

BOOK OF INSTRUCTIONS

WISCONSIN *Air-Cooled*

4 CYLINDER VALVE-IN-HEAD ENGINES



READ THE *STARTING AND OPERATING INSTRUCTIONS* THOROUGHLY BEFORE STARTING A NEW ENGINE. BECOME ACQUAINTED WITH THE ENGINE COMPONENTS; THEIR LOCATION, MAINTENANCE AND ADJUSTMENT REQUIREMENTS.

**Models V-465D
V-460D, V-461D**

3-3/4" Bore – 4" Stroke
177 cu. in. Displacement

3-1/2" Bore – 4" Stroke
154 cu. in. Displacement

ISSUE MM-308

INTRODUCTION

This manual has been compiled to suit the service requirements of the basic engines and accessories most commonly supplied with engines.

Wisconsin Motor Corporation adapts its engines to suit individual customer requirements whenever practical. However, it would become too involved to include all variations in one manual; therefore, should any problems arise concerning engine servicing, we advise that a Wisconsin distributor or authorized service station be contacted, as they are capable of identifying all parts by the specification number stamped on the name plate of engine.

A listing of approved Wisconsin service stations appears in the back of this manual.

WISCONSIN heavy duty air cooled engines are of the most advanced design and are built in a modern factory, equipped with the latest machinery available. Only the best materials, most suitable for the particular part, are used. During production, every part is subjected to the most rigid inspection, as are also the completely assembled engines. After assembly, every engine is operated on its own power for several hours. All adjustments are carefully made so that each engine will be in perfect operating condition when it leaves the factory.

Back of the Wisconsin Motor Corporation are more than fifty years of engineering experience in the design of gasoline engines for every conceivable type of service. The performance of these engines is proof of the long satisfactory service you too can expect from your engine.

Like all fine machinery, the engine must be given regular care and be operated in accordance with the instructions.

SAFETY PRECAUTIONS

Precaution is the best insurance against an accident.

Never fill fuel tank while engine is in operation or hot, to avoid the possibility of spilled fuel causing a fire.

Never operate engine in a closed building unless the exhaust is piped outside. This exhaust contains carbon monoxide, a poisonous, odorless and invisible gas, which if breathed causes serious illness and possible death.

Never make adjustments on machinery while it is connected to the engine, without first removing the ignition cable from the spark plug. Turning over the machinery by hand during adjusting or cleaning might start the engine and machinery with it, causing serious injury to the operator.

Keep this book handy at all times, familiarize yourself with the operating instructions.

KEEP ENGINE CLEAN

PREVENT OVERHEATING

This engine is cooled by a flow of air from a combination fan-flywheel, encased in a sheet metal shrouding. The air is divided and directed by ducts and baffle plates to insure uniform cooling of both banks of cylinders. *If dirt and chaff are allowed to accumulate in the cylinder shrouding or in the V between cylinder banks*, the flow of cooling air will be restricted, creating an overheating condition, which could result in costly repairs.

The rotating screen, illustrated in *Fig. B*, is recommended for engines operating in dusty and dirty conditions. The screen deflects foreign materials away from the air intake opening and helps maintain maximum cooling efficiency. **Keep rotating screen clean.** Even a small section of screen clogged up with dirt will restrict the intake of cooling air enough to bring about an overheating condition.

With reference to Figures A and B; follow these few cleaning and maintenance instructions to insure trouble free and satisfactory engine performance.

1. Cylinder head covers can be removed by releasing snap clips and unscrewing wing nut. Clean out all dirt and chaff from interior of shroud and from between fins of cylinders and heads.
2. Remove dirt and chaff from cylinder heat deflectors at manifold ports.
3. Keep space between cylinder banks clean.

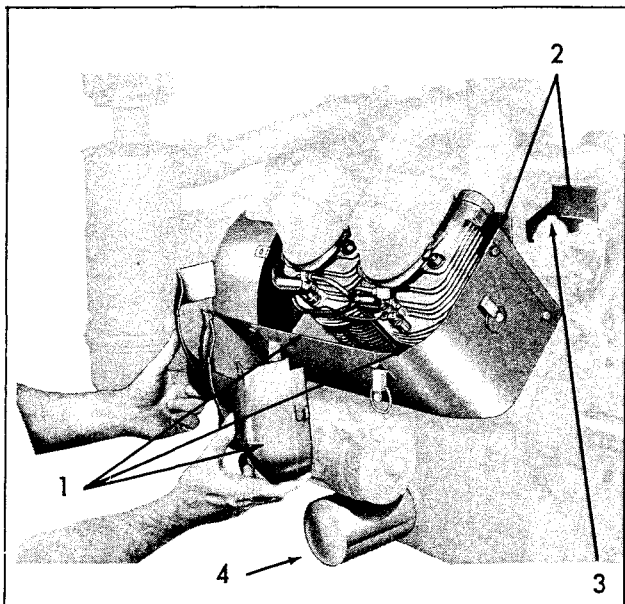


Fig. A

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4. Replace this oil filter cartridge every other oil change. If operating conditions are extremely dusty replace cartridge every oil change. See **Oil Filter** instructions, Page 10.
5. Rotating screen must be kept clean. Accumulated dirt caked on screen will restrict cooling.
6. Read instructions on air cleaner regarding its care. The entire air cleaner should be removed from the engine at least once a year, and washed in a solvent to clean out dirt gathered in the back fire trap and filter element.
7. The collector type pre-cleaner must be emptied of accumulated dirt frequently, depending on dust conditions. Do not use oil or water in pre-cleaner, this must be kept dry.
8. Do not allow shrouding to become damaged or badly dented as this will retard air flow.

