

TENTATIVE

TM 11-972

WAR DEPARTMENT TECHNICAL MANUAL

COLES SIGNAL LABORATORY

POWER UNIT

PE-235-A

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WAR DEPARTMENT

2 JUNE 1944

WAR DEPARTMENT,
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Tentative TM 11-972, Power Unit PE-235-A, is published for the information and guidance of all concerned.

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G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

IC 11 (5); plus par. 9a, FM 21-6.
(For explanation of symbols see FM 21-6.)

ONAN ELECTRIC PLANTS

WARNING

THIS ELECTRIC PLANT MUST BE INSTALLED AND BE OPERATED ACCORDING TO OUR INSTRUCTIONS. AN IMPROPER INSTALLATION OR THE USE OF OIL OR FUEL OTHER THAN THAT RECOMMENDED IN THIS MANUAL, RELIEVES THE MANUFACTURER OF ALL RESPONSIBILITY FOR PLANT PERFORMANCE.

READ THIS SERVICE MANUAL CAREFULLY!

IMPORTANT!!!

USE OF LEADED FUELS

The performance of gasoline engines deteriorates with use until it eventually becomes necessary to remove the carbon, grind the valves, install new spark plugs, etc.

Lead is added to many gasolines to increase the octane rating. Due to the action of the lead in the combustion chamber, on the valve seats, and on the spark plugs, the use of such fuels causes the engine performance to deteriorate more rapidly. When using highly leaded fuel, there is a regularly increasing lead content in the crankcase oil.

If the gasoline contains $\frac{1}{2}$ cubic centimeter, or less, of lead per gallon there is little such effect. However, as the proportion of lead is increased the deterioration in engine performance is greatly accelerated.

Under normal operating conditions with unleaded fuel it may be necessary to remove carbon each 1000 operating hours, grind valves each 1000 to 2000 operating hours, clean spark plugs each 200 operating hours, and change crankcase oil each 100 to 200 operating hours.

When using Army 80 octane fuel, aviation 100 octane fuel, or other fuel containing more than 2 cubic centimeters of lead per gallon, change the crankcase oil each 50 operating hours. When using such highly leaded fuels it may be necessary to remove carbon and grind valves each 100 to 200 operating hours, clean spark plugs each 50 operating hours, and replace them each 100 to 200 operating hours. If carbon is removed every 100 to 150 operating hours, the periods between valve grinding jobs usually can be considerably lengthened.

When using leaded fuels, inspect the engine more often and give it the more frequent service required.

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GENERAL INFORMATION

THE PURPOSE OF THIS BOOK - This instruction book is furnished with each **ELECTRIC PLANT**. Every owner or operator should read the book thoroughly to familiarize himself with the characteristics of this plant. A thorough understanding of the Plant will help greatly to reduce the repair expense, and to allow the operator to determine what the cause of trouble may be in the event that it occurs. The various subjects treated in this book are all of vital importance to the performance and service which the plant renders.

KEEP THIS BOOK HANDY - A very simple error on the part of the operator in the use of improper oil, fuels, or in neglect of routine servicing and inspection, may cause the plant to fail at a time when its satisfactory operation is essential. For this reason, we strongly urge that the book be kept on hand, perhaps near the plant if possible, so it can be referred to in time of need.

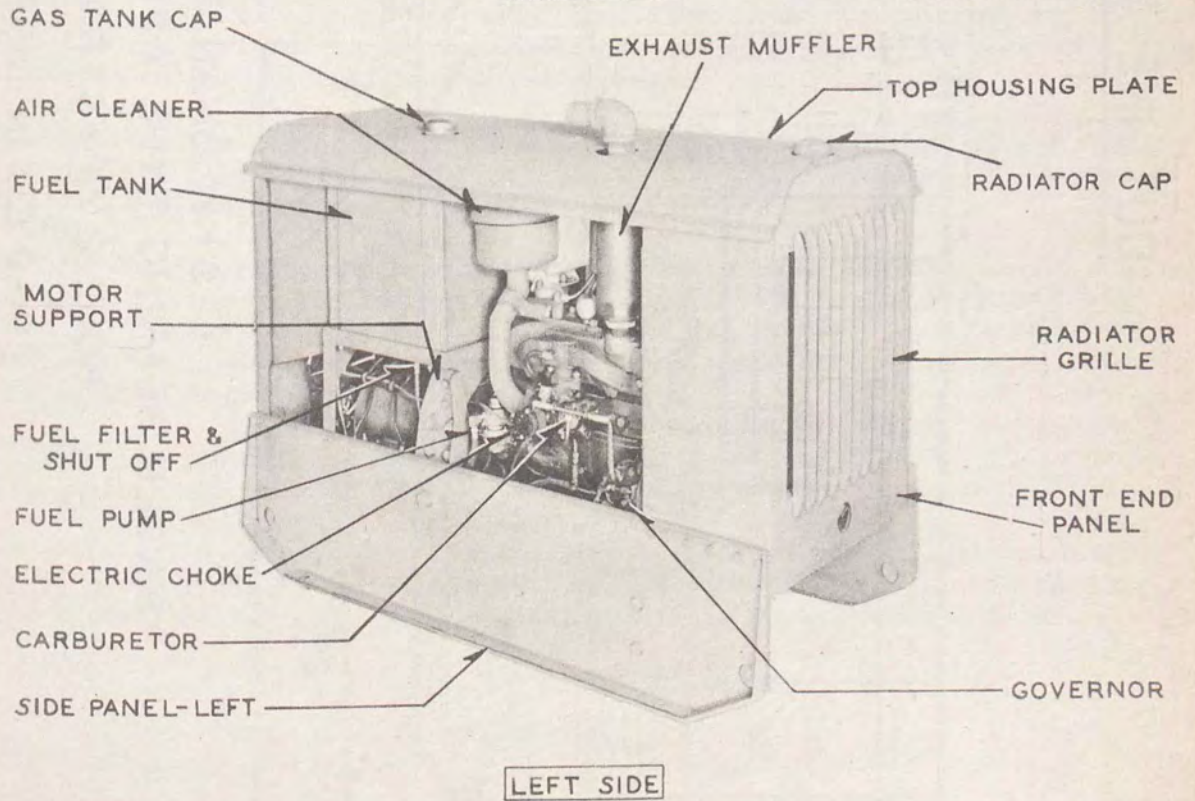
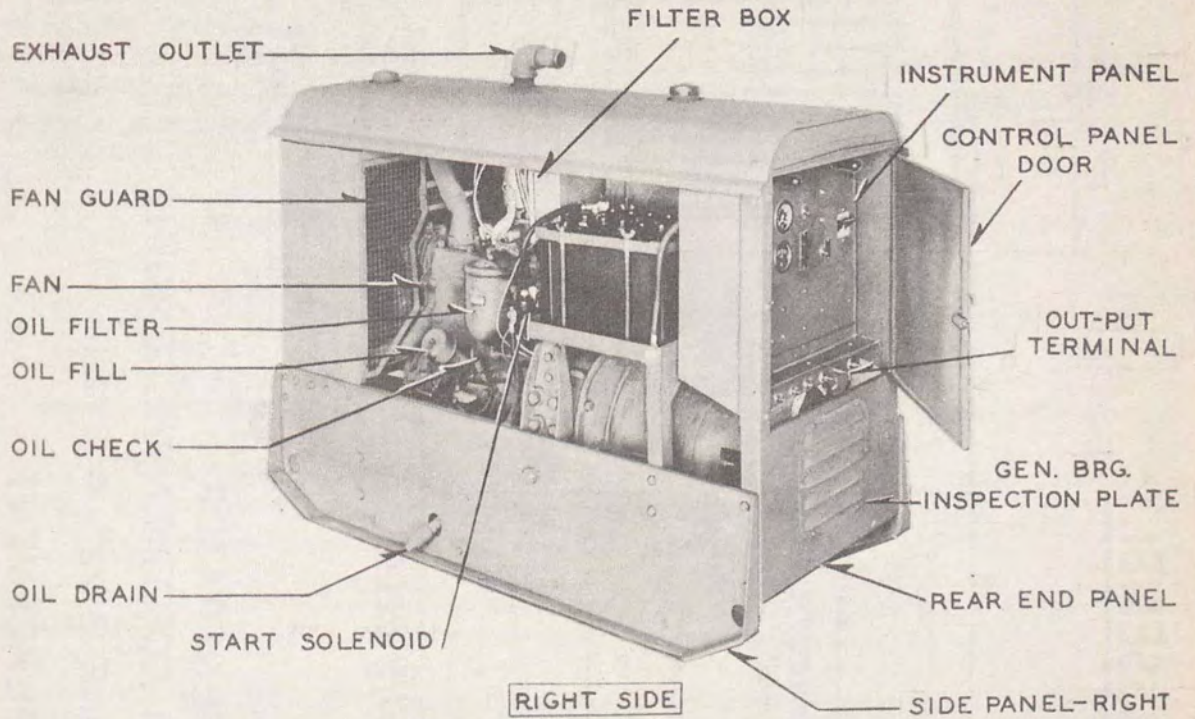
SERVICE - If in the event some trouble occurs or parts are needed which the operator or a capable service man cannot handle, the manufacturer will furnish any help needed. When asking for help be sure to furnish the **SERIAL, MODEL and GENERATOR** numbers of the plant. This information is absolutely essential. Be sure to furnish all other details available.

GUARANTEE

THIS ELECTRIC PLANT is guaranteed to produce its rated output plus a substantial overload in temperatures up to 100 degrees Fahrenheit. It is further guaranteed to be mechanically and electrically perfect when shipped to you. All mechanical and electrical parts which fail within a period of one year, will be replaced free of charge, upon delivery to the factory and after inspection has proven the defect to be from natural causes, and not the result of tampering or neglect. All standard accessory parts such as carburetor, ignition system, batteries, etc., are not guaranteed by us, but are guaranteed by the respective manufacturers and replacement will be made by them according to the terms of the manufacturer's guarantee.

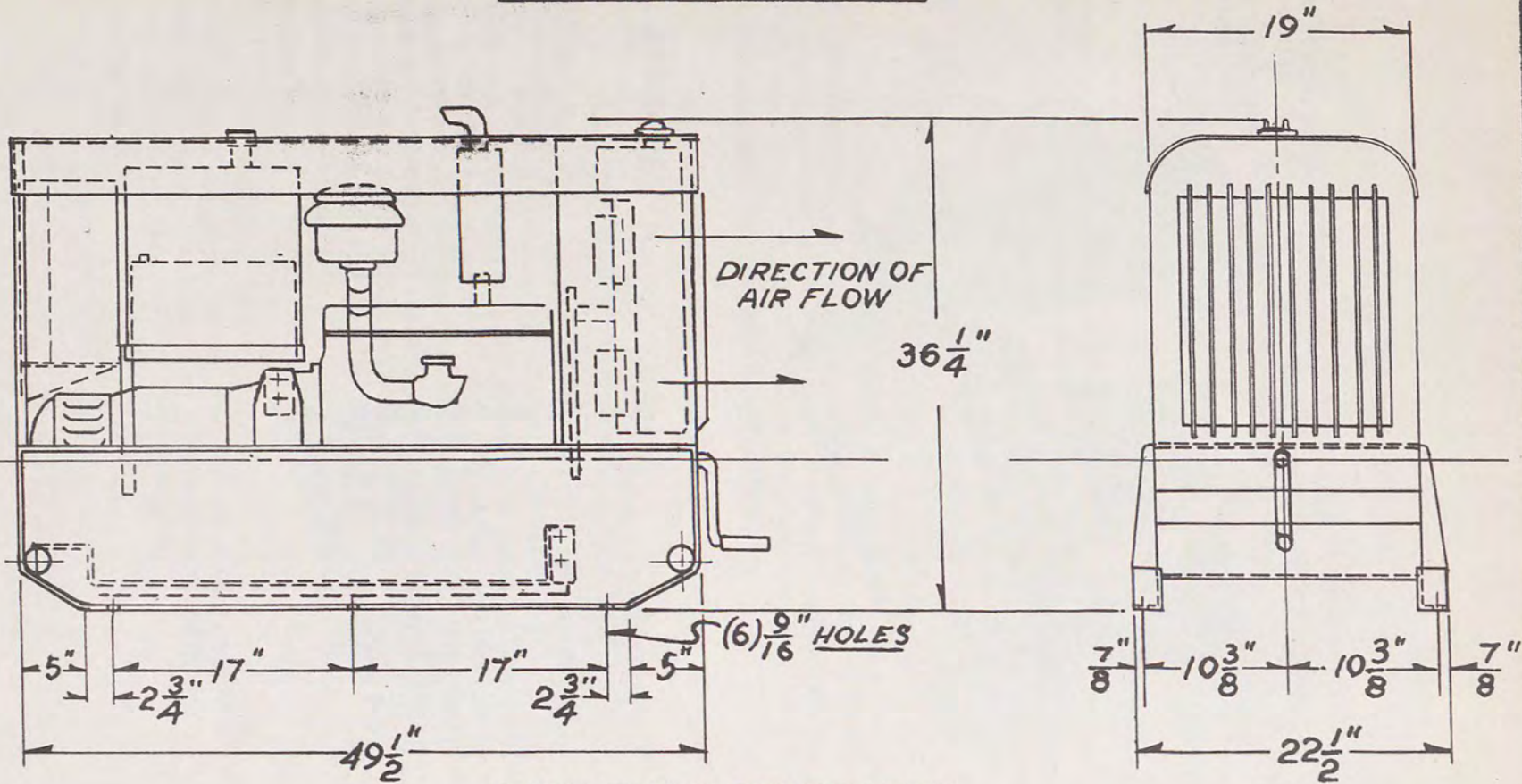
NOTE: - You may find that all of the pages in this book are not consecutively numbered. This does not mean that any pages are missing. All of the pages that apply and only those that do are included.

POWER UNIT CWC4-5S



2

OUTLINE ASSEMBLY



5 KW ONAN GENERATOR
SINGLE BEARING TYPE Y-91 CONTINENTAL ENGINE
BORE $2\frac{7}{8}$ "-STROKE $3\frac{1}{2}$ " 4 CYL.
90.9 CU. IN. DISPLACEMENT

MECHANICAL SPECIFICATIONS

CONSTRUCTION

The engine and generator are connected together as one unit mounted on heavy steel skids or chassis. The plant is partially enclosed in a steel housing. The controls for the plant are set in an all steel control panel box mounted at the rear of the plant directly over the generator.

ENGINE

GENERAL SPECIFICATIONS - The engine is a 4 cylinder, water cooled, 4 cycle L-head type. Bore is 2-7/8", Stroke is 3-1/2". Displacement is 90.0 cubic inches. Develops 17.1 Horsepower at 1800 RPM (continuous duty) and 19.3 horsepower at 1800 RPM (Intermittent duty). Compression Ratio is 6.1 to 1.

CRANKSHAFT - Three bearing design forged from high carbon steel proportioned in relation to engine size. Has extreme rigidity and durability for heavy duty service. Precise balancing for flexible performance.

CAMSHAFT - Forged from alloy steel, cam faces are almost glass hard and ground to a mirror-like surface. Shaft operates in bronze bushings.

CONNECTING RODS AND PISTONS - Connecting rod bearings are thin shell, steel backed babbitt securely locked and supported. They are interchangeable. Pistons are cast iron, tin plated to prevent scuffing and undue wear. Circular strutted, ribbed and annealed. Pistons have three rings.

VALVES - Intakes are of chrome nickel steel. Exhausts of XCR Austenitic steel. Valve guides are finished to a bearing-like surface. Both intake and exhaust valves are one piece forgings.

COOLING SYSTEM - Capacity of cooling system is 12 quarts. Circulation is controlled and directed by the internal construction of the cylinder block. Full length water jackets surround the cylinder bores and valves. Water completely surrounds each cylinder. Water circulation is maintained by means of a centrifugal type water pump and a thermo syphon control.

CARBURETION - An updraft carburetor is used - Electrically choked. It connects with an oil bath air cleaner that filters the air taken into the fuel system.

IGNITION - Ignition is furnished from a 12 volt battery and gear driven distributor. It has a hand set spark advance. Firing order is 1-3-4-2. System includes a 12 volt coil. Ignition control is provided at the control panel.

ELECTRICAL SPECIFICATIONS

GENERATOR

The generator and engine are built together as one unit. The frame is bolted to an adapter casting carried on the engine flywheel housing. The armature is coupled to the flywheel of the engine and supported at the engine end by the rear main bearing of the engine. A metallic disc coupling which accomodates misalignment of the armature but also serves as a solid drive member connects the generator blower bolted directly to the engine flywheel with the armature shaft. The outboard end of the armature is carried in a grease sealed ball bearing.

This Onan Generator is of the four pole, integrally excited, AC type. The fields are stationary and the armature rotates. The exciter is an integral part of the alternator rotor. The exciter armature produces the direct current output for exciting the alternator during the running cycle.

This direct current output may be used to charge a starting battery, the rate being controlled by a two step regulator mounted on the instrument panel.

Extremely large commutator and collector rings are mounted at the outboard end of the generator. Generator winding insulation is in accordance with class "A" A.I.E.E. standards. All of the windings are impregnated with insulating varnish and baked. A cooling blower bolted directly to the engine flywheel draws air during operation over the windings of the exciter and alternator.

CONTROLS

The plant has a control panel containing the plant controls. It is mounted in the housing at the rear of the plant directly over the generator. It contains the gasoline and oil gauges, ammeter, and stop and start switches. Starting and stopping of the plant is handled directly at the control panel or by remote control station.

The plant is started by means of a separate 12 volt starting motor. A starting solenoid and pilot relay are in the starting circuit.

VOLTAGES

Standard voltage is 110-220 volts, 3 wire, single phase.

INSTALLATION

The proper installation of the plant is absolutely necessary for satisfactory and continuous service. Location, ventilation and temperature are among the main factors to consider.

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

The location should be such that the air is not dirty or extremely humid. If these conditions can not be avoided, the plant should be inspected more often. Also take any preventive or corrective measures necessary. Sub-ground levels are to be avoided because of dampness, poor air circulation and possible collection of dangerous exhaust gases leaking from the line.

If the plant is to be permanently mounted, a base should be built and the enclosure should be at least 10 feet square. If it is to be operated as a portable unit, a sub-base should be provided and the plant protected against extreme exposure to the elements. If installed aboard a mobile vehicle, the compartment must be as large as possible and sufficient ventilating openings provided.

VENTILATION - This is an important factor as any gasoline engine generates a great deal of heat which must be dissipated. Overheating will reduce the efficiency and may cause damage to the plant.

The air that circulates must be clean. Otherwise it will deposit the dirt on the plant. This will act as a blanket and reduce the cooling so that the plant will overheat. The plant should be installed at least 24" away from any wall or air circulation barrier.

If the plant is mounted in an enclosure, air intake and discharge openings should be provided. They should be at least 1-1/2 times the size of the radiator. The air inlet should be as close to the plant as possible. Both types of openings should be shielded with a screen and louvres. A thermal ventilator in the form of a cupola or stack can be built into the roof to provide normal air circulation when the plant has shut down.

Additional ventilation precautions must be observed when the plant is mounted aboard a vehicle. Usually the compartment is small so that more openings have to be provided. These can be directly above the cylinders, opposite the fan or in the floor.

In extremely cold weather the temperature of the enclosure can be controlled by closing off the openings and allowing the heat of the plant to heat the room. Normal temperatures can thus be maintained. When used as a portable unit, some type of wind barrier or temporary walls should be used to keep the plant at the correct operating temperature.

MOUNTING BASE - If the plant is installed permanently on a base, it should be high enough from the floor to allow easy access to all of the parts, and to guard against damage which may be caused by bumping the plant with other objects. The base should be from 9" to 12" high. The plant should never be bolted solidly to any foundation. Shock absorber mountings are provided to prevent vibration.

INSTALLATION

This electric plant is shipped complete with all the accessories necessary to put it into immediate service. If special conditions are encountered, additional equipment may be needed to meet those conditions.

FUEL TANK - A standard type fuel tank is furnished with each plant. Where a separate mounting tank is used it is necessary that a flexible fuel line connect it to the plant. For permanent installations, a larger supply tank may be used. Underwriters instructions should be observed in making such an installation. The tank may be installed underground. In no case should the lift of the fuel to the plant be more than 6 feet nor should the fuel have to run through more than 25 feet of tubing unless a separate fuel pump is used. Be sure the tank is well vented.

EXHAUST SYSTEM - An automotive muffler and exhaust tubing is supplied and is to be connected to the plant. Where the exhaust line passes through a wall, that wall should be shielded and the line insulated by means of a metal flange. A rigid exhaust pipe may be used but a piece of flexible tubing should be inserted between it and the plant. If the line is extended over 10 feet the size of pipe or tubing should be increased one size for every six feet.

The exhaust line should be pitched downward from its connection at the plant. This holds true no matter what type of muffler is used. If it is necessary to pitch the line upward, a condensation trap should be installed close to the plant. This may be any type of fitting which will collect the condensation in the line. It should be inspected and drained periodically. If desired, an underground exhaust muffler may be installed.

All exhaust connections must be tight and free from leaks, particularly in sub ground level installations as carbon monoxide fumes are poisonous and extremely dangerous.

MAIN LINES - The main lines should be of the correct size and sufficiently insulated for protection of both the plant and operator. A main line fused switch or circuit breaker should be installed in the electrical line close to the plant.

GROUNDING - The plant should be grounded even though it may be used as a portable unit. This can be done by driving a ground rod or 1/2" pipe into the ground close to the plant. Use a ground clamp and a #10 or #12 wire to connect the ground rod to either a negative battery post or to the neutral (white) main line wire at the plant. Do not ground the plant itself or use any radio ground.

BATTERIES - A single unit 12 volt starting battery is furnished with this plant. The polarity markings of the battery posts and the panel terminals must be observed when changing the battery or cables. Maintain the water level in the battery.

PREPARATION

COOLING SYSTEM

RADIATOR - The cooling system of these plants employs a centrifugal type of water pump, gear-driven from the engine timing gear to force water from the radiator to the cylinder. The water capacity is 12 quarts.

Be sure, whenever the plant is operated, that the radiator is full of water; a loss of water through condensation or through the overflow will always occur, and this loss must be replaced by adding water occasionally. Check the water level daily when the plant is first started, and as frequently thereafter as is deemed necessary after observation of normal water loss has established a given number of hours of operation between inspection periods.

KEEP WATER CONNECTIONS TIGHT. CHECK WATER LEVEL FREQUENTLY. ALWAYS REPLACE WATER FILLER CAP SECURELY.

COOLING FAN - Air is driven through the radiator away from the engine by a V-belt driven fan. The fan hub is lubricated with regular engine oil. Remove the plug between the V-belt sheave and the fan blade assembly. Fill to the point of overflowing and replace the plug so that it is tight.

FAN BELT - Test the fan belt tension. It should be such that one side of the fan belt can be moved inward or outward about $3/4$ " easily. Extreme tension will cause rapid wear of the fan hub bearing. V-belts do not require the tension to prevent slippage that flat belts do. To adjust the fan belt, loosen the 2 set screws on the flywheel hub. Turning the front section of the pulley widens or narrows the belt track, in turn loosening or tightening the belt. Be sure the set screws are secured after adjustment of the belt.

FUEL SUPPLY SYSTEM

Fuel is supplied to the carburetor by a mechanical fuel pump, located on the left side of the plant below the cylinder. BE SURE ALL FUEL CONNECTIONS ARE TIGHT BETWEEN TANK AND PUMP, AND BETWEEN PUMP AND CARBURETOR.

The fuel pump has a mechanical operating handle on it so that the pump can be operated manually in order to fill the carburetor. When starting or if the fuel tank has been refilled after running dry, use this pump before starting. It will save battery wear. This fuel pump is of the standard AC type as used on most modern automobiles, and service for it is obtainable at any automotive supply house. A fuel filter bowl and screen are integral parts of this pump. The bowl should be removed occasionally and emptied, wiped out carefully and replaced carefully against the gasket with the lock nut turned up securely to insure against leakage.

PREPARATION

LUBRICATION

The foregoing details on installation and the description of the plant and its parts should provide sufficient information to allow proper installation and general knowledge as to the make-up of the plant.

After the plant has been properly installed, the crankcase should be filled with 4-1/2 quarts of SAE 20 oil, if the engine is operating at a temperature above 50 degrees Fahrenheit; SAE 10 oil if the plant is operating in a temperature below 50 degrees Fahrenheit. See oiling system page for details of operation.

