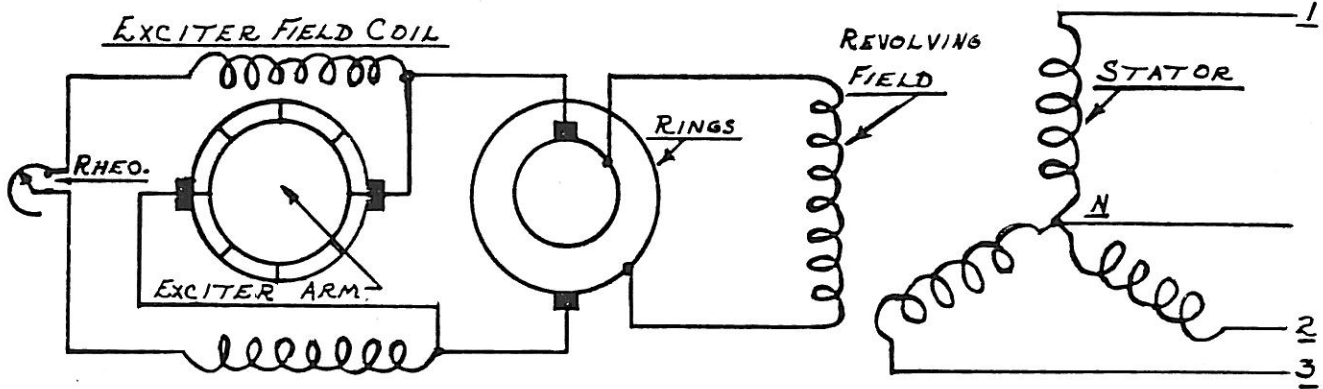
The brushes should be checked periodically to make certain that they move freely in their holders and that the brush tension arm is adjusted to provide proper brush tension. For new brushes, the tension spring should be set in the first notch of the tension arm. After the brushes are worn, the tension spring should be advanced to other notches to provide the proper tension. When the brushes have worn to about one-half their original length, they should be replaced. If this is not done, damage to the commutator or collector rings may result.

It is necessary that the brushes be kept free from dirt and oil at all times.

In replacing brushes, it is important that all brushes be of the proper grade, preferably of the same kind and type as were originally supplied with the generator. Lift the brush tension arms and remove the old brushes. When installing the new brushes, insert them only part way into the holders so that the brush tension arm will rest against the side of the brush and prevent it from contacting the commutator or collector ring. This is necessary, since before the machine can be used, the brushes must be fitted to the commutator or collector rings. For the proper method to be used in seating the brushes, see sketch and Note 2 in rear of manual.

THEORY OF OPERATION

The schematic connection diagram of a revolving field, 3 phase, AC generator with DC exciter shown below is also applicable to single phase alternators if appropriate stator connections are considered.



In the revolving field generator, the armature windings are stationary and is called the stator. The revolving field, which is basically revolving electromagnets, rotates inside the stator winding. Load connections are made to the stator leads, 1, 2, 3 and N.

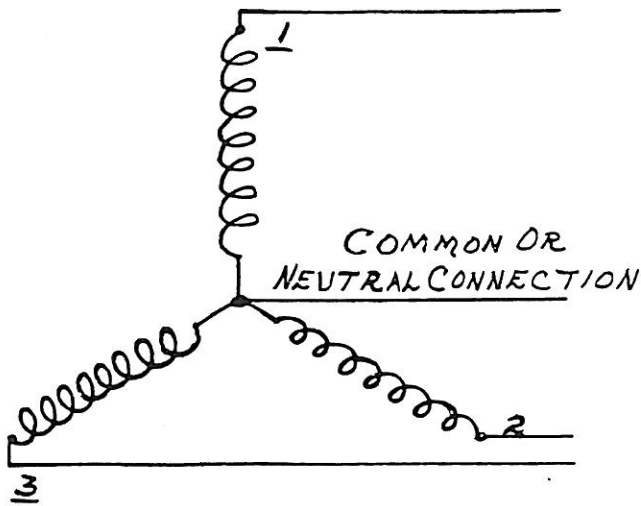
When the generator attains about three-fourths normal running speed, a voltage is generated in the exciter armature due to the residual magnetism in the exciter field poles. This causes a current to flow in the exciter field coils, which in turn reinforces the armature voltage. Since the revolving field windings are connected across the exciter armature, current flows also in these windings. The magnitude of the armature voltage of the exciter, and hence the current in the revolving fields, is a function of the resistance of the exciter field circuit, and therefore, may be controlled by the exciter field rheostat or voltage regulator. If the alternator is equipped with an automatic voltage regulator, the regulator automatically adjusts the effective resistance of the exciter field circuit to compensate for variations in stator output voltage caused by the load demands on the stator winding.

The internal connections of the stator vary with the specific needs of the customer. Three-phase and single-phase windings are the most common although some units are made so that they can be externally re-connected for either single-phase or three-phase service. The user should consult the wiring diagram included in this booklet before connecting this unit to his service lines.

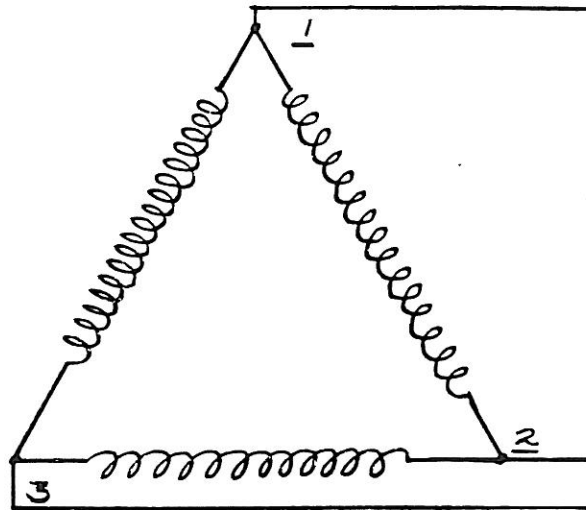
THREE PHASE CONNECTIONS

A three-phase alternator has three complete armature windings in the stator. It is actually equivalent to three single-phase alternators, except that it maintains a 120 electrical degree separation between each phase. Instead of having two separate leads for each phase, however, the phases may be connected together in such a way that they will not interfere with one another.

The two methods of connecting three phase machines are known as Star and Delta. These connections are important, as they determine the voltage rating of the machine.



WYE OR STAR CONNECTION



DELTA CONNECTION

The left view above shows the star connection of a three-phase AC winding. The coils represent the three phase windings of the machine and are spaced 120° apart. The center connection of this STAR is the point at which all three windings terminate and this point is called the neutral connection. The three outer ends of the coils are the starts of each winding and are connected to the line wires. The letter "Y" is commonly used as the symbol of the star connection.

The sketch at the right shows the method of making the DELTA connection. The symbol for the Delta connection is the triangle.

VOLTAGE OF STAR AND DELTA CONNECTIONS

Since the star connection makes it possible to get more than one terminal voltage from a generator, most are star connected internally at the factory. You will note from the star connected diagram at the above left that there are twice as many turns between terminals 1 and 2 as between terminal 1 and the neutral connection. Since the number of turns directly affects the voltage, you can see that for a given voltage per phase the terminal voltage between any two legs will be greater than that between the neutral connection and any leg. The voltage increase, however, will not be quite double because the spacing of the two windings in the machine is 120° apart, and consequently, their maximum voltages occur at slightly different times. If the load is connected between two legs (i.e., between terminals 1 and 2) the voltage will be 1.73 times the voltage between the neutral connection and any leg. The star line voltage divided by 1.73 gives the voltage between the neutral connection and any leg.

Generators having six or twelve terminal leads may be connected for star or delta operation permitting several terminal voltage possibilities. Since there is no neutral on the delta connection, only one terminal voltage is possible on delta connected generators. For further information concerning connections, refer to the detailed wiring diagram.

When connecting a 3-phase generator for standby service, it is

important that the standby generator is properly phased out so that 3 phase motors will run in the same direction on standby power as on the regular power. The quickest and surest way of checking this is to use a three phase motor. First connect it to the regular power source: note the direction of rotation, and mark the phase wires 1, 2 and 3; also mark the motor leads 1, 2 and 3 to correspond with the generators leads. Then transfer the motor leads to the generator to be used for standby service. If the motor runs in the same direction, mark the standby generator leads 1, 2 and 3 to correspond with the motor lead markings. If the motor runs in the opposite direction, interchange any two leads. The motor should now run in the right direction, and the standby generator leads should be marked to correspond with the motor leads. These wires should be connected to the generator disconnect switch for standby service.

INSULATION:

Generators that have been in transit for several days may be subjected to extreme temperature changes. This will usually cause excessive condensation. The generator windings should be thoroughly dried out before bringing the generator up to full name plate voltage. If this precaution is not taken, serious damage may result to the generator.

This generator was very carefully subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated. All machines are insulated to the highest degree believed commercially practical. The latest and newest in insulation materials and baking techniques are used. The finest insulation job may be quickly destroyed by carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a very expensive break-down, making it necessary to return the generator to the factory at costly shipping rates on machines of this weight, to say nothing of the loss of time.

WARNING: High voltage (dielectric) testing must not be given to this machine without first observing NEMA rules. The insulation of the generator winding may be safely checked by using a megger. A high megger reading indicates low insulation leakage.

To be safe, on machines of 50 kilowatts and larger, dry out the machines by the following procedure. Short circuit the generator lead wires firmly. Adjust the field rheostat to maximum resistance so that the stator winding will not be overloaded. Run the generator and reduce the field resistance to a point where the unit produces rated AC name-plate CURRENT. This may be measured with a clip-on ammeter at the generator leads. Make sure that the AC current does not exceed the name-plate rating. Machines of small capacity may be dried out by putting them into a hot-dry room or heating them moderately from an outside source.

Experience has shown that it is necessary to take these precautions in some localities. Quite often seaboard installations are very humid. Some installations will be in atmospheres that are much more corrosive than others. A little precaution along these lines could eliminate an unnecessary repair job.

NO VOLTAGE BUILD UP

Sometimes direct current exciters lose their residual magnetism. This can be easily and quickly restored by raising the DC brushes and

contacting the positive and negative brushholders to a 6- or 12-volt storage battery for just an instant to produce the desired polarity. The exciter field rheostat should be adjusted to minimum resistance during this operation.

Rotor Damage

Bearing failure will be evidenced by noise and excessive heating when the generator is in operation. An occasional check of the air gap between the rotor and the stator will indicate bearing wear and eventual failure. **DO NOT RUN THE GENERATOR AFTER THE ROTOR HAS BEGUN TO RUB ON THE STATOR.** Serious damage will result.

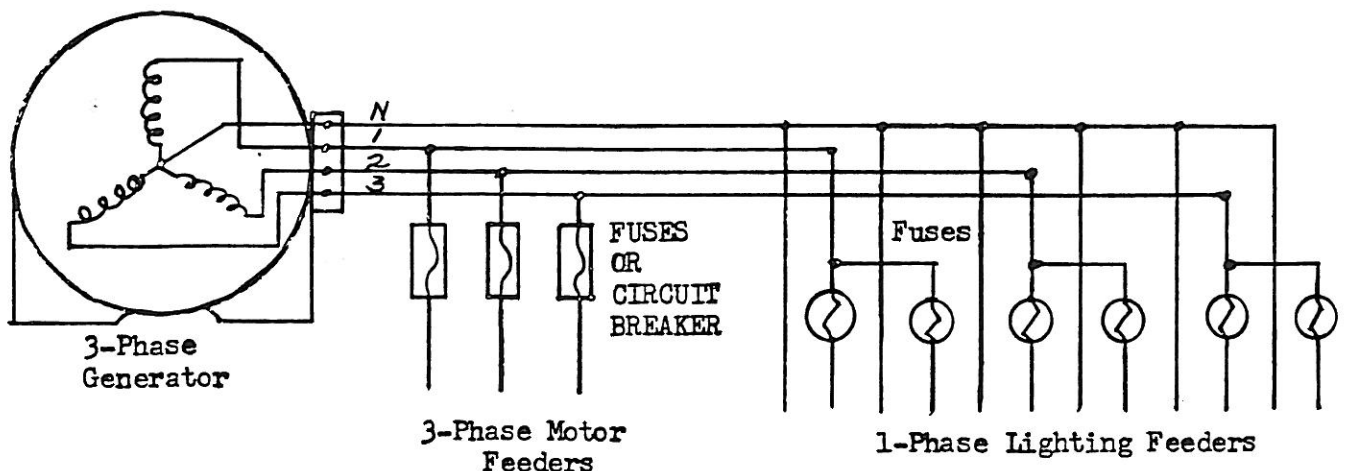
If the rotor becomes defective, it should be returned to the factory, giving full name-plate data. Do not attempt to have the rotor rewound by an unauthorized repair shop. The rotor coils are enclosed in a welded copper and brass squirrel cage damper winding. It is not practical for an outside shop to attempt to rebuild this assembly because of special tooling and techniques required. The factory can perform a complete rebuilding or rewinding job on this assembly in about one-fourth the time required by inexperienced outside shop personnel.

Experience has shown that outside repairs on rotors are not usually satisfactory. It is often necessary to return the rotor to the factory after local repairmen have accumulated substantial charges. Should you have a failure, we recommend that you notify the factory so that immediate steps may be taken to restore the plant to service with a minimum of charges and "down-time". Rotors for large generators are not ordinarily kept in stock, but in cases of extreme emergency a rotor can be repaired or rewound in forty-eight hours. If a new rotor must be built, it may take from two to three weeks.

The rotors on generators are subjected to extreme centrifugal forces. The prime mover must be adequately governed so as to prevent overspeed.

The damper bar cage serves to prevent excessive hunting when AC generators are operated in parallel.

BALANCING A 3 PHASE 4 WIRE GENERATOR FOR SINGLE PHASE SERVICE



The illustration above shows one way of distributing AC current from a 3-phase, 4-wire generator. The single phase load should be connected to the lighting feeders through fuses as shown. A separate

fuse box should be used for distributing three-phase power for motors, etc. The total current on each phase can be checked anywhere between the generator and the feeder panel. This is best done with a clip-on ammeter. The line current on each phase should be balanced as evenly as possible, and in no case should it exceed the rated current of the generator. The appliances that are turned on will determine the amount of current in each phase leg. Overloading one or two phases will reduce the total amount of load that a 3-phase generator can deliver without undue temperature rise. Voltage regulation on an overloaded phase may be poor. This unbalance can quickly be remedied by removing part of the load from the overloaded phase and adding it to another phase, so as to balance each phase as evenly as possible. If the load on each phase is perfectly balanced, the current in the neutral line will be zero.