Never operate engine with air shrouding removed.

Every 4 to 8 hours, depending on dust conditions, check air cleaner and change oil. See *Page 12*.

Every 8 hours check crankcase oil level. Keep filled to **full** mark on oil gauge saber, but no more. **Every 50 hours** drain crankcase and refill with fresh oil. See *Lubrication, Pages 8 and 9*.

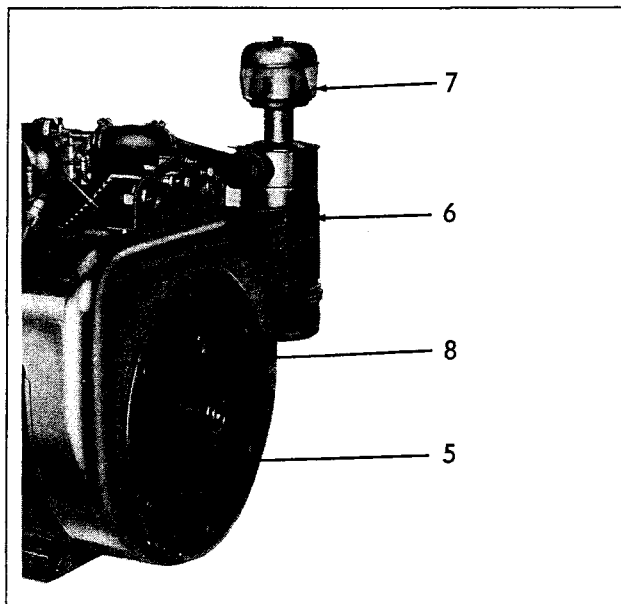


Fig. B

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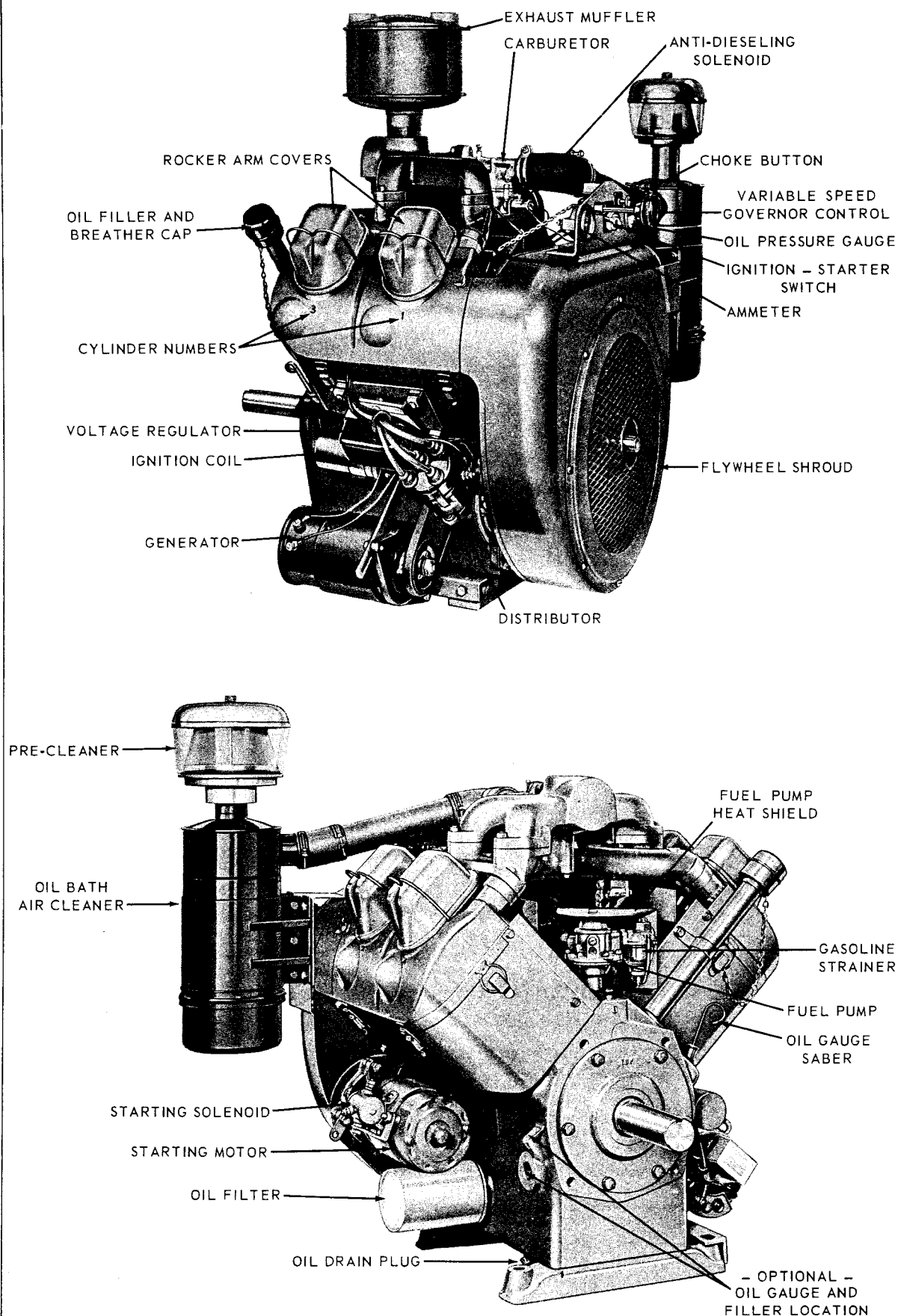
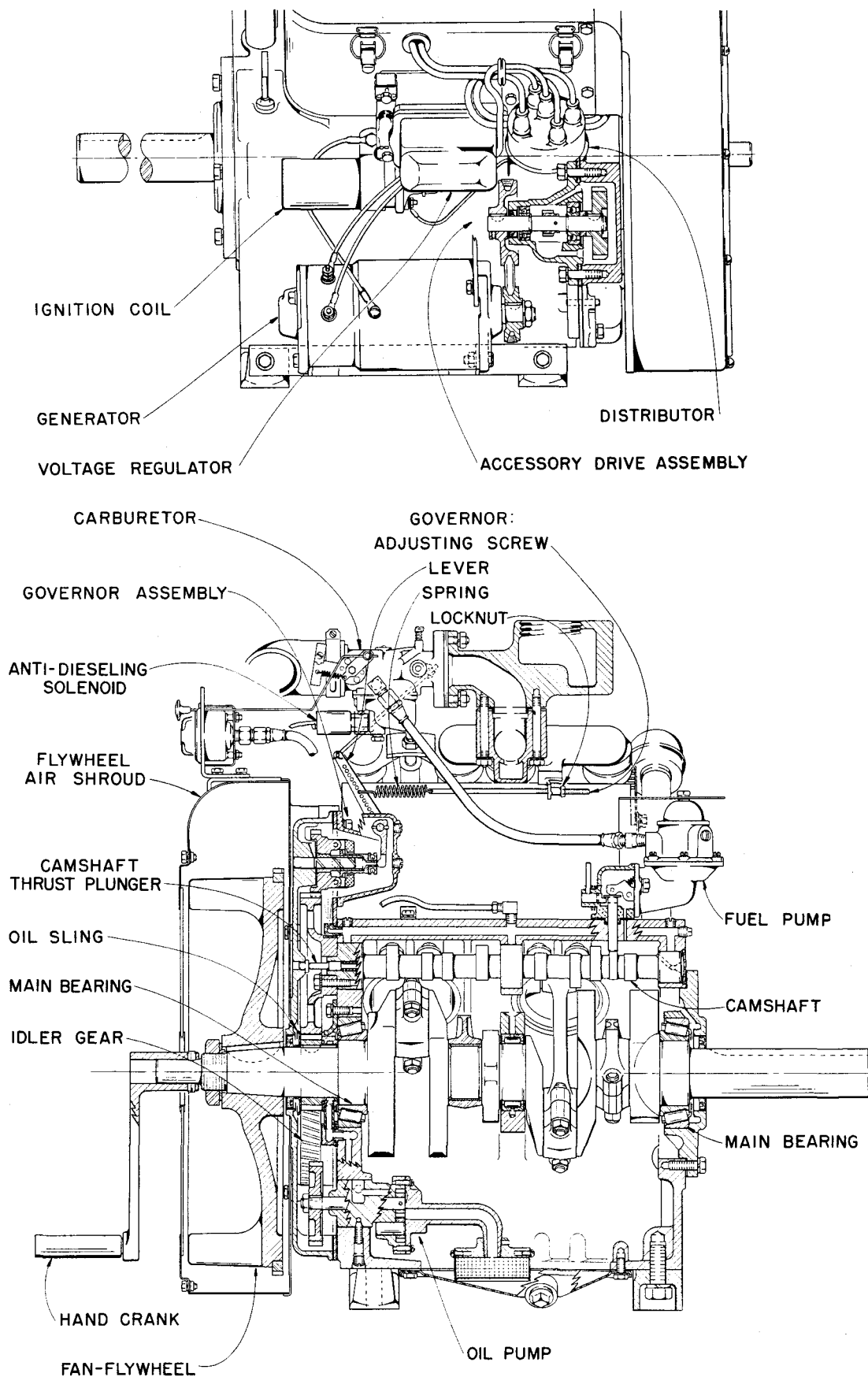
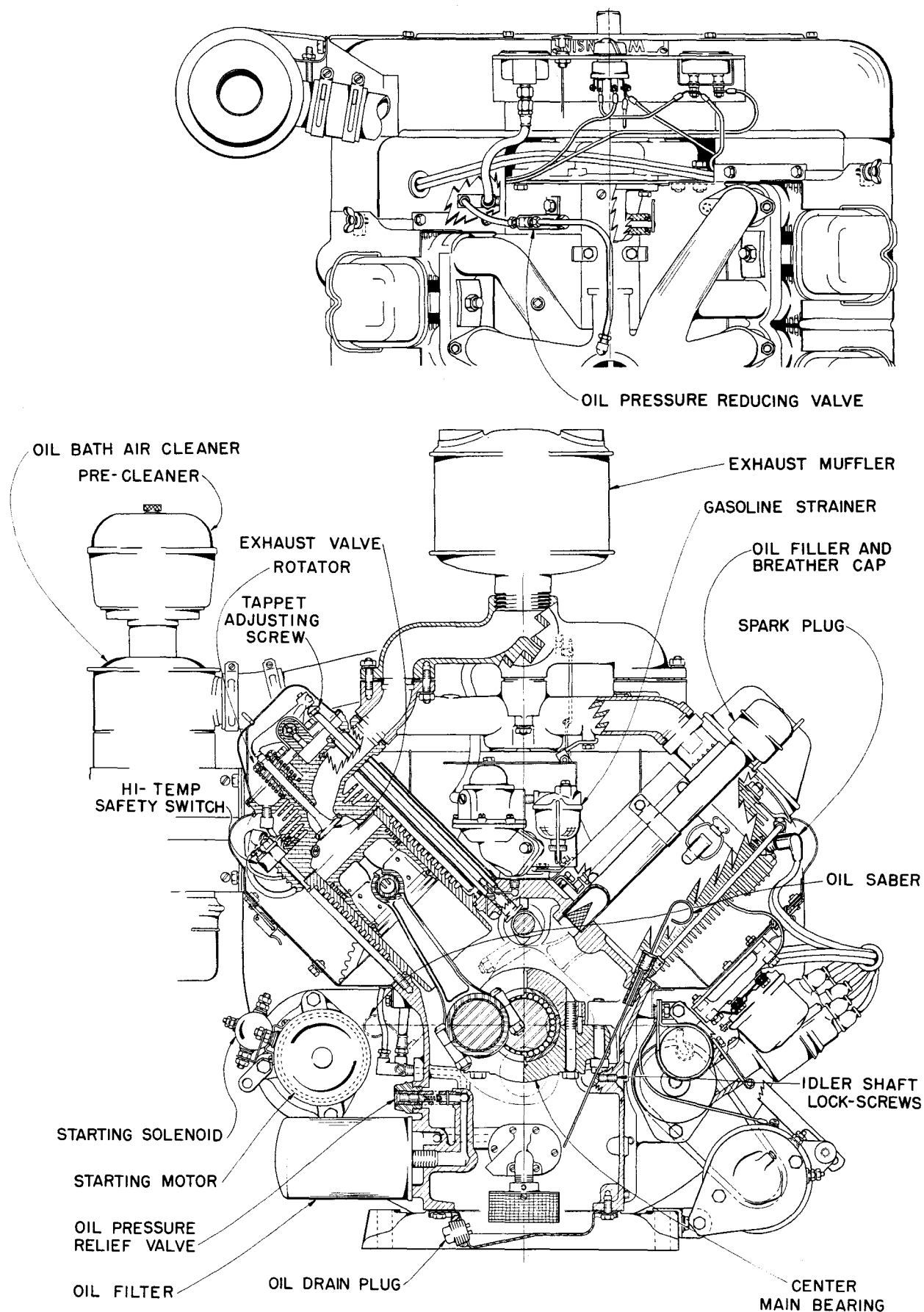