The oil level is checked by a bayonet gauge on the right side of the engine. The oil level should always be maintained between the "L" and "F" marks on this gauge. The oil level should be checked daily until the operator is familiar with the natural oil consumption of the machine, and as frequently thereafter as is deemed necessary, to insure that the oil level never drops below the "L" mark on the gauge.

CHANGE OIL FREQUENTLY - THE OIL MUST BE DRAINED AT LEAST ONCE EACH 100 to 200 HOURS OF OPERATION, depending on the nature of the service. In low temperatures, change the oil more frequently. In average operating temperature, that is, between 50 and 80 degrees Fahrenheit, the oil may be changed only once each 200 hours of operation. If the plant is operated in temperatures above 80 degrees, it should be changed after each 100 hours of operation.

IMPORTANT: The capacity of the crankcase at the initial filling is 4½ quarts - 3½ quarts for the crankcase and 1 quart for the oil filter. When draining and refilling with fresh oil, only 3½ quarts will be needed, as one quart will remain in the filter.

IT IS RECOMMENDED, HOWEVER, THAT BOTH THE CRANKCASE AND FILTER BE DRAINED AT LEAST EVERY OTHER TIME, AS WELL AS WHEN PREPARING FOR COLD WEATHER OPERATION.

WE HAVE APPROVED THE FOLLOWING OILS AS SATISFACTORY FOR USE IN THIS PLANT:

Texaco, Havoline, Mobiloil, Pure Oil and Quaker State:-
SAE #10W for Winter - SAE #10 for Summer
SAE #20 for Extreme Temperatures

It is not necessary to limit yourself to the use of these oils only. Many other oils have satisfactory operating characteristics, and if in doubt about the quality of any oil other than those named, write us for information. If possible, use the above approved oils.

ABNORMAL OPERATING CONDITIONS

COLD WEATHER OPERATION

LUBRICATION - For temperatures of 0° F. or lower diluted crankcase oil should be used for easier starting and satisfactory lubrication.

1. Run the plant until oil in the engine is warm.
2. Drain off the crankcase oil. Also drain filter.
3. Thoroughly mix 4 quarts of SAE 10 or LOW with one pint of clean kerosene or a good grade of distillate if kerosene is not available.
4. Fill the crankcase to the required level (4-1/2 quarts).
5. Immediately start the plant and allow to run for 10 minutes to circulate the mixture in the lubricating system.

It is best to use SAE 10 or LOW for this mixture. SAE 20 may be used but is not recommended. Do not use a heavier grade as the mixture will separate each time the engine is stopped. This will defeat the purpose of the mixture and may cause some damage. When adding the lubricant between drain periods prepare a separate mixture. Do Not Add Kerosene Only. Mix 1/2 pint of kerosene with one quart of SAE 10 or LOW and add as much of this to the crankcase as is needed.

CAUTION! When lubricant is diluted as above it should be changed after every 50 hours of operation and should be checked often.

COOLING SYSTEM - The liquid in the cooling system must be protected against freezing when temperatures are 32° F. or lower.

1. Drain the system of the water - open the petcock at the bottom of the radiator.
2. Flush the entire system with running water or a special flushing agent if available.
3. Prepare the anti-freeze as directed by the manufacturer. Typical types are alcohol, glycerines, prestone, zerone and others. Do not use a distillate or kerosene, as fire may result.
4. Add water and a correct amount of anti-freeze according to the type used.
5. The entire cooling system has a capacity of 12 quarts. Do not fill to over-flowing but to a point several inches below the top of the radiator neck.
6. If necessary to add more anti-freeze, drain as much as there has to be added and then add whatever is needed.

CAUTION! - Check the cooling liquid often both as to amount and degree of protection. This is especially necessary when the temperature changes a great deal or goes down.

DUST OR DIRT

Under adverse sand or dust conditions it is necessary to check the plant and service it more often.

1. Keep the plant as clean as possible.
2. See that the supplies of fuel and oil are in air tight containers.
3. Check the ignition-Distributor points more often and clean as is necessary.
4. Clean the air cleaner and refill the oil bath as often as is necessary. Check daily.
5. Clean commutator and brushes often. See that brushes ride easily in the holders.

OPERATION

When the previous details on preparation have been taken care of, the plant can be started and operated. The following precautions should be observed:

CAUTION! If installed in a total enclosure, be sure that all the ventilation openings are open. Failure to do this will cause excessive overheating and subsequent water shortage resulting in serious damage to the plant.

In cold weather (temperature below 30° F.) disconnect the electrical load before starting plant. After it is operating satisfactorily, turn on the equipment, a portion at a time.

STARTING THE ENGINE - Press the start button and hold down for about five seconds, then release. The plant is automatically choked. Repeat the procedure until the plant starts. If after a few trials the plant will not start, check the fuel supply and ignition wires, and repeat the original starting procedure.

OPERATION AFTER ENGINE STARTS - Check the oil pressure and water temperature at the respective gauges after the engine warms up, and at regular intervals thereafter. Also check the charge gauge, which shows the amount of charge going into the starting battery. This should read from 2 to 10 amperes. Checking the panel controls periodically will insure the plant operating correctly at all times.

STARTING THE ENGINE MANUALLY - In case the starting battery does not furnish sufficient cranking power, the plant can be readily started manually. However, the battery will need sufficient power to operate the ignition coil. Under these circumstances, follow this procedure:

1. Throw remote manual start switch to manual position.
2. Crank the engine by hand until it starts. (Each plant is supplied with a hand crank). Do not spin the crank, but use a strong upward pull.

STOPPING THE ENGINE - IMPORTANT! Before pressing the STOP button in the control panel, it is necessary to throw Manual Ignition Switch to Remote position.

SERVICE AND MAINTENANCE

It is important that certain inspections be made at definite periods to keep the power plant at the maximum level of operating efficiency. It is strongly advisable to keep a service log of your plant as a continuous operating check. Use the standard service log form.

DAILY SERVICE The daily service checks should be a matter of routine and should positively cover the following steps:

1. The cooling liquid level.
2. The crankcase oil level.
3. The fuel supply.
4. The operation of the fuel, temperature gauge and ammeter for NORMAL INDICATION. Whatever correction measures are necessary should be taken without delay.

WEEKLY SERVICE This inspection should cover the above (daily) points. Normal weekly operation is 50 to 100 hours. If necessary, on the basis of previous lubrication information, the oil should be changed. In addition, check and correct the condition of the battery, its charge, water level, gravity and condition of terminals. Wash corrosion off with water and apply vaseline.

MONTHLY SERVICE The monthly service will cover the preceding points as well as the following: (This is for about 200 hours of operation)

OIL - The oil will very probably have to be changed by this time. First, run the plant until it is warmed up. Then drain and refill with 4-1/2 quarts of the specified oil. IMPORTANT-- NEVER ATTEMPT TO DRAIN THE OIL OUT OF A COLD ENGINE.

SPARK PLUGS - Remove the shields from the spark plugs and the plugs from the cylinder head, clean the points with a scraper and wire brush, removing all the carbon. Reset the gaps to about .027".

FUEL SYSTEM - Remove the bowl from the fuel pump or filter. Clean both the bowl and screen and then replace.

IGNITION - Remove the distributor cap and attachments. Inspect the points. If too badly pitted, replace with new ones. Otherwise, smoothen them with a tungsten file. Another method is to remove the points and work them back and forth a few times on a piece of carborundum. Following this, clean them by inserting a piece of clean paper between the open points, closing them and pulling the paper out. NEVER USE SANDPAPER OR EMERY CLOTH OR CLOTH. The gaps should be adjusted to .025".

MINOR LUBRICATION - Place a drop of light lubricating oil on the throttle shaft, governor linkage and all other ball joints.

EXHAUST - Inspect all exhaust connections. Replace or tighten any parts requiring this correction.

MONTHLY GENERATOR CHECK Inspect the commutator and collector rings and clean them if necessary. Brushes should be checked for good contact and easy riding in holders.

DISTRIBUTOR

IGNITION is provided by means of an ignition coil operating off the starting battery, and a distributor. The current from the battery is first fed to the ignition coil through the breaker arm of the distributor. The coil steps up the current to the necessary high voltage with a resulting high output in the secondary circuit. The breaker arm of the distributor interrupts the primary circuit of the ignition coil, thus creating the correctly timed, high tension sequences to the spark plugs by means of the distributor cap.

THE ADJUSTMENT OF THE IGNITION TIMING is accomplished by rotating the distributor the CLOCKWISE direction to RETARD THE SPARK, and the COUNTER-CLOCKWISE direction to ADVANCE THE SPARK. Under normal condition the timing will not have to be adjusted, as it is correctly set at the factory, however, it may be necessary to make adjustments if a change in fuel characteristics creates pinging in the motor. The lower the octane of the gasoline used, the more severe the pinging becomes, and the more power loss will result. Consequently, the spark will need to be retarded to eliminate the pinging.

THE POSITION OF CORRECT TIMING is at a point when the engine has maximum power, that is, when the generator develops a maximum voltage under full, constant load. A further check of correct timing is to accelerate the plant rapidly from no load to full load. If the distributor is correctly set, NO PING WILL BE PRESENT. If there is a ping, adjust the distributor until the ping is eliminated.

SPARK PLUGS

The spark plugs are a very important part of the ignition mechanism, and many of the troubles that occur may be avoided by their proper care and attention.

IGNITE THE AIR-GAS MIXTURE - The spark plugs receive the high tension current from the distributor, and through the electrodes, set off the spark which ignites the mixture. Therefore, the condition of the electrodes and the gap at which they are set are extremely important to plug efficiency. Follow the instructions on the periodical service page.

VISUAL TESTS OF SPARK PLUG OPERATION - Examine the lower ends of the porcelains (the part nearest the shell).

If they have a LIGHT BROWN COLOR, the plugs are firing at full efficiency.

If they have a DEAD WHITE COLOR, too hot a plug is being used or the gasoline mixture is too lean.

If it is covered by DULL, STICKY DEPOSIT, too cold a plug is being used, or the gasoline mixture is too rich.

If it is covered by a SHINY, BLACK DEPOSIT, the plug used is too cold, or the engine is pumping oil.

EXAMINE THE ELECTRODES - If both electrodes are pitted and burned excessively, the plug being used is too hot, or a poor grade of fuel has been used.

SERVICE AND MAINTENANCE

SPARK PLUGS Cont'd.

DIFFERENCE BETWEEN A "HOT" AND "COLD" PLUG - A "Hot" plug has a large area of the insulator exposed to the burning gases in the cylinder. This maintains the firing end at a comparatively high temperature and tends to vaporize any oil or fuel that comes in contact with the insulator. It is used for cold climate operation and in engines pumping oil. A "Cold Plug" has a small area of the insulator exposed to the burning gases in the cylinder. A lower temperature is thereby maintained in the insulator. This plug is used for severely heavy service, and in extremely hot climates.

After each inspection of the plugs, clean and reset the gaps to .027". When installing plugs, particularly in aluminum heads, examine the threads and remove any burrs that may be present before inserting the plugs. If the plugs are screwed in too tight, the shells may become distorted, the gap may change, or leakage result. If screwed in too loose, they will leak and overheat.

WATER PUMP

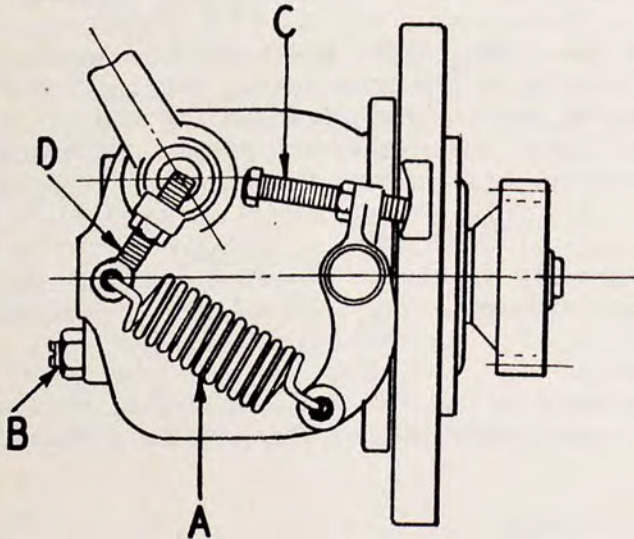
FRONT END TYPE - Little trouble should be expected from the water pump. If it is necessary to remove and dismantle it, follow these directions:

1. Remove the nut holding the fan pulley and pull or press the pulley off. Do not pound on the pulley flange with a hammer as breakage will result.
2. Remove the rear cover.
3. To remove the impeller, remove the 1/8" pipe plug in the left top side (viewed from the front) of the pump body, then using the slot in the pump shaft as a guide line up the retaining set screw with this hole and loosen the set screw with a long screw driver. Be sure that screw is out enough to be free from the hole in the shaft. The impeller may then be pulled off.
4. To remove the ball bearings, remove the lock screw on the under side of the pump body and press the entire assembly out through the front.
5. The seal will be found assembled in the impeller hub. Care must be taken in removing this assembly as the carbon seal is fragile and easily broken. The holes in the brass cup holding the seal in place should be lined up with the slots in the impeller hub. These are provided to prevent dirt from forming behind the seal ears and preventing efficient sealing. To reassemble merely reverse the procedure. One point to note is to have the dog-tooth screw project far enough to line up the impeller on the shaft. Press the impeller flush with the end of the shaft. When re-assembling pump pack the space between the bearings with a good grade of sodium soap type grease such as Mobilgrease No. 5.

GOVERNOR

GOVERNOR OPERATION - A Pierce Industrial type governor is used on this plant. The proper operation of the governor assembly is absolutely essential, as it controls the speed of the engine, and the voltage output of the generator. When the governor is operating normally, the speed of the engine will be controlled within 75 RPM. The normal speed of the plant is 1800 RPM at full load.

If the governor assembly has not been tampered with, no change in its operation should occur. However, if for any reason, the governor does not properly control the speed within the 75 RPM range, the voltage variation, and consequently, the brilliancy of the lamps will vary greatly as the load is increased or decreased on the generator.



If the governor is disassembled, or if the carburetor is removed from the engine, resetting of the external parts of the governor will be necessary. This is done in the following manner.

Re-adjusting.

1. With the spring tension on the main governor spring "A", adjust rod length so carburetor lever clears wide open stop by at least $1/64$ ".
2. Screw bumper screw "B" out far enough so that it does not function. Adjust governor for desired speed by turning adjusting screw "C".
3. Should governor surge under load or part load conditions, screw auxiliary adjusting screw "D" out a few turns at a time until surging stops. For close regulation, keep auxiliary adjusting screw "D" in as close as possible, without making governor surge.
4. Should governor surge at no load speed, screw bumper screw "B" in until surge is eliminated, then set lock. Don't run screw "B" in far enough to increase engine speed.

There is no routine servicing which must be taken care of on the governor assembly other than placing a drop of oil occasionally on the link between the throttle arm of the carburetor and the governor arm, and on the throttle shaft in the carburetor. None of the parts of the governor should require replacement during the life of the machine.

The following figures show the construction of the Zenith 61 Series Carburetors.

The removable Venturi (1) (see Figure 1) increases the velocity of air which passes through the carburetor. In selecting the venturi, it is best to use the smallest size which will permit full power development.

MAIN JET SYSTEM: The Main Jet (2), often referred to as the "high speed jet," exerts its principal influence at the higher engine speeds. Fuel from the bowl is metered through the Main Jet (2) and discharged into the air stream through the Main Discharge Jet (3).

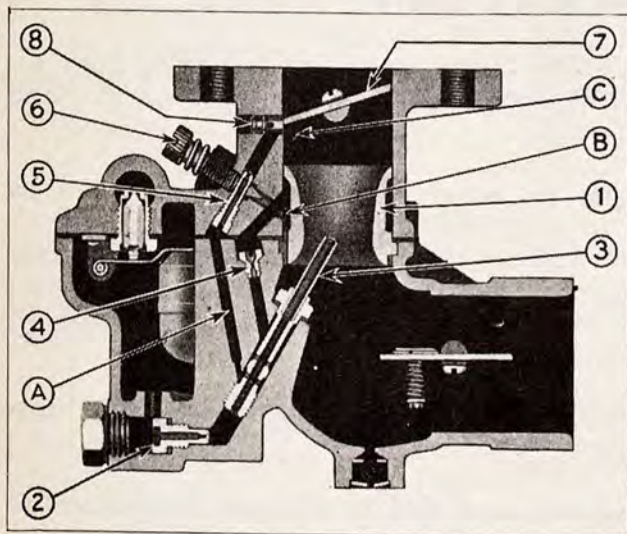


Figure 1

COMPENSATING SYSTEM: The compensating system consists of the Main Discharge Jet (3) and the Well Vent (4). The flow of fuel from the Main Jet (2) is controlled by the size of the Well Vent (4) and the size of the Main Discharge Jet (3). The mixture delivered through the Main Discharge Jet may be made richer by either increasing the size of the Main Discharge Jet or by decreasing the Well Vent. Conversely the mixture may be made leaner by either decreasing the size of the Main Discharge Jet or by increasing the size of the Well Vent.

IDLING SYSTEM: The Idling system consists of the Idling Jet (5) and the Idle Adjusting Needle (6). The Idling Jet (5) receives its fuel from the Main Discharge Jet (3) through Channel (A). The fuel is metered through the Idling Jet (5) and is mixed with air which is admitted from behind the venturi (1), through channel (B). The Idle Adjusting Needle (6) controls the amount of air which is admitted to the Idling System. The Idling System functions only at Idling and Low Speeds. At these speeds, the Throttle Plate (7) is almost closed and there is a very strong suction past the edge of the Throttle Plate. This suction draws the mixture of fuel and air from the Idling Jet (5) which discharges into the air stream through the Priming Plug (8).

ECONOMIZER SYSTEM: To develop full power, a certain mixture of fuel and air is required. Under part load, a leaner mixture may be used and operating costs reduced. In the Zenith 61-Series Carburetor, this is regulated automatically by the position of the throttle shaft.

Figure (2) shows the position of the throttle shaft (9) at closed throttle. At this point no suction is transmitted to the bowl, because the channel (C) (see Figures 1 and 2) is below the throttle plate (7), thus permitting a full flow of fuel through the idling system.

When the throttle is opened sufficiently to bring the throttle plate (7) just below the channel (C), approximately 1/4 open, a strong suction acts through channels (D), (E) and (F) thus holding back the fuel in the bowl and causing a lean mixture through the part throttle operation. The bowl ventilation from the intake

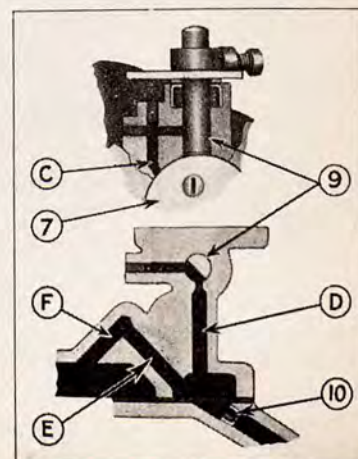


Figure 2

of the carburetor is restricted by a bushing (10) (see Figure 2) thus preventing bowl ventilation from overcoming the suction from channels (C and D).

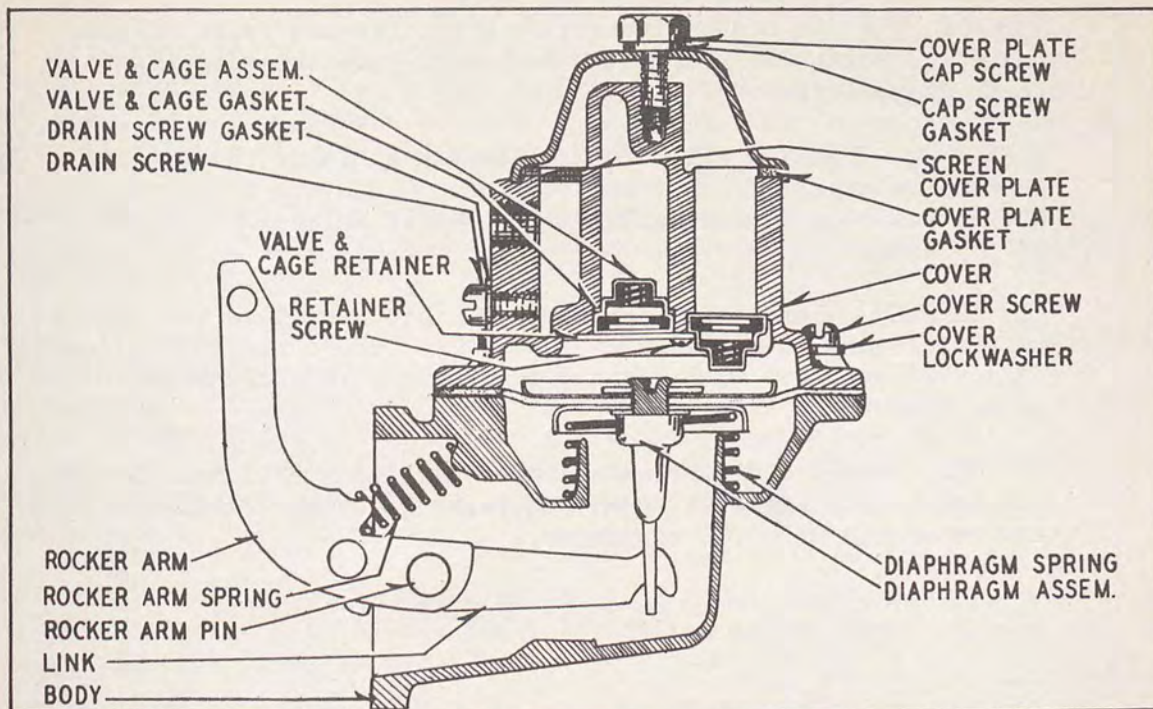
For full power operation, at wide open throttle, this suction is cut off, due to the position of the slot in the throttle shaft, and permits the full flow of fuel necessary for full power.

ADJUSTMENT - Preliminary adjustment: Warm up the motor. Set idling needle adjustment (6) and main jet adjustment (if there is one) at one full turn open. With motor at FULL LOAD, turn main jet adjustment (if available) down until motor runs unevenly or loses speed. Then turn it back until motor operates smoothly and regains its speed. Follow the same procedure when setting the idling adjustment needle, but have the motor running at idling speed.

If there is a hunt, i.e. motor gains and loses speed alternately, open a half turn more.

Be careful not to turn it more than that, as the hunt may be drowned out, resulting in excessive gasoline consumption.

FUEL PUMP



SERVICE INSTRUCTIONS - A.C. FUEL PUMP

If there is a lack of fuel at the carburetor, check the following:

CAUSE	REMEDY
Gasoline tank empty	Refill
Leaky tube or connections	Replace tubing and tighten all pipe connections at the fuel pump and gas tank
Bent or kinked tubing	Replace tubing.
Dirty screen	Clean the screen. Make certain that the cork gasket is properly seated when reassembling.
Loose cover plate cap screw.	Tighten cover plate cap screw securely, replacing cover plate cap screw gasket if necessary with new one.

If there is a fuel leakage at the edge of the diaphragm -

CAUSE	REMEDY
Loose cover screws	Tighten cover screw alternately and securely. Also check inlet and outlet pipe connections.

NOTE: Check if leak occurs at pipe fittings thus allowing fuel to run down pump to flange and appear to originate there. Do not use shellac or any other adhesive on the diaphragm.

SERVICE AND MAINTENANCE

SIX MONTHS SERVICE The six months inspection will likewise cover all the preceding points. In addition to these, give the plant the following services:

GENERATOR - Replace all worn brushes and springs. Remove the gasket and cover of generator bearing. Clean out all hardened grease and repack with ball bearing grease only. DO NOT USE CUP GREASE.

AIR CLEANER - Remove the air cleaner. Dip and rinse the inside of the cleaner in kerosene or gasoline. Remove old oil and re-fill oil level cup with fresh oil as used in the crankcase. Replace cleaner.

CONTROL - Check and tighten all electrical connections. Examine contact points wherever found (on relays, voltage regulators, etc.) and reburnish with .00 sandpaper.

SERVICE AND MAINTENANCE

YEARLY ENGINE SERVICE

Once each year, if the plant is used under normal conditions, the accumulated hours of operation will total 2500 or more. After each 2500 to 3000 hours of operation, the engine should be given a thorough going over, including inspection of pistons, piston rings, valves, crankcase.