DO NOT "OVER-MOTOR"

AC motors should not be any larger than actually necessary to pull the load. Motors that are only carrying partial load create a lagging power factor. On installations where the larger part of the load on the generator is motor load, it is recommended that power factor improvement capacitors be used to improve the power factor. Power factor should be corrected so that it does not drop below 80%. The value of power factor is something that is within the control of the user. To correct, it may be necessary to have the counsel and the service of a competent electrical man.

It is customary to rate AC alternators at 80% power factor. The kilowatt output will be less than the normal if the nature of the load causes the power factor to fall below 80%. The generator probably would not even be able to carry full load current as stamped on the name-plate, because the lagging component of the low power factor load has a demagnetizing effect on the generator fields. This would require a substantial increase in generator field current with greater heat dissipation in the field. This is usually the limiting factor.

Ordinarily, utility companies carry a proportionally large residential load which is mostly 100% power factor load from lamps and heating devices. Thus, the motor load of low power factor may be but a small part of the total electrical load. Consequently, experienced engineering service may be recommended to more satisfactorily utilize the generator capacity of independent systems where the load is mostly running motors.

OPERATING INSTRUCTIONS VOLTAGE REGULATOR

If the voltage regulator has been supplied with the generator as original equipment by the generator manufacturer, it is probably already adjusted to operate with that particular generator. If this is the case, it is only necessary to turn the regulator automatic-manual switch to "ON" and to adjust the A. C. voltage to the desired value by means of the regulator voltage adjusting rheostat. As a check, however, it is suggested that the operator follow through the steps outlined below when the generator is run for the first time.

To place the regulator into service for the first time proceed as follows:

1. Before starting prime mover, turn regulator automatic-manual switch to "OFF" and turn the alternator field rheostat to maximum resistance. Do not use this rheostat unless necessary to provide minimum stable exciter voltage.
2. Start the generating unit. When full R.P.M. is reached, adjust the A. C. voltage to 60%-70% of normal name plate value with exciter shunt field rheostat.
3. Turn automatic-manual switch "ON" and regulator will immediately bring the A.C. voltage up to approximately normal name-plate value.
4. Turn the automatic-manual switch "OFF" and notice if the voltage settles back to a value of 60%-70% of normal. If higher, readjustment of exciter field rheostat is necessary.
5. Close the automatic-manual switch again and adjust the A.C. voltage to rated value by means of the regulator rheostat. If the desired operating voltage is not within the range of the regulator rheostat, obtain correction by adjusting sliding collar of A.C. series resistor. Increase effective resistance of this series resistor to raise the output voltage and decrease the resistance to lower the output voltage. Proper resistor adjustment enables the regulator rheostat to lower the output voltage to at least 10% below normal operating voltage.
6. With the regulator operating, gradually apply load to the generating set until full rated load is reached. Voltage should be steady under all loads except for a slight dip at the instant the load is applied; and should not deviate more than 3% from normal up to full rated load while generator speed is held within the same limits.
7. If the voltage varies more than 3% as load is varied from no load to full load, improvement may be obtained by setting the exciter rheostat to a position to result in a lower voltage than 60%-70% of the normal value as specified in step No. 2. At this time it may be worth while to experiment with various exciter rheostat settings to determine which position results in the best regulation. Be sure to mark this setting of the exciter rheostat so that it may always be returned to this position for voltage regulator operation.
8. The regulator is now adjusted to automatically control the generator output voltage.

The Automatic-Manual Switch may be left "ON" when starting or stopping the generating unit. It is necessary to turn this switch "OFF" only when controlling voltage manually.

The Polarity Reversing Switch should be REVERSED approximately every 24 hours of actual operation to insure maximum contact life.

MAINTENANCE INSTRUCTIONS

To obtain the best possible service from your regulator, the following maintenance is suggested.

1. Keep the inside of the relay assembly free from dirt and other contamination.
2. Check the electrical connections and mechanical parts for looseness periodically.
3. Clean the regulator's vibrating relay contacts with emery cloth or by grinding whenever regulation becomes poor due to dirt or badly pitted contact surfaces. Wipe the contact surfaces free of dust before putting the regulator back into operation. Replace the contacts before the tungsten surfaces become worn down to the steel backing. If this is not done, welding will take place between the contacts, and damage due to high voltage may result.

NOTE: When replacing contacts, extreme care should be taken that the new contacts face one another squarely when in the closed position. Also, in order that the same regulation characteristics may be maintained, it is of great importance that gaps between new contacts when in the full open position be same as gaps when existed between the original contacts. Following completion of contact replacement a careful examination of contact arms and springs should be made to eliminate any friction or binding between these parts.

4. Change the position of the polarity reversing switch approximately every 24 hours of regulator operation. This switch reverses the direction of current flow through the regulator's vibrating contacts, thus preventing the current from gradually transferring a large amount of metal from one contact to the surface of the other contact.

If the regulator is equipped with automatic polarity reversal feature, make sure that the polarity reversing switch motor rotates when the regulator is in operation. Rotation may be observed thru the hole in the front panel of the regulator unit.

CAUTION: As a safety precaution, be sure to shut down the generating set while working on the voltage regulator or other parts of the unit and its controls.

TROUBLE SHOOTING HINTS VOLTAGE REGULATOR

When difficulties arise in maintaining proper voltage regulation, do not try to make corrective adjustments on the voltage regulator until it is certain that the regulator is actually at fault. Unsatisfactory voltage regulation is often symptomatic of troubles external to the regulator such as: defective prime mover operation, slipping belts, poor brush adjustments, and unusual load conditions. To isolate such troubles from those caused by a defective or improperly adjusted regulator, attempt to manually regulate the voltage with the exciter rheostat while the regulator is turned off (on "Manual"). If the same symptoms then exist, it is fairly certain that the regulator is not at fault. If, however, the difficulty vanishes upon switching to manual operation, the regulator or its connections are probably responsible.

Whatever may be the cause of unsatisfactory voltage regulation, the following list of common symptoms are shown with suggested corrective measures.

VOLTAGE DOES NOT BUILD UP WHEN REGULATOR IS TURNED ON

Regulator may be connected to wrong A.C. Voltage... compare regulator nameplate voltage with measured voltage across regulator A.C. connections when generator is operating at rated voltage.

Contacts may not be making electrical contact due to worn or dirty surfaces.

Voltage adjusting Rheostat may be turned too far in "decrease" direction.

A. C. Series Resistor may be adjusted for too little resistance...see the section dealing with operation.

Check exciter speed and brush contact, and connection.

Check A. C. generator collector ring brushes for poor contact or loose connections.

VOLTAGE ERRATIC OR UNSTEADY

Shunt Field Resistor may be improperly adjusted...see operating instructions.

Gap between regulator relay Vibrating Arm and Bumper Post may be too narrow.

Check regulator relay for binding in Armature or Vibrating Contact Arm...these parts should move freely for a short distance beyond their normal operating positions.

Check A. C. generator for variations in speed.

Check exciter brush adjustment and exciter belts for slip.

If all other adjustments seem to be in proper order,

try changing tension of contact arm tension spring. This spring is adjusted at the factory for satisfactory operation under average conditions, but regulator performance with a particular generator can sometimes be improved by making small changes in the tension of this spring. First release the tension in several small steps. If improvement is not gained, try increasing the tension slightly.

VOLTAGE OVERSHOOTS WHEN REGULATOR IS TURNED ON

Voltage adjustment of the regulator may be turned too far in "increase" direction.

Check regulator connections to exciter and exciter rheostat.

Regulator may not be connected to proper A.C. voltage... compare regulator nameplate voltage with measured voltage across regulator A.C. connections when generator is operating at rated voltage.

Shunt Field Resistor may be adjusted for too little resistance...see operating instructions.

A.C. Series Resistor may be adjusted for too much resistance...see operating instructions.

DEGREE OF REGULATION IS UNSATISFACTORY

Check adjustment of shunt field resistor...see operating instructions.

Vibrating Contacts may be dirty or badly pitted.

Check for loss of speed in generator or exciter on application of load.

Check for binding of moving relay parts.

Check for overload of generator or exciter.

If all other adjustments seem to be in proper order, improvement may be gained by releasing slightly the tension of Contact Arm Tension Spring.

VIBRATING CONTACTS SPARK EXCESSIVELY

Spark Suppressor Condenser may be defective.

Shunt Field Resistor may be adjusted for too much resistance or may be open.

Power factor of generator load may be too low.

Alternator field resistor, if used, may be adjusted for too much resistance.

VOLTAGE DROPS EXCESSIVELY WITH INCREASE IN GENERATOR LOAD.

Make sure that regulator is turned on, that Regulating Relay vibrates.

Check for loss of speed in generator or exciter on application of load.

Shunt Field Resistor may be adjusted for too little resistance.

Check for overload on generator or exciter.

Should it be impossible to locate and rectify the cause of poor regulation, contact the factory, or the nearest factory representative.

NOTE: If the regulator is not equipped with a built-in shunt field resistor, all references to this part shall apply to the exciter field rheostat.

VOLTAGE REGULATORS EQUIPPED WITH SINGLE PHASE CROSS CURRENT COMPENSATORS.

Where parallel operation of two or more single-phase generators is contemplated, provision for such operation must be provided in the control mechanism of the generating sets. Such features include the employment of engine governors displaying similar operating characteristics as well as synchronizing and cross current compensation circuits in the control system of the generators.

In general, two additional components are included in the control panel where single phase cross current compensation is provided, namely the compensator (phase shift network) and its associated current transformer. These components are permanently wired into the circuit as shown in the attached wiring diagram. Their function is to provide a reactive component of voltage of the proper amplitude and phase necessary to compensate the exciter circuit in order to minimize the flow of cross current between two or more generators connected to the common load.

VOLTAGE REGULATORS WITH 3 PHASE CROSS CURRENT COMPENSATION

Where parallel operation of two or more 3 phase generators is required all of the above conditions noted for single phase must be fulfilled. However, since a quadrature component of voltage is already available due to the phase relation existing between the 3 generator phase loads, no phase shift network is required.

PROCEDURE FOR SYNCHRONIZING BY "DARK LAMP METHOD"

The synchronizing lamps and circuit breaker are located on the generator control panel so that the operator may observe the lamps and manipulate the breaker during the synchronizing procedure.

Provision is made for synchronizing by the "Dark Lamp Method". A suggested procedure is outlined below. Each engine-generator set is provided with its own synchronizing lamps and breaker. However, when the set is on the line, the breaker is connected in shunt with its own lamps and they will, therefore, be extinguished.

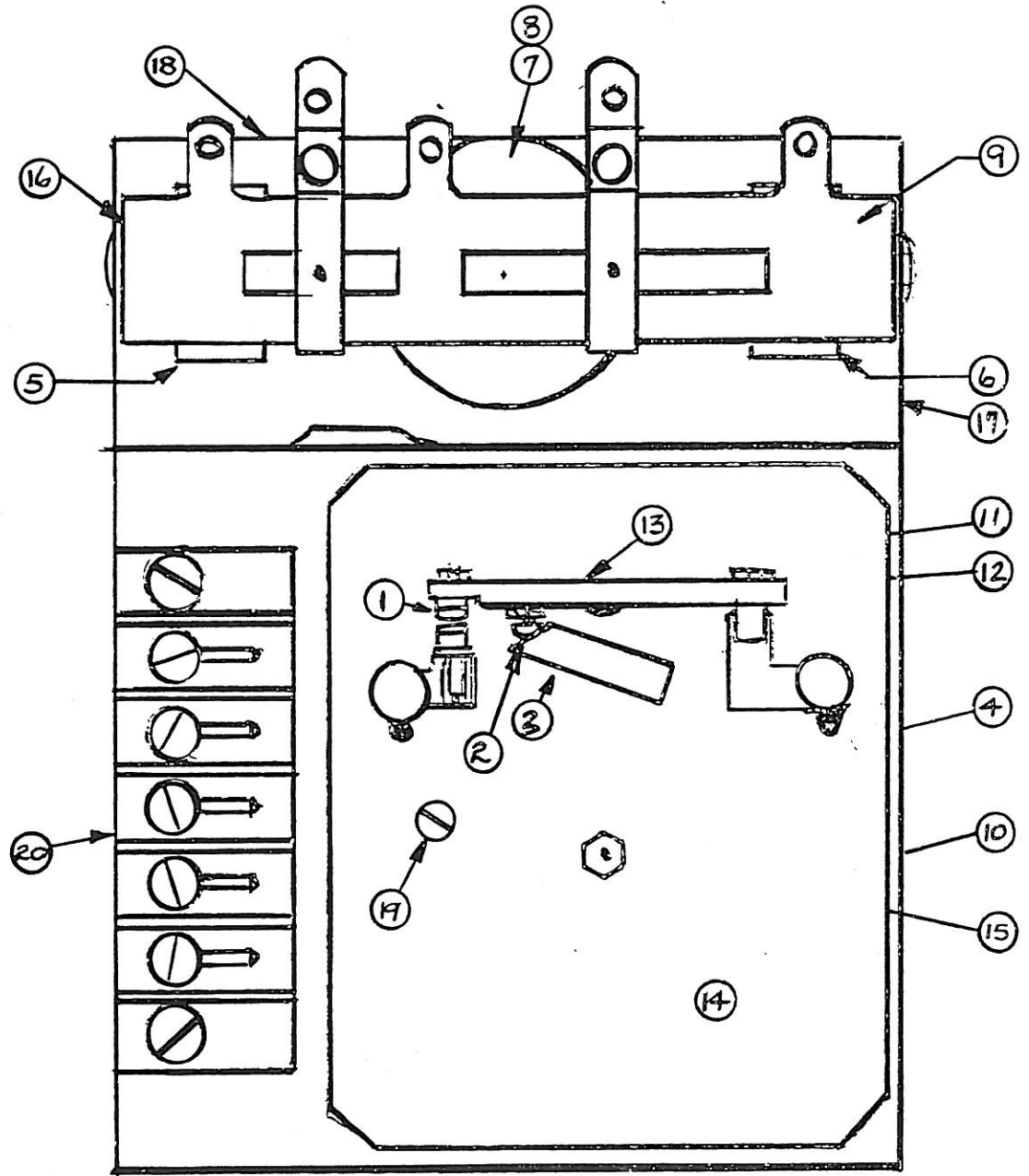
System wiring should, of course, be such that the load side of all unit breakers is connected to the common bus. Assume that unit #1 is on the line carrying the load, its breaker is on (lamps extinguished), output voltage and frequency normal. It is desired to bring unit #2 on the line to handle additional load requirements.