Fig. 1

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GENERAL INFORMATION AND DESIGN

Wisconsin engines are of the four cycle type, in which each of the four operations of **suction**, **compression**, **expansion** and **exhaust** requires a complete stroke. This gives one power stroke per cylinder for each two revolutions of the crankshaft.

COOLING

Cooling is accomplished by a flow of air, circulated over the cylinders and heads of the engine, by a combination fan-flywheel encased in a sheet metal shroud. The air is divided and directed by ducts and baffle plates to insure uniform cooling of all parts.

Never operate an engine with any part of the shrouding removed, because this will retard the air cooling.

Periodically, remove the cylinder head shrouding and clean out all the dust and chaff which may have collected between the fins of the cylinder barrels and cylinder heads. Dirt deposits between the cooling fins and in the shrouding will retard the flow of air and cause the engine to overheat. *See Page 3.*

CARBURETOR

The proper combustible mixture of gasoline and air, is furnished by a balanced carburetor, giving correct fuel to air ratios for all speeds and loads.

IGNITION

The spark for ignition of the fuel mixture is directed from the coil to the spark plugs, at the proper time, by a **distributor**. Electric starter and generator are furnished with distributor ignition.

Magneto ignition can be furnished in place of distributor, when specified. The high tension magneto used, is fitted with an impulse coupling that provides a powerful spark for easy starting.

LUBRICATION SYSTEM

A gear type pump provides pressurized lubrication to the connecting rod bearings, camshaft bearings, tappets, valve train and to an oil spray nozzle in the gear cover. The spray nozzle lubricates the governor and gear train. The oil expelled from these areas form a mist which lubricates the cylinder walls and the anti-friction crankshaft bearings.

All of the circulated oil passes thru a **full-flow oil filter**. Crankcase impurities are collected in the filter element, thereby minimizing friction and reducing wear to critical moving parts of the engine.

GOVERNOR

A governor of the centrifugal flyball type controls the engine speed by varying the throttle opening to suit the load imposed upon the engine. All engines are equipped with either **fixed speed** governors, a **variable speed regulator** to control the governed speed of the engine, or an **idle control**.

ROTATION

The rotation of the crankshaft is clockwise when viewing the flywheel or cranking end of the engine. This gives **counter-clockwise** rotation when viewing the power take-off end of the engine. The flywheel end of the engine is designated the **front end**, and the power take-off end, the **rear end** of the engine.

HORSEPOWER CHART

R.P.M.	V-460D V-461D	V-465D
1600	40.9	41.6
1800	45.6	47.5
2000	50.2	52.4
2200	53.8	56.7
2400	56.8	60.0
2600	58.4	63.0
2800	60.2	64.5
3000	60.5	65.9

HORSEPOWER

The horsepower given in the above chart is for an atmospheric temperature of 60° Fahrenheit, at sea level, and at a Barometric pressure of 29.92 inches of mercury.

For each inch lower Barometer reading, deduct 3½% from above horsepower.

For each 10° higher temperature, there will be a reduction in horsepower of 1%.

For each 1000 ft. altitude above sea level, there will be a reduction in horsepower of 3½%.

The friction in new engines cannot be reduced to the ultimate minimum during the regular block test, but engines are guaranteed to develop at least 85 per cent of maximum power when shipped from the factory. The power will increase as friction is reduced, during a few days of operation. The engine will develop at least 95% of power shown on chart when friction is reduced to a minimum.