Most important step in the yearly servicing is the grinding of valves and carbon cleaning. This is one of the most frequently desirable operations on even the best of gasoline engines.

However, it may be found desirable to grind valves and clean carbon more frequently than once a year. The necessity for valve grinding is usually quickly determined by noting a loss of power due to loss of compression. The valve face may become pitted and sometimes the valve stems become warped. If this is the case, the valve does not form a perfect seal entirely all the way around its seat when in its closed position. Consequently, leakage of compression and loss of power result.

The regrinding of valves is not a difficult job but each operation must be given careful thought and attention. The instructions below, when followed precisely, will considerably simplify the job.

VALVE GRINDING

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

- | | |
|------------------------|--|
| 1 Cylinder Head Gasket | 1 Carburetor Flange Gasket |
| 1 Cylinder Base Gasket | 1 Set Radiator Hoses |
| 1 Water Inlet Gasket | 1 Radiator Inlet Gasket |
| 1 Water Outlet Gasket | 1 Complete Set Piston Rings - Optional |
| 1 Manifold Gasket | 1 Complete Set Valves - Optional |

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

1. Disconnect battery from starting circuit.
2. Drain all water from the radiator and engine.
3. Disconnect radiator fittings from cylinder head.
4. Disconnect fuel line from pump to carburetor.
5. Remove air cleaner and choke assembly.
6. Remove carburetor and manifold.
7. Remove tappet cover.
8. Disconnect ignition wires and remove spark plugs.
9. Remove cylinder head nuts and pull cylinder head from the block.
(Do not pry head off with screw driver if it sticks. Tap the head sharply with a hammer to loosen it from the gasket).
10. Remove the crankcase.
11. Remove the connecting rod caps.
12. Remove the connecting rod and piston.
(Be sure to mark alignment for replacement).

Inspect the piston rings carefully. Be sure that any accumulated carbon is removed from the oil return slot in the oil control ring. Replace them whenever the valves are ground. Then wrap the pistons in cardboard or rags so that neither piston or rings will be damaged while the rest of the engine is being serviced.

SERVICE AND MAINTENANCE

In order to grind the valves, it is first necessary to remove the valve springs and locks. This can be done by pressing down on the valve washers by hand and removing the lock. The valve can be lifted out of the cylinder block.

Check the valves carefully, and if the stems are badly worn or not straight, the valves should be replaced with new ones. Valves that are badly pitted on their faces, can be reconditioned by refacing them on a valve face grinder. If this is done, be sure to get a true 45° face. When lapping or grinding each valve to its seat, be sure that no dirt is allowed to get into the guide to shove the valve off-center.

Use a light coil spring under each of the valves as it is being lapped to raise the valve off its seat during the process. Use a medium grade compound, and only a light pressure. Rotate the valve with a vacuum cup tool, fastening it to the top of the valve head. Repeat the oscillating and lifting motion, replacing the compound as it wears out and loses its cutting properties, until a clean surface is produced on both valve and seats alike. There should be bright silvery band of uniform width all around the valve face. If valve seat is badly pitted, it will be necessary to reface it.

Carefully clean all traces of the compound from the surface and check each valve for a tight seat, by making pencil marks across the face at intervals, and then rotate the valves, part of a turn against the seat, with a firm pressure and again lift out to observe if the pencil marks are all rubbed out. Re-grind until this test shows a gas tight mating of valve to seat. Replace valves, Spring & locks.

Inspect the cylinder head and scrape and remove all carbon. Clean the head thoroughly by washing. Then replace it on the block and reassemble the engine in the reverse procedure as was outlined before for disassembling. USE NEW GASKETS. It is poor economy to invest considerable labor and time in servicing a plant and then to have poor service because of defective gaskets. When you come to replacing the tappet cover leave it off until the tappets are adjusted as outlined below.

VALVE TAPPET ADJUSTMENT - The tappets are designed with a self-locking adjusting screw requiring three wrenches when adjusting for clearance. If a tappet face scores from too close adjustment, or if breakage results, replace with a new one. The clearance for both intake and exhaust valves is .014" with the engine cold. DO NOT SET THEM CLOSER as this allows for normal expansion. Closer setting WILL RESULT IN THE TAPPET FACES BECOMING BADLY SCORED OR CUT OR THE VALVE HEAD BECOMING WARPED OR BADLY BURNED.

After the engine has been started and run for a short time, it is advisable to go over each of the cylinder head nuts to be absolutely sure they are tight. Use a good box or socket wrench when tightening the nut.

SERVICE AND MAINTENANCE

MAJOR ENGINE OVERHAUL

DETERMINING THE NEED FOR A MAJOR OVERHAUL - Serious noises in the engine usually accompany inefficiency. These noises are generally caused by loose main or connecting rod bearings, timing gears, piston pins, wrist pins, or other important working parts of the engine. If such noises are present, an overhaul is usually necessary, but first, its absolute necessity can be determined by removing the crankcase and inspecting the bottom side of the engine. Place a trouble lamp inside and inspect all of the working parts. Try the fit of the connecting rods on their bearings as well as the fit of other internal working parts. There should be no play (or very little) in any moving parts. If there is, an overhaul should be made at once.

SHOULD BE PERFORMED BY EXPERT - An overhaul of this plant should be carried out by an expert who is familiar with the principles and characteristics of internal combustion engines.

DISMANTLING THE PLANT - This operation should be taken step by step in the most natural order possible. By carefully examining each part as it is removed from the plant, the mechanic can readily determine which of them must be replaced, which must be repaired and which part adjusted.

VALVE TIMING - Proper setting of the valves with relation to the crankshaft (valve timing) is extremely important to successful motor operation. The recommended timing of valves is the result of exhaustive tests. For this reason the mechanic should never attempt to alter the original factory setting.

The practical method of setting the camshaft is by flywheel markings and tappet clearances. On the rim of the flywheel there are certain stamped markings which can be seen through the flywheel housing inspection hole as the wheel is rotated. These markings are "Ex.C", indicating EXHAUST CLOSING, "IGN" indicating IGNITION, and "D.C." indicating TOP DEAD CENTER OF No. 1 or No. 4 piston. The mark "D.C.", when under the inspection hole pointer indicates that No. 1 or No. 4 piston is at top dead center and is about to descend on the intake stroke. When the markings "Ex.C" are just beneath the flywheel pointer the exhaust valve should just have closed. This should be the case when the tappet adjusting screw is adjusted to ".014".

Because of manufacturing tolerances "building up" in one direction in the case of gear driven front ends it may be that the cam and idler gears will not mesh together exactly when the "Ex.C" mark on the flywheel is under the pointer and camshaft is actually in the exhaust closing position. In other words, a tooth on the gear will not be exactly opposite a space in the other. The mechanic should always bear in mind that the cam gear will turn slightly to the right or to the left as the case may require, due to angular pitch of the teeth in the case of helical gears. This turning may be just enough so that when fully in mesh the camshaft will be exactly in the correct position for proper timing. In case this spiral wind does not compensate for manufacturing tolerances, advance the cam gear the fractional tooth width necessary for correct meshing.

UNDER NO CIRCUMSTANCES SHOULD THE CAMSHAFT BE RETARDED IN ORDER TO EFFECT PROPER MESHING. The timing of the top center events of the camshaft used in this plant engine: exhaust closing on dead center; inlet opening on dead center.

SERVICE AND MAINTENANCE

MAJOR ENGINE OVERHAUL Cont'd.

CONNECTING ROD BEARINGS - The lower connecting rod bearings are securely locked and readily interchangeable. Bronze bushings are used in the upper end for the piston pin. Servicing of the rod will consist of bushing replacements. The piston pin bushing is diamond bored and it is not recommended that replacement be made in the field. It is preferable to replace the entire rod. When a shell in the lower end becomes defective for any reason it should be serviced by discarding the old one at once and replacing it with a new one. Under no condition should fitting ever be attempted by scraping or filing of the cap or blade. This would permanently ruin the rod. Since the shells are interchangeable, simple replacement results in a proper fit. Care should be taken not to get foreign matter behind the shells when assembling.

MAIN BEARINGS - Servicing of the main bearing shells will consist of replacing them. If a shell becomes defective it should be discarded and replaced with a new one. Under no condition should fitting ever be attempted by scraping or filing of the bearing caps. Such practice would permanently ruin the case. As a general rule, the same procedure can be followed as in replacing connecting rod shells. Oil seals should be replaced during service of bearings and crankshaft.

CRANKSHAFT - The crankshaft should seldom, if ever, cause trouble due to its large diameter, special heat treatment and accurate precision balancing. Unless cut by dirty oil, badly burned bearings or sprung by accident, the shaft will last the lifetime of the engine with but scant attention. End play should be adjusted immediately when it becomes noticeably excessive, not because of damage to the shaft, but because of damage to the front main bearing, the rear face of which is the thrust face on this model. The end thrust of the crankshaft is regulated by a removable thrust collar just to the rear of the crankgear, together with a shim pack to the rear of this collar. When servicing a crankshaft or other parts in connection with the shaft, always make sure that all oil holes in the shaft are open and clean.

PISTON RINGS - A properly fitted piston ring, while not a large part, is one of the most important parts in an engine, as they are directly related to the degree of power of the engine. Servicing of piston rings will consist obviously of replacing old rings with new ones. Care must be taken to place the correct type of ring in the proper groove. New rings should be fitted to each individual bore, and carefully filed at the joint so that a gap of .008" to .013" of an inch remains. Determine this gap by applying a feeler to the gap while the ring is in the bore to which it is being fitted. Rings should be true, and just thick enough to have .0015" to .002" clearance in their respective grooves. Here again a feeler should be used. Should the ring be too thick, which is seldom the case, it can be reduced to fit its groove by lapping on a sheet of .000 emery cloth. Place the cloth on a surface plate or other perfectly flat surface. While lapping the pressure must be equal at all points. **CARE MUST BE TAKEN, IN ASSEMBLING THE RINGS THAT THEY ARE NOT SPRUNG OUT OF THEIR NATURAL SHAPE AND PERMANENTLY DISTORTED.**

PISTON PINS - The piston pins are locked in place by retaining snap rings in the piston bosses at either end of the pin. Standard finished size of the pin is .7084" to .7086". They are available for service in several oversizes. Pins are selected in production to obtain fits as follows: .0003" loose in pin bushing and .0003" tight in piston boss. The pins are manufactured with an out of round and taper allowance of only .0002". It is important when assembling the piston pin that both lock rings are in place in each piston before the rod and piston pin assembly is put back into the engine.

MAJOR ENGINE OVERHAUL Cont'd.

PISTONS - Like all mechanical units being subject to wear, pistons will eventually require replacement. In addition to the standard size for the plant, they are available in a number of standard oversizes, if the cylinders are to be honed or bored to oversize diameter. Extreme care is required for this operation and should be undertaken only in a properly equipped shop by expert mechanics.

TIMING GEARS - Replacement of front drive gears should not be necessary, except after many seasons of service. When replaced, they should be fitted metal to metal, rather than composition replacement. Generally, all the gears in the train must be replaced at one time. Where both gears are to be replaced, new gears of exactly the same size as the replaced parts should be used unless at some previous time changes such as replacement of bushings have been made which would affect gear centers.

CAMSHAFT AND BUSHINGS - Unless sprung while out of the engine assembly the shaft as a whole will always remain in perfect alignment, providing, of course, that ample lubrication has always been provided. Should the cams become cut or scored, they can be reconditioned by honing, if they are not too badly damaged. Care must be taken to hold the hone squarely on the cam face and the movement should be in the direction of rotation. If too badly cut on the cams or at the bearings as the result of scratches from dirt in the oil, the camshaft should be serviced by replacement of a new one.

CONNECTING RODS - The sides of the crank end of the connecting rods are not protected by babbitt in this engine. These faces are steel and are exposed to the steel crankshaft. In fitting rods it is of vital importance that a side play clearance of .008" to .012" be provided to prevent scoring of the rod side faces. In replacing complete piston and rod assemblies it is important to align them on an alignment fixture.

FLYWHEEL - The flywheel is attached to the crankshaft flange with six bolts. One of these is offset 1/16", with a corresponding hole in the shaft flange. Thus the flywheel can be assembled in but one position with regard to No. 1 and 4 crank pins. The flywheel will seldom require replacing. CAUTION: When replacing a flywheel or installing a new one make certain that it is true and securely bolted to the crankshaft flange. When finally secured, the flange or rim of the wheel should run within .004" of being true. This can be checked with a dial indicator clamped to the housing. If not within limits specified the wheel must be removed and any chips or foreign matter on the flange face or recess of the wheel must be removed. IN FINAL ASSEMBLY THE NUTS SHOULD BE SET UP VERY TIGHTLY.

SERVICE AND MAINTENANCE

MAJOR ENGINE OVERHAUL Cont'd.

GOVERNOR - It will be necessary to reset the governor adjustment following each engine overhaul. For complete details see the Governor section.

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

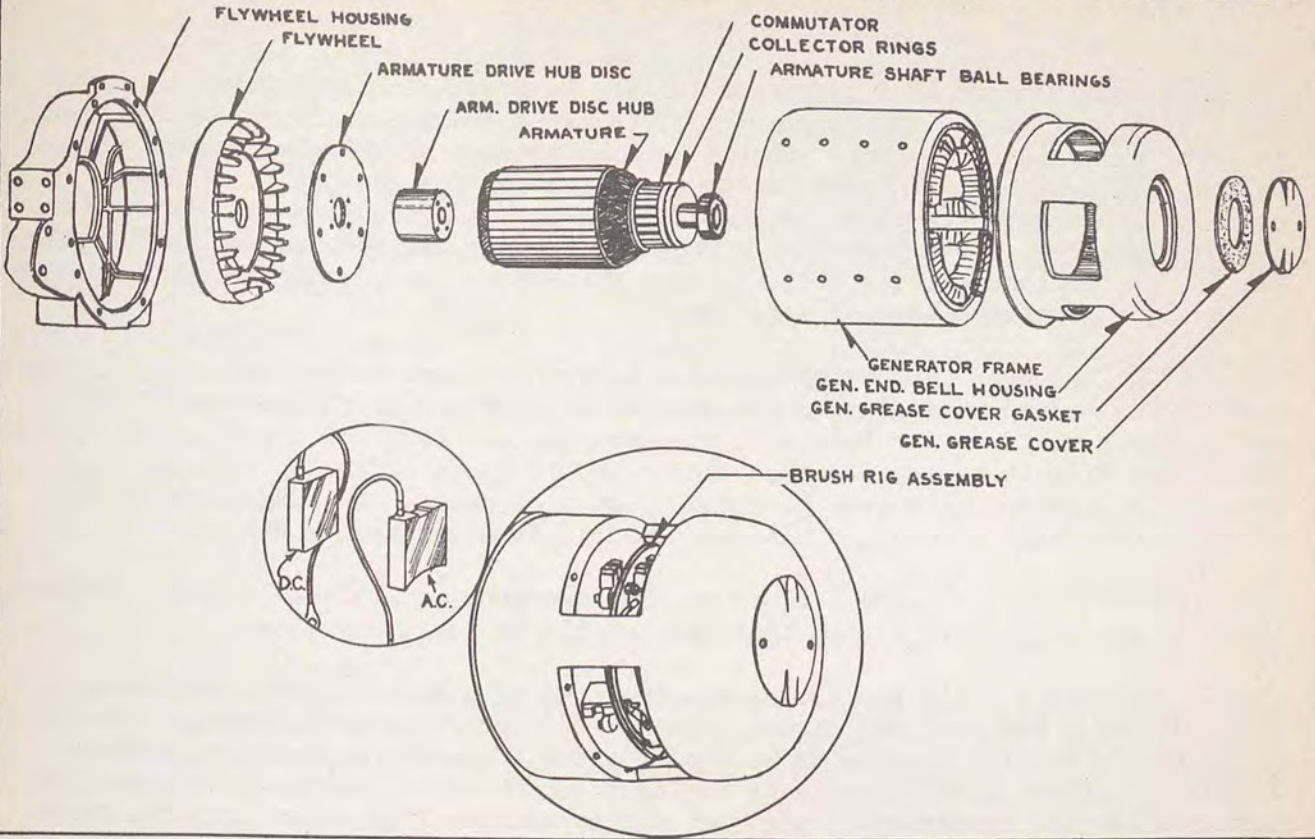
FOLLOWING IS A TABLE OF CLEARANCES FOR BEARINGS AND OTHER PARTS OF THE ENGINE, AND SUGGESTED METHODS FOR CHECKING THEM.

	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>TESTING DEVICES</u>
Valve Tappet Clearance - Intake	.012"	.014"	Thickness Gauge
Valve Tappet Clearance - Exhaust	.012"	.014"	Thickness Gauge
Valve Seat Width - Intake	1/16"	3/32"	Scale
Valve Seat Width - Exhaust	3/32"	5/32"	Scale
Valve Stem Clearance in Guide - Intake	.001	.0026"	Plug Gauge & Mike
Valve Stem Clearance in Guide - Exhaust	.0027"	.0043"	Plug Gauge & Mike
Crankshaft Main Bearing - Diameter	.001"	.0029"	Feeler
Crankshaft End Play	.003"	.005"	Feeler Gauge
Connecting Rod Bearing - Diameter	* .0015	.002"	Feeler
Connecting Rod Bearing - End Play	.004"	.006"	Feeler
Timing Gear Backlash	.001"	.004"	Dial Indicator
Piston - Cylinder Clearance	.0015"	10-15# Pull	Feeler
Camshaft Main Bearings - All Bearings	.002"	.004"	
Piston Pin in Rod	.002-3"	loose	

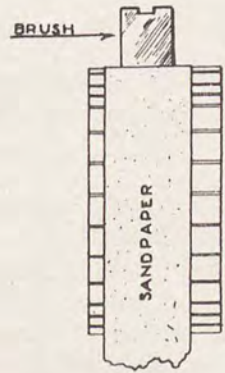
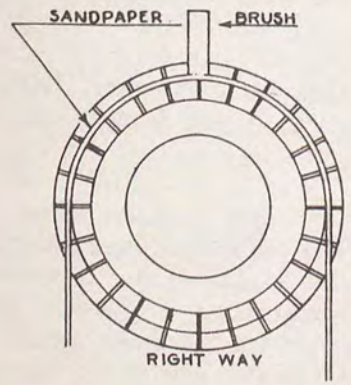
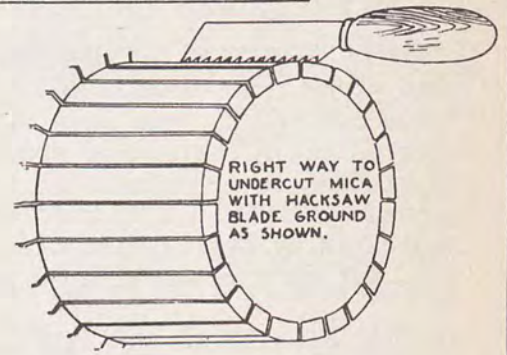
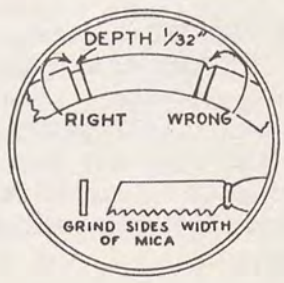
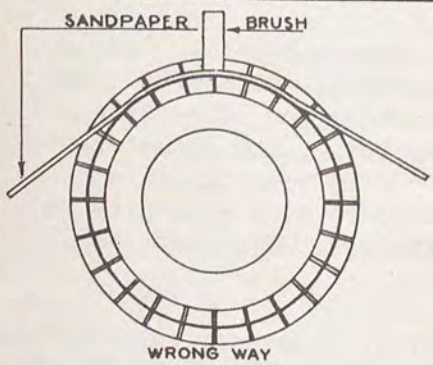
* Desired Clearance

Use piece of feeler stock to check bearing clearance for Rods & Mains

ALTERNATING CURRENT GENERATOR ASSEMBLY



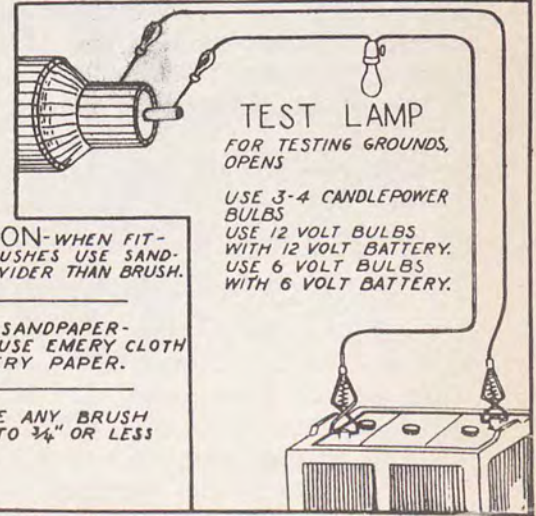
CARE OF COMMUTATOR AND BRUSHES



CAUTION—WHEN FITTING BRUSHES USE SANDPAPER WIDER THAN BRUSH.

USE 00 SANDPAPER—NEVER USE EMERY CLOTH OR EMERY PAPER.

REPLACE ANY BRUSH WORN TO $\frac{3}{4}$ " OR LESS



SERVICE AND MAINTENANCE
GENERATOR SERVICE

The most common cause of a generator failing to produce current is an external short somewhere on the main line. If it is suspected that this is the cause of failure, the main line circuit should be disconnected by throwing the main line switch, and a test lamp placed across the output of the generator. If the plant fails to generate with the AC main line disconnected from the plant, then the trouble lies in the generator. When the trouble has been traced to the generator, the following tests will indicate whether or not the difficulty is due to short or grounded field or armature.

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

Loose brush wires can cause failure of the generator to produce current. Brushes in which the leads have become loosened, should be replaced.

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

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

TESTING AC WINDING OR ARMATURE FOR OPEN CIRCUITS - First, disconnect battery and AC line wires from the plant. RAISE ALL BRUSHES FROM COMMUTATOR AND COLLECTOR RINGS. Place one end of test lamp wire on outer or insulated collector ring. Place other end of test lamp wire on the inner collector ring. If test lamp burns, AC armature winding is not open. If test lamp does not burn, AC armature winding is open. NOTE: An open circuit in the AC armature winding will result in the plant failing to generate.

Placing one end of test lamp wire on shaft, the lamp should not burn when other end of test lamp wire is placed on either collector ring. If light burns, it indicates a ground in AC winding.

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

SERVICE AND MAINTENANCE

TESTING FIELDS FOR GROUNDS OR SHORT CIRCUITS - Disconnect battery and AC line wires from the plant. RAISE ALL BRUSHES FROM COMMUTATOR AND COLLECTOR RINGS. Disconnect DC field wire. Connect one end of test lamp wire to DC field wire. Place other end of test lamp wire to ground on a clean surface of the generator frame. If test lamp burns, the field circuit is grounded. If test lamp fails to burn, the field circuit is not grounded. NOTE: A ground in the field circuit would be indicated by excessive flickering of the lights on the AC line, a dim light, or the generator failing to produce current. Shorted field coils will run much cooler than the rest, and may be located by feeling the temperature of the coils.

REMOVING GENERATOR FROM ENGINE - The generators of these plants are carried directly on a turned diameter of the rear crankcase adapter. If for any reason, mechanical or electrical, it becomes necessary to remove the generator from the engine, proceed in the following manner:

First, disconnect battery cables, main lines and ignition wires from the control unit. Second, remove the cover from the rear of the generator and lift all of the brushes in their guides. When pulled partly out, the brush spring will slip down the side of the brushes and hold them in place to prevent their being damaged when the generator frame is removed. If the plant is equipped with a gasoline tank atop the generator, disconnect the fuel line from the fuel tank of the carburetor. Remove the four nuts at the rear of the generator bearing support casting, holding the generator frame to the adapter casting, loosen and remove those at the bottom first. The generator frame can now be pried and pulled from the adapter casting.

After the generator frame has been removed from the adapter, the armature will be extended from the crankshaft without any rear support, and care should be taken that the engine is not turned over rapidly, or that nothing is allowed to drop on the armature. Remove the armature from the crankshaft by loosening the hexagon bolts at the front of the armature shaft where the drive disc is bolted to the flywheel. The armature can then be pulled away from the engine. It should be handled carefully so it will not damage the laminations, commutator or collector rings.