1. Circuit Breaker on control panel of Unit #2 - "OFF"
2. Start Engine of Unit #2
3. Synchronizing Lamps on #2 Control Panel should flash on and off. If lights remain extinguished, check to make sure the Synchronizing switch is "ON". The two lamps are connected in series so that if either one of the two burns out or is broken, the other will not light. (It is a good idea to always keep a spare on hand.)
4. It is reasonable to assume that if the governors operate properly, and in the same manner as they did when they were checked at the factory, that unit #2, which is unloaded, will be operating somewhat faster (greater R.P.M.) than Unit #1 which is loaded. Therefore, the synchronizing lamps will oscillate in brilliance in proportion to the number of times the oncoming alternator is overtaking the loaded alternator speed. It is the function of the synchronizing lamp to detect this difference in speed and also to indicate when the units are in synchronism. **THE ALTERNATORS ARE SYNCHRONIZED WHEN THE LIGHTS ARE "OUT".**
5. During the period when the lamps are out (this should be a period of several seconds) close the circuit breaker of Unit #2, bringing it on the line. The lamps of Unit #2 will now be shunted by the breaker and will stay off until the breaker is opened.

NOTE: In removing either of the sets from the line, preparatory to shutting it down, the above sequency of operations should be reversed, i.e.,

1. Open circuit breaker of unit to be taken off the line.
2. Shut down the engine of the unit.

If this procedure is not followed, and the engine is shut off before the generator circuit to the load bus is broken, the generator will tend to become a motor, deriving its voltage from the common bus, and will tend to keep the engine running. This could result in damage to the alternator or the engine, or both.



VOLTAGE REGULATOR

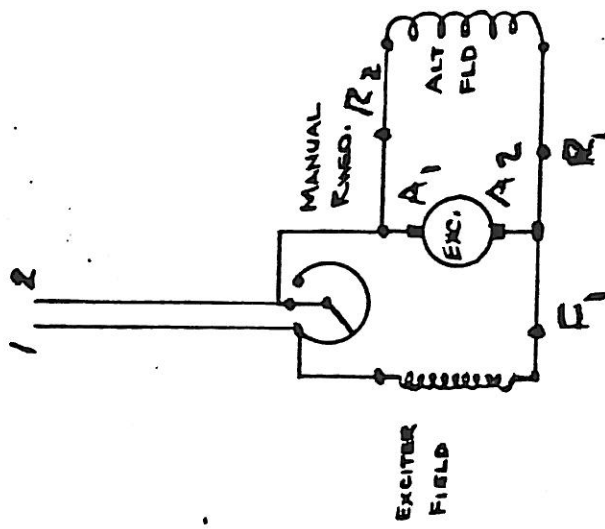
No.	Description	Part No.
1.	Complete Set Contacts	1B1123
2.	Bumper	1B1124
3.	Vibrator	1B1013
4.	Spark Suppressor Condenser (not shown)	1B1125
5.	Reverse Polarity Switch	1B1126
6.	Automatic Manual Switch	1B1039
7.	Voltage Control Rheostat	1B1038
8.	Rheostat Knob	1B1133
9.	A. C. Series Resistor & C.C.C. Resistor	1A1250
10.	A. C. Operating Coil (not shown)	1B1128
11.	Contact Pressure Spring (not shown)	1B1129
12.	Armature Torsion Spring (not shown)	1B1130
13.	Vibrating Contact Arm	1B1058
14.	Complete Preadjusted Relay Assembly	1B1131
15.	Armature Assembly (includes all parts on armature)	1B1132
16.	Resistor Mounting Bracket	1P1060
17.	Main Mounting Panel	1B1306
18.	Switch Panel	1B1064
19.	Contact Arm Tension Spring Adjustment Screw	1B1065
20.	Terminal Block	1E1311
21.	Regulating Relay Cover (not shown)	1B1302

When ordering spare or replacement parts, specify the number of the part needed, along with the model and serial number of the regulator for which the part is intended.

Refer to latest wiring diagram for listing of potential transformers, cross current compensation transformers, radio interference suppression, temperature compensation, etc.

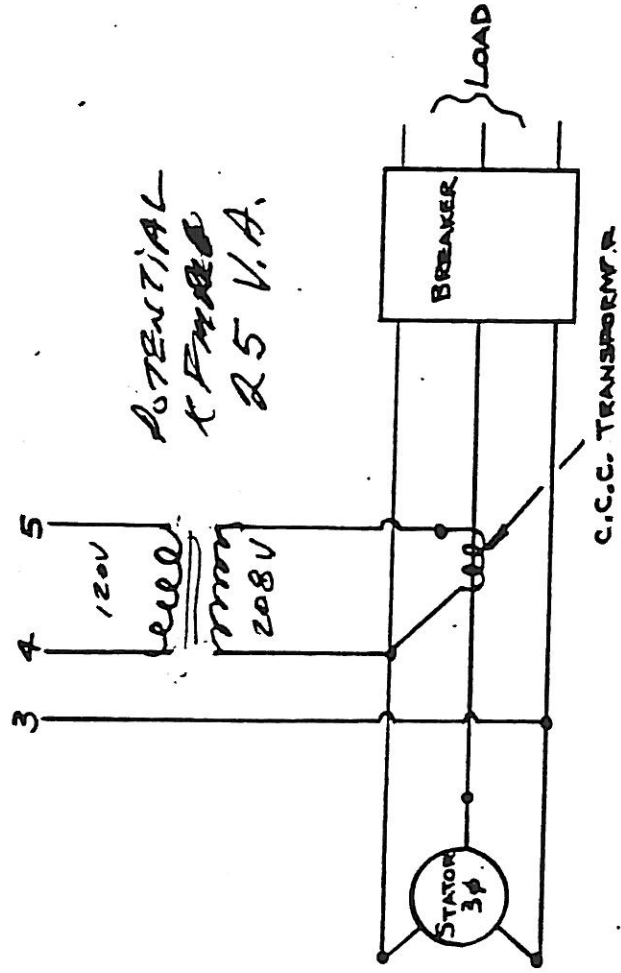
Direct all parts orders to factory or nearest factory representative.

REGULATOR



EXCITER
FIELD

TERMINALS



POTENTIAL
P.T. 120V
25 V.A.

BREAKER

LOAD

C.C.C. TRANSFORMER

- 100 -

100/5 CURRENT TRANSFORMER
25 VA

REGULATOR

CONNECTIONS

15KW
120/208V
3 PHASE

MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

Trouble	Cause	Remedy
Generator fails to build up rated voltage	Voltmeter inoperative	Replace Voltmeter
	Open field circuit. (Field coils, field rheostat, field resistor.)	Check continuity with DC. (AC test lamps will not usually light up on field coils with many turns; consequently, DC should be used for testing.) A bank of batteries connected in series to give 12 to 24 volts will usually suffice. If open circuit is indicated, repair or replace defective part. (See Note 1.)
	Loss of residual magnetism, either by short circuit, lightning striking system, or long inactivity.	Raise DC brushes and contact positive and negative brush-holders to a 6- or 12-volt storage battery for just an instant to produce the desired polarity.
Poor Brush Contact	<ol style="list-style-type: none"> 1. Brushes and holders should be kept free from excessive dirt and grease. 2. See that brushes move freely in holders. Sticking may cause undue sparking. 3. Check Brush tension. Brush holder tension springs which actuate the brush holder tension arms have been adjusted at the factory for proper tension. However, after the brushes have been worn down to half of their original length, the spring tension may be increased one notch. Brushes should be checked periodically so when brushes have worn to the point where brush holder tension arm is almost at the end of travel, the brush may be replaced. On small machines using fixed brush holders and fiber caps, the brush spring tension is not adjustable, and when the brush has worn to about 1/2 its original length it should be replaced. Care should be taken, however, to see that the shunt does not get twisted too tightly and become pinched between turns of the brush spring. Tighten caps well to assure good contact. 	

MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

Trouble	Cause	Remedy
Generator fails to build up rated voltage (cont'd)	Poor Brush contact (cont'd)	4. Replacing brushes. It is important that all brushes be of the same grade, preferably, the same kind and type as supplied with the original unit. After brushes have been installed in the holders, it is necessary that the brushes be fitted to the commutator or collector ring. (See note 2.)
	Armature shorted or grounded.	Remove armature and test on growler. If test shows short, or open, armature will have to be repaired or rewound.
	Field coils shorted or grounded	Disconnect field leads (F ₁ and F ₂) from brushes and armature leads and check for continuity and resistance to ground with ohm meter or lamp and batteries. (See note 1.)
	Short circuit on line	Locate short in system before connecting generator to line. Check for shorted filter condensers on output of generator.
	Too Much Field Resistance	Reduce resistance of field resistor or rheostat.
	Open ammeter shunt or filter inductor.	Check continuity and replace.
	Open armature winding due to commutator throwing solder from riser. Due to excessive heat and load.	Commutator must be resoldered, turned, and undercut.
	Brushes not in commutating plane.	This trouble will only be encountered in larger plants having adjustable brush rings or spiders. In the smaller plants the position of the brushes is fixed by design. On the 12 and 14" field frames the adjustable ring may be repositioned so that the brushes are under the poles. The optimum point is the one in which the D.C. armature voltage is maximum
	Wrong rotation.	The machine must be run in the correct direction. (Looking at the unit from the commutator end, belt drive plants usually

MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

Trouble	Cause	Remedy
Generator fails to build up rated voltage (cont'd)	Wrong rotation (cont'd)	rotate clockwise; engine driven plants rotate counter-clockwise. If it is desired to run the machine in the opposite direction to the way it was adjusted at the factory, the internal connections of the generator will have to be changed, and the commutating plane of the brushes readjusted. The sure way is to take all the wires off the positive brushholder and place them on the negative brushholder and place all the wires which originally connected to the negative brushholder on the positive brushholder. On a straight shunt-wound machine, rotation can be changed simply by interchanging the field leads. To adjust the commutating plane of the brushes, shift the brush spider or ring in the direction which results in the highest D.C. armature voltage with minimum sparking at the brushes when the field rheostat or resistor is at minimum resistance setting.
	Faulty voltage regulator operation.	Try operating the plant without voltage regulator. See the instruction manual for the particular voltage regulator used.
Low output voltage	Excessive load	Reduce load
	Insufficient excitation due to too much resistance in the field.	Reduce the amount of field resistance.
	High resistance connections.	Connections will be warm or hot to the touch. Make better electrical and mechanical joints and connections.
	High Line Losses	Increase size of line wires
	Low speed 1. Belt slipping 2. Defective governor 3. Defective bearing 4. Excessive load	1. Tighten Belt. 2. Adjust, repair, or replace governor. 3. Replace bearings. 4. Reduce load.

MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

Trouble	Cause	Remedy
Low output voltage (cont'd)	Brushes not seated properly or dirty.	Clean or replace brushes and reseat. (See Note 2.)
	Dirty Commutator	Sand commutator lightly with sandpaper or crocus-cloth. DO NOT USE EMERY PAPER. If commutator is greasy, wipe with non-inflammable liquid.
	Shorted field coil	Test field coils for possible shorts. Replace bad coil.
	Reversed field coil connection.	Check as in Note 1, reconnect coil properly.
High output voltage	Improper field resistance setting.	Increase resistance of field resistor or rheostat.
	Excessive speed.	Reduce engine speed to rated value
	Improper governor adjustment.	Reset governor.
	Faulty voltage regulator operation.	Try operating without voltage regulator. (See voltage regulator instruction manual)
	Operating in sub-zero temperatures.	Add in more field resistance until plant reaches operating temperature.
Excessive heating. Most machines are designed to withstand a temperature rise of 40°C. (See nameplate data for specific plant)	Overload	Reduce load. (Check ammeter readings against nameplate rating.) Allow proper correction value for power-factors less than unity.
	Clogged ventilating screens.	Remove and clean air passages in screens. Make sure passages within machine are open.
	High Room Temperature	Improve ventilation to operating area.
	Insufficient air circulator	Provide cross ventilation, additional openings to room housing plant.
	Operating with excessive voltage.	Check voltage drop in distribution lines and connections. Provide service lines large enough to overcome excessive line drops.
	Armature or field coils shorted or grounded.	Repair or replace.
	Excessive brush pressure.	Adjust pressure or replace tension springs or brushes and springs.
	Flexible coupling not in line or belt too tight.	Align coupling or sheeves and adjust belt tension.

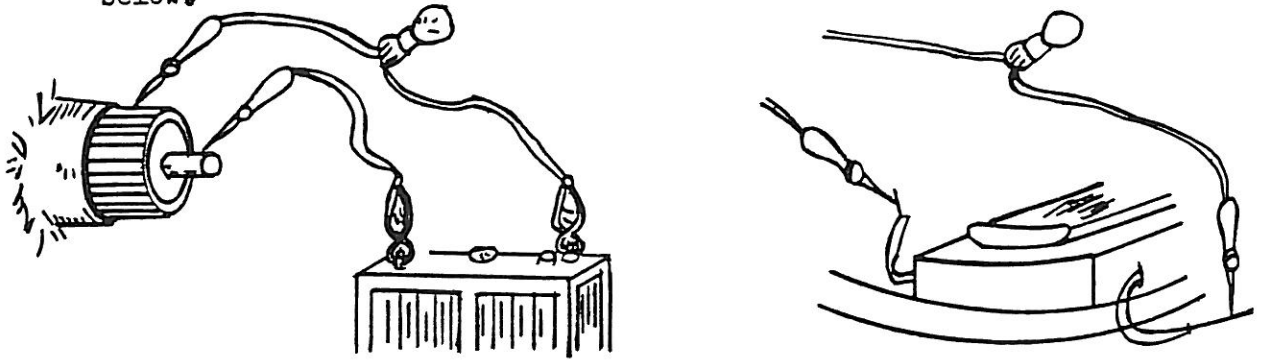
MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

Trouble	Cause	Remedy
Excessive Heating (Cont'd)	End Bells out of position	Realign
	Bent Shaft	Straighten or replace
Excessive Sparking at the brushes	Brushes dirty or not seated properly	Clean or replace and reseal. (See Note 2)
	Improper brush grade	Use only brushes recommended, or duplicate of original brushes
	High Mica	Commutator should be turned on lathe and undercut. (See Note 3.) All micas should be carefully undercut below commutator surface.
	High commutator bar or rough commutator	1. It may be necessary to machine the commutator on a lathe; however, when doing so a competent machinist must be employed. Make absolutely sure that the armature shaft is centered concentric with the bearing surface. Don't machine commutator until you have checked to see that shaft center is concentric with bearing. The surface of the commutator should be machined as little as possible and polished with fine grit, high grade sandpaper after under- cutting. 2. A very effective polisher may be constructed by folding several layers of canvas or duck over the end of a strong piece of wood and tacking it in place. The canvas pad may be held on the commutator or collector rings. This will give a high polish without cutting the surface, however, if the commutator is pitted, it will be necessary to first polish with a fine grade of sandpaper, (00), following it with the canvas polisher. NEVER USE EMERY CLOTH TO POLISH, since it contains metallic particles which will short out the commuta- tor.
	Lack of brush pressure.	Adjust or replace tension springs.