For continuous operation, allow 20% of horsepower shown as a safety factor.

INSTRUCTIONS FOR STARTING AND OPERATING

LUBRICATION

Before starting a new engine, fill crankcase with the correct grade of lubricating oil, as specified in "Grade of Oil" chart. Fill through the breather tube opening with **6 quarts** of oil, and check level by means of the oil gauge saber. When replacing oil filter, an additional **1 quart** of oil is required.

For **run-in of new engines**, use same oil as recommended in *Grade of Oil Chart*.

The standard **oil gauge saber** is located on the left hand side, below the oil filler-breather tube. *See Fig. 1.* When specified, a saber can be furnished on the opposite side, behind the starting motor.

High grade oil of the body suited to the requirements of your engine is the most important single item in the economical operation of the unit, yet it is the cheapest item of operating cost. **Select your oil solely on quality and suitability** — never on price — for no one thing is so sure to bring about unsatisfactory performance and unnecessary expense as incorrect lubrication.

Important: S. A. E. Viscosity Numbers classify oils in terms of body only, without consideration of quality or character, therefore we list certain grades of **Mobiloil** as typical examples of lubricants possessing the qualities we believe desirable in oils for **Wisconsin** engines. We plainly state that these grades of **Mobil oils** are listed because of their recognized quality and world-wide distribution. **There are other high quality oils on the market that are equally satisfactory for Wisconsin engines.**

SERVICE CLASSIFICATION OF OIL

In addition to the S.A.E. Viscosity grades, oils are also classified according to severity of engine service.

Use oil classified as **Service MS**. This type of oil is for engines performing under unfavorable or severe operating conditions such as: high speeds, constant starting and stopping, operating in extreme high or low temperatures and excessive idling.

GRADE OF OIL

SEASON OR TEMPERATURE	GRADE OF OIL	EXAMPLE
Spring, Summer or Autumn + 120°F to + 40°F	SAE 30	Mobiloil A
Winter + 40°F to + 15°F + 15°F to 0°F Below Zero	SAE 20-20W SAE 10W SAE 5W-20W	Mobiloil Arctic Mobiloil 10W Mobiloil 5W-20W
Crankcase Capacity		6 Qts.
Additional for Oil Filter		1 Qt.

Follow summer recommendations in winter, if engine is housed in warm building.

Check oil level every 8 hours. Change oil every 50 hours of operation.

To drain oil, remove drain plug in oil pan at oil filter side. Oil should be drained while engine is hot, as it will then flow more freely.

FUEL

The fuel tank should be filled with a **good quality** gasoline, free from dirt and water. Some of the poorer grades of gasoline contain gum which will deposit on valve stems, piston rings, and in the various small passages in the carburetor, causing serious trouble in operating, and in fact might prevent the engine from operating at all.

Use only reputable, well known brands of gasoline of the REGULAR GRADE.

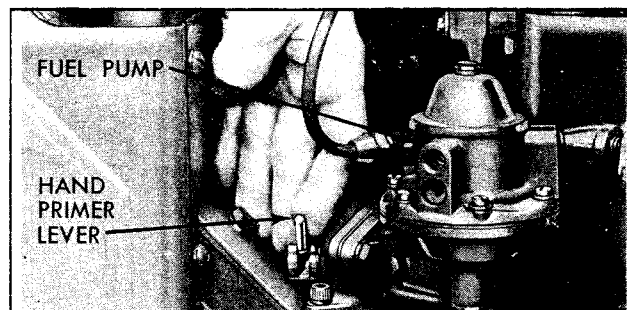


Fig. 2

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The gasoline should have an octane rating of at least 90. Fuel with a low octane rating will cause detonation, and if operation is continued under this condition, severe damage will result to the engine. Cylinders and pistons will be scored, head gaskets blown out, bearings will be damaged, etc.

Be sure that air vent in fuel tank cap is not plugged with dirt, as this would prevent fuel from flowing to the carburetor.

FUEL PUMP

When starting a new engine for the first time, or when engines have been out of operation for a while, the hand primer lever on the fuel pump should be used to pump gasoline into the dry carburetor. *See Fig. 2.* When priming, a distinct resistance of the fuel pump diaphragm should be felt when moving the hand lever back and forth. If this does not occur, the engine should be turned over a revolution so that the fuel pump cam will be rotated from its upper position, which would prevent priming. The primer lever should be given about 20 to 30 strokes, depending on how much fuel, if any, there is in the carburetor float chamber. After the carburetor is full, the primer lever will move more easily.

STARTING

ELECTRIC STARTING MOTOR

A 12 volt starting motor with an attached starting solenoid is provided as standard equipment on this model engine, unless otherwise specified. The starter is a product of either the Delco-Remy Company or Prestolite Company.

Do not oil Bendix drive. Keep screw thread clean and if necessary, lubricate with powdered graphite.

STARTING PROCEDURE

1. Check crankcase oil level and fuel supply. Open fuel valve.
2. Disengage clutch, if furnished.
3. New engines require priming; refer to "Fuel Pump" paragraph for instructions.
4. Set throttle about 1/2 open if variable speed governor control is furnished; with a two-speed control, start in full load position.
5. Turn **ignition-starting switch** to 'start' position and at the same time pull out choke button only sufficient to start the engine. Release choke button to open position after engine starts, but re-

choke if it tends to stop. **Even a hot engine requires a momentary choking when starting.** When engine starts release switch to 'run' position.