ASSEMBLING GENERATOR TO ENGINE - Before installing the frame on the crankcase, remove the bearing cap from the rear of the generator, clean the bearing surface in the frame and the bearing on the armature carefully. Line up the notch in the bearing with the pin in the end frame. The frame should be installed over the armature very carefully, and the four cap screws that retain it should be tightened gradually and alternately, never pulling one down tight before the others are nearly down. Repack the bearing with only regular ball bearing grease. See Service instructions.

BRUSH RIG POSITION - It will not be necessary to loosen the bolts retaining the brush rig assembly to the rear of the generator frame during the disassembling of the generator. However, if this has been done accidentally, or for removal of the brush rig for servicing, when the brush rig is reinstalled, it should be turned to the position marked by the small indicating point on the frame of the generator, and the notch or mark on the brush rig. This is called the neutral position, and unless the brush rig is replaced properly in this position, excessive arcing of the brushes, heating of the generator fields and armature, and low voltage production will result.

GENERAL

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

1. ENGINE FAILS TO START OR IS HARD TO START:
 - (a) Poor compression
 - (b) Too Heavy Oil. Thickened due to drop in Temperature.
 - (c) Fuel Tank Empty - Low Grade of Fuel used.
 - (d) Air Lock in Fuel Line.
 - (e) Improper Fuel Mixture - Air Cleaner Clogged.
 - (f) Defective Ignition.
 - (g) Spark Plug Fouled - Too large or small gap - Porcelain Cracked.
2. ENGINE STARTS, BUT DOES NOT CONTINUE RUNNING:
 - (a) Overheated - Poor Ventilation.
 - (b) Piston Sticking.
 - (c) Air Lock in Fuel System. Air Vent Clogged.
 - (d) Dirt, Water or Ice in Fuel System.
 - (e) Heavy Load on Plant from Motors, Appliances, etc.
 - (f) Defective or Shorted Stop Button.
 - (g) Short Circuit on Line. Defective Motors or Appliances.
 - (h) Faulty Ignition - Breaker Arm Sticking.
3. PLANT STARTS, BUT DOES NOT PRODUCE CURRENT:
 - (a) Open Line Wire or Switch.
 - (b) Defective Panel Wiring, or hook up.
 - (c) Blown Fuses.
 - (d) Brushes Stuck in Holders and not touching Commutator.
 - (e) Brushes worn too low and not seating properly. (See Generator Section).
4. PLANT RUNS TOO HOT:
 - (a) Spark Advanced or Retarded.
 - (b) Exhaust Back-up - Improper discharge.
 - (c) Improper Ventilation (See Installation section).
 - (d) Air Cleaner Dirty.
 - (e) Low Oil Level or Improper Grade for Climatic Conditions.
 - (f) Carburetor Mixture too Rich
5. PLANT USES EXCESSIVE AMOUNT OF OIL:
 - (a) Oil not changed often enough - Dirty Oil (See Lubrication Section).
 - (b) Too Rich a mixture, causing excessive Cylinder Wear - Check Oil Level.
 - (c) Piston Rings Stuck, due to improper Lubrication, overheating or defective plugs.
 - (d) Engine Overheated, due to poor ventilation.

ENGINE SERVICE DIAGNOSIS LACK OF POWER

- | | |
|--|------------------------------------|
| 1. Low or Poor Compression | 4. Air Cleaner Restricted |
| 2. Ignition System Defective | 5. Low Octane Fuel |
| 3. Carburetor not Functioning Properly | 6. Overheating |
| | 7. Improper Grade Viscosity of Oil |

OVERHEATING

- | | |
|---|--------------------------------|
| 1. Insufficient amount of Air Circulation | 5. Ignition System Defective - |
| 2. Improper Grade & Viscosity of Oil. | |
| 3. Fuel Mixture too Lean or Rich | 6. Valve Timing Too Early |
| 4. Air Cleaner Restricted | |

ENGINE

POOR COMPRESSION

- | | |
|-----------------------------------|--|
| 1 Incorrect Valve Clearance | 6 Cylinder Head Gasket Leaking |
| 2 Valve Stems or Lifters Sticking | 7 Piston Rings Broken, Worn or Stuck |
| 3 Valve Stems or Guides Worn | 8 Pistons or Rings Improperly Fitted |
| 4 Valve Springs Weak or Broken | 9 Piston Ring Grooves Worn |
| 5 Valve Timing Incorrect | 10 Cylinder Scored or Worn Excessively |

EXCESSIVE CYLINDER AND PISTON WEAR

- | | |
|--|---|
| 1 Improper Grade & Viscosity of Oil | 6 Piston Rings not Properly Fitted to Piston Groove and Cylinder Wall |
| 2 Lack of Oil | 7 Piston Rings Stuck in Piston Grooves or Broken |
| 3 Dirty Oil | 8 Air Cleaner Not Clean, Allowing Dirt to Enter Combustion Chamber |
| 4 Overheating | 9 Carburetor Fuel Mixture too Rich |
| 5 Piston Improperly Installed and Fitted | |

CRANKSHAFT BEARING FAILURE

- | | |
|---|---|
| 1 Crankshaft Bearing Journal Out of Round | 6 Bearings Improperly Fitted |
| 2 Crankshaft Bearing Journal Rough | 7 Bearings Loose in Crankcase |
| 3 Crankshaft Oil Passage Restricted | 8 Crankshaft or Bearings Out of Alignment |
| 4 Bearings Sprung | 9 Lack of Oil |
| 5 Bearings Loose | 10 Low Oil Pressure |
| | 11 Improper Grade & Viscosity of Oil |

CONNECTING ROD BEARING FAILURE

- | | |
|----------------------------|--------------------------------------|
| 1 Crankshaft Surface Rough | 6 Loose in Connecting Rod |
| 2 Restricted Oil Passage | 7 Bent Connecting Rod |
| 3 Bearings Sprung | 8 Lack of Oil |
| 4 Bearings Loose | 9 Low Oil Pressure |
| 5 Improperly Fitted | 10 Improper Grade & Viscosity of Oil |

BURNED VALVES AND SEATS

- | | |
|--|--|
| 1 Improper valve clearance | 7 Improper Type Valves - Use Genuine Parts |
| 2 Weak Valve Springs | 8 Valve Head Too Thin Causing Hot Sections |
| 3 Improper Valve Timing | 9 Fuel Mixture Flow Restricted |
| 4 Late Ignition Timing | 10 Valve Seats too Narrow |
| 5 Excessive Carbon Deposits Around Seat and Valve Head | 11 Overheating |
| 6 Valves Sticking in Guides | |

VALVE STICKING

- | | |
|---|-------------------------------------|
| 1 Incorrect Valve Clearance | 4 Valve Stems Scored or Dirty |
| 2 Insufficient Clearance Between Valve Stem and Guide | 5 Valve Lifters Sticking |
| 3 Valve Springs Weak or Broken | 6 Use of Fuel with High Gum Content |

EXCESSIVE OIL CONSUMPTION

- | | |
|---|--|
| 1 Piston Rings Broken, Worn or Stuck | 6 Crankshaft & Connecting Rod Bearing Worn or Excessive End Play |
| 2 Piston Rings Improperly Fitted | 7 Overheating |
| 3 Piston Ring Slots Clogged with Carbon | 8 Improper Grade & Viscosity of Oil |
| 4 Cylinder Bore Out of Round or Excessive Taper | 9 Excessive Oil Pressure |
| 5 Cylinder Bore Scored or Badly Worn | 10 Oil Level too High |
| | 11 Oil Leaks at Gaskets and Seals |

SERVICE DIAGNOSIS
ENGINE
IGNITION SYSTEM

- | | |
|-------------------------|---------------------------------------|
| 1 Loose connections | 4 Stop wire grounded |
| 2 Pitted breaker points | 5 Ignition coil defective |
| 3 Defective condenser | 6 Incorrect setting of breaker points |

LOW OIL PRESSURE

- | | |
|---|--|
| 1 Improper Grade & Viscosity of Oil | 5 Oil Pump Gear to Housing Clearance Excessive |
| 2 Oil Pressure Relief Valve Stuck | 6 Oil Pump Worn Excessively |
| 3 Oil Pump Screen Clogged | 7 Leak in system |
| 4 Excessive Crankshaft & Connecting Rod Bearing Clearance | |

POPPING, SPITTING & SPARK KNOCK

Pinging or Spark Knock - Caused by Ignition Being Advanced too Far.
Popping or Spitting - Advance or Late Ignition.

- | | |
|---|---|
| 1 Defective Ignition System. | 7 Excessive Carbon Deposits in Combustion Chamber |
| 2 Carburetor Not Properly Adjusted. | 8 Valves Not Seating Properly |
| 3 Valve Clearance Adjusted too Close. | 9 Valve Timing Early |
| 4 Weak Valve Springs | 10 Piston & Rings in Poor Condition |
| 5 Hot Spot in Cylinder Head, Usually Caused by Clogged Water Passages | 11 Inferior Grade of Fuel |
| 6 Exhaust Valve Head too Thin Causing Hot Sections | |

GENERATOR SERVICE DIAGNOSIS

GENERATOR HEATING

May be due to one of the following causes:

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

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

FIELD COIL HEATING

1. Too high an operating speed of the plant, with a resultant high output voltage.
2. A partial short-circuit of one coil.

SERVICE DIAGNOSIS

POOR COMMUTATION

GENERATOR

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

FAILURE OF GENERATOR BUILD-UP

1. The speed of the set may be below normal.
2. A reversed field winding.
3. A reversed shunt field.
4. The brushes incorrectly located, and not on neutral position.
5. An external short circuit on the line would prevent its building up.
6. An open circuit in the shunt field.

NOISE IN BRUSHES

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

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

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

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

Ordinarily the commutator will require only an occasional wiping with a non-linting material, but if blackening appears and grows worse, the cause must be determined and removed.

Use no lubricant on the commutator. The use of any lubricant will only cause sparking and increase the commutation difficulties.

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

INSTRUCTIONS FOR ORDERING PARTS FROM FACTORY

If these instructions are followed when ordering parts, it will greatly speed up the handling of your order, and help us in rendering prompt and efficient service.

When ordering parts BE SURE to specify part for ONAN plant MODEL NO. _____
SERIAL NO. _____ GENERATOR NO. _____.

The Model and Serial Number of the ONAN PLANT will be found on the name plate located on the side of the engine crankcase.

Parts MUST also be ordered by PARTS NUMBER and by DESCRIPTION in full as given in Parts List. DO NOT ORDER PARTS IN SETS. Always give exactly the quantity of each part desired.

If in doubt as to the part or parts needed, and it is possible, send the broken or worn part to us by Parcel Post. Write the name and address plainly on the package so that it can be identified when received. All parts will be held until a letter of advice is received.

Write, stating what the part or parts are that are being returned and the purpose for the return regardless of any previous correspondence. Glue the letter (which must bear a three cent stamp) to outside of the package. DO NOT SEAL PACKAGE.

PLEASE DO NOT ORDER PARTS in a letter in which some other subject is treated.

SEND PARTS ORDER TO D. W. ONAN & SONS, ADDRESSING THE LETTER AS FOLLOWS:

D. W. ONAN & SONS
39-57 ROYALSTON AVE. NORTH
MINNEAPOLIS, MINNESOTA

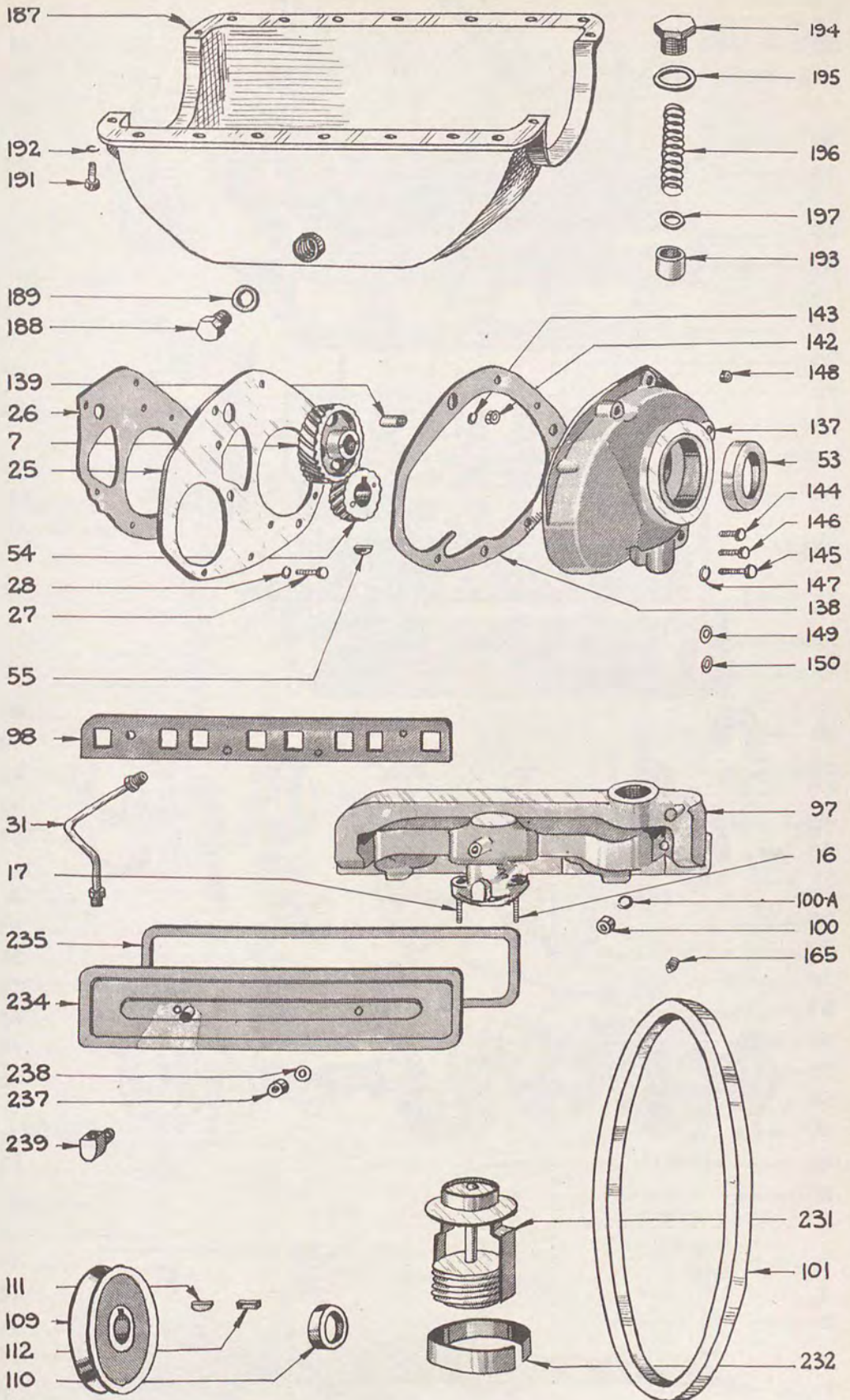
State definite shipping instructions - Express, Freight or Parcel Post, when ordering parts.

All shipments are complete, properly packed and in good order when delivered to the transportation company.

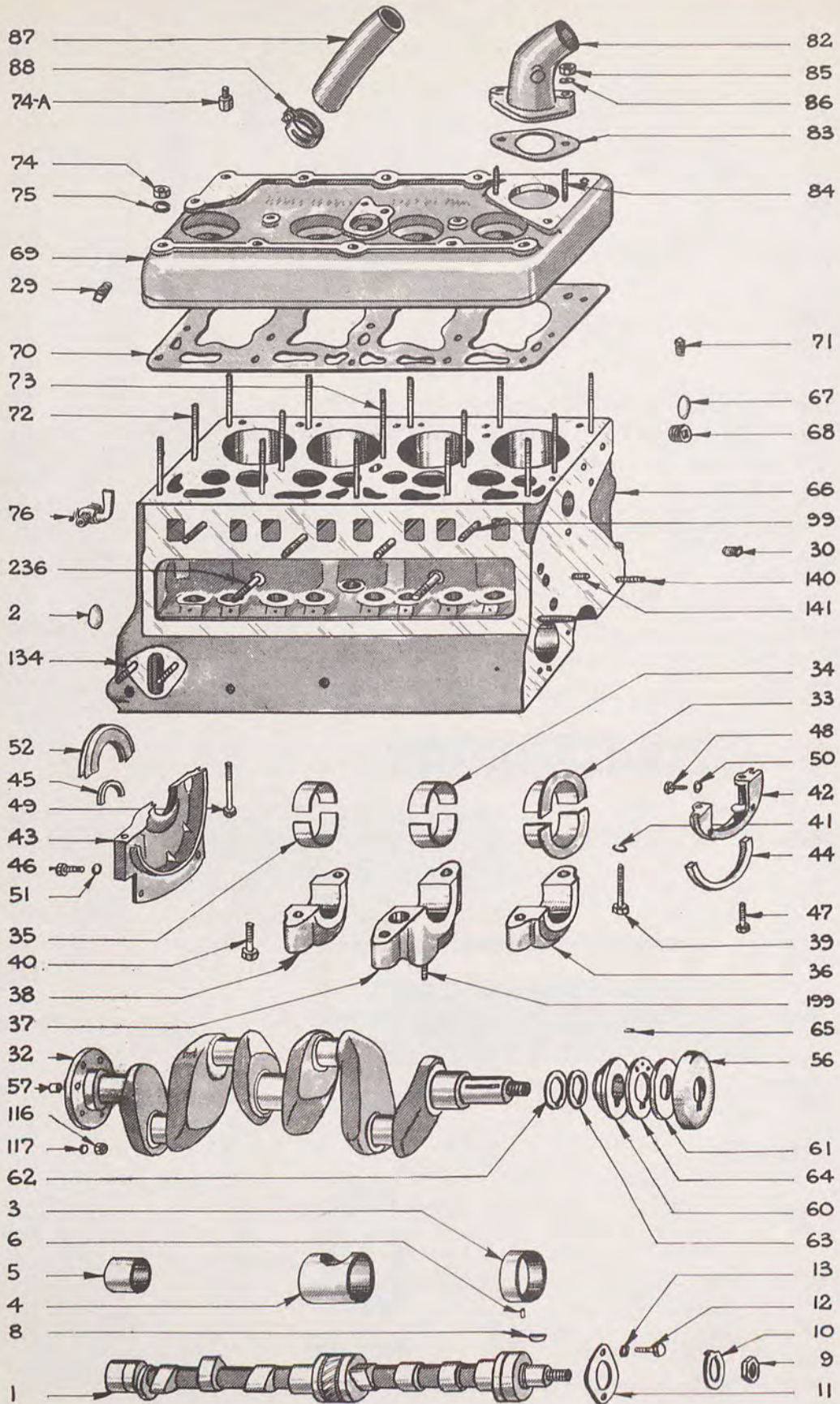
When a damaged shipment is received, claims should be filed immediately against the transportation company from whose hands shipment has been taken. All claims for shortages or errors in packing must be made immediately upon receipt of shipment, and must be accompanied by the original invoice or packing slip with the proper notation of damage or shortage signed by the transportation company at destination.

Parts prices quoted herein are F.O.B. Factory.