MAINTENANCE SERVICE INSTRUCTIONS
For DC Generators and Exciters
AC Alternators

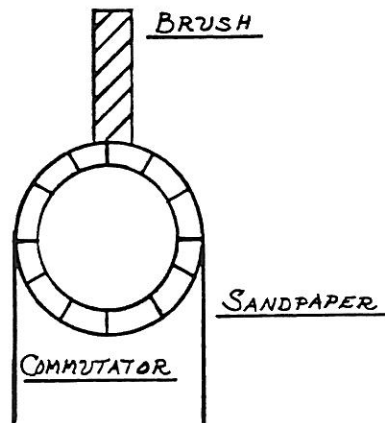
Trouble	Cause	Remedy
Excessive sparking (cont'd)	Brushes not in commutating plane	(See Page 20)
	Brushes sticking in brushholders	Clean brushes and brushholders and adjust brushes.
	Overload	Check ammeter readings with nameplate rating. Reduce load.
	Grounded, open, or shorted field coil windings.	Replace or repair defective coil.
	Open Armature	Repair or replace armature.
	Loose brushholder	Re-align and tighten holder.
Fluctuating DC voltage	Irregular speed of engine.	Adjust governing device.
	Unstable voltage regulator.	Try operating without voltage regulator. See voltage regulator instruction manual.
	Fluctuating load	Stabilize load.
	Poor brush contact	(See Pages 19 & 20)
	Loose terminal connections	Make better connections mechanically & electrically.
	Generator overloading	Reduce load
	Defective bearing	Replace worn bearings
Polarity of generator reversed	Long inactivity, short circuit, lightning striking system, etc.	Raise DC brushes and contact positive and negative terminals with 6 to 12 volts to produce correct polarity.
Radio Interference	Radio Frequency interference due to sparking of brushes	Connect .5 mfd condensers from all brushes to frame. Voltage rating should be at least double the rated voltage on the circuit to which they are connected. If condensers are already connected to these points, replace with new condensers.
	Radio frequency interference caused by leakage of static charge from generator shaft.	Install shaft grounding brush assembly.
	Radio interference caused by electrical system of engine	Suppress radio interference in usual manner. It is suggested that competent radio man or electrician be consulted.

Note 1: The electrical circuit for continuity tests with battery and lamp is shown below.

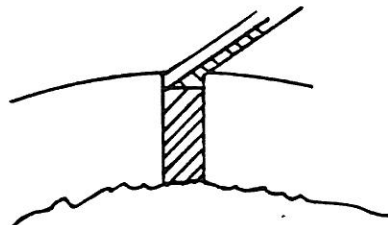


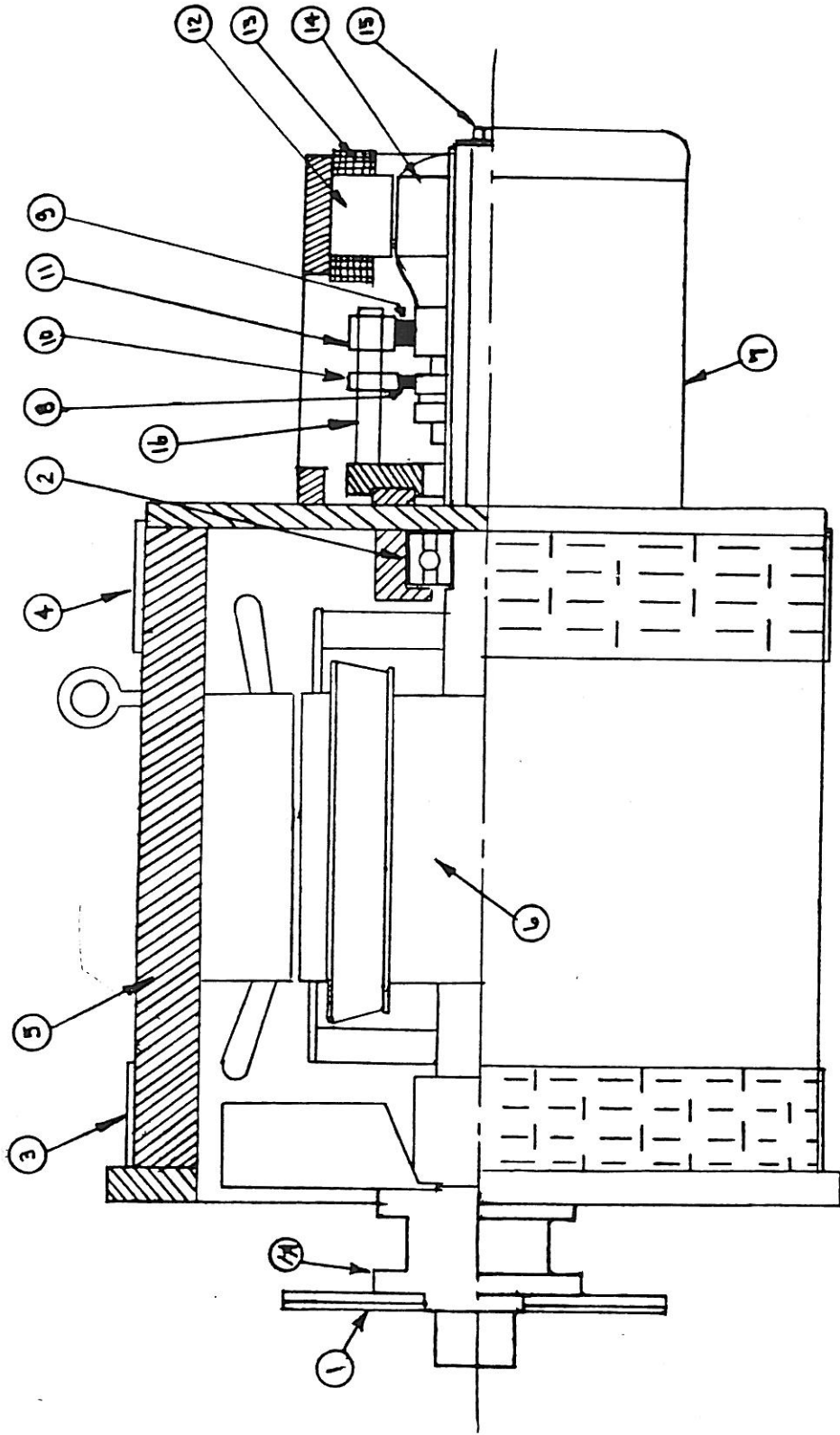
A high reading (Regohm) ohmmeter may be used in place of this circuit.

Note 2: Proper method for fitting brushes to commutator and collector rings is shown below.



Note 3: The proper method for undercutting the mica on a commutator is shown below:





GENERATOR ASSEMBLY

Generator Parts List

Key No.	Part No.	Part Name	No. Req'd
1	S-1768	Coupling Disc.	2
1-A	G-2805	Coupling Hub and Fan Assy Complete	1
2	D-22	Main Bearing	1
3	S-2464	Drive End Cover (Alternator)	1
4	G-2784	Outboard End Cover	1
5	G-2774	Stator Assy Complete	1
6	G-2775	Rotor Assy Complete	1
7	G-2777	Exciter Assy Complete	1
8	Y-51	Ring Brushes	2
9	Y-2	Commutator Brushes	2
10	G-2284	Ring Brush Holder	2
11	G-34	Commutator Brush Holder	2
12	G-292-A	Exciter Field Pole Assy only	4
13	H-365	Exciter Field Coils	4
14	G-2131-4	Exciter Armature Assy	1
15	S-1635	Exciter Armature Stud	1
16	G-2270-2	Exciter Brush Gear Assy Complete	1

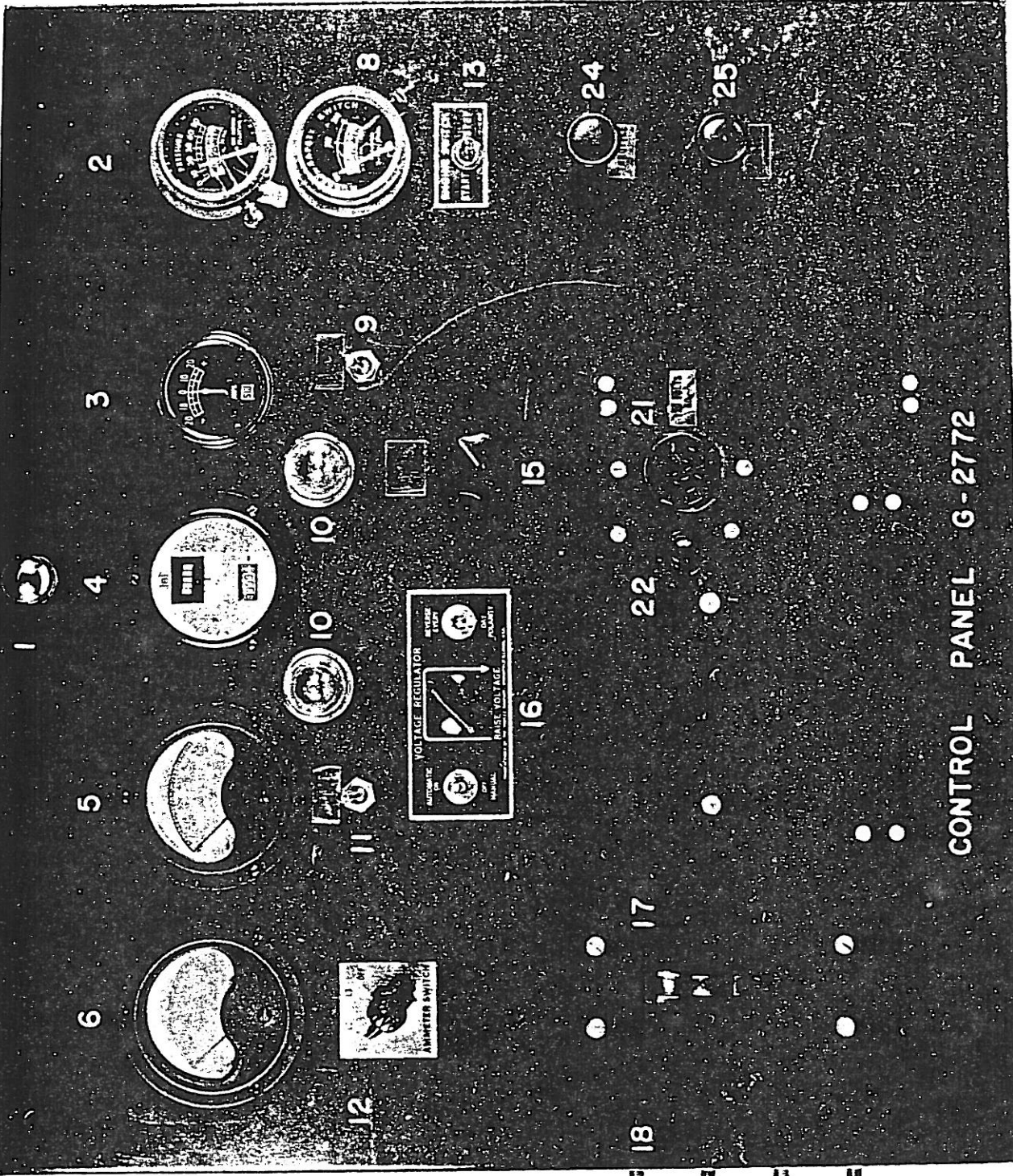
Control Panel Parts List and Spare Parts

<u>Part No.</u>	<u>Key</u>	<u>Part Name</u>	<u>Req'd</u>
EE-924	1	Panel Lamp Socket	1
EE-925		Panel Lamp Bulb, 6 volt, GE-40	1
OP-1	2	Oil Pressure Guage, with shutdown	1
15-0021	3	Ammeter, Charge Rate, D. C.	1
FM-5	4	Running Time & Frequency Meter	1
VM-44	5	Voltmeter, A. C.	1
AM-64	6	Ammeter, A.C.	1
CT-15	7	Cross Current Transformer	1
WT-1	8	Water Temperature Guage, with shutdown	1
EE-151	9	Panel Lamp Switch, toggle	1
EE-920	10	Synchronizing Lamp Socket	2
EE-935		Synchronizing Lamp Bulbs, 230 volt GE-S6	2
EE-151	11	Synchronizing Lamp Switch, Toggle	1
EE-253	12	Ammeter Selector Switch, Rotary	1
EE-156	13	Engine Start-Stop Switch, Toggle	1
EE-660	14	Control Terminal Strip, Barrier Type, 12P	1
R-48	15	Exciter Manual Field Rheostat	1
EE-719	16	Exciter Voltage Regulator	1
EE-859	17	Circuit Breaker	1
J-205	18	Load Terminal Board	2
3518		Load Terminal Screws, 1/4 -20 x 1-3/4 Brass	4
4810		Load Terminal Nuts 1/4 -20 Hex Brass	8
EE-530	19	Load Terminal Suppression Capacitors	3
EE-555	20	Voltage Regulator Suppression Capacitors	2
EE-310	21	3 wire convenience Receptacle	1
EE-425	22	Receptacle Fuse Holder	1
EE-442		Receptacle Fuse, 15 amp	1
EE-659	23	Generator Terminal Strip, Barrier Type, 8P	1
CT-14		Current Transformers (in Tap Change Box)	3