If flooding should occur, continue cranking with the starting motor, but with choke open (choke button in).

After engine starts; allow it to warm up a few minutes before applying load, as prescribed in 'Warm-Up Period' paragraphs.

New engines; started for the first time, should be "run-in" gradually to insure trouble-free service and long engine life. Refer to "Starting and Operation of New Engine" instructions, on the inside front cover of this manual, for correct *running-in* procedure.

WARM-UP PERIOD

The engine should be allowed to warm up to operating temperature before load is applied. This requires only a few minutes of running at moderate speed. **Racing an engine or gunning it,** to hurry the warm-up period, **is very destructive** to the polished wearing surfaces on pistons, rings, cylinders, bearings, etc., as the proper oil film on these various surfaces cannot be established until the oil has warmed up and become sufficiently fluid. This is especially important on new engines and in cool weather.

Racing an engine by disconnecting the governor, or by doing anything to interfere with the governed control engine speed, **is extremely dangerous.** The governor is provided as a means for controlling the engine speed to suit the load applied, and also as a safety measure to guard against excessive speeds, which not only overstrain all working parts, but which might cause wrecking of the engine and possible injury to bystanders.

All parts of the engine are designed to safely withstand any speeds which might normally be required, but it must be remembered that the stresses set up in rotating parts increase with the square of the speed. That means that if the speed is doubled, the stresses will be quadrupled, and if the speeds are trebled, the stresses will be nine times as great.

Strict adherence to the preceding instructions cannot be too strongly urged, and greatly increased engine life will result as a reward for these easily applied recommendations.

STOPPING ENGINE

To stop engine; turn *ignition-starting switch* to 'off' position.

If the engine has been running hard and is hot, do not stop it abruptly from full load, but remove the load and allow engine to run idle at 1000 to 1200 R.P.M. for three to five minutes, depending on how hot the engine has been. This will reduce the internal temperature of the engine much faster, minimize valve warping, and of course the external temperature, including the manifold and carburetor will also reduce faster, due to air circulation from the flywheel.

One of the main troubles caused by the abrupt shutting off of a hot engine is *vapor lock*. This will result

in hard starting, which can be overcome by choking the engine when cranking or waiting until the engine has cooled off sufficiently to overcome the vapor lock.

ANTI-DIESEL VALVE

High compression engines have a tendency to occasionally *diesel*, after the ignition has been shut off. To rectify this condition, an *anti-dieseling solenoid valve* is provided to assure immediate stopping. When the ignition is turned off, the solenoid becomes de-energized and releases a valve that shuts off the fuel supply in the carburetor, thus stopping the engine. **CAUTION: Engine will not operate if ignition wire from anti-diesel solenoid to starting switch is disconnected.**

If solenoid is removed from carburetor for some reason, use a new fibre washer in reassembly, and tighten to 100 inch pounds torque.

OIL FILTER

A *full-flow* oil filter is furnished on this model of engine as standard equipment. Since all of the circulated oil passes thru the filter, it is very important that it be serviced regularly in order to function properly.

When the filter element becomes clogged, the oil bypasses the filter material by means of a relief valve located in the top of the oil filter. *See Fig. 3.* As a result, there is no variation in oil pressure to indicate that the oil filter is clogged and requires replacement. **The oil filter should be replaced after every other oil change. If operating conditions are extremely dusty, replace filter after every oil change.**

The oil filter is easily removed by unscrewing it from its mounting pad on the side of the crankcase. Refer to "Oil Filter" in disassembly instructions. When re-assembling a new filter, add a film of oil to the face of the rubber gasket at the base - turn filter to a snug fit, then ½ turn more. **Do not over-tighten.**

Pour 1 additional quart of oil into crankcase when replacing oil filter. Use only a *Wisconsin* oil filter, specially designed for this model of engine. **Refer to parts list for correct service part number.**

BREATHER CAP

The crankcase is ventilated thru a breather cap mounted to the top of the oil filler tube, as illustrated in *Fig. 3.* At every oil change, it is recommended that the cap be cleaned by washing in kerosene.

OIL PRESSURE AND ADJUSTMENT

HIGH PRESSURE SYSTEM

Oil supplied to the connecting rod bearings, at 50 P.S.I. gauge pressure (was 40 P.S.I.), is controlled by a *pressure relief valve*, properly adjusted at the factory. Readjustment, when necessary, must be made while engine is running. Refer to *Fig. 3* and the following instructions:

The *oil pressure relief valve* is located beneath the starting motor and next to the oil filter. The stub end of the valve is closed off by an *expansion plug*. Remove plug from the end of the valve, then, with a