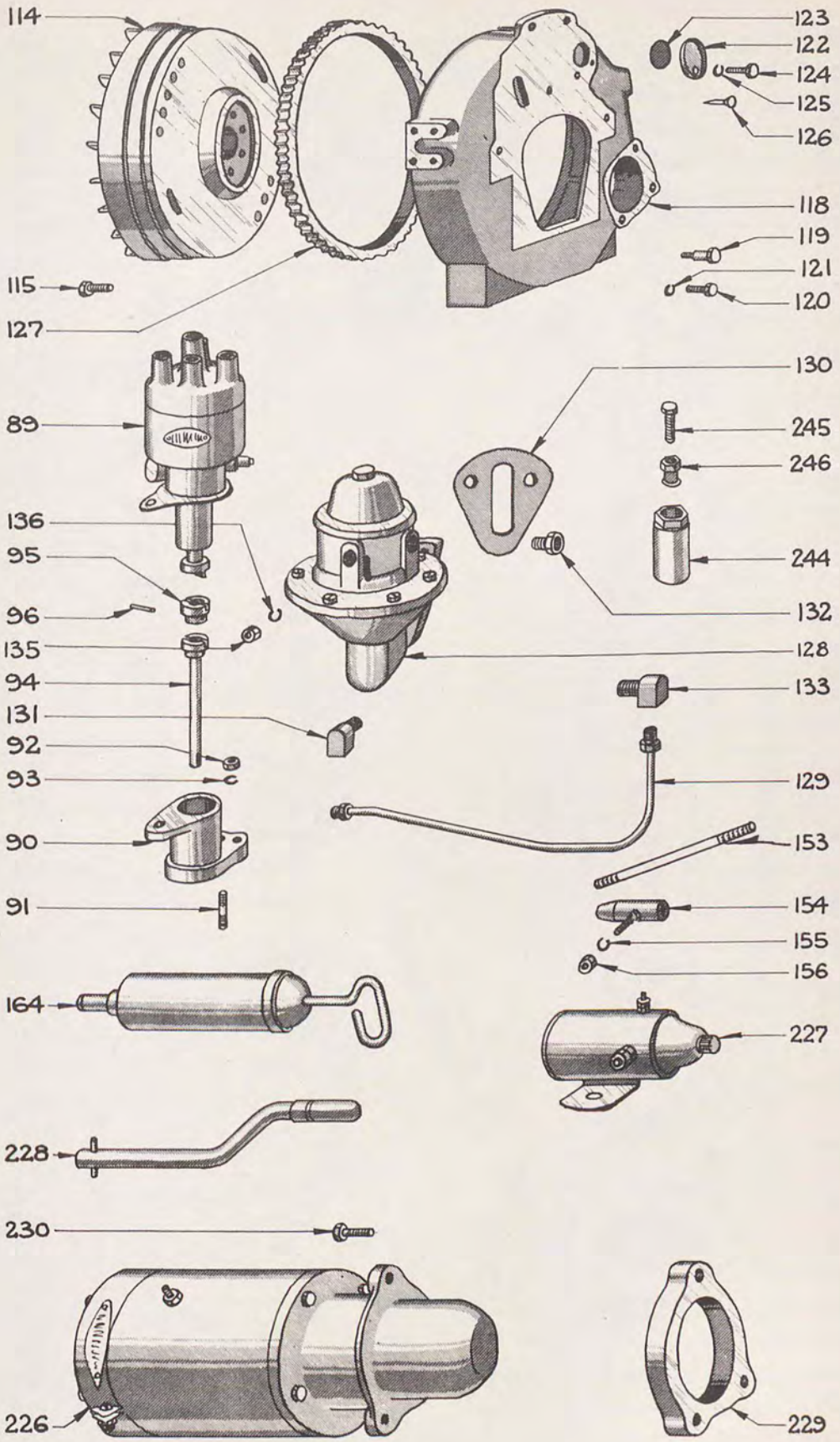
ENGINE PARTS



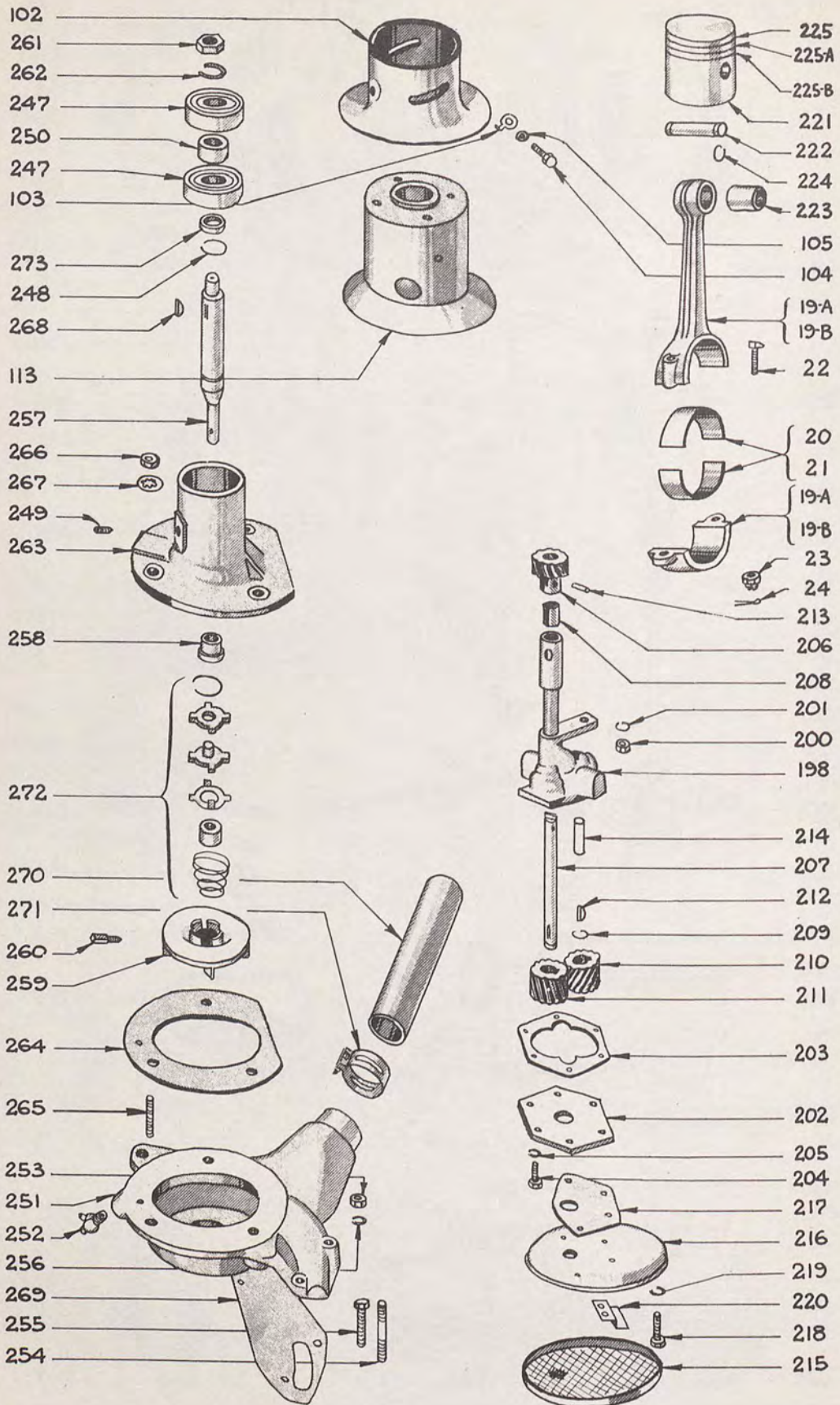
ENGINE PARTS



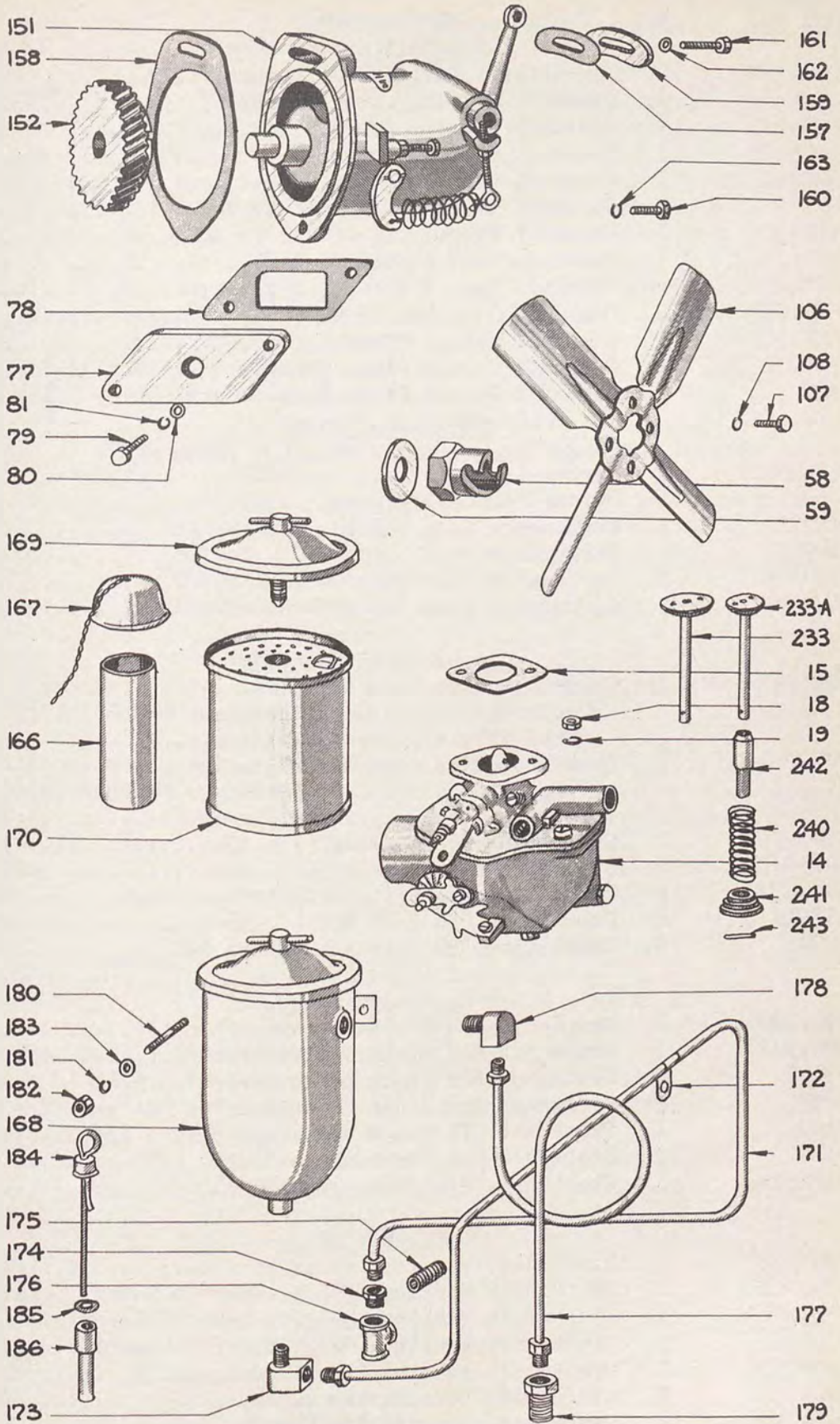
ENGINE PARTS



ENGINE PARTS



ENGINE PARTS



ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Camshaft Group</u>				
1	Y400I-408	1	Camshaft.....	\$ 10.50
2	X-2236	1	Camshaft Bearing Hubbard Plug (Rear) - 1-1/2".....	.01
3	Y400G-227	1	Camshaft Bushing (Front).....	.15
4	Y400G-228	1	Camshaft Bushing (Center).....	.25
5	Y400G-229	1	Camshaft Bushing (Rear).....	.12
6	7RG-119	1	Camshaft Bushing Pin - 5/32" x 1".....	.01
7	Y400H-304	1	Camshaft Gear.....	4.10
8	X-506	1	Camshaft Gear Key.....	.01
9	X-18242	1	Camshaft Gear Nut - 3/4-16.....	.12
10	D600I-258	1	Camshaft Gear Nut Lock.....	.01
11	Y400I-203	1	Camshaft Thrust Plate.....	.52
12	X-3182	2	Camshaft Thrust Plate Screw - 5/16-18 x 3/4".....	.01
13	X-202	2	Camshaft Thrust Plate Screw Lockwasher - 5/16".....	.01
<u>Carburetor Group</u>				
(See Fuel Supply Groups on Pages 41, 46 and 49)				
14	Y91F-258	1	Carburetor.....	13.14
15	NF-104	1	Carburetor Gasket.....	.01
16	X-19974	1	Carburetor Stud - 5/16-18 x 1-5/16".....	.10
17	X-19975	1	Carburetor Stud - 5/16-18 x 1-9/16".....	.10
18	X-1801-E	2	Carburetor Stud Nut - 5/16-18 x 17/64.....	.01
19	X-197-A	2	Carburetor Stud Nut Lockwasher - 5/16".....	.01
<u>Connecting Rod Assembly</u>				
19-A	Y400D-4001	2	Connecting Rod Assembly (Cyl. 1 & 3) Includes Connecting Rod & Cap, Bearings, Pin Bushing, Bolts & Nuts.....	5.25
19-B	Y400D-3001	2	Connecting Rod Assembly (Cyl. 2 & 4) Includes Connecting Rod & Cap, Bearings, Pin Bushing, Bolts & Nuts.....	5.25
20	Y400G-219	2	Connecting Rod Bearing (1 & 3).....	.35
21	Y400G-218	2	Connecting Rod Bearing (2 & 4).....	.35
22	Y400D-200	8	Connecting Rod Bolt.....	.10
23	X-18210	8	Connecting Rod Bolt Nut - 5/16-24.....	.05
24	X-608	8	Connecting Rod Bolt Nut Cotter Pin.....	.01
<u>Crankcase Group</u>				
25	Y69B-4060	1	Crankcase End Plate Assembly (Front).....	9.25
26	Y69B-305	1	Crankcase End Plate Gasket (Front).....	.08
27	X-3182	3	Crankcase End Plate Screw (Front) - 5/16-18 x 3/4".....	.01
28	X-202	3	Crankcase End Plate (Front) Screw Lockwasher - 5/16".....	.01
29	X-100	1	Crankcase Oil Gauge Hole Pipe Plug - 1/8".....	.01
30	X-116	2	Crankcase Oil Header Pipe Plug - 1/4".....	.03
31	Y91F-3270	1	Crankcase Ventilator Tube Assembly.....	.46
<u>Crankshaft Group</u>				
32	Y400G-213	1	Crankshaft.....	25.00
33	Y400G-2121	1	Crankshaft Bearing (Front, Upper & Lower).....	1.84
34	Y400G-2151	1	Crankshaft Bearing (Center, Upper & Lower).....	.90
35	Y400G-2161	1	Crankshaft Bearing (Rear, Upper & Lower).....	.95
36	Y400B-318	1	Crankshaft Bearing Cap (Front).....	.85
37	Y400B-316	1	Crankshaft Bearing Cap (Center).....	1.25
38	Y400B-317	1	Crankshaft Bearing Cap (Rear).....	.80

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Crankshaft Group Cont'd.</u>				
39	X-3544-A	1	Crankshaft Bearing Cap Screw - 1/2-13 x 2".....\$.35
40	X-3544	5	Crankshaft Bearing Cap Screw - 1/2-13 x 2-3/8".....	.09
41	3X-B2B-110	6	Crankshaft Bearing Cap Screw Nut Washer.....	.01
42	D600B-322	1	Crankshaft Bearing Filler Block (Front).....	.85
43	D600B-406	1	Crankshaft Bearing Filler Block (Rear).....	1.60
44	D600B-214	2	Crankshaft Bearing Filler Block Cork (Front).....	.22
45	D600B-217	2	Crankshaft Bearing Filler Block Cork (Rear).....	.02
46	X-3056	2	Crankshaft Bearing Filler Block Screw - 1/4-20 x 5/8" (Rear).....	.01
47	X-3164	2	Crankshaft Bearing Filler Block Screw (Front) - 5/16-18 x 7/8".....	.01
48	X-3159	2	Crankshaft Bearing Filler Block Screw (Front) - 5/16-18 x 1".....	.02
49	6RB-105	2	Crankshaft Bearing Filler Block Screw - 5/16-18 x 2-5/8" (Rear).....	.07
50	X-202-B	6	Crankshaft Bearing Filler Block Screw Lockwasher - 5/16".....	.01
51	X-201	2	Crankshaft Bearing Filler Block Screw Lockwasher - (Rear) - 1/4".....	.01
52	D600B-305	1	Crankshaft Bearing Oil Guard (Rear).....	.25
53	21RM-201	1	Crankshaft Bearing Oil Seal.....	.67
54	Y400H-205	1	Crankshaft Gear.....	2.50
55	X-534	1	Crankshaft Gear Key.....	.05
56	Y400C-215	1	Crankshaft Oil Thrower.....	.07
57	15LG-202	1	Crankshaft Pilot Bushing.....	.15
58	10FO-201	1	Crankshaft Starting Jaw.....	.75
59	X-1377-A	1	Crankshaft Starting Jaw Washer.....	.01
60	Y400C-217	1	Crankshaft Thrust Plate.....	.90
61	Y400C-219	1	Crankshaft Thrust Plate Spacer.....	.38
62	9LC-208	4	Crankshaft Thrust Shim (.002 thick).....	.01
63	9LC-218	3	Crankshaft Thrust Shim (.008 thick).....	.01
64	Y400C-218	1	Crankshaft Thrust Washer.....	.66
65	6TG-101	3	Crankshaft Thrust Washer Pin - 5/32 x 1/2.....	.01
<u>Cylinder Group</u>				
66	Y91A-5001-A	1	Cylinder & Crankcase Assembly - Includes cylinders, valve stem guides, bushings, bearing caps, screws, studs & nuts...	65.31
	Y91A-5001-C	1	Cylinder & Crankcase Assembly - Includes all of "A" assembly parts above plus complete piston & piston rings.....	79.30
	Y91A-5001-I	1	Cylinder & Crankcase Assembly - Includes all of the "C" assembly parts above plus complete valve mechanism.....	91.34
67	X-2207	2	Cylinder Core Hole Hubbard Plug - 1-1/8".....	.01
68	X-112	3	Cylinder Core Hole Pipe - Plug.....	.06
69	Y91A-401	1	Cylinder Head.....	12.14
	Y91A-4011	1	Cylinder Head Assembly - Includes cylinder head, studs & pipe plug.....	13.36
70	Y400A-412	1	Cylinder Head Gasket.....	.96
71	X-101-B	1	Cylinder Head Pipe - Plug.....	.05
72	X-19046	14	Cylinder Head Stud - 3/8-24 x 3-1/2.....	.06
73	X-19195	1	Cylinder Head Stud - 3/8-24 x 4".....	.07
74	3X-X-18231	15	Cylinder Head Stud Nut - 3/8-24.....	.03
74-A	F-162A-214	4	Cylinder Head Stud Spacer Screw.....	.05

ENGINE PARTS ILLUSTRATED

<u>REF.</u> <u>NO.</u>	<u>PART NO.</u>	<u>AMT.</u>	<u>DESCRIPTION</u>	<u>LIST</u> <u>EACH</u>
<u>Cylinder Group Cont'd.</u>				
75	3X-UB-110	9	Cylinder Head Stud Washer.....\$.01
76	X-1005	1	Cylinder Water Drain Cock.....	.31
77	Y400K-238	1	Cylinder Water Inlet Hole Cover.....	.63
78	Y400K-212	1	Cylinder Water Inlet Hole Cover Gasket.....	.01
79	6FK-131	2	Cylinder Water Inlet Hole Cover Screw - 3/8-16 x 7/8".....	.02
80	X-318	2	Cylinder Water Inlet Hole Cover Screw Gasket - 3/8"	.01
81	X-203	2	Cylinder Water Inlet Hole Cover Screw Lockwasher - 3/8".....	.01
82	F600K-335	1	Cylinder Water Outlet Elbow.....	.83
83	C400K-215	1	Cylinder Water Outlet Elbow Gasket.....	.02
84	X-1955	2	Cylinder Water Outlet Elbow Stud - 5/16-18 x 1-5/8".....	.04
85	X-1801-E	2	Cylinder Water Outlet Elbow Stud Nut - 5/16-18.....	.01
86	X-202	2	Cylinder Water Outlet Elbow Stud Nut Lockwasher - 5/16".....	.01
87	P57A-204	1	Cylinder Water Outlet Hose - 1-3/4" x 2-1/8" x 6-3/4"	.27
88	X-2354	2	Cylinder Water Outlet Hose Clamp -04
<u>Distributor Group</u>				
(See Ignition and Distributor Parts Pages 46, 48 and 54)				
89	6027	1	Distributor (Auto-Lite #IGW-4156C).....	8.78
90	Y91M-321	1	Distributor Adapter.....	2.14
91	X-190014-C	1	Distributor Adapter Stud - 3/8-16 x 1-1/2".....	.04
92	X-1802-G	1	Distributor Adapter Stud Nut - 3/8-16.....	.01
93	X-203	1	Distributor Adapter Stud Nut Lockwasher.....	.01
94	Y91M-2110	1	Distributor Drive Shaft Assembly.....	1.14
Includes shaft, coupling & pin				
95	Y91M-211	1	Distributor Drive Shaft Coupling.....	.56
96	X-1735	1	Distributor Drive Shaft Pin.....	.01
<u>Exhaust Manifold Group</u>				
97	Y400E-507	1	Exhaust & Intake Manifold.....	10.33
98	Y400E-302	1	Exhaust Manifold Gasket.....	.08
99	X-4200	4	Exhaust Manifold Stud - 3/8-16 x 1-11/16".....	.05
100	6EE-100	4	Exhaust Manifold Stud Nut - 3/18-16.....	.03
100-A	UB-110	4	Exhaust Manifold Stud Nut Washer.....	.01
<u>Fan Assembly</u>				
101	Y69K-219	1	Fan Belt.....	1.20
102	Y400K-320	1	Fan Belt Adjusting Flange.....	.76
103	8UK-205	2	Fan Belt Adjusting Flange Nut Lock.....	.02
104	JS-108	2	Fan Belt Adjusting Flange Screw - 1/4-20 x 1/2"....	.01
105	X-201	2	Fan Belt Adjusting Flange Screw Lockwasher - 1/4"....	.01
106	Y91K-221	1	Fan Blades.....	3.20
107	X-3182	4	Fan Blade Screw - 5/16-18 x 3/4".....	.01
108	X-202	4	Fan Blade Screw Lockwasher.....	.01
109	Y400K-338	1	Fan Drive Pulley.....	3.37
110	Y400K-219	1	Fan Drive Pulley Dust Seal.....	.13
111	X-534	1	Fan Drive Pulley Key.....	.05
112	C400K-217	1	Fan Drive Pulley Keyway Plug.....	.01
113	Y400K-251	1	Fan Hub.....	4.59

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Flywheel Assembly Group</u>				
114	Y91C-4010	1	Flywheel & Blower Assembly -	\$ 28.49
115	C400C-206	6	Flywheel Bolt.....	.07
116	X-18237	6	Flywheel Bolt Nut.....	.03
117	X-297	6	Flywheel Bolt Nut Lockwasher.....	.01
	Y91B-411	1	Flywheel Housing Assembly - Includes cover, felt, pointer screws & washers.....	
118	Y91B-411	1	Flywheel Housing.....	15.70
119	F600B-200	2	Flywheel Housing Dowel Screw - 7/16-14 x 1-7/16"...	.11
120	X-3429	3	Flywheel Housing Screw - 7/16-14 x 1-1/8".....	.03
121	X-204	5	Flywheel Housing Screw Lockwasher - 7/16".....	.01
122	F400C-206	1	Flywheel Housing Timing Hole Cover.....	.07
123	F400C-208	1	Flywheel Housing Timing Hole Cover Felt.....	.01
124	6AB-107	1	Flywheel Housing Timing Hole Cover Screw - 3/8-16 x 5/8".....	.02
125	X-203	1	Flywheel Housing Timing Hole Cover Screw Lockwasher 3/8".....	.01
126	X-3043-A	1	Flywheel Pointer.....	.02
127	15SC-309	1	Flywheel Ring Gear.....	2.00
<u>Fuel Pump Group</u>				
(See Fuel Supply Groups on Pages 38, 46 and 49)				
128	Y91V-201	1	Fuel Pump.....	6.50
129	Y91F-3280	1	Fuel Pump Carburetor Tube Assembly.....	1.35
130	Y400V-200	1	Fuel Pump Gasket.....	.01
131	X-12251	1	Fuel Pump Inlet Elbow.....	.13
132	X-12252	1	Fuel Pump Outlet Connection.....	.10
133	X-12332	1	Fuel Pump Outlet Street Ell.....	.02
134	X-1952	2	Fuel Pump Stud - 5/16-18 x 1-1/4".....	.04
135	X-1801-E	2	Fuel Pump Stud Nut - 5/16-18.....	.01
136	X-202	2	Fuel Pump Stud Nut Lockwasher - 5/16".....	.01
			Fuel Pump Kit.....	.75
<u>Gear Cover Group</u>				
137	Y91B-410	1	Gear Cover.....	8.44
138	Y69B-309	1	Gear Cover Gasket.....	.10
139	7TC-215	2	Gear Cover Ring Dowel.....	.09
140	X-4266	1	Gear Cover Ring Dowel Stud - 3/8-16 x 2-1/8".....	.05
141	X-4240	1	Gear Cover Ring Dowel Stud - 3/8-16 x 2-7/8".....	.06
142	X-1802-G	2	Gear Cover Ring Dowel Stud Nut - 3/8-16.....	.01
143	X-203	2	Gear Cover Ring Dowel Stud Nut Lockwasher - 3/8"...	.01
144	X-3159	1	Gear Cover Screw - 5/16-18 x 1.....	.02
145	X-3232	3	Gear Cover Screw - 5/16-18 x 1-1/4".....	.02
146	X-3181	2	Gear Cover Screw - 5/16-18 x 2".....	.04
147	X-202	3	Gear Cover Screw Lockwasher - 5/16".....	.01
148	X-1801-E	1	Gear Cover Screw Nut - 5/16-18.....	.01
149	6AA-136	1	Gear Cover Screw Nut Washer - 11/32" x 1/2" x 1-32	.01
150	X-1454	1	Gear Cover Screw Nut Washer - 21/64" x 5/8" x 1/32"	.01

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Governor Group</u>				
151	Y91S-4000	1	Governor Assembly.....	\$ 22.65
152	Y91H-301	1	Governor Accessory Drive Gear.....	4.38
153	6020	1	Governor Link.....	.15
154	X-12218	1	Governor Control Rod Ball Joint - 1/4".....	.55
155	X-201	1	Governor Control Rod Ball Joint Lockwasher - 1/4".....	.01
156	X-18137	2	Governor Control Rod Ball Joint Nut - 1/4-28x7/32".....	.02
157	Y91S-215	1	Governor Flange Gasket.....	.01
158	F400S-200	1	Governor Gasket.....	.02
159	Y91S-214	1	Governor Gasket Plate.....	.03
160	X-3252	1	Governor Screw - 3/8-16 x 1-3/8".....	.02
161	X-3261	1	Governor Screw - 3/8-16 x 1-3/4".....	.03
162	X-318	1	Governor Screw Gasket.....	.01
163	X-203	1	Governor Screw Lockwasher - 3/8".....	.01
<u>Intake Manifold</u>				
165	X-100	1	Intake Manifold Pipe - Plug - 1/8".....	.01
98	Y-400E-302		Intake Manifold Gasket.....	.08
<u>Oil Filler Group</u>				
166	Y91L-3170	1	Oil Filler Tube Assembly.....	1.43
167	Y400L-2620	1	Oil Filler Tube Cover Assembly.....	.52
<u>Oil Filter Group</u>				
(See Oil Supply Groups on Page 46)				
168	Y91L-400	1	Oil Filter.....	3.51
169	Y91L-2130	1	Oil Filter Cover Assembly.....	1.50
170	Y91L-315	1	Oil Filter Element.....	.75
171	Y112L-3020	1	Oil Filter Inlet Tube Assembly.....	.97
172	16CL-210	2	Oil Filter Inlet Tube Clip.....	.21
173	22AL-201	1	Oil Filter Inlet Tube Elbow.....	.11
174	C400F-210	1	Oil Filter Inlet Tube Fitting.....	.16
175	M4L-200	1	Oil Filter Inlet Tube Nipple.....	.07
176	X-12170	1	Oil Filter Inlet Tube Tee.....	.20
177	Y91L-2140	1	Oil Filter Outlet Tube Assembly.....	1.00
178	22AL-201	1	Oil Filter Outlet Tube Elbow.....	.16
179	C400F-210	1	Oil Filter Outlet Tube Fitting.....	.16
180	X-4125	2	Oil Filter Stud - 5/16-17 x 31/32".....	.04
181	X-202	2	Oil Filter Stud Lockwasher - 5/16".....	.01
182	X-1801-E	2	Oil Filter Stud Nut - 5/16-18 x 17/64".....	.01
183	B2K-134	2	Oil Filter Stud Washer.....	.01
<u>Oil Gauge Group</u>				
184	Y400L-2540	1	Oil Gauge Assembly - Includes rod, cover & felt...	.48
185	K404L-210	1	Oil Gauge Rod Cover Felt.....	.01
186	Y400L-253	1	Oil Gauge Rod Support.....	.16
<u>Oil Pan Group</u>				
187	Y400B-4200	1	Oil Pan Assembly - Includes pan, reinforcement, baffle, drain plug, base & gasket.....	3.75
188	W4B-109	1	Oil Pan Drain Plug.....	.08
189	W4B-108	1	Oil Pan Drain Plug Gasket.....	.01
190	Y400B-320	1	Oil Pan Gasket.....	.10
191	X-3182	1	Oil Pan Screw - 5/16-18 x 3/4".....	.01
192	X-202	1	Oil Pan Screw Lockwasher - 5/16".....	.01