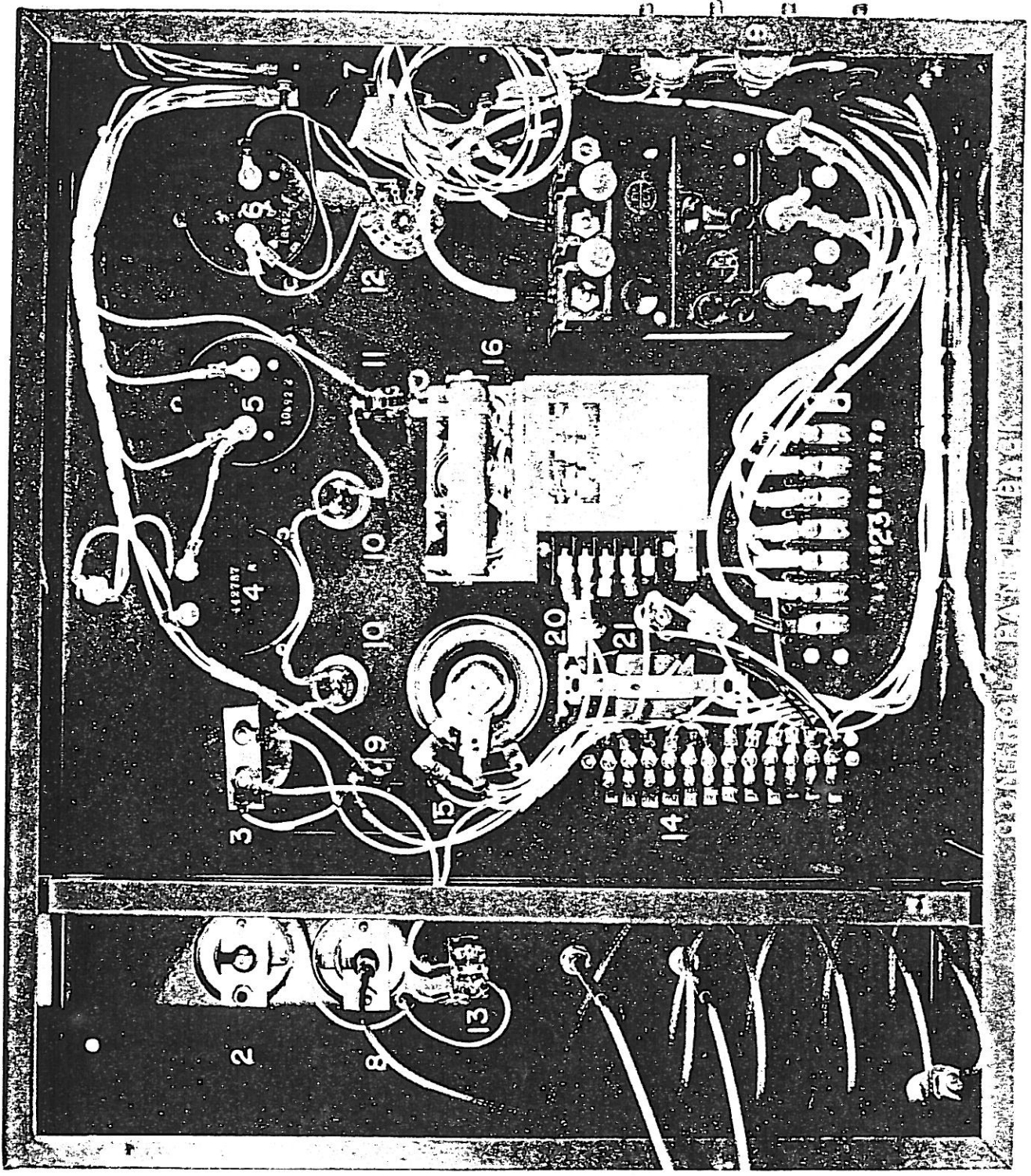


SPARE PARTS (Stored in tool box)

15-0100		Spark Plugs	1
Y-2		Commutator Brushes, Alternator	2
Y-51		Slip Ring Brushes, Alternator	2
EE-442		Receptacle Fuses, 15 Amp/	5

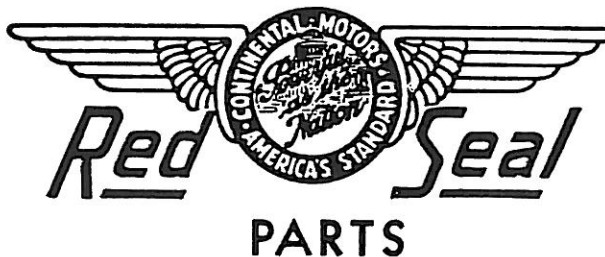


CONTROL PANEL G-2772



Continental Motors Corporation

GENUINE



SERVICE

PARTS

ISSUED NOV. 8, 1957
CHANGES

PARTS EFFECTED	DATE	SCN. NO.

ENGINE MODEL FA162

SPECIFICATION 2358

Qty.	Part Number	Description
<u>CYLINDER & CRANKCASE - SECTION 1</u>		
CYLINDER & CRANKCASE		
1	F162A-4251-A	Cylinder & Crankcase Assembly (stripped) Composed of: Cylinder & crankcase, caps, bearings, guides, inserts, support, screws, stud, plugs, pins
1	F162A-4251-C	Cylinder & Crankcase Assembly Composed of: "A" assembly plus pistons and rings
1	F162A-4251-I	Cylinder & Crankcase Assembly Composed of: "C" assembly plus complete valve mechanism
1	F162A-4251-S	Cylinder & Crankcase Assembly Composed of: "I" assembly plus connecting rods, crankshaft, camshaft, front end plate, gears, filler blocks, cylinder head, gaskets, gear cover assy., oil pump assy., oil pan assy., studs, nuts, screws, washers, plugs and lockwires
1	F162U-120	Service gasket set (complete engine)
CRANKSHAFT BEARING CAPS		
1	F400B-348	Cap, bearing, crankshaft (front)
1	X-14294	Washer, 3/8 between bearing cap and oil pump mounting lug
1	F400B-350	Cap, bearing, crankshaft (center)
1	F400B-349	Cap, bearing, crankshaft (rear)
4	X-2986	Screw, crankshaft bearing cap to cylinder 1/2-13 x 2-5/8
2	X-3511	Screw, crankshaft bearing cap to cylinder 1/2-13 x 3-1/4
6	3X-B2B-110	Washer, plain, crankshaft bearing cap to cylinder screw 1/2
2	6SH-100	Wire, lock, crankshaft bearing cap to cylinder screw (front) and rear #19 x 10
2	X-1333-B	Wire, lock, crankshaft bearing cap to cylinder screw (center)
FILLER BLOCKS		
1	D600B-340	Block, filler (front)
2	X-3924	Screw, filler block to crankcase (front) 5/16-18 x 7/8
2	X-297-A	Washer, lock, filler block to crankcase screw 5/16
1	F400B-255	Gasket, filler block to oil pan (front)

Qty.	Part Number	Description
1	D600B-406	Block, filler (rear)
2	X-2958	Screw, filler block to crankcase (rear) 5/16-18 x 2-5/8
2	X-297-A	Washer, lock, filler block to crankcase screw 5/16
1	F400B-255	Gasket, filler block to oil pan rear
2	T427B-201	Seal, filler block to crankshaft (rear)
2	X-3056	Screw, filler block to flywheel housing
2	X-201	Washer, lock, filler block to flywheel housing
1	D600B-305	Guard, oil, crankshaft bearing (rear)
1	F400B-251	Felt, rear bearing oil guard
HOLE COVERS AND PLUGS		
2	X-1954-B	Stud, fuel pump hole cover to cylinder 5/16-18 x 1-1/2
2	X-1801-E	Nut, fuel pump hole cover to cylinder stud 5/16-18
2	X-202	Washer, lock, fuel pump hole cover to cylinder stud 5/16
1	16EV-201	Gasket, fuel pump, hole cover to cylinder
2	X-3236	Screw, plugging, air cleaner stud hole 5/16-18 x 1/2
2	X-14192	Washer, copper, air cleaner stud hole plugging screw 5/16
5	X-3940	Screw, plugging, generator bracket stud hole 3/8-16 x 5/8
5	X-14134	Washer, copper, generator bracket stud hole plugging screw 3/8
1	X-2236	Plug, hubbard, camshaft bushing (rear) 1-1/2
1	X-2207	Plug, hubbard, cylinder core hole 1-1/8
1	X-2202	Plug, hubbard, cylinder core hole 1-3/8
2	X-137-A	Plug, pipe, crankcase oil header 1/4 (c'sunk-special)
1	X-137-A	Plug, pipe, crankcase oil cross drill 1/4 (c'sunk-special)
1	X-100	Plug, pipe, oil filter return hole (left side 1/8 ext. head)
1	X-101	Plug, pipe, cylinder water jacket drain (1/4 ext. head)
<u>CYLINDER HEAD - SECTION 2</u>		
CYLINDER HEAD		
1	F162A-352	Head cylinder
15	X-19828	Stud, cylinder head to cylinder 7/16-20 x 3-15/32
15	3X-X-1803-E	Nut, cylinder head to cylinder stud 7/16-20
15	3X-X-1408	Washer, plain, cylinder head to cylinder stud 7/16
1	F400A-336	Gasket, cylinder head to cylinder

Qty.	Part Number	Description
CYLINDER HEAD PLUGS		
1	X-3940	Screw, plugging, distributor adapter stud hole 3/8-16 x 5/8
1	X-14134	Washer, copper, distributor adapter stud hole plugging screw 3/8
2	X-3236	Screw, plugging, oil filter stud hole 5/16-18 x 1/2
2	X-14192	Washer, copper, oil filter stud hole plugging screw 5/16
1	X-2538	Plug, special, distributor drive hole
1	X-101-B	Plug, pipe, cylinder head thermometer hole 1/2 (c'sunk)

CRANKSHAFT - SECTION 3

Qty.	Part Number	Description
CRANKSHAFT		
1	F400C-5000	Crankshaft Assembly
1	F600C-205	Plate, thrust, crankshaft
1	D600C-204	Washer, thrust, crankshaft
3	8TC-101	Pin, crankshaft thrust wash. to crankcase 5/32 x 1/2
8	10EC-204	Shim, thrust, crankshaft .002
8	10EC-205	Shim, thrust, crankshaft .008
1	A600C-204	Thrower, oil, crankshaft
1	D600-O-201	Jaw, starting, crankshaft
1	8UO-202	Washer, crankshaft starting jaw to crankshaft
1	15LG-202	Bushing, pilot, clutch

Qty.	Part Number	Description
CRANKSHAFT BUSHINGS		
1	F600G-3491	Bearing, main, crankshaft (front-upper & lower)
1	F400G-J111	Bearing, main, crankshaft (center-upper & lower)
1	F600G-3471	Bearing, main, crankshaft (rear-upper & lower)
	F400T-151	Kit, main bearing (engine set)

CONNECTING ROD - SECTION 4

Qty.	Part Number	Description
CONNECTING RODS		
2	F400D-5021	Rod Assembly, connecting (cylinders 1-3) with bearings
2	F400D-3031	Rod Assembly, connecting (cylinders 2-4) with bearings
8	C600D-206	Bolt, connecting rod
8	X-18188	Nut, connecting rod bolt 3/8-24
8	X-601	Pin, cotter, connecting rod bolt 3/32 x 3/4

Qty.	Part Number	Description
CONNECTING ROD BEARINGS		
4	F600G-341	Bearing, connecting rod (1-3 connecting rods)
4	F600G-342	Bearing, connecting rod (2-4 connecting rods)
	F400T-152	Rod Bearing kit (engine set)

PISTON - SECTION 5

Qty.	Part Number	Description
PISTONS		
4	F162A-4101-A	Piston Assembly (complete)
	Composed of:	1 F162A-410 Piston 3 A600A-333 Rings 1 11EA-200 Pin 1 F162A-323 Ring 2 X-7011 Rings
4	F162A-4101-E	Piston Assembly
	Composed of:	1 F162A-410 Piston 1 11EA-200 Pin 2 X-7011 Rings
4	F162A-4101-ESF	Piston Assembly (semi-finished)
	Composed of:	1 F162A-410-SF Piston 1 11EA-200 Pin 2 X-7011 Rings
4	F162A-410	Piston
4	F162A-410-SF	Piston (semi-finished)

Qty.	Part Number	Description
PISTON RINGS		
12	A600A-333	Ring, piston (first, second & third grooves)
4	F162A-323	Ring, piston (bottom groove) oil ring

Qty.	Part Number	Description
PISTON PINS		
4	11EA-200	Pin, piston
8	X-7011	Ring, retaining, piston pin
4	F400G-211	Bushing, piston pin

Qty.	Part Number	Description
RING KITS		
	F162T-153-C	Ring Kit, rebore (engine set)
	F162T-152-C	Ring Kit, rering (engine set)
	F4162T-128	Ring Kit, 2 in 1 (engine set)

Qty.	Part Number	Description
CAMSHAFT - SECTION 6		
CAMSHAFT		
1	F400I-403	Camshaft
1	D600I-259	Plate, thrust, camshaft
1	X-3362	Screw, camshaft thrust plate to crankcase 7/16-14 x 1-1/4
1	X-270	Washer, lock, camshaft thrust plate to crankcase screw 7/16
2	X-2977	Screw & lockwasher assy., camshaft thrust plate to crankcase 3/8-16 x 7/8

Qty.	Part Number	Description
CAMSHAFT BUSHINGS		
1	*F600G-295	Bushing, camshaft (front) (F226G-227 Service bushing)
1	*Y400G-228	Bushing, camshaft (center) Y400G-231 Service bushing)
1	*Y400G-229	Bushing, camshaft (rear) (Y400G-232 Service bushing)
	F400T-181	Kit, camshaft bushing (finish reamed)

Qty.	Part Number	Description
TIMING GEARS		
1	F400H-310	Gear, timing camshaft
1	X-506	Key, camshaft timing gear to camshaft
1	X-18242	Nut, camshaft timing gear to camshaft 3/4-18
1	D600I-258	Lock, nut, camshaft timing gear to camshaft nut
1	D600H-300	Gear, timing crankshaft
1	X-511	Key, crankshaft timing, gear to crankshaft
1	F600L-203	Plate, oiler, timing gear