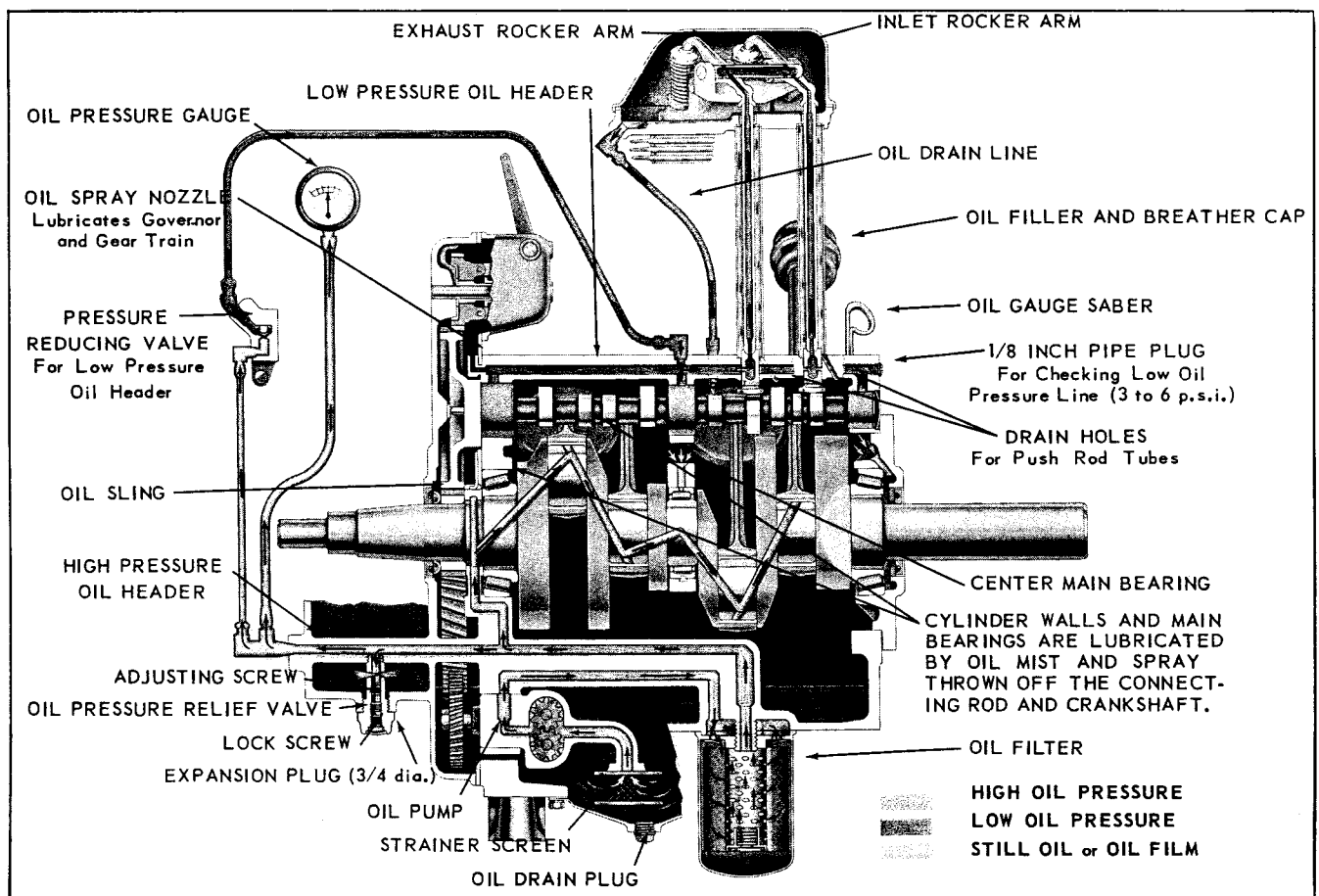


Fig. 3, LUBRICATION SYSTEM

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3/16 Allen wrench, remove the outer **lock screw**. With the same Allen wrench, adjust the spring tension by means of the **adjusting screw**; turn clockwise to increase gauge pressure or counter-clockwise to reduce gauge pressure.

Note: With engine running at 1800 R.P.M. and engine oil hot, adjust oil pressure 50 to 52 P.S.I. Idle engine at 1000 R.P.M., and if oil pressure falls below 15 P.S.I., check for irregularities in the oil pump, bearings and oil connections to collet. The collet itself seldom needs replacement.

After adjustment is made, be sure the outer screw is reassembled to lock the spring tension adjusting screw. Use a new 3/4 inch expansion plug to seal off any oil which may by-pass the screw threads.

LOW PRESSURE SYSTEM

The upper, or **low pressure oil header** supplies oil to the camshaft bearings, tappets, valve train and governor-gear train nozzle at 3 to 6 P.S.I., thru a **pressure reducing valve** from the main or **high pressure oil header**. This pressure is not registered on a gauge, but can be checked by connecting a low pressure gauge to the 1/8" pipe tap located at the take-off end of the engine above the camshaft plug. Operate the engine at 1800 R.P.M. when making this check.

The **pressure reducing valve** is mounted on the crankcase in front of No. 2 cylinder beneath the air duct of No. 2-4 bank. This valve is properly adjusted by the manufacturer and should not be tampered with. If

valve becomes faulty, it should be replaced with a completely new unit.

AIR CLEANER

The oil bath air cleaner, illustrated in Fig. 4, is an essential accessory, filtering the air entering the carburetor, and preventing abrasive dirt from entering the engine and wearing out valves and piston rings in a very short time.

The air cleaner must be serviced frequently, depending on the dust conditions in which the engine is operated. This servicing will vary, from once every few days of operation in comparatively clean conditions to twice a day in dusty conditions.

Remove oil cup from bottom of air cleaner and clean thoroughly. Add the same grade of oil as used in the crankcase, to the **level line** indicated on the oil cup. Detailed instructions are printed on the air cleaner.

Operating the engine under dusty conditions without oil in the air cleaner or with dirty oil, may wear cut cylinders, pistons, rings and bearings in a few days time, and result in costly repairs.

At least once a year, or oftener if conditions are severe, the air cleaner should be removed from the engine and the element, which is not removable, should be washed in a solvent to clean out accumulated dust and dirt.

Check air cleaner hose connections to carburetor, for leaks or breaks. In dusty conditions dirt can enter the engine through very small openings. Replace broken and damaged hose clamps.