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Oil Pressure Relief Valve Group</u>				
193	15SL-211	1	Oil Pressure Relief Valve.....\$.10
194	41AL-200	1	Oil Pressure Relief Valve Plug.....	.08
195	X-365	1	Oil Pressure Relief Valve Plug Gasket.....	.01
196	10EL-230	1	Oil Pressure Relief Valve Spring.....	.02
197	W5L-213	UAR	Oil Pressure Relief Valve Spring Washer.....	.01
<u>Oil Pump Assembly</u>				
	Y400L-4036	1	Oil Pump Assembly..... Includes Oil pump body, gears, strainer, frame, screen, cover, shaft, idler stud, suction tube, screws and nuts.	10.40
198	Y400L-403	1	Oil Pump Body.....	3.30
199	X-19003	1	Oil Pump Body Stud - 3/8-16 x 1-3/8".....	.01
200	X-1802-G	1	Oil Pump Body Stud Nut - 3/8-16.....	.01
201	X-203	1	Oil Pump Body Stud Nut Lockwasher - 3/8".....	.01
202	17EL-2001	1	Oil Pump Cover Assembly.....	.70
203	C400L-231	1	Oil Pump Cover Gasket.....	.01
204	X-3056	2	Oil Pump Cover Screw - 1/4-20 x 5/8".....	.01
205	X-201	2	Oil Pump Cover Screw Lockwasher - 1/4".....	.01
206	D600H-220	1	Oil Pump Drive Gear (Driven).....	1.50
207	Y400L-245	1	Oil Pump Drive Shaft.....	1.00
208	Y400G-208	1	Oil Pump Drive Shaft Bushing.....	.30
209	D600L-204	1	Oil Pump Drive Shaft Snap Ring.....	.01
210	C400H-213	1	Oil Pump Gear (Driven).....	1.30
211	Y400H-209	1	Oil Pump Gear (Driver).....	1.30
212	X-584	1	Oil Pump Gear Key (Driver).....	.01
213	6UH-101	1	Oil Pump Gear Pin (Driven).....	.01
214	21UL-210	1	Oil Pump Idler Gear Stud.....	.10
215	D600L-2120	1	Oil Pump Oil Strainer Assembly.....	.10
216	17EL-300	1	Oil Pump Oil Strainer Frame.....	.10
217	17EL-204	1	Oil Pump Oil Strainer Frame Gasket.....	.01
218	X-3056	4	Oil Pump Oil Strainer Frame Screw - 1/4-20 x 5/8".....	.01
219	X-201	4	Oil Pump Oil Strainer Frame Screw Lockwasher - 1/4".....	.01
220	C400L-229	1	Oil Pump Oil Strainer Spacer.....	.01
<u>Piston Assembly</u>				
	Y400A-3181-A	4	Piston Assembly - Includes piston pin, retaining ring & complete piston rings.....	3.60
	Y400A-3181-E	4	Piston Assembly - Includes piston, pin & retaining ring.....	3.20
	Y400A-3181-ESF	4	Piston Assembly (Semi-Fin.) Includes piston (semi-fin.), pin & retaining ring.....	2.90
221	Y400A-318	4	Piston.....	2.60
	Y400A-318-SF	4	Piston (Semi-Fin.).....	2.30
222	Y400A-207	4	Piston Pin.....	.30
223	PYG-203	4	Piston Pin Bushing.....	.20
224	PYA-202	8	Piston Pin Retaining Ring.....	.01
225	Y400A-310	4	Piston Ring (Top Groove).....	.10
225-A	Y91A-301	4	Piston Ring (2nd Groove).....	.20
225-B	Y91A-305	4	Piston Ring (Bottom Groove).....	.20

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
<u>Starting Group</u>				
226	Y91M-322	1	Starter.....	\$ 23.40
227	75635	1	Starter Switch Solenoid.....	2.75
228	5533	1	Starting Crank.....	1.25
229	Y91M-245	1	Starting Motor Spacer.....	3.54
230	X-3119	3	Starting Motor Spacer Screw - 3/8-16 x 2-1/8".....	.05
<u>Valve Group</u>				
233	Y400I-301	4	Valve (Intake).....	.50
233-A	Y400I-210	4	Valve (Exhaust).....	.80
234	Y400A-3170	1	Valve Chamber Cover Assembly.....	2.87
235	PYA-305	1	Valve Chamber Cover Gasket.....	.05
236	X-4015	2	Valve Chamber Cover Stud - 1/4-20 x 2-1/4".....	.04
237	X-1800-C	2	Valve Chamber Cover Stud Nut - 1/4-20.....	.01
238	X-366	2	Valve Chamber Cover Stud Nut Gasket.....	.01
239	22AL-201	2	Valve Chamber Cover Vent Tube Elbow.....	.08
240	Y400I-215	8	Valve Spring.....	.24
241	Y400I-204	8	Valve Spring Seat.....	.08
242	Y400I-209	8	Valve Stem Guide.....	.23
243	Y400I-205	8	Valve Stem Key.....	.01
	Y400I-2110	8	Valve Tappet Assembly.....	.75
			Includes valve, tappet, screw & nut	
244	Y400I-211	8	Valve Tappet.....	.55
245	Y400I-213	8	Valve Tappet Adjusting Screw.....	.05
246	Y400I-212	8	Valve Tappet Adjusting Screw Locknut.....	.04
	T-2	1	Valve Tappet Wrench - 37/64".....	.88
	T-5	1	Valve Tappet Wrench - 49/64".....	1.13
	T-7	1	Valve Tappet Wrench - 57/64".....	.99
<u>Cooling System</u>				
231	F218K-304	1	Thermostat.....	1.05
232	F600K-203	1	Thermostat Adapter Ring.....	.09
	Y400K-4072	1	Water Pump Assembly	
			Includes body, support, shaft, bushing, impeller, seal, fan hub, screw, studs & nuts...	16.50
247	X-13073	2	Water Pump Ball Bearing.....	1.40
248	F600K-272	1	Water Pump Ball Bearing Retaining Ring.....	.01
249	Y400K-235	1	Water Pump Bearing Retaining Screw.....	.04
250	Y400K-236	1	Water Pump Bearing Spacer.....	.07
251	Y400K-407	1	Water Pump Body.....	8.37
252	X-940	1	Water Pump Body (Grease) Fitting.....	.17
253	X-1802-G	3	Water Pump Body Stud Nut - 3/8-16.....	.01
254	X-19006	2	Water Pump Body Stud - 3/8-16 x 1-3/4".....	.04
255	X-3276	1	Water Pump Body Screw - 3/8-16 x 2-1/2".....	.06
256	X-203	3	Water Pump Body Screw Lockwasher - 3/8".....	.01
257	Y400K-237	1	Water Pump Drive Shaft.....	1.99
258	D600G-283	1	Water Pump Drive Shaft Bushing.....	.46
259	Y400K-332	1	Water Pump Drive Shaft Impeller.....	1.70
260	X-3054-C	1	Water Pump Drive Shaft Impeller Screw - 1/4-20.....	.10
261	X18053-B	1	Water Pump Drive Shaft Nut - 7/16-20.....	.03
262	X-270	1	Water Pump Drive Shaft Nut Lockwasher - 7/16".....	.01
263	Y400K-3351	1	Water Pump Drive Shaft Support Assembly.....	3.28
264	Y400K-234	1	Water Pump Drive Shaft Support Gasket.....	.03

ENGINE PARTS ILLUSTRATED

REF. NO.	PART NO.	AMT.	DESCRIPTION	LIST EACH
			<u>Cooling System Cont'd.</u>	
265	X-19098	3	Water Pump Drive Shaft Support Stud - 3/8-16 x 1..\$.08
266	X-18158	3	Water Pump Drive Shaft Support Stud Nut - 3/8-16..	.03
267	X-297	3	Water Pump Drive Shaft Support Stud Nut Lockwasher - 3/8".....	.01
268	X-504	1	Water Pump Drive Shaft Woodruff Key, #5.....	.01
269	Y400K-340	1	Water Pump Gasket.....	.04
270	Y112K-210	1	Water Pump Hose.....	1.25
271	X-2359	2	Water Pump Hose Clamp - 1-7/8".....	.05
272	Y400K-3330	1	Water Pump Seal Assembly.....	.84
273	F600K-273	1	Water Pump Snap Ring Retainer.....	.05

ENGINE PARTS
(Not Illustrated)

PART NO.	DESCRIPTION	LIST EACH
<u>FUEL SUPPLY GROUP</u>		
(See Fuel Supply Groups on Pages 38, 41 and 49)		
5729	Gas Tank Cap.....	\$.35
8157	Drain Cock Screen.....	.75
	Street Elbow for Gas Line - 1/4".....	.15
19467	Fuel Line - 18-1/2".....	1.25
W-735	Gas Tank Shut-Off Valve.....	.75
12251	Fuel Pump Inlet Elbow - 450x4.....	.15
Y-12332	Fuel Pump Outlet Street Elbow.....	.05
NF-104	Carburetor Gasket.....	.05
	Filter Bowl Gasket.....	.05
	Fuel Pump Kit.....	.75
<u>AIR CLEANER GROUP</u>		
6040	Hose Clamps.- 1-3/4".....	.15
6019	Air Cleaner Through Bolt.....	.70
6014 Air	Air Cleaner Adaptor Tube Assembly.....	8.20
6016	Air Cleaner Adaptor Mounting Bracket.....	.45
6015	Air Cleaner Bracket Clamp.....	.45
	Pipe Coupling - 1-1/4".....	.35
X-2359	Air Cleaner Hose Clamp - 1-5/8" I.D..... (2 used)	.10
PY-91339	Air Cleaner Brace.....	1.00
6039	Air Cleaner to Adaptor Hose - 1-1/2" I.D. x 2".....	.20
6021	Air Cleaner Assembly.....	5.80
<u>OIL SYSTEM GROUP</u>		
(See Oil Supply Groups on Page 42)		
W400X4	Inverted Male Elbow - Oil Pressure Gauge Line.....	.25
6029	Oil Line Clamp - Tinnerman #3.....	.10
	Oil Drain Pipe Bushing - 1/2".....	.10
76834	Oil Line to Pressure Gauge - #10902.....	1.55
	Oil Line Pipe Coupling - 1/2".....	.10
78234	Oil Line Fitting - 3/4" to 1/2" - Brass.....	.75
	Oil Line Clamp - Tinnerman #3.....	.10
	Oil Line Pipe Nipple - 1/2" x 5-1/2".....	.20
	Oil Drain Pipe Plug - 1/2".....	.10
	Oil Drain Adaptor Gasket.....	.05
X5147	Oil Filter Inlet Tube Fitting.....	.20
<u>DISTRIBUTOR PARTS GROUP</u>		
(See Ignition and Distributor Parts Pages 40, 48 and 54)		
6027	Distributor Assembly Complete.....	9.50
CB-140	Insulating Bushing.....	.05
IB-23	Breaker Point Lock Nut.....	.05
IG-90	Thrust Washer.....	.05
IG-94	H.T. Wire Terminal..... (5 used)	.05
IG-495	Cam Sleeve Felt Wick.....	.05
IG-644	Distributor Drive Coupling.....	.65
IG-816C	Thrust Washer.....	.05
IG-2860A-3	Advance Control Arm Assembly.....	.25
IGB-21	Terminal Post Insulation.....	.05
IGB-22	Insulating Washer.....	.05
IGB-264	Rubber Plug.....	.05
IGB-1007	Distributor Cap Spring & Hinge Assembly.....	.05

ENGINE PARTS
(Not Illustrated)

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>LIST EACH</u>
<u>DISTRIBUTOR GROUP CONT'D.</u>		
IGB-1010	Breaker Plate Part Assembly.....\$.20
18907	Condenser Assembly.....	.70
6023	Rotor.....	.35
IGB-1241	Distributor Cap Assembly.....	.95
IGB-2176	Distributor Base Assembly.....	1.85
IG-579A	Absorbent Bronze Bearing.....(2 used)	.20
X-490	Press In - Sleeve Oiler.....	.10
6024	Breaker Screw Point.....	.30
IGS-104	Thrust Washer.....	.05
IGW-38	Insulating Bushing.....	.05
IGW-39	Terminal Post - #10-32.....	.05
IGW-54	Washer.....	.05
IGW-3028*	Breaker Arm Assembly.....	.60
IGW-3048LQ	Drive Shaft & Governor Assembly.....	3.00
IGB-301S	Weight Spring Set.....	.20
IGW-37	Lock Spring Ring.....	.05
IGW-92	Washer.....	.05
IGW-1014LB	Weight Assembly.....(2 used)	.25
IGW-2048LD	Drive Shaft Assembly.....	3.00
IGW-2100LAA	Cam & Stop Plate - 4 Cylinder L.H.....	1.40
SW-213	Distributor Drive Rivet.....	.05
8X-59	#8-32 x 3/16 Rd. Hd. Screw.....	.05
8X-173	#10-32 Hex Nut.....(2 used)	.05
8X-183A	#10 Plain Washer.....	.05
X-195	#8 Lock Washer.....(3 used)	.05
X-196	#10 Lock Washer.....(2 used)	.05
8X-304	#8-32 x 5/16" Rd. Hd. Screw.....(3 used)	.05
X-1270	#10 Shakeproof Washer.....	.05
X-1276	#8 Shakeproof Washer.....	.05
	*Service Contact Set IGW-3028S.....	.90

MISCELLANEOUS PARTS
(Not Illustrated)

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
74263	Switch, High Water Temperature Cut-Out.....\$	9.50
6851	Tube, Suppressor Shield.....	.10
6287	Wire, #16 Shielded - Cut-Out Switch to Stop Button.....	.85
79402	Battery, Storage - 12 V. - less electrolyte.....	14.00
79421	Electrolyte, Battery - 1 gal. (2 required for #79402 Batty.)Net	2.00

ENGINE PARTS
(Not Illustrated)

(See Ignition and Distributor Parts Pages 40, 46 and 54)

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>LIST EACH</u>
<u>IGNITION GROUP</u>		
5141	Distributor Shield Nipple.....(6 used)‡	.30
5944	Distributor Shield Coupling Nut.....(9 used)	.25
6010	Distributor Shield Collar.....	.85
6011	Distributor Shield.....	3.00
6025	Distributor Stationary Arm - IGW3028 Autolite.....	2.15
6031	High Tension Cable - 16" to Coil Box.....	.65
6032	High Tension Cable - 16-1/2" #4 Plug.....	.65
6033	High Tension Cable - 16" - #1, 2 & 3 Plug.....	.65
6803	Bonding Strap - 10" Center to Center.....	.30
6804	Bonding Strap - 9" Center to Center.....	.35
6805	Bonding Strap - 14" Center to Center.....	.40
6807	Battery Cable - Negative to Ground - 16".....	.65
6808	Battery Cable - Positive to Solenoid - 12".....	.50
6809	Start Relay to Solenoid Lead - #16 Motor Lead Wire 50" Red.....	.50
6810	Ignition Relay to Coil Lead - #16 Motor Lead Wire 40" Green.....	.50
6811	Distributor to Coil Lead-7 mm. Wire - 16" Shielded.....	.50
6812	Spark Plug - Champion J8.....	.65
8927	Battery - 12 Volt - 129C.....	14.20
19853-A	Spark Plug Shield Assembly.....(4 used)	.75

MUFFLER GROUP

6036	Flexible Exhaust Tubing - 1-5/8" x 36".....	1.50
6220	Muffler Support Bracket.....	.85
6960	Muffler -.....	4.50
	Reducer Bushing - 1-1/2" to 1".....	.20
	Reducer Elbow - 1-1/2" to 1-1/4".....	.60
	Close Nipple - 1".....	.15
	Pipe Nipple - 1-1/2" x 2-1/2".....	.25
	Pipe Nipple - 1-1/4" x 2-1/2".....	.20
	Pipe Nipple - 1" x 1-1/2".....	.15
	Pipe Coupling - 1-1/4".....	.20

RADIATOR GROUP

6012	Radiator - #2366.....‡	35.00
6019	Radiator Cap.....	.35
6219	Radiator to Support Gasket - 2-1/4" x 5/16" leather.....(2 used)	.05
W-145	Radiator Drain Cock.....	.40
	Radiator Drain Pipe Nipple - 1/4" x 2".....	.10
	Radiator Tank Cap Chain and Spring Assembly.....	.15
	Radiator Cap Washer.....	.10
	Radiator Drain Coupling - 1/4".....	.10
	Street Elbow - 1/4" - Block Drain.....	.15
W-145	Radiator Drain Cock - Block.....	.40

MISCELLANEOUS PARTS

6020	Governor Linkage.....	1.25
164-T-38	Grease Gun.....	.75
W400x4	Inverted Male Elbow - 400x4 Weatherhead.....	.25
W50x4	Inverted Male Elbow - 450x4 Weatherhead.....	.40

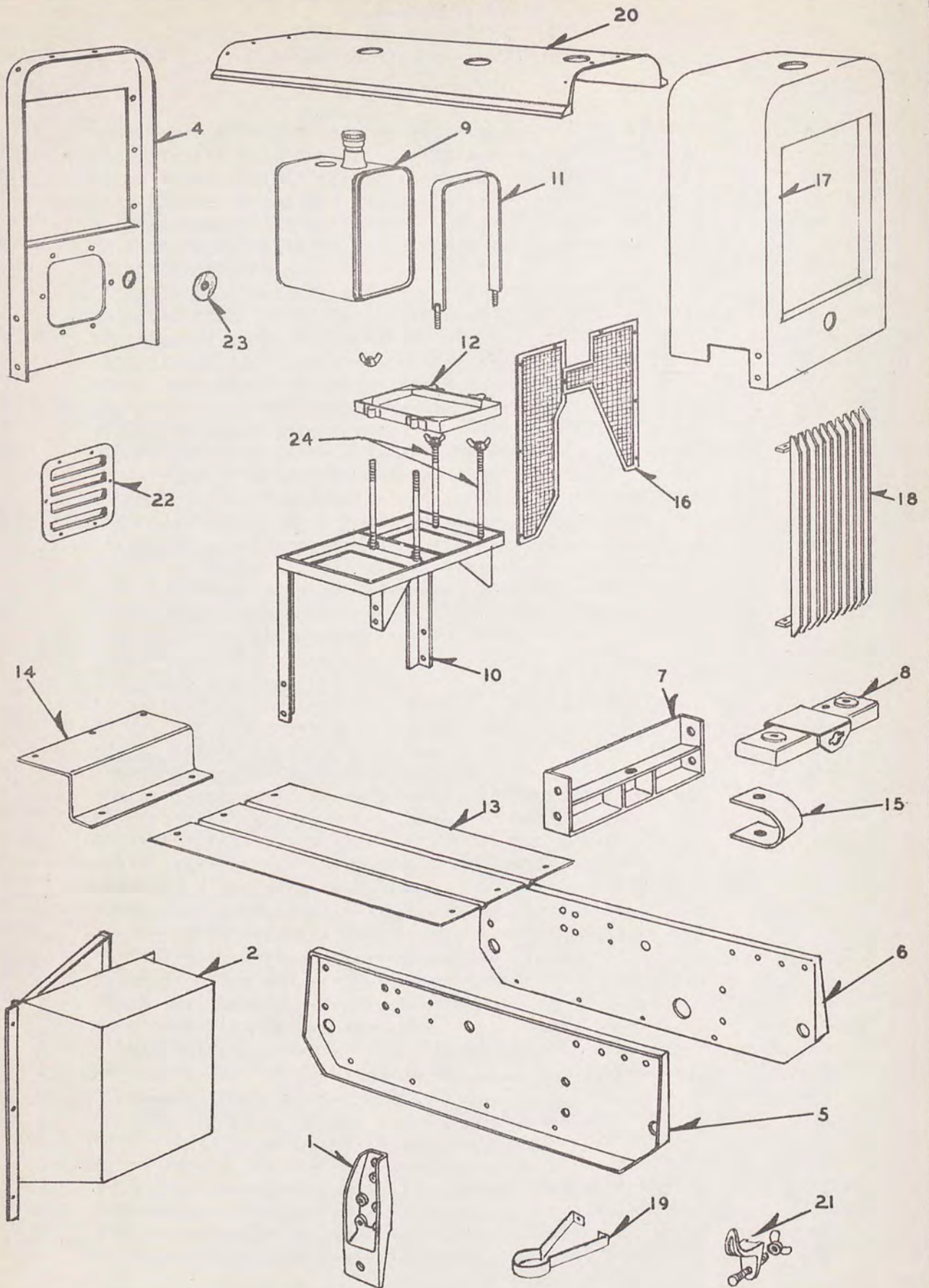
CARBURETOR PARTS
(Not Illustrated)

(See Fuel Supply Groups on Pages 38, 41 and 46)

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>LIST EACH</u>
B2-140C-4	Throttle Body.....	\$ 4.00
CT57-4	Packing Washer.....	.05
C131-4x2	Packing Washer.....	.05
CR38-8	Float Hinge Bracket.....	.10
T73-9	Bracket Drive Screw.....(3 used)	.05
CRL21-26	Throttle Stop Pin.....	.05
CR28-300x2 *	Throttle Stop Lever.....	.60
T1S8-12	Throttle Stop Screw.....	.05
CT63-9 *	Stop Lever Taper Pin.....	.05
C24-10x2	Throttle Lever (F drill on 5/8" CC).....	1.20
T8S10-9	Lever Clamp Screw.....	.05
C23-331 *	Throttle Shaft.....	.60
C21-88	Throttle Plate.....	.70
T15B5-3	Throttle Plate Screw.....(2 used)	.05
T41-5	Place Screw Lockwasher.....(2 used)	.05
C46-25	Idle Adjusting Screw.....	.30
C111-9	Adjusting Screw Spring.....	.10
CT91-1	Fuel Inlet Pipe Plug.....	.10
C85-28	Float.....	1.00
C120-4	Float Axle.....	.10
C142-16	Bowl to Body Gasket.....	.10
T1S10-10	Body Assembly Screw.....(4 used)	.05
T41-10	Assembly Screw Lockwasher.....	.05
B3-85A	Fuel Bowl.....	5.00
C101-17	Air Shutter.....	.50
C106-2	Air Shutter Lever.....	.35
CRL34-1	Lever Swivel.....	.20
CT52-1	Swivel Washer.....	.05
T1S8-6	Swivel Screw.....	.05
C109-2	Air Shutter Bracket.....	.35
C110-1	Wire Clamp.....	.05
T1S8-10	Wire Clamp Screw.....	.05
T21S8	Clamp Screw Nut.....	.05
T15B5-3	Air Shutter Screw.....(2 used)	.05
T41-5	Air Shutter Screw Lockwasher.....(2 used)	.05
C105-60	Air Shutter Shaft.....	.85
T22S8	Air Shutter Shaft Nut.....	.05
T45-8	Air Shutter Shaft Nut Lockwasher.....	.05
C140-2	Bracket Assembly Screw.....	.05
C138-24	Shaft Hole Plug.....	.35
T56-23	Shunt Hole Plug Fibre Washer.....	.05
CT91-3	Bowl Drain Plug.....	.10
T56-23	Lower Plug Fibre Washer.....	.05
C38-51-16	Venturi.....	1.10
C52-6-22	Main Jet.....	.75
T56-24	Main Jet Fibre Washer.....	.05
C55-6-14	Idling Jet.....	.50
C66-46-45	Main Discharge Jet.....	.60
T56-52	Discharge Jet Fibre Washer.....	.05
C29-478	Parts marked (*) are part of Throttle Shaft & Lever Assembly.....	1.40