*Production bushings

TIMING COVER - SECTION 7

Qty.	Part Number	Description
GEAR COVER		
1	F400B-4142	Cover Assembly, gear
1	8TC-200	Dowel, ring, gear cover to crankcase
1	X-5771	Screw, gear cover to cylinder 3/8-16 x 1-1/8
1	X-3368	Screw, gear cover to crankcase (at ring dowel) 7/16-14 x 1-1/2
1	X-270	Washer, lock, gear cover to crankcase screw 7/16
1	X-3295	Screw, gear cover to filler block 3/8-16 x 1-1/8
1	X-14134	Washer, copper gear cover to filler block
1	X-3299	Screw, gear cover to front filler block 3/8-16 x 2
1	X-14134	Washer, copper, gear cover to filler block screw (front) 3/8
2	X-5821	Screw & lockwasher 3/8-16 x 1-1/8 gear cover to filler block
1	X-5823	Screw, dowel, gear cover to end plate
1	X-1803-H	Nut, gear cover to end plate dowel screw 7/16-14
1	X-270	Washer, lock, gear cover to end plate dowel screw 7/16
1	X-3295	Screw, gear cover to end plate 3/8-16 x 1-1/8
1	X-1802-G	Nut, gear cover to end plate 3/8-16
1	X-203	Washer, lock, gear cover to end plate 3/8
2	X-4200	Stud, gear cover to cylinder (upper holes) 3/8-16 x 1-11/16
2	X-1802-G	Nut, gear cover to cylinder stud 3/8-16
2	X-203	Washer, lock, gear cover to cylinder stud 3/8
1	F400B-320	Gasket, gear cover to end plate
1	X-1555	Seal, oil, crankshaft bearing (front)

Qty.	Part Number	Description
CRANKCASE END PLATE (FRONT)		
1	F400B-318	Plate, end, crankcase (front)
1	D600B-203	Dowel, crankcase end plate to crankcase
1	X-3896	Screw & washer assy. front end plate to crankcase 5/16-18 x 3/4
1	F400B-225	Gasket, crankcase end plate to crankcase

VALVE - SECTION 8

Qty.	Part Number	Description
VALVES & ASSOCIATED PARTS		
4	F600I-229	Valves, intake
4	F400I-335	Valves, exhaust
4	F140A-216	Inserts, valve seat (exhaust) .010 O.S.
8	F400I-233	Guide, valve stem
8	Y400I-215	Spring, valve (intake & exhaust)
4	F400I-202	Retainer, valve spring
4	Y400I-205	Lock, retainer, valve spring
4	Z120I-3000	Cap assy. - pos. roto - exhaust
8	Z120I-235	Lock - valve spring retainer - pos. roto

Qty.	Part Number	Description
VALVE TAPPETS		
8	Y400I-2110	Tappet Assembly, valve
8	Y400I-211	Tappet, valve
8	Y400I-213	Screw, adjusting, valve tappet
8	Y400I-212	Nut, lock, valve tappet adjusting screw
<u>VALVE COVER - SECTION 9</u>		
VALVE TAPPET CHAMBER COVER		
1	F400A-3960	Cover Assembly, valve tappet chamber
2	X-4036	Stud, valve tappet chamber cover to cylinder 1/4-20 x 1-3/8
2	X-18327	Nut, valve tappet chamber cover to cylinder stud
2	X-334	Gasket, valve tappet chamber cover to cylinder stud 7/16
1	F124A-201	Gasket, valve tappet chamber cover to cylinder
1	P39A-221	Tube, vent, valve chamber cover
1	X-12150	Elbow, valve chamber cover vent tube
	F162U-109	Kit, valve grind gasket
<u>OIL PAN - SECTION 10</u>		
OIL PAN		
1	F400B-4002	Pan Assembly, oil
14	X-3896	Screw & lockwasher assembly, oil pan to crankcase
2	F400B-442	Gasket, oil pan and filler block
1	W4B-109	Plug, drain, oil pan
1	W4B-108	Gasket, oil pan drain plug
	F124U-107	Kit, oil pan gasket
<u>OIL PUMP - SECTION 11</u>		
OIL PUMP		
1	F600L-41319	Pump Assembly, oil
	Composed of:	
	1 F600L-4130	Body assy.
	1 F400L-2511	Cover assy.
	1 D600L-2120	Screen assy.
	1 17EL-300	Frame
	1 F218L-204	Shaft
	1 F600H-205	Gear
	1 F600H-217	Gear
	1 F600H-218	Gear
	1 8UL-212	Stud
	1 D600L-204	Ring
	1 C400L-228	Spacer
	1 C400L-231	Gasket
	1 17EL-204	Gasket
	1 X-5798	Screw & washer assy.
	1 X-17095	Pin
	1 X-584	Key
1	F600L-4130	Body Assembly, oil pump
	Composed of:	
	*1 F600L-413	Body
	1 D600G-274	Bushing
		*Not Serviced Separately
1	X-20040	Stud, oil pump body to bearing cap 3/8-16 x 1-1/2
1	X-1802-G	Nut, oil pump body to bearing cap stud 3/8-16
1	X-203	Washer, lock, oil pump body to bearing cap stud 3/8
1	F218L-204	Shaft, drive, oil pump
1	D600L-204	Ring, snap, oil pump drive shaft
1	F400L-210	Bushing, oil pump drive shaft (in crankcase)
1	D600G-274	Bushing, oil pump drive shaft (in pump body)
1	F600H-205	Gear, drive oil pump drive gear to shaft 3/16 x 15/16
1	F600H-217	Gear, driver, oil pump
1	X-584	Key, oil pump driver gear to shaft (Woodruff #3)
1	F600H-218	Gear, idler, oil pump
1	8UL-212	Stud, oil pump idler gear
1	F400L-2511	Cover Assembly, oil pump
2	X-5798	Screw & washer, oil pump cover to body
1	C400L-231	Gasket, oil pump cover to body
1	X-5798	Screw & washer, oil pump strainer screen frame to cover
1	17EL-204	Gasket, oil pump strainer screen frame to cover
1	C400L-228	Spacer, oil pump strainer screen frame to cover
1	D600L-2120	Screen assembly, strainer, oil pump
1	F600T-293	Kit, oil pump repair
<u>OIL CONTROL - SECTION 13</u>		
OIL FILLER		
1	D600L-2270	Cap Assembly, oil filler
1	X-12210	Nipple, close, oil filler
OIL GAUGE ROD		
1	D600L-3000	Rod Assembly, oil gauge
1	K404L-210	Felt, oil gauge rod cover
1	Y400L-266	Support, oil gauge rod

Qty.	Part Number	Description
OIL PRESSURE RELIEF VALVE		
1	15SL-211	Valve, relief, oil pressure
1	F400L-223	Spring, oil pressure relief valve
UAR	W5L-213	Washer, adjusting, oil pressure relief valve
1	41AL-200	Plug, oil pressure relief valve
1	X-365	Gasket, oil pressure relief valve plug
OIL TUBES & CONNECTIONS		
1	X-12393	Elbow: 1/8 - oil pressure gauge outlet
<u>FLYWHEEL - SECTION 17</u>		
FLYWHEEL		
1	F162C-2260	Flywheel Assembly
6	X-5822	Boit, flywheel to crankshaft
6	X-18237	Nut, flywheel to crankshaft bolt 3/8-24
6	X-297	Washer, lock, flywheel to crankshaft bolt 3/8
FLYWHEEL RING GEAR		
1	H8C-300	Ring gear, flywheel
FLYWHEEL HOUSING		
1	F600B-600	Flywheel housing - SAE #4 foot type
2	C400B-226	Dowel screw: 7/16-14 x 1-1/2, flywheel housing to crankcase
3	X-3362	Screw: 7/16-14 x 1-1/4, flywheel housing to crankcase
5	X-204	Lockwasher: 7/16, flywheel housing to crankcase
1	X-3043-A	Flywheel pointer (drive screw)
1	F400C-206	Timing hole cover
1	F400C-208	Timing hole cover felt
9	X-3940	Screw: 3/8-16 x 5/8
		1 - Timing hole cover to flywheel housing
		8 - Dash support bracket hole plug
9	X-203	Lockwasher: 3/8
		1 - Timing hole cover to flywheel housing
		8 - Dash support bracket hole plug
<u>STARTING CRANK - SECTION 19</u>		
STARTING CRANK		
1	PF162-3111	Starting crank assembly
1	PF162-218	Support - starting crank
<u>MANIFOLD & MUFFLER - SECTION 20</u>		
INTAKE & EXHAUST MANIFOLD		
1	F400E-514	Manifold, intake & exhaust
6	X-4200	Stud, intake & exhaust manifold to cylinder 3/8-16 x 1-11/16
1	X-19897	Stud, intake & exhaust manifold to cylinder (center) 3/8-16 x 5-1/8
7	X-18278	Nut, intake & exhaust manifold to cylinder stud 3/8-16 (brass)
2	X-14323	Washer, plain, intake & exhaust manifold to cylinder stud 3/8
4	X-14141	Washer, intake & exhaust manifold to cylinder 13/32
1	F400E-303	Gasket, intake & exhaust manifold to cylinder
1	X-100	Plug, pipe, intake manifold 1/8 (ext. head)
2	X-4180	Stud: 3/8-16 x 4, exhaust manifold outlet elbow to manifold - front
2	X-4217	Stud: 3/8-16 x 1-5/8, exhaust manifold outlet cover plate to manifold - rear
2	F600E-226	Gasket: 1/16 thick
		1 - Exhaust manifold outlet elbow to manifold - front
		1 - Exhaust manifold outlet cover plate to manifold - rear
1	F600E-227	Cover plate - assemble to exhaust manifold outlet - rear
1	F400E-321	Elbow: 2" std. pipe, assemble to exhaust manifold outlet front
4	X-14323	Washer: plain: 13/32 x 3/4
		2 - Stud, exhaust manifold outlet elbow to manifold - front
		2 - Stud, exhaust manifold outlet cover plate to manifold - rear
4	X-18278	Nut: 3/8-16
		2 - Stud, exhaust manifold outlet elbow to manifold - front
		2 - Stud, exhaust manifold outlet cover plate to manifold - rear
1	H260E-200	Crab, stud, exhaust & intake manifold to crankcase - center

Qty.	Part Number	Description
<u>WATER PUMP - SECTION 26</u>		
WATER PUMP		
1	F162K-3973	Pump Assembly, water - complete
	Composed of:	
	1 F162K-397	Body
	1 F226K-2230	Shaft
	1 F162K-2560	Impeller
	1 N62K-211	Seal
	1 X-7021	Retainer
	1 F400K-291	Water shedder
	4 X-3794	Screw cover to body
	1 F400K-392	Water pump cover
	1 F400K-391	Water pump cover gasket
	1 X-7022	Bearing seat ring
	1 F400K-385	Fan hub
	1 12AK-203	Flange - fan belt adj.
	2 8UK-205	Nut lock, fan belt adj. flange
	2 X-3899	Screw & washer: fan belt adj. flange
1	X-12191	St. ell 3/8, water pump body
1	X-14134	Washer, plain, water pump to cylinder 3/8
1	F400K-340	Gasket, water pump to cylinder
1	X-3939	Screw, 3/8-16 x 2-1/4 water pump to cylinder
2	X-5793	Screw & lockwasher assy. 3/8-16 x 2-1/4 water pump to crankcase
1	X-3979	Screw & lockwasher assy. 3/8-16 x 1-1/4 water pump crankcase manifold side
1	X-5036	Connection - water pump body at by-pass conn.
1	F400T-202	Kit, water pump repair

FAN - SECTION 27

Qty.	Part Number	Description
FAN		
1	F162K-415	Fan blades - 18"
4	X-3896	Screw & washer assy: 5/16-18 x 3/4, fan blades to hub

Qty.	Part Number	Description
FAN HUB		
1	F400K-385	Hub, fan
1	12AK-203	Flange, adjusting, fan belt
2	JS-108	Screw, fan belt adjusting flange to fan hub 1/4-20 x 1/2
2	X-201	Washer, lock, fan belt adjusting flange to fan hub 1/4
2	8UK-205	Lock, nut, fan belt adjusting flange to fan hub

FAN DRIVE PULLEY

1	F140K-302	Pulley, fan drive (on crankshaft)
1	X-511	Key, fan drive pulley to crankshaft (Morton Hi-Pro #HP-808)
1	C400K-217	Plug, keyway, fan drive pulley

WATER DISTRIBUTION - SECTION 28

CYLINDER WATER CONNECTIONS

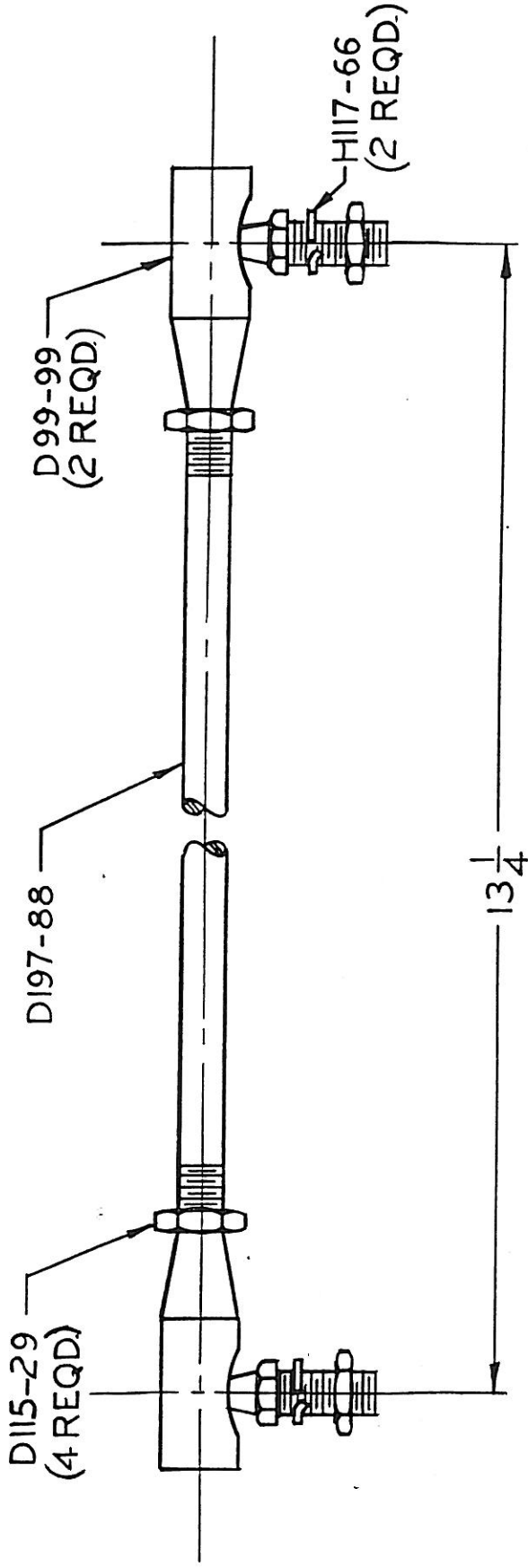
1	F400K-380	Elbow, outlet, cylinder water
2	X-19837	Stud, cylinder water outlet elbow to head 5/16-18 x 2-1/8
2	X-1801-E	Nut, cylinder water outlet elbow to head stud 5/16-18
2	X-202	Washer, lock cylinder water outlet elbow to head stud 5/16
1	C400K-215	Gasket, cylinder water outlet elbow to head
1	X-5035	Connection - outlet elbow at by-pass conn.
1	F162K-2710	Recirculating tube assy. - outlet elbow to water pump