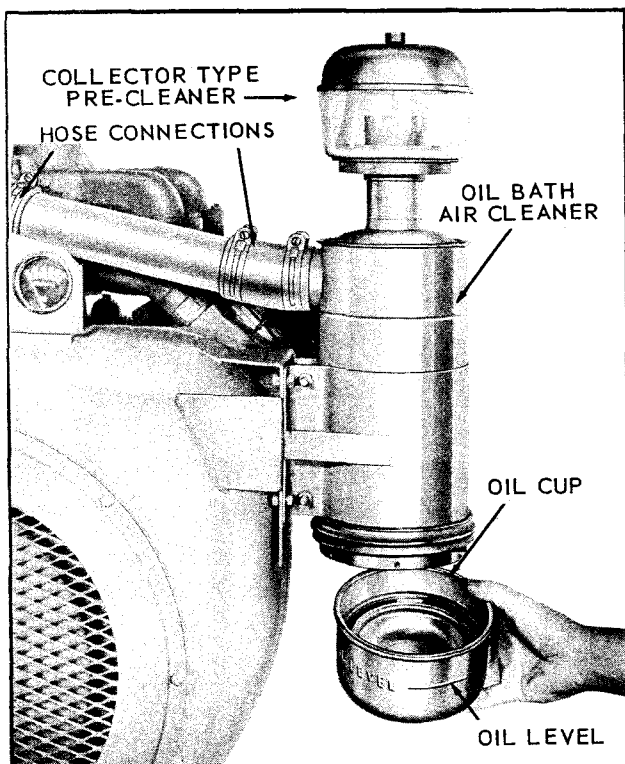


Fig. 4

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PRE-CLEANER

The collector type pre-cleaner, mounted to the top of the air cleaner as illustrated in Fig. 4, removes the larger dirt and dust particles before the air reaches the main air cleaner.

Clean bowl regularly of accumulated dust and dirt. **Do not use oil or water in pre-cleaner, this must be kept dry.**

Daily attention to the air cleaner and pre-cleaner is one of the most important considerations in prolonging engine life.

GASOLINE STRAINER

The gasoline strainer is very necessary to prevent sediment, dirt and water from entering the carburetor and causing trouble or even complete stoppage of the engine. This strainer has a glass bowl and should be inspected frequently, and cleaned if dirt or water are present.

To remove sediment bowl, loosen nut below bowl and swing wire bail to one side, see Fig. 5. There will be less danger of breaking the gasket if the bowl is given a twist as it is being removed. Clean bowl and screen thoroughly. Replace gasket if it has become damaged or hardened. Repair kits are available for service replacement, refer to parts list in rear of manual.

CARBURETOR ADJUSTMENT

The main metering jet in the carburetor is of the fixed type, that is, it requires no adjustment. The idle needle should be adjusted for best low speed operation, while carburetor throttle is closed by hand. For illustrations and more information, see Carburetor

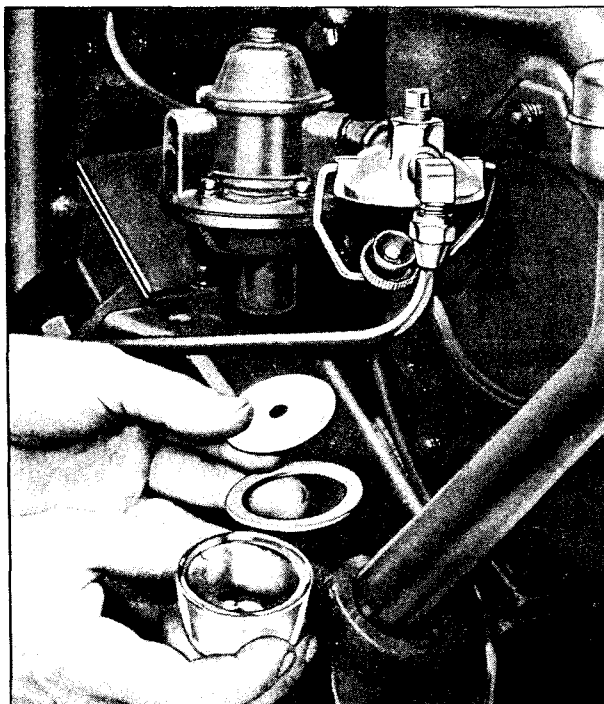


Fig. 5.

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Manufacturer's Instruction Bulletin in the back of this manual.

IGNITION SYSTEM

A battery ignition system is standard equipment on this model of engine. The distributor is of the automatic advance type and it is driven off an engine speed shaft through a pair of two to one ratio gears, thus driving the distributor rotor at one half engine speed in a counter-clockwise direction when viewed from above.

The running spark advance of the engine is 23° and the distributor is fully advanced at 2000 R.P.M.

Engine must be running at 2000 R.P.M. or over, when checking or adjusting spark advance.

NOTE: The distributor, generator, regulator and ignition coil furnished are products of either the *Delco-Remy* Company or *Prestolite* Company. It is suggested that when replacement of any of these parts becomes necessary, that the replaced parts be of the same manufacture as the other components.

TIMING

FIRING ORDER

The **firing order** of the cylinders is **1-3-4-2**, and the battery type distributor rotates at one-half engine speed, as is the case with conventional 'in line' engines. The intervals between the firing of the cylinders is 180°. No. 1 cylinder is the one nearest to the flywheel in the left bank of cylinders, when viewed from the flywheel end of the engine. No. 3 cylinder is the other cylinder in this bank. No. 2 cylinder is the one nearest to the flywheel in the right bank of cylinders and No. 4 is the other cylinder in this bank. The