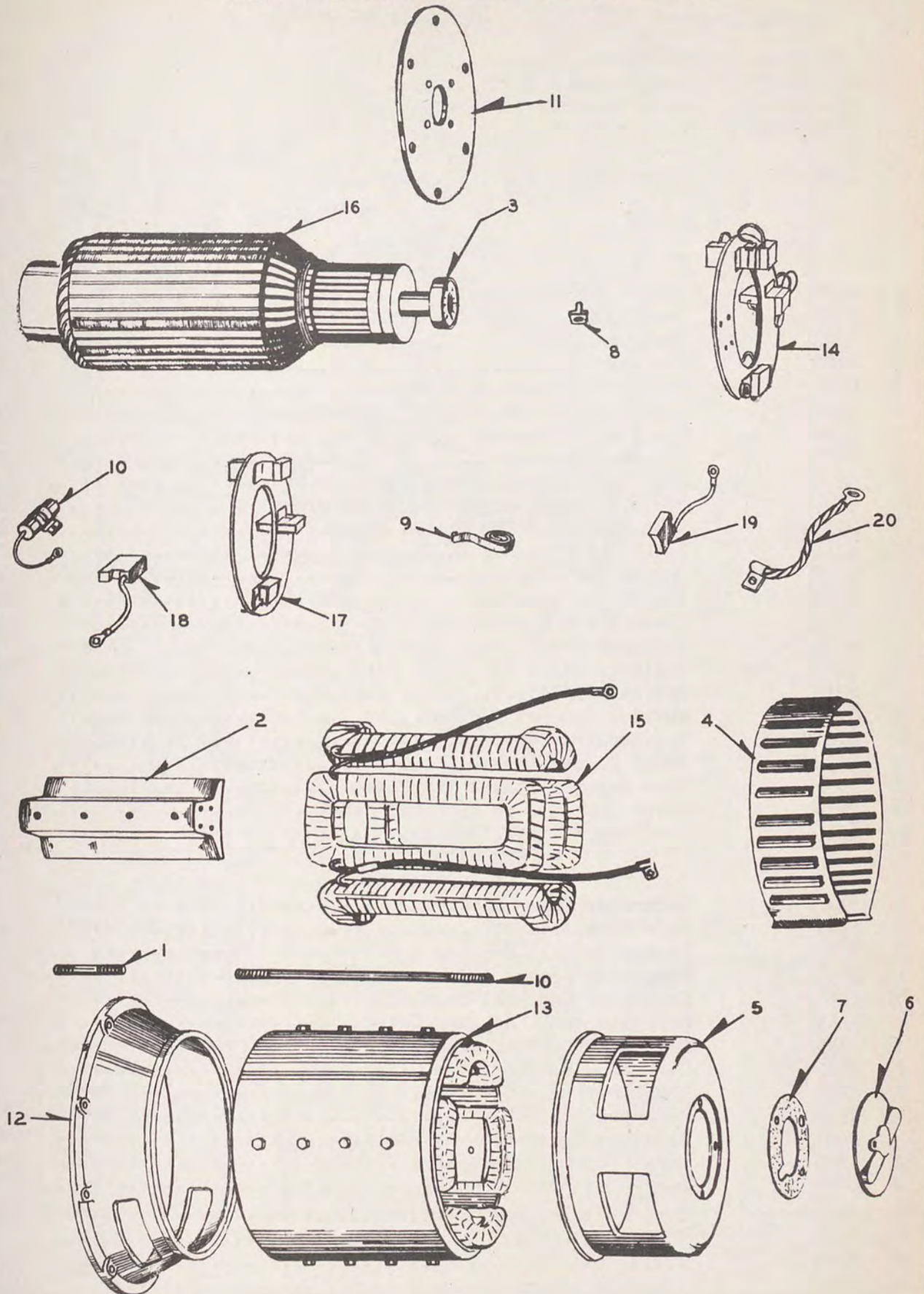
Continued on Page 51

HOUSING



GENERATOR

IN ORDER TO AVOID ERRORS WHEN ORDERING PARTS ALWAYS SPECIFY MODEL NUMBER AND SERIAL NUMBER OF YOUR PLANT



CARBURETOR PARTS
(Not Illustrated)

REF. NO.	PART NO.	DESCRIPTION	LIST EACH
	C77-18-27	Well Vent.....	\$.25
	C81-17-25	Fuel Valve & Seat.....	.75
	T56-20	Fuel Valve Seat Fibre Washer.....	.05
	Y400H-205	Crankshaft Gear.....	2.50
	X-534	Crankshaft Gear Key.....	.05
	CL38-23	Lower Plug.....	.35

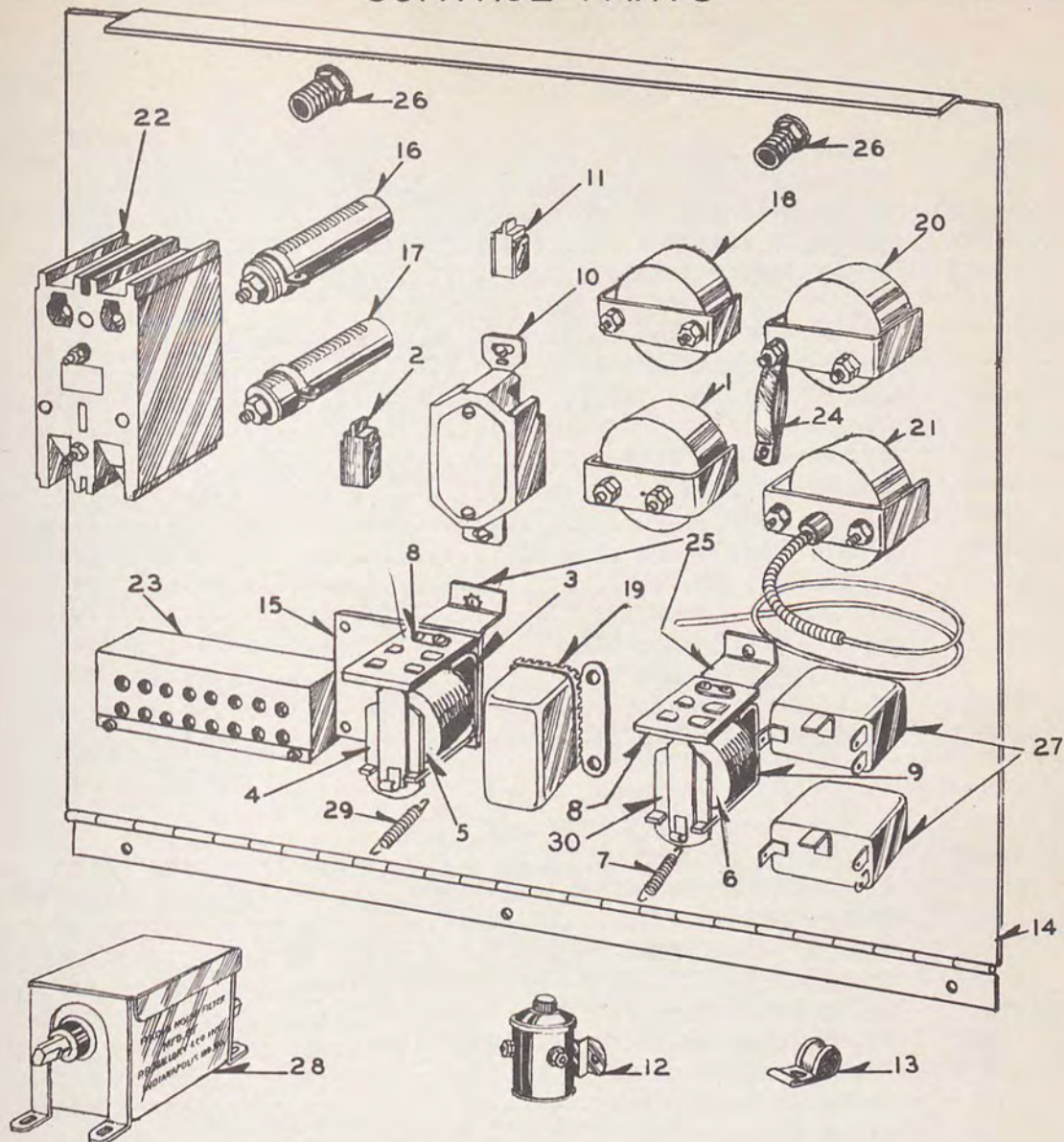
HOUSING GROUP
(Illustrated)

1	6200	Rear Motor Mounting.....	1.45
2	6201	Instrument Panel Frame and Door.....	23.50
3	6202	Instrument Panel.....	7.50
4	6203	Rear End Panel.....	15.00
5	6204	Side Panel - R.H.....	17.50
6	6205	Side Panel - L.H.....	17.50
7	6206	Front Motor Support	5.50
8	6207	Radiator Support.....	5.50
9	6208	Fuel Tank - 6 Gallons.....	15.00
10	6209	Fuel Tank and Battery Mounting Frame.....	9.50
11	6210	Fuel Tank Mounting Strap.....	1.00
12	6211	Battery Top Frame.....	2.25
13	6212	Bottom Dust Pan.....	7.50
14	6213	Rear Dust Pan.....	4.50
15	6215	Front Motor Mounting Spring.....	1.50
16	6216	Radiator Fan Guard.....	6.50
17	6217	Radiator Shell and Front Panel.....	30.00
18	6218	Radiator Grille.....	6.00
19	6220	Muffler Support Bracket.....	.85
20	6221	Top Housing Panel.....	15.00
21	75727A	Crank Holder Assembly.....	.65
22	78043	Rear Bearing Inspection Plate.....	.40
23	78104	Cover for hole in Rear End Panel.....	.05
24	6214	Stud for battery rack.....	.35

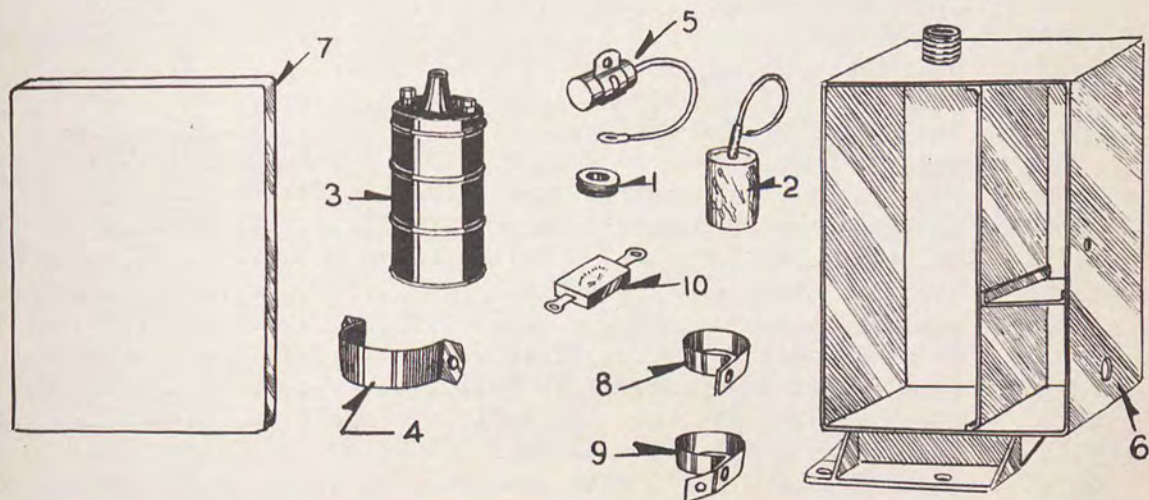
GENERATOR GROUP
(Illustrated)

1	5102	Generator Frame Stud.....(4 used)	.35
2	5105	Pole Shoe.....(4 used)	4.50
3	5055	Generator Ball Bearing - Hoover.....	5.35
4	5151	Generator Frame Bell Housing Band.....	.65
5	5154	Generator End Bell Housing.....	6.50
6	5155	Generator Bell Housing Cover.....	1.25
7	5156	Bell Housing Bearing Cover Gasket - Armstrong.....	.20
8	5160	Generator Bearing Stop Clip.....	.15
9	5190	Brush Spring - D.C.....(2 used)	.30
10	5928	Condenser .1 MFD.....(2 used)	.50
11	6001	Armature Drive Disc.....	3.00
12	6003	Generator Frame Adaptor.....	7.50
13	6500	Generator Frame & Coils.....	100.00
14	6506	Brush Rig Assembly Complete.....	\$ 15.50
	6507	Field Coil Only.....	7.50
15	6508	Field Coil Set.....	30.00
16	6509	Armature Assembly.....	100.00

CONTROL PARTS



FILTER BOX PARTS



REF. NO.	PART NO.	DESCRIPTION	LIST EACH
17	6510	Brush Rig Only.....	\$ 11.65
18	75354	DC Brush - 1/2 x 1/4 x 1/4 - L-51.....(2 used)	1.00
19	75361	AC Brush - 9/32 x 7/8 x 1-1/4 - L-51.....(3 used)	.65
20	75787	Ground Jumper.....	.35
	19653	Brush Spring - AC.....(3 used)	.35

FILTER BOX GROUP

(See Ignition and Distributor Parts Pages 40, 46 and 48)

1	1053	Rubber Grommet - 3/8" x 1/2" I.D.....	.10
2	1805	Choke Coil - RF 581.....(2 used)	.75
3	2325	Ignition Coil - 12 Volt.....	5.50
4	2328	Ignition Coil Clamp.....	.35
5	5928	Condenser .1 MFD.....(2 used)	.50
6	6007	Filter Box.....	3.30
7	6009	Filter Box Cover.....	.75
8	6035	Choke Coil Bracket.....(2 used)	.20
		Filter Box Assembly.....	11.50
		Lead - #18 Remote Black - 4".....(5 used)	.20
		Lead - #18 Remote Black - 2".....(2 used)	.20
9	6038	Choke Coil Bracket - 2 Holes.....	.20
10	19645	Condenser .01 MFD.....	.55

CONTROL PARTS

(Illustrated)

1	1412C	Ammeter - 10-0-10 DC.....	2.50
2	1422	Ignition Toggle Switch - 3 Wire.....	.75
3	1445	Charge Relay.....	4.50
4	1446A	Charge Relay Armature and Blade Assembly.....	1.10
5	1448A	Charge Relay Coil and Core Assembly.....	1.60
6	1542	Pilot Relay Core and Coil Assembly.....	.80
7	1548	Pilot Relay Armature Return Spring.....	.10
8	1553A	Insulating Panel with Contacts.....	.80
9	1714	Ignition Pilot Relay.....	4.50
10	1740	Start-Stop Switch - C&H 230 V. - No. 7066.....	1.00
11	1912	Panel Light Switch.....	.75
12	75635	Start Solenoid - No. SS4022.....	2.75
13	6030	Panel Lead Clamp - Tinnerman #4.....	.15
14	6202	Instrument Panel.....	7.50
15	6222	Relay Panel.....	1.00
16	6813	Resistor - 2 Ohm, 50 Watt, 3/4" x 4".....	1.10
17	8905	Resistor - .5 Ohm, 50 Watt, 3/4" x 4".....	1.50
18	15168	Engine Oil Pressure Gauge.....	1.50
19	75866	Voltage Regulator - 12 Volt TCA 4001 - Autolite.....	2.25
20	76564	Fuel Gauge with Electric Tank Element & Resistor.....	2.50
21	76567	Engine Water Temperature Gauge.....	3.00
22	76758	Multi-breaker - 25 Amp. 2 Pole - 1 Throw.....	10.50
23	77151	Terminal Block - 8 Place - No. 1008.....	2.00
24	76868	Fuel Gauge Resistance.....	.60
25	78669	Relay Bracket.....	.25
26	7282	Panel Light Receptacle - 12 Volt.....	.60
27	7242	Start Relay - RMB #60 - 12 Volt - 1 Pole - No Clips.....	1.45
27	7241	Stop Relay - RMB #60 - 12 Volt - 1 Pole - No Clips.....	1.45
28	6034	Noise Filter - FL 12 with Bracket.....(2 used)	7.00
29	1630	Charge Relay Armature Return Spring.....	.10
30	1715	Pilot Relay Armature & Blade Assembly.....	.85

PART NO.DESCRIPTION

1513	Charge Relay Coil Washer - 1-1/2" OD.....	\$.05
6013	Choke Shaft.....	.50
10779	Chase Nipple and Lock Nut.....(2 used)	.35
19922	Choke Shaft Knob.....	.35
19929	Cover for Electric Choke.....	1.50
78589	Bracket for Electric Choke.....	.50
78608	Electric Choke Assembly.....	3.50
78680	Electric Choke Element - Temp. 280°.....	1.50
78692	Electric Choke Bimetal and Cover.....	2.00
99-299	Nameplate - Remote - Manual.....	.10
99-304	Nameplate - AC Output.....	.10
99-305	Nameplate - Remote Control.....	.10
99-307	Nameplate - Start-Stop.....	.15

PANEL LEAD WIRES
(Not Illustrated)

#14 Rockbestos Lead Wire Used on Following:

Start Relay to #13 Terminal 13-7/8"25
Ignition Relay to #8 Terminal 13".....	.25
Start Switch to Start Relay 16".....	.30
Start Relay to Ground 10".....	.20
D.C. Ammeter to Start Relay 13".....	.30
D.C. Ammeter to #4 Terminal 13-3/4".....	.30
Start Switch to #3 Terminal 12-1/2".....	.25
Stop Switch to #2 Terminal 9-5/8".....	.20
Fuel Gauge to #9 Terminal 21-1/2".....	.45
Panel Light Switch to Voltage Regulator 8-1/4".....	.25
Start Stop Switch to Ground 10-3/4".....	.20
Fuel Gauge Resistor to Voltage Regulator 8-1/2".....	.20
Ignition Relay to Stop Relay 7-1/8".....	.20
Start Relay to Stop Relay 4-1/8".....	.15
Voltage Regulator to 2 Ohm Resistor 15-1/4".....	.30
Voltage Regulator to 2 Ohm Resistor 14-1/4".....	.30
D.C. Ammeter to Charge Relay 7-3/4".....	.20
Charge Relay to .5 Ohm Resistor 10".....	.20
Panel to Lead Clamp - Tinnerman #4.....	.15
Charge Relay to #6 Terminal 6".....	.15

#16 Black Remote Lead Wire Used on Following:

Resistor Slide Lead 5".....	.10
#2 Terminal to Remote Stop 20".....	.30
#3 Terminal to Remote Stop 20".....	.30

#12 Black Remote Lead Wire Used on Following:

Circuit Breaker to AC Output (2) 16".....	.30
Circuit Breaker to Radio Noise Filter 29".....	.40
Circuit Breaker to Radio Noise Filter 36".....	.45

SCREWS, NUTS & BOLTS

<u>AMT.</u>	<u>DESCRIPTION</u>	<u>LIST EACH</u>
2	Round Head Machine Screw - 6-32 x 1/4 Plated.....\$.05
6	Round Head Machine Screw - 6-32 x 1/2 Plated - Stop Sw-2 Knob-4....	.05
1	Round Head Machine Screw - 8-32 x 1/4 - Filter Box.....	.05
11	Round Head Machine Screw - 8-32 x 5/16 - Brg. In.-7 Cond.-4.....	.05
10	Round Head Machine Screw - 8-32 x 3/8 - Gas Gauge-5 Dist. Sh.-5....	.05
4	Round Head Machine Screw - 8-32 x 1/2 Plated - Sol.-2 F.Gd.-1 Oil Sol.-2 F.Gd.-1 Oil Line-1.....	.05
8	Round Head Machine Screw - 8-32 x 5/8 - Fil. Mtg.....	.05
2	Round Head Machine Screw - 8-32 x 7/8 Brass N.P. - Relay.....	.05
2	Round Head Machine Screw - 8-32 x 1" Plated - Terminal Blk.....	.05
2	Round Head Machine Screw - 8-32 x 2-3/4" - Circuit Breaker.....	.05
16	Round Head Machine Screw - 10-32 x 3/8" Brass N.P. - L.P.-4 U Reg.-1 Relay-8 B.R.-3.....	.05
4	Round Head Machine Screw - 10-32 x 1/2" - Filter Box.....	.05
3	Round Head Machine Screw - 10-32 x 5/8" Brass N.P. - Brush Rig.....	.05
1	Round Head Machine Screw - 10-32 x 3/4" Brass N.P. - Brush Rig.....	.05
2	Round Head Machine Screw - 10-32 x 1" Brass - Shield.....	.05
4	Round Head Machine Screw - 10-32 x 1-1/2" - Spark Plug Shield.....	.05
3	Round Head Machine Screw - 10-32 x 7/8" - R.C.-2 Voltage Reg.-1....	.05
10	Round Head Machine Screw - 1/4-20 x 1/2"-Hsg.-7Bond St.-1 I.P.-3..	.05
2	Round Head Machine Screw - 1/4-20 x 1-3/4" - Terminal.....	.05
2	Round Head Machine Screw - 1/4-20 x 4-1/2" - Resist Mtg.....	.10
30	Hex Head Cap Screw - 1/4-20 x 1/2 - Housing.....	.05
1	Hex Head Cap Screw - 1/4-20 x 1" - Battery Gauge.....	.05
1	Hex Head Cap Screw - 1/4-28 x 1-7/8" - Muffler Bracket.....	.05
4	Hex Head Cap Screw - 5/16 US x 3/4" - Generator.....	.05
16	Hex Head Cap Screw - 5/16 US x 1-1/2" - Generator.....	.10
5	Hex Head Cap Screw - 1/2 US x 1" - Front End Mounting.....	.10
2	Hex Head Cap Screw - 1/2 US x 1-1/4" - Radiator.....	.10
9	Hex Head Cap Screw - 1/2 US x 1-1/2" - Engine Mounting.....	.10
14	Hex Head Cap Screw - 3/8 x 3/4" - Side to Front Pan-10 Side Pan to Radiator Support.....	.05
12	Hex Head Cap Screw - 3/8 US x 1" - Batt. Sup.-8 Gen.-4.....	.05
8	Hex Head Cap Screw - 3/8 US x 1-1/4" - Generator Adapter.....	.05
2	Hex Head Cap Screw - 3/4 US x 1" - Side Plate to Eng. Sup.....	.05
6	Hex Nuts - 6-32 Steel - Cap-2 Pan-4.....	.05
14	Hex Nuts - 8-32 Steel - Oil Line-1 Rad. Gd.-1 Fil.-10.....	.05
8	Hex Nuts - 8-32 Brass N.P. - Panel.....	.05
6	Hex Nuts - 10-32 Steel - S. Pl. Sh.-4 Filter Box-2.....	.05
15	Hex Nuts - 10-32 Brass N.P. - Panel.....	.05
13	Hex Nuts - 1/4-20 Brass N.P. - Pan-5 Terminal -8.....	.05
28	Hex Nuts - 1/4-20 Steel - Hsg.-25 Air Cl.-2 Bat. St.-1.....	.05
1	Hex Nuts - 1/4-28 Steel - Muffler Bracket.....	.05
22	Hex Nuts - 3/8" U.S. - Housing.....	.05
8	Hex Nuts - 1/2" U.S. - Housing.....	.05
6	Lockwasher (6-32) #6 x 5/64" x 1/32" - Cap-2 Pan-4.....	.05
24	Lockwasher (8-32) #8 x 5/64" x 3/64".Sol.-2 Brg.C-6 Oil L-1 R.Gd.-1 G.Ga.-5 Fil.8 Sh.-1.....	.05