THERMOSTAT

1	F218K-202	Adapter ring
1	GD157K-204	Thermostat

**SERVICE KITS
(Engine Sets)**

F162U-120	Service Gasket Set
F400T-151	Kit, Main Bearing
F400T-152	Kit, Rod Bearing
F162T-153-C	Ring Kit, Rebores
F162T-152-C	Ring Kit, Rering
F4162T-128	Ring Kit, 2 in 1
F400T-181	Kit, Camshaft Bushing
F600T-293	Kit, Oil Pump Repair
F400T-202	Kit, Water Pump Repair
F162U-109	Kit, Valve Grind Gasket
F124U-107	Kit, Oil Pan Gasket



THROTTLE ROD ASS'Y

HOOF PRODUCTS CO.
NO. D177-49

9/9/57

Sheet 1 of 2

HOOF PRODUCTS COMPANY
6543 South Laramie Ave.
Chicago 38, Illinois

GOVERNOR MODEL GD 270-C5537
CODE CHART #1A

SERVICE PARTS LIST

CODE NO.	PART NO.	NO. REQ'D	PART NAME
1	D 164-451	1	Assembly-Governor Body (Service)
		1	D 101-298---Body
		1	D 133-14----Bearing-Rear Main
		2	D 133-24----Bearing-Rocker Shaft
		1	D 127-133---Shaft-Rocker
		1	D 108-8 ---Seal-Rocker Shaft Oil
		1	D 117-72 ---Washer-Lever Spacer
		1	D 164-357---Lever-Throttle
		1	D 132-76 ---Pin-Throttle Lever to Rocker Shaft
		2	D 150-101---Spacer Welch Plug
		1	D 140-24 ---Plug-Welch
		1	D 120-10 ---Nameplate
		2	D 114-68 ---Screw-Nameplate to Body
		1	D 165-31 ---Retainer-Bearing to Shaft
2	D 105-67	1	Lever-Rocker Shaft
3	D 117-86	1	Washer-Spring Bushing to Sensitivity Pin
4	D 114-163	2	Screw-Lever to Rocker Shaft
5	D 164-120	1	Assembly-Bumper Screw
		1	D 114-127---Screw-Bumper
		1	D 115-29 ---Nut Bumper Screw Lock
		1	D 117-91 ---Seal-Bumper Screw Oil
		1	D 110-65 ---Spring - Bumper
6	D 114-132	1	Screw-Speed Adjusting
7	D 115-29	2	Nut-Lock
			1-Speed Adjusting
			1-Sensitivity Pin
11	D-105-223	1	Lever-Speed Adjusting
12	D 129-18	1	Bushing-Adjusting Lever Pivot
13	D 117-87	1	Lockwasher-Adjusting Lever to Body
14	D 114-179	1	Screw-Adjusting Lever to Body
15	D 164-316	1	Assembly-Spring Bushing & Bearing
		1	D 129-29 ---Bushing
		1	D 133-17 ---Bearing
16	D 117-46	1	Washer-Sensitivity Pin
17	D 117-87	1	Lockwasher-Sensitivity Pin
18	D 110-85	1	Spring-Speed (120# Rate-Black)
19	D 110-73	1	Spring-Throttle Lever Tension
20	D 132-81	1	Pin-Sensitivity Adjusting
21	D 165-18	1	Retainer-Spring Bushing to Pin

HOOF PRODUCTS COMPANY
6543 South Laramie Ave.
Chicago 38, Illinois

GOVERNOR MODEL GD 270-C5537

CODE NO.	PART NO.	NO. REQ'D.	PART NAME
*22	D 164-407	1	Assembly-Main Shaft Complete
23	D 164-293	1	Assembly-Main Shaft-Gear-Cover & Yoke
		1	D 164-294---Assembly- Main Shaft & Gear
			1-D 127-153---Main Shaft
			1-D 171-41 ---Gear Drive
		1	D 164-295---Assembly-Cover & Bearing
			1-D 101-280---Cover
			1-D 133-22 ---Bearing-Front Main
			1-D 116-32 ---Rivet-Cover to Body
		1	D 172-18 ---Yoke-Flyweight
24	D 164-393	1	Assembly-Thrust Sleeve & Bearing
		1	D 129-37 ---Sleeve
		1	D 133-35 ---Bearing Thrust
		2	D 117-121---Washer
		1	D 165-28 ---Retainer
25	D 164-118	2	Assembly-Flyweight
		1	D 173-5 ---Flyweight
		1	D 132-34---Pin-Thrust
		1	D 133-6 ---Bearing
26	D 132-88	2	Pin-Flyweight Pivot
27	D 165-32	4	Retainer-Flyweight Pivot
37	D 114-128	1	Screw-Cover to Body
76	D 133-14	1	Bearing-Rear Main

*D 164-407 includes items #23 to #27 inclusive.

PARTS LIST

Donaldson Corporation

Air Cleaner E-527

<u>Part No.</u>	<u>Part Name</u>	<u>Req'd.</u>
P-8242	Body Assembly	1
P-7409	Oil Cup Assembly	1
P-2706	Cup Clamp Assembly	1

PARTS LIST FOR FM-XZE4BL6F MAGNETOS

September 10, 1957

Rotation CW, Impulse Coupling UB-20, Lag Angle 20°

Manufacturer: Hollingsworth

Manufacturer's Specification No. FL62M-443 - (Continental Engine)

Order by Part No.	Name of Part	No. Used
C682A	End Cap Cover Gasket	1
A799X	High Tension Cable Outlet Guide Block	1
A800A	End Cap Cover	1
8S6D	End Cap Cover Screws - #8-32x3/8	1
8S8D	End Cap Cover Screws - #8-32 x 1/2	2
F983B	High Tension Lead and Suppressor Assembly	1
BL232	Vent Hood	2
6S6N	Vent Hood Screw - #6-32 x 3/8"	2
BL355X	Primary Ground Strip Guide	2
D1498	Magnetic Rotor Gear Snap Ring	1
GL498	Distributor Shaft Snap Ring	1
T1498	Fulcrum Pin Snap Ring	1
BL498B	Rotor Drive End Bearing Snap Ring	1
CL498D	Rotor Drive End Shaft Snap Ring	1
QW2425	Frame	1
KX2430A	End Cap	1
1GS10D	End Cap Screws #10-24 x 5/8"	2
1OS18D	End Cap Screw #10-24 x 1 1/8"	2
CX2433X	Feed-thru Condenser	1
8S4U	Condenser Screw #8-32 1/4"	1
W2437X	Breaker Arm Support Bracket and Points	1
6S6U	Breaker Arm Terminal Screw & Lockwasher #6-32 x 3/8"	1
6S6U	Contact Support Locking Screw and Lockwasher #6-32 x 3/8"	2
8S6U	Contact Support Locking Screw and Lockwasher #8-32 x 3/8"	1
G2457AX	Primary Ground Screw Insulating Bushing	2
D2458	Contact Support Locking Screw Plate Washer	1
D2458	Primary Ground Washer #6	4
6S8N	Primary Ground Screw #6-32 x 1/2"	2
6LW1	Primary Ground Lockwasher	2
6N1	Primary Ground Nut	2
E2460B	Brush and Spring Assembly	1
B2474EX	Distributor Block	1
8S8D	Distributor Block Screw #8-32 x 1/2"	2
RS2477C	Coil Assembly	1
25SS14A	Coil Bridge Set Screw	2
HT2480	Magnetic Rotor Assembly - CW	1
A2492A	Rotor Drive End Seal Outer Washer	1
A2492C	Rotor Drive End Seal Inner Washer	1
A2492C	Bearing Grease Retaining Washer	1
L2498	End Cap to Frame Gasket	1
L2499A	Primary Ground Wire Assembly	1
T2514	Primary Ground Terminal Strip	1
W2514	Primary Ground Strip to Contact Support	1
F2533	Magnetic Rotor Gear Pin	1
S2563	Coupling Hub Assembly	1

Order by Part No.	Name of Part	No.Used
EZ2463C	Impulse Coupling Complete	1
E2565	Impulse coupling Drive Spring	1
A2568	Impulse Coupling Pawl Stop Pin	1
K2570	Impulse Coupling Pawl Nut	1
A2665E	Rotor Cam End Bearing Spacer	2
C2723	Rotor Drive End Bearing Shim	2
B2744A	Ground Cable Outlet Bushing	1
X2765X	Magnetic Rotor	1
G2788	Cam Wick and Holder Assembly	1
G3861	Magnetic Rotor Drive End Seal	1
UX4631	Bearing Support	1
8S6G	Bearing Support Screw #8-32 x 3/8"	4
A5931B	Impulse Coupling Nut Lockwasher	1
Q5939X	Distributor Shaft and Gear	1
C5949	Magnetic Rotor Drive End Bearing	1
D5949A	Magnetic Rotor Cam End Bearing	1
D5950C	Distributor Bearing	1
F5952	Magnetic Rotor Gear	1
EX5957	Impulse Coupling Shell	1
B5963	Impulse Coupling Pawl Spring	2
B5969	Contact Support Plate Washer	1
B603QA	Vent Cover	2
6S5N	Vent Cover Screw #6-32 x 5/16"	2
A6032A	Vent Screen	2
C6032B	Vent Screen	2
B6120	Coil Clip	1
3K1	Key Rotor to Impulse Coupling	1

Parts whose service numbers end in X are
fungus treated

SERVICE PARTS LIST
 Zenith Carburetor Division
 Bendix Aviation Corp.
 Detroit, Mich., U.S.A.

*Parts in repair kit
 xParts in Gasket set
 x*Parts in gasket set and
 in Repair kit

<u>Part No.</u>	<u>Part Name</u>	<u>Quan.</u>	
BL2-12237	Body, Throttle (complete)	1	
CT48-9	Seal, throttle shaft	1	*
CT52-53	Retainer, shaft seal	1	*
CR37-1X1	Plug, thru. shaft hole	1	*
C29-1219	Shaft & lever, throttle	1	
C23-618	Shaft, throttle	1	
CR28-1	Lever, throttle stop	1	
T8S8-10	Screw, throttle stop	1	
CT63-9	Taper pin, stop lever	1	
C24-28HX2	Lever, throttle clamp	1	
T8S10-9	Screw, lever clamp	1	
C21-202	Plate, throttle	1	
T315B5-3	Screw, throttle plate	2	*
CT91-1	Plug, 1/8 pipe, fuel inlet	2	
C46-25	Needle, idle adjusting	1	*
C111-9	Spring, idle needle	1	
C85-115	Float	1	
C120-59	Axle, Float	1	*
C142-65	Gasket, bowl to body	1	x*
T311S12-10	Screw, Bowl to body assy.	4	(2)*
BL3-12237	Bowl, fuel	1	
C135-29	Disc, drain	1	*
CT57-4	Washer, choke shaft packing	1	*
C131-4X2	Retainer, shaft packing	1	*
CR37-1X1	Plug, choke shaft hole	1	*
C101-68	Plate, choke	1	
T315B5-3	Screw, choke plate	2	*
C108-177-3	Shaft & lever, choke	1	
T8S8-7	Screw, lever swivel	1	
C109-60	Bracket, choke	1	
C110-7	Clip, bracket tube	1	
T8S8-8	Screw, clip clamp	1	
T21S8	Nut, clamp screw	1	
C140-58	Screw, bracket clamp	2	
C112-6	Spring, choke lever return	1	
CT91-3	Plug, 1/8" pipe, bowl drain	1	
C71-33	Adjustment, main jet	1	
T56-23	Washer, main jet adj.	1	x*
B38-73-24	Venturi	1	
C52-7-31	Jet, Main	1	*
T56-24	Washer, main jet	1	x*
C55-22-16	Jet, idle	1	*
C66-100-70	Jet, main discharge	1	
T56-4	Washer, discharge jet	1	x*
C77-18-12	Jet, well vent	1	*
C81-1-40	Valve & Seat, fuel	1	*
T56-23	Washer, valve seat	1	x*
C141-4-1	Gasket, flange	1	*
C181-325	Gasket set	1	
K12237	Repair kit		

DELCO-REMY
SERVICE PARTS LIST

Model No. 1100535 - Generator

Sheet 1 of 2 Sheets
Date 11-11-57

Part No.	Name	No. Req'd.
1921351	ARMATURE	1
19114618	Pole Shoe	2
1843646	Screw - Pole shoe	2
1858754	Stud & lead assembly - terminal	1
1858751	Stud - terminal	1
200362	Clip - terminal (to brush)	1
1885090	Bushing - terminal stud ins.	2
1858753	Washer - ins. terminal stud	2
1881109	Washer - plain terminal stud	2
1904661	Lockwasher - terminal stud	4
121743	Nut - terminal stud	4
1913554	Field coil set	1
1858751	Stud - terminal	1
200362	Clip - terminal (to brush)	1
1911491	Insulator - field coil	2
1913564	FRAME - COMMUTATOR END (& PIN ASSEMBLY)	1
809062	Dowel pin - C. E.	1
1880635	Oiler - C. E.	1
1911097	Plug - oil wick	1
804076	Wick - oil	1
812823	Bushing - C. E.	1
1913565	Plate - brush	1
1886496	Screw - brush plate attaching	3
121841	Lockwasher - brush plate attach. screw	3
1906923	Brush - main	2
1906940	Brush - third	1
1850759	Arm - brush	3
1850767	Spring - brush (3rd.)	1
1850760	Spring - brush (main)	2
1857412	Washer - brush arm space	3
132688	Screw - brush attaching lead	3
1904377	Lockwasher - brush attaching screw	3
820524	Plate - end cover (C.E.)	1
817220	Gasket - end cover plate (C.E.)	1
1886496	Screw - end cover plate attaching C.E.	3
121841	Lockwasher - end cover plate attaching screw C.E.	3
1872638	Cover band	1
132926	Screw - cover band attaching	1
120614	Nut - cover band attaching	1
1873830	FRAME - DRIVE END	1
1880641	Oiler - D. E.	1
817224	Collar - Space (outside - D.E.)	1
809961	Felt washer D.E.	1
819104	Retainer - felt washer - D. E.	1
809945	Washer - space (inside - D.E.)	1
954378	Ball bearing - D. E.	1
1911263	Plate - retainer - ball bearing - D.E.	1

DELCO-REMY
SERVICE PARTS LIST

Model No. 1100535 - Generator

Sheet 2 of 2 Sheets
Date 11-11-57

Part No.	Name	No. Req'd.
1912008	Gasket - ball bearing retainer plate D.E.	1
1904370	Screw - ball bearing retainer plate attach.	3
1880781	Lockwasher - ball bearing retainer plate attaching screw	3
809593	Dowel pin - D.E.	1
124545	Woodruff Key - D.E.	1
806915	Nut - shaft - D.E.	1
804000	Lockwasher - Shaft nut D.E.	1
815018	Thru bolt	2
120638	Lockwasher - thru bolt	2
1118790	Regulator (for service parts see Regulator Group 6-F)	1
132900	Screw - regulator attaching	2
138479	Lockwasher - regulator screw attaching	2
1856056	Washer - plain - regulator attaching screw	2
1911485	Lead - regulator to "A" terminal	1
1911481	Lead - regulator to "F" terminal	1

DELCO-REMY
SERVICE PARTS LIST

Model No. #1108070 Cranking Motor

Sheet 1 of 2 SHEETS
Date 11-11-57

Part No.	Name	No. Req'd.
1929404	ARMATURE	1
810601	Pole Shoe	4
1881869	Pole shoe screw	4
1848837	Stud - Terminal	1
1861076	Washer - Ins. terminal stud (25/64 O.D.)	2
1904669	Washer - Ins. terminal stud (9/16 O.D.)	2
812622	Washer - Plain - terminal stud	1
120381	Lockwasher - Terminal stud	4
805258	Nut - terminal stud	4
826282	Field coil (upper half)	1
826281	Field Coil (lower half)	1
1908580	FRAME - COMMUTATOR END	1
817313	Pin - Brush holder hinge	2
817314	Pin - Brush holder stop	2
812016	Pin - Brush holder hinge & ins.	2
812015	Pin - Brush holder stop & ins.	2
809062	Dowel Pin - C. E.	1
114998	Oiler - C. E.	1
802694	Wick - C. E.	1
1865182	Plug - End - C. E.	1
811553	Brush	4
813521	Spring - Brush	4
810226	Holder - Brush	4
115903	Screw - Brush attaching	4
813554	Lead - Brush ground	2
1929443	Screw - brush ground lead attaching	2
121841	Lockwasher - Brush ground lead attaching screw	2
819362	Lead - Brush & field connector	1
132892	Screw - Brush & field connector (& field coil)	2
106497	Lockwasher - Brush & Field connector (& field coil)	2
818265	Washer - Space - D. E.	1
817114	Cover band	1
1942583	HOUSING - MOTOR DRIVE	1
1862383	Bushing - D. E.	1
1928023	Washer - Space - D. E.	1
1868788	Oiler - D. E.	1
802697	Wick - D. E.	1
1928021	Stop - Pinion - D. E.	1
1928022	Lock Ring - Pinion stop - D. E.	1
809593	Dowel Pin - D. E.	1
1930547	Lever - Shift	1
1881861	Spring - Shift lever	1
1835998	Support - Spring	1
1929127	Stud - Shift lever	1
120381	Lockwasher - Shift lever stud	1
805258	Nut - Shift lever stud	1
1933471	MOTOR DRIVE	1
	(FOR parts see motor drive group 4)	
1912055	Plunger & link	1

DELCO - REMY
SERVICE PARTS LIST

Model No. #1108070

Sheet 2 of 2 Sheets
Date 11-11-57

<u>Part No.</u>	<u>Name</u>	<u>No. Req'd.</u>
1853305	Pin - Shift lever	1
112726	Cotter pin - Shift lever	1
1118136	SOLENOID SWITCH (For service parts see parts list)	1
1916529	Screw - Switch attaching	4
1912390	Connector (Switch to cranking motor)	1
809053	Thru bolt	2
120380	Lockwasher - Thru bolt	2

Continental Motors Corp.

Bulletin No. 1539970
Sheet No. 1 of 1
Date 7/19/54

AC SPARK PLUG DIVISION
General Motors Corporation
Flint, Michigan

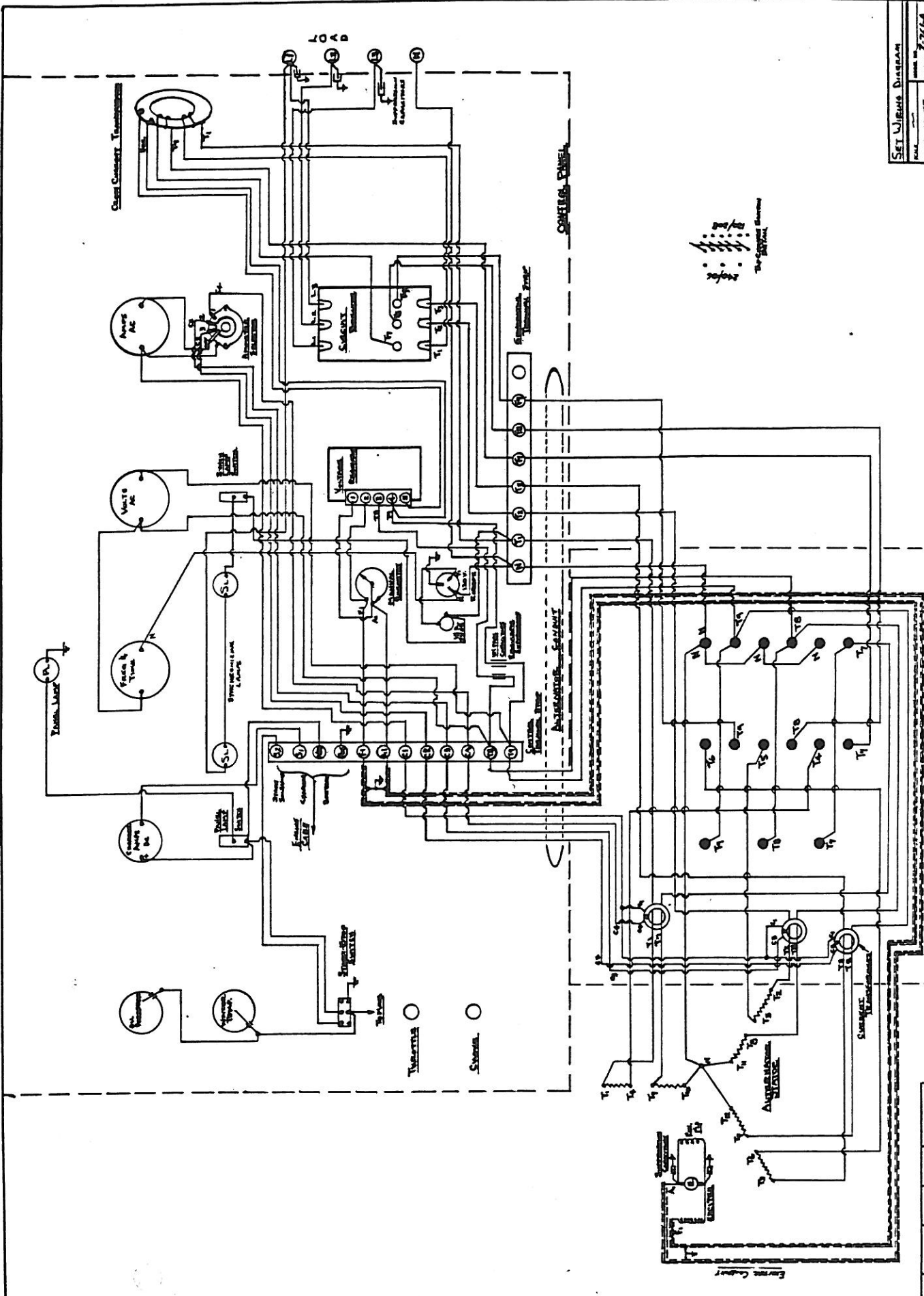
Single Pump

AC SERVICE BULLETIN

SUBJECT Service Parts List
Series "CG" AC Fuel Pump #1539970

<u>Part No.</u>	<u>Part Name</u>	<u>Qty.</u> <u>Req.</u>	
5591868	Diaphragm & Pull Rod Assembly	1	
856122	Body	1	
5592264	Cover & Plug Assembly	1	
1523134	Rocker Arm	1	
5590152	Bail Assembly (5592050)	1	Type FP-1
5590156	Bowl, Glass (1523620)	1	Type FP-5
855532	Cap, Rocker Arm Spring	2	
855017	Clip, Link Pin	4	
855228	Cover, Bottom	1	
855229	Gasket, Bottom Cover	1	
5590037	Gasket, Bowl (854003)	1	Type FG-1
1521953	Gasket, Valve & Cage	2	
1522280	Lever, Priming	1	
855374	Link	2	
855064	Lockwasher, Cover Screw	6	
855016	Pin, Link	2	
1521289	Pin, Rocker Arm	1	
1523664	Retainer, Valve & Cage	1	
854009	Screen	1	
(a) 5593521	Screw, Bottom Cover	3	
855493	Screw, Top Cover	6	
436748	Screw, Valve & Cage Retainer	1	
855253	Spring, Diaphragm	1	
855253	Spring, Rocker Arm	1	
5591860	Valve & Cage Assembly	2	
1521288	Washer, Rocker Arm Pin	1	

(a) 7/19/54 Was 132108



SET UP INSTRUCTIONS	
DATE: 12/15/57	REV: 1
BY: J. B. E.	CHK: J. B. E.
APP: J. B. E.	CHK: J. B. E.
WINPOWER MFG. CO. MONTICELLO, IOWA	

IMP CHANGE BOOK

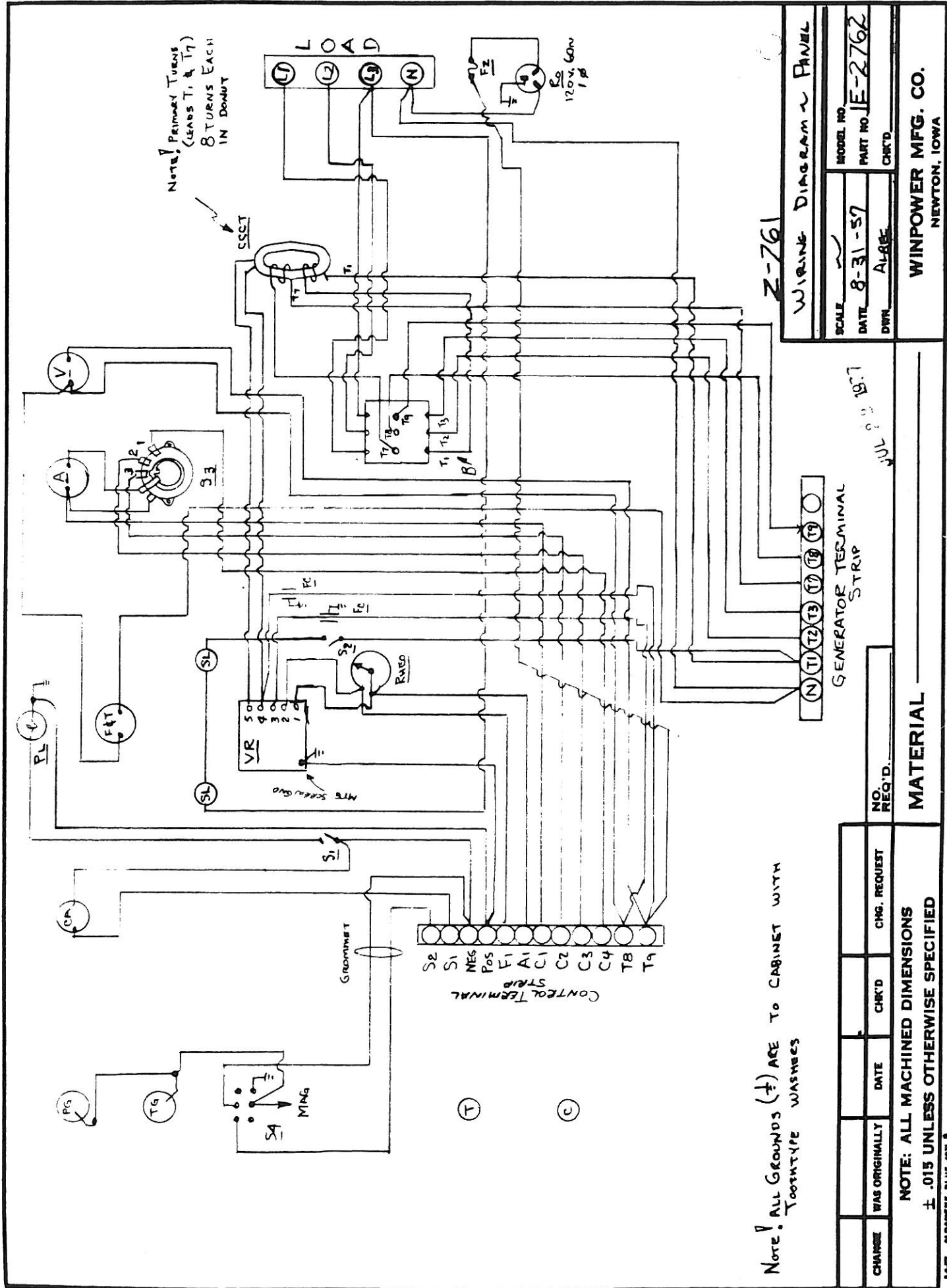
NO. REQ'D.

MATERIAL

DATE	CHK'D	CHK'D
BY	BY	BY
APP	APP	APP

NOTE: ALL MACHINED DIMENSIONS
± .015 UNLESS OTHERWISE SPECIFIED

IE-2762



NOTE: ALL GROUNDS (⊥) ARE TO CABINET WITH TOOTHTYPE WASHERS

CHANGE	WAS ORIGINALLY	DATE	CHK'D	CHG. REQUEST	NO. REQ'D.	MATERIAL

NOTE: ALL MACHINED DIMENSIONS ± .015 UNLESS OTHERWISE SPECIFIED

WINPOWER BLUE 1971

Z-261

WIRING DIAGRAM PANEL

SCALE		MODEL NO.	
DATE	8-31-57	PART NO.	IE-2762
DRAWN	ALBEE	CHK'D	

WINPOWER MFG. CO.
NEWTON, IOWA

IE-2762