SCREWS, NUTS & BOLTS

<u>AMT.</u>	<u>DESCRIPTION</u>	<u>LIST EACH</u>
21	Lockwasher (10-32) 3/16" x 1/16" x 3/64" - Panel-11 S.P.Sh.-4 Fil.Box-4 D.Sh.-2.....\$.05
36	Lockwasher (1/4") 1/4" x 3/32" x 1/16" - Air Cleaner-2 Housing-32 Battery-2.....	.05
8	Lockwasher (5/16") 5/16 x 1/8 x 3/32 - Gen.-4 Batt.-4.....	.05
4	Lockwasher - 3/8" x 1/8" x 1/8" - Generator.....	.05
36	Lockwasher - 3/8" x 1/8" x 1/16" - Housing-18 Generator-8 Filter Box-5 Radiator-4 Air Cleaner-1.....	.05
11	Lockwasher - 1/2 x 11/64" x 1/8" - Housing.....	.05
2	Lockwasher - 3/4" x 1/4" x 3/16" - Housing.....	.05
18	Shakeproof Lockwasher (Ext.) #1108 - Pan.-14 D.Sh.-4.....	.05
4	Shakeproof Lockwasher (Ext.) #1110 - Panel.....	.05
16	Shakeproof Lockwasher (Int.) #1210 - Brush Rig.....	.05
6	Shakeproof Lockwasher (Int.) #1214 - Panel.....	.05
16	Shakeproof Lockwasher (Int.) #1218 - Generator.....	.05
6	Flatwasher Brass N.P. (#8) .172 ID x 3/8" OD x .032" - Pan.....	.05
8	Flatwasher Brass N.P. (#10) .200" ID x 7/16" OD x .036" Brush Rig...	.05
10	Flatwasher Brass N.P. (1/4") .200" ID x 9/16" OD x .040"-Pan.-2 Term.8	.05
4	Flatwasher Brass N.P. (5/16") .337" ID x 3/4" OD x .064" - Gen.....	.05
4	Flatwasher Brass N.P. (3/8") .391" ID x 1" OD x .081" - Panel.....	.05
2	Flatwasher Brass (1/2") 9/16" ID x 1-1/4" OD x .091" Not Plated Panel Lamp.....	.05
4	Flatwasher Steel (#8) SAE - Distributor Coil.....	.05
3	Flatwasher Steel (1/4") SAE - Dist. Sh.-1 Batt. Gd.-2.....	.05
4	Flatwasher Steel (5/16") SAE - Battery Rack.....	.05
6	Flatwasher Steel (3/8") SAE - Filter Box -4 Muffler-2.....	.05
3	Mica Washer - 3/16" ID x 3/4" OD x 1/16" - Generator.....	.05
1	Copper Washer Plated 5/16" ID x 9/16" OD x 1/16" - Generator.....	.05
8	Sheet Metal Screws - Type A #14 x 3/4" R.H. - Housing.....	.05
4	Sheet Metal Screws - Type A #6 x 1/4" R.H. - Housing.....	.05
8	Sheet Metal Nuts #1383 .035 Used with 14A Screw - Housing.....	.05
4	Sheet Metal Nuts #1434 .034 Used with 14A Screw - Housing.....	.05
1	Wing Nut - 1/4" Steel - Crank Clamp.....	.10
4	Wing Nut - 5/16" Steel - Battery Top Rack.....	.10
6	Insulating Washer - .195"ID x 1/2"OD x 3/64"Canvas Base - Nat.Term..	.05
8	Insulating Washer - .253"ID x 3/4"OD x 1/16"Canvas Base - Nat.Term..	.05
2	Insulating Bushing - .195" ID x 5/16" OD x 3/64" Canvas Base Nat. Terminal.....	.05
2	Insulating Bushing - .253" ID x 3/8" OD x 3/64" Canvas Base Nat. Terminal.....	.05

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H4600-235-A	POWER UNIT PE-235-A: 110/220-v, 28.4 amp, 5-kw at 80% pf; 3-wire; single-phase, 60-cycle.	1		
	3H1902	ENGINE: 4-cycle, 4-cylinder; L head; 2-7/8" bore; 3-1/2" stroke; 17.1-HP; 1800 rpm; Continental Model Y91.	1		
	3H2408	GENERATOR: 110/220-v, 28.4-amp, 5-kw at 80% pf; 3-wire; single-phase, 60-cycle, Onan Model 261.	1		
ENGINE PARTS					
Air Cleaner Group					
	3H1902/C29	AIR CLEANER ASSEMBLY.	1		*
	3H1902/C40	CLAMP: 1-3/4" hose.	2	*	*
	3H1902/H10	HOSE: 1-1/2" ID x 2" L.	1	*	*
Camshaft Group					
	3H1902/C1	CAMSHAFT.	1		*
	3H1902/G26	GEAR: camshaft.	1		*
	3H1902/P9	PLATE: camshaft-thrust.	1	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
		Carburetor Group			
	3H1902/C4	CARBURETOR: updraft; 1", Zenith; 61 x 7.	1		*
	3H4552C/597	AXLE: float.	1	*	*
	3H713/B6	BOWL: fuel.	1		*
	3H4563C/F1	FLOAT.	1	*	*
	3H4563D/G4	GASKET: bowl-to-body.	1	*	*
	3H1902/G1	GASKET: carburetor.	1	*	*
	3H750-1/G1	GASKET KIT: carburetor.	1	*	*
	3H713/V1	VALVE AND SEAT: fuel.	1	*	*
		Connecting Rod and Piston Group			
	3H1902/R6	CONNECTING ROD ASSEMBLY: cylinders 1 and 3; includes No. PYG-203 bushing; No. Y400G-219 bearings, bolts, nuts, and cotter pins.	2		*
	3H1902/B4	BEARING: connecting rod; upper and lower; cylinders 1 and 3.	2	*	*
	3H1902/R7	CONNECTING ROD ASSEMBLY: cylinders 2 and 4; includes No. PYG-203 bushing; No. 400G-218 bearings, bolts, nuts, and cotter pins.	2		*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/B5	BEARING: connecting-rod, cylinders 2 and 4.	2	*	*
	3H1902/B19	BUSHING: piston-pin.	4	*	*
	3H1902/P7	PISTON ASSEMBLY:	4	*	*
	3H1902/P4	PIN: piston.	4	*	*
	3H1902/R4	RING: piston; top-groove; compression.	4	*	*
	3H1902/R3	RING: piston; 2nd-groove; compression.	4	*	*
	3H1902/R2	RING: piston; oil; bottom-groove.	4	*	*
	3H1902/R5	RING: retaining; piston-pin.	8	*	*
		Crankshaft Group			
	3H1902/C14	CRANKSHAFT.	1		
	3H1902/G30	GEAR: crankshaft.	1		*
		Cylinder Block and Crankcase Group			
	3H1902/C30	CYLINDER AND CRANKCASE ASSEMBLY: includes cylinder valve guides, bushings, bearings, caps, screws, studs, nuts, pistons, piston rings, and complete valve mechanism.	1		
	3H1902/B2	BEARING: crankshaft; center, upper, and lower.	1	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/B6	BEARING: crankshaft; front, upper, and lower.	1	*	*
	3H1902/B3	BEARING: crankshaft; rear, upper, and lower.	1	*	*
	3H1902/B15	BUSHING: camshaft; center.	1		*
	3H1902/B14	BUSHING: camshaft; front.	1		*
	3H1902/B16	BUSHING: camshaft; rear.	1		*
	3H1902/B17	BUSHING: crankshaft; pilot.	1		*
	3H1902/S67	SHIM: crankshaft thrust; 0.008" thick.	3	*	*
	3H1902/S68	SHIM: crankshaft thrust; 0.002" thick.	4	*	*
	3H1902/G14	GASKET: inlet hole cover; cylinder.	1	*	*
	3H1902/G5	GASKET: outlet; water; cylinder.	1	*	*
	3H1902/G24	OIL GAUGE ASSEMBLY: includes felt and support.	1		*
		Cylinder Head Group			
	3H1902/H1	CYLINDER HEAD ASSEMBLY: includes water outlet elbow studs and pipe plug.	1		*
	3H1902/G3	GASKET: cylinder head.	1	*	*
	3H1902/G14	GASKET: inlet hole cover; cylinder.	1	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/G5	GASKET: water outlet elbow, cylinder. Engine Control Group	1	*	*
	3H2408/A1	AMMETER, 10-0-10 amp; d.c.	1	*	*
	3H4595/G22	GAUGE: gasoline; with electric tank, element resistor.	1	*	*
	3H4595/G21	GAUGE: water-temperature.	1		*
	3H4595/G30	GAUGE: oil-pressure engine.	1		*
	3H4512.5/L1	LINE: oil, copper, oil pressure gauge.	1		*
	3Z9895	SWITCH: start-stop.	1	*	*
	3H1902/S72	SWITCH: toggle; ignition	1	*	*
	2Z7590	RELAY: pilot; SPST; 60-11101-start; RBM type.	1	*	*
	2Z7585-24	RELAY: SPST; 60-211001-stop; RBM type. Flywheel Group	1	*	*
	3H1902/G9	GEAR: ring; flywheel. Fuel Pump Group	1		*
	3H1902/F15	PUMP: fuel.	1		*
	3H1902/G8	GASKET: filter-bowl	1	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/G67	GASKET: fuel-pump.	1	*	*
	3H1902/K3	KIT: fuel-pump.	1	*	*
	3H1902/C34	Fuel Tank Group CAP: gasoline-tank.	1		*
	6Z3320-2	TUBING: copper, 1/4" dia. No. 20 gauge.	1	*	*
	3H1902/V6	VALVE: shut-off, gasoline-tank.	1	*	*
		Generator Group (Battery Charging)			
	3H4512.5/R34	REGULATOR: voltage; Autolite EO6568.	1		*
	3H2408/R4	RELAY: charge.	1	*	*
	3H2408/R5	RESISTANCE: charge; 0.5-ohm, 50-watt.	1		*
	3H2408/R6	RESISTANCE: charge; 2-ohm, 50-watt.	1		*
		Governor Group			
	3H1902-1/G9	GASKET: governor.	1	*	*
	3H1902/G13	GASKET: governor-flange.	1	*	*
	3H1902-2/G3	GASKET: governor-screw.	1	*	*
	3H1902/G27	GEAR: governor accessory drive.	1		*

* Indicates stock available

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/G31	GOVERNOR ASSEMBLY. Idler Gear and Gear Cover Group	1		*
	3H1902/G11	GASKET: gear-cover. Ignition Group	1	*	*
	3H1902/C18	COIL: ignition; Autolite CF4004.	1	*	*
	3DA10-136	CAPACITOR: fixed-mica; 0.01- μ f.	2	*	*
	3H1902/D1	DISTRIBUTOR ASSEMBLY: Autolite Electric No. IGW-4156C.	1		*
	3H1902/B21	BASE ASSEMBLY: for distributor; includes bearing and oiler.	1		*
	3H1902/F18	BREAKER PLATE ASSEMBLY.	1	*	*
	3H1902/B25	BUSHING: insulating.	1	*	*
	3H1902/C35	CAP ASSEMBLY: for distributor.	1		*
	3H1902/C17	CAPACITOR: distributor.	1	*	*
	3H1902/A1	CONTACT SET: service includes No. IGW-3028 breaker arm and No. 6024 distributor point.	1	*	*
	3H1902/S51	DRIVE SHAFT AND GOVERNOR ASSEMBLY.	1		*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/P20	PLATE: cam and stop.	1		*
	3H1902/R12	RING: lock-spring.	1		*
	3H1902/S52	DRIVE SHAFT ASSEMBLY.	1		*
	3H1902/S26	SPRING SET: weight.	1		*
	3H1902/W11	WASHER.	1		*
	3H1902/W12	WEIGHT ASSEMBLY.	1		*
	3H1902/R9	ROTOR: distributor; Autolite 1239.	1	*	*
	3H1902/S53	DISTRIBUTOR DRIVE SHAFT ASSEMBLY.	1		*
	3H1902/C42	COUPLING: drive-shaft.	1		*
	3H1902/P19	PIN: drive-shaft.	1		*
	3H1902/R10	RELAY: ignition; pilot.	1	*	*
		Manifold Group			
	3H1902/G7	GASKET: exhaust-manifold.	1	*	*
	3H1902/G7	GASKET: intake-manifold.	1	*	*
		Muffler Group			
	3H1902/M2	MUFFLER.	1	*	*

* Indicates stock available

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
		Oil Filter Group			
	3H1902/F1	FILTER: oil.	1		*
	3H1902/E4	ELEMENT: oil-filter.	1		*
	3H1902/T19	TUBE ASSEMBLY: oil-filter outlet.	1		*
	3H1902/T20	TUBE ASSEMBLY: oil-filter inlet.	1		*
		Oil Pan Group			
	3H1902/G16	GASKET: oil-pan.	1	*	*
		Oil Pressure Regulator Group			
	3H1902/G19	GASKET; plug; oil-pressure relief valve.	1	*	*
	3H1902/S11	SPRING: oil-pressure relief valve.	1	*	*
	3H1902/V1	VALVE: relief; oil-pressure.	1	*	*
		Oil Pump Group			
	3H1902/P16	OIL PUMP ASSEMBLY: includes oil-pump body, gears, strainer assembly, cover, shaft, idler stud, suction tube, screws, and nuts.	1		*
	3H1902/G2	GASKET: oil-pump cover.	1	*	*
	3H1902/G28	GEAR: oil-pump; (driven).	1		*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-335-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/G29	GEAR: oil-pump, (driven).	1		*
	3H1902/S7	SHAFT: drive; oil-pump.	1		*
	3H1902/S12	STRAINER ASSEMBLY: oil-pump.	1	*	*
	3H1902/G10	GASKET: strainer; oil-pump frame.	1	*	*
	3H1902/B18	BUSHING: oil-pump drive shaft.	1		*
		Radiator Group			
	3H1902/C6	CLAMP: hose; 2-1/16" ID.	2	*	*
	3H1902/H3	HOSE: outlet; water; cylinder; 1-3/4" ID x 6-3/4" L.	1	*	*
	3H1902/G66	GASKET: leather; 2-1/4" x 5/16".	2	*	*
	3H1902/T2	THERMOSTAT.	1		*
	3H1902/R1	RADIATOR: No. 2366.	1		*
		Spark Plug Group			
	3H1902/C16	CABLE SET: high-tension; includes 1 No. 6031 cable, 1 No. 6032 cable, and 1 No. 6033 cable.	1	*	*
	3H1920/G13	GASKET: spark-plug.	4	*	*
	3H4412-8	PLUG: spark; hot; 14mm; Champion J8.	4	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/S55	SHIELD ASSEMBLY: for spark plug. Starting Crank Group	4	*	*
	3H1902/C13	CRANK: starting. Starting Motor Group	1		*
	3B129C	BATTERY: storage; 12-v.	1		*
	3H1902/S9	SOLENOID: starter switch.	1		*
	3H1902/S13	STARTER: Autolite MBG-4015.	1		*
	3H1902/B23	BENDIX ASSEMBLY.	1		*
	3H1902/S27	SPRING DRIVE.	1	*	*
	3H1902/B22	BRUSH SET.	1	*	*
	3H4580A/D20	SPRING: brush.	4	*	*
	3H1902/C36	WIRE: battery-to-ground; 16" Continental No. LW-206-24.	1	*	*
	3H1902/C41	WIRE: battery-to-starter switch; 12" Continental No. LW-205-36. Valve and Valve Cover Group	1	*	*
	3H1902/G21	GASKET: valve-cover.	1	*	*

* indicates stock available

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/G32	GUIDE: valve-stem.	8	*	*
	3H1902/K4	KEY: valve-stem.	8	*	*
	3H1902/S6	SEAT: valve-spring.	8	*	*
	3H1902/S10	SPRING: valve.	8	*	*
	3H1902/V1	VALVE: exhaust.	4	*	*
	3H1902/V2	VALVE: intake.	4	*	*
	3H1902/T1	TAPPET ASSEMBLY: valve.	8	*	*
		Water Pump and Fan Group			
	3H1902/B11	BELT: fan.	1	*	*
	3H1902/B10	BLADE: fan.	1		*
	3H1902/C5	CLAMP: hose; water-pump; 1-7/8".	2	*	*
	3H1902/G22	GASKET: water-pump.	1	*	*
	3H1902/H4	HOSE: water-pump.	1	*	*
	3H1902/P17	WATER PUMP ASSEMBLY: includes body, support, shaft, bushing, impeller, seal, fan hub, screws, studs, and nuts.	1		*
	3H1902/B1	BEARING: ball; water-pump.	2	*	*

* Indicates stock available.

MAINTENANCE PARTS LIST FOR POWER UNIT FE-235-A.

NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H1902/B20	BUSHING: water-pump drive shaft.	1	*	*
	3H1902/G23	GASKET: water-pump drive shaft support.	1	*	*
	3H1902/J1	IMPELLER: pump drive shaft.	1		*
	3H1902/H5	HUB: fan.	1	*	*
	3H1902/S4	SEAL ASSEMBLY: water-pump.	1	*	*
	3H1902/S8	SHAFT: drive; water-pump.	1		*
		GENERATOR PARTS (AC)			
	3H2408/A2	ARMATURE ASSEMBLY.	1		*
	3H4512.5/B25	BEARING: generator; Hoover No. 7306.	1	*	*
	3H4595/B16	BRUSE: ac; 9/32" x 7/8" x 1-1/4"; L-51.	3	*	*
	3H2408/B3	BRUSH: dc; 1/2" x 1-1/4" x 1-1/4"; L-51.	2	*	*
	3H2408/C1	CAPACITOR: 0.1 uf.	2	*	*
	3H4595/G17	GASKET: cover; generator end bell.	1		*
	3H2408/R2	RIG ASSEMBLY: brush.	1	*	*
	3H2408/S1	SPRING: brush dc.	2	*	*

* Indicates stock available

MAINTENANCE PARTS LIST FOR POWER UNIT PE-235-A.

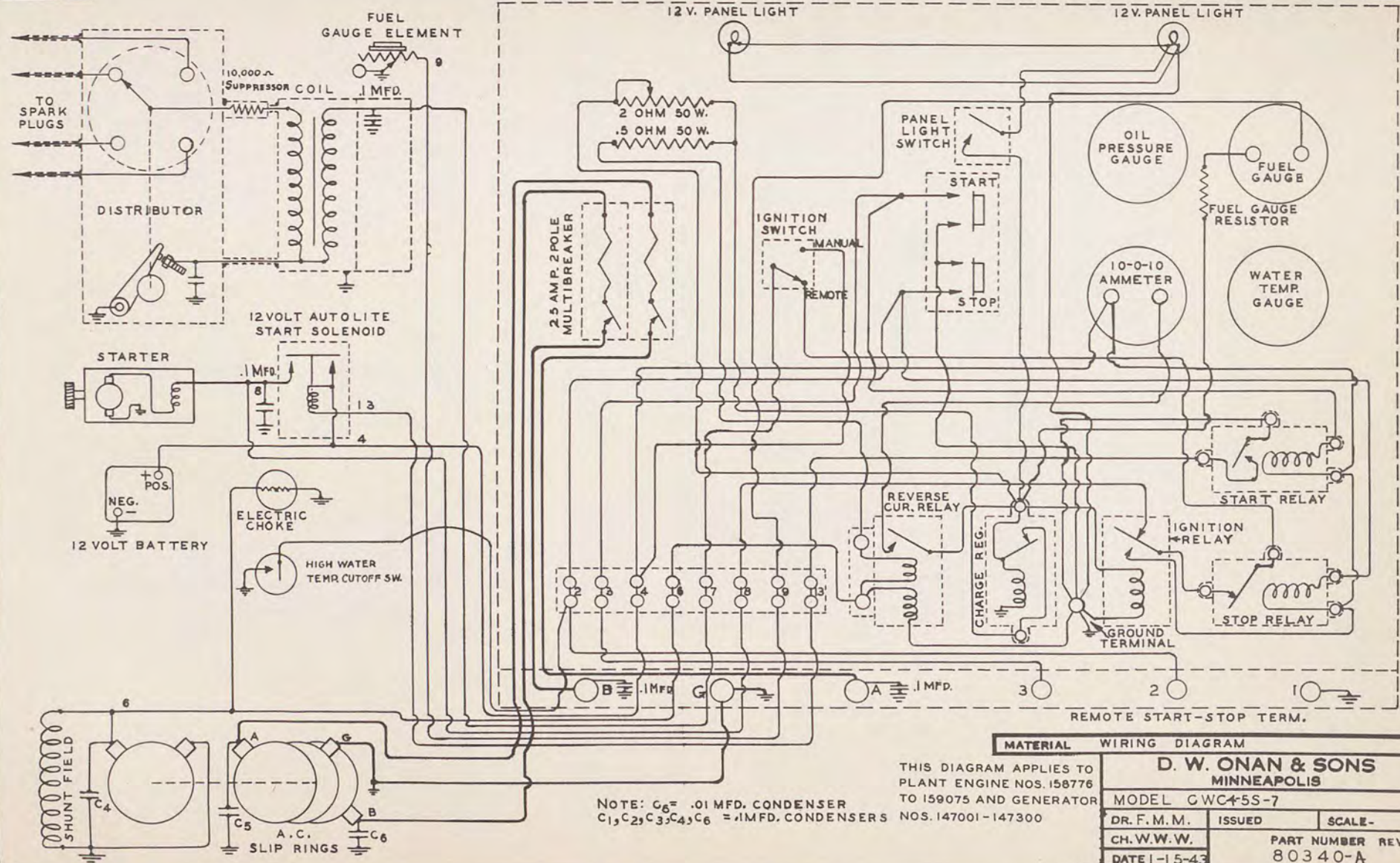
NOTE: Order maintenance parts by stock number, name, and description.
Only maintenance parts listed can be requisitioned.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Station stock	Region stock
	3H2408/S2	SPRING: brush ac.	3	*	*
		ACCESSORIES, APPENDAGES, AND SUPPLIES			
	6D7800B22A	BOOK: instruction.	1		
	3H4600D-235A/41	GROUP HARDWARE ASSEMBLY: includes screws, nuts, washers, studs, and bolts used in Power Unit PE-235-A.	1	*	*

* Indicates stock available.

80340-A

USED ON MODEL
CWC4-5S-7



NOTE: C₆ = .01 MFD. CONDENSER
C₁, C₂, C₃, C₄, C₅ = .1 MFD. CONDENSERS NOS. 147001-147300

MATERIAL WIRING DIAGRAM		
THIS DIAGRAM APPLIES TO PLANT ENGINE NOS. 156776 TO 159075 AND GENERATOR		
D. W. ONAN & SONS MINNEAPOLIS		
MODEL CWC4-5S-7		
DR. F. M. M.	ISSUED	SCALE-
CH. W. W. W.		PART NUMBER REV.
DATE 1-15-43		80340-A

WAR DEPARTMENT
UNSATISFACTORY EQUIPMENT REPORT

FOR FROM	(Technical service)	MATERIEL (Station)	DATE
TO		(Next superior headquarters)	(Station)
(Technical service)			

COMPLETE MAJOR ITEM

NOMENCLATURE	TYPE
MODEL	MANUFACTURER
U. S. A. REG. NO.	SERIAL NO.
EQUIPMENT WITH WHICH USED (IF APPLICABLE)	
DATE RECEIVED	

NOMENCLATURE OF DEFECTIVE COMPONENT

PART NO.	TYPE
MANUFACTURER	DATE INSTALLED

LENGTH OF SERVICE

DATE OF INITIAL TROUBLE TOTAL TIME INSTALLED	TOTAL PERIOD OF OPERATION BEFORE FAILURE (FILL IN WHERE APPLICABLE) <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">YEARS</td> <td style="width: 15%;">MONTHS</td> <td style="width: 15%;">DAYS</td> <td style="width: 15%;">HOURS</td> <td style="width: 15%;">MILES</td> <td style="width: 15%;">ROUNDS</td> </tr> </table>	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS		

DESCRIPTION OF TROUBLE AND PROBABLE CAUSE

GIVE TYPE OF FAILURE. MECHANICAL, ELECTRICAL, WORKMANSHIP, MATERIAL, DESIGN

UNUSUAL SERVICE CONDITIONS

GIVE BRIEF DESCRIPTION

TRAINING OR SKILL OF USING PERSONNEL (CHECK ONE)	POOR	FAIR	GOOD
DESCRIPTION OF ANY REMEDIAL ACTION TAKEN			

RECOMMENDATIONS

<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; text-align: center;">1ST IND.</td> <td style="width: 20%;"></td> <td style="width: 50%;"></td> </tr> <tr> <td>OFFICE</td> <td>STATION</td> <td>DATE</td> </tr> <tr> <td colspan="3" style="text-align: center;">(Technical service)</td> </tr> </table> <p>TO CHIEF</p> NAME STATION	1ST IND.			OFFICE	STATION	DATE	(Technical service)			<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">ORIGINATING OFFICER</td> </tr> <tr> <td>SIGNATURE</td> </tr> <tr> <td>NAME</td> </tr> <tr> <td>RANK AND TITLE</td> </tr> <tr> <td>ORGANIZATION</td> </tr> </table>	ORIGINATING OFFICER	SIGNATURE	NAME	RANK AND TITLE	ORGANIZATION
1ST IND.															
OFFICE	STATION	DATE													
(Technical service)															
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NAME															
RANK AND TITLE															
ORGANIZATION															

INSTRUCTIONS

1. It is imperative that the Chief of Technical Service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design or operational defects in matériel with a view to improving and correcting such defects, and for use in recommending modifications of matériel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair, or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (Change No. 3).
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out by using or service organizations and forwarded in duplicate through command channels to the chief of technical service. The office of the chief of technical service receiving the report will forward an information copy to the Commanding General, Army Ground Forces or Army Air Forces, whichever is applicable, and to the Commanding General, Army Service Forces.
8. Necessity for using this form will be determined by the using or service troops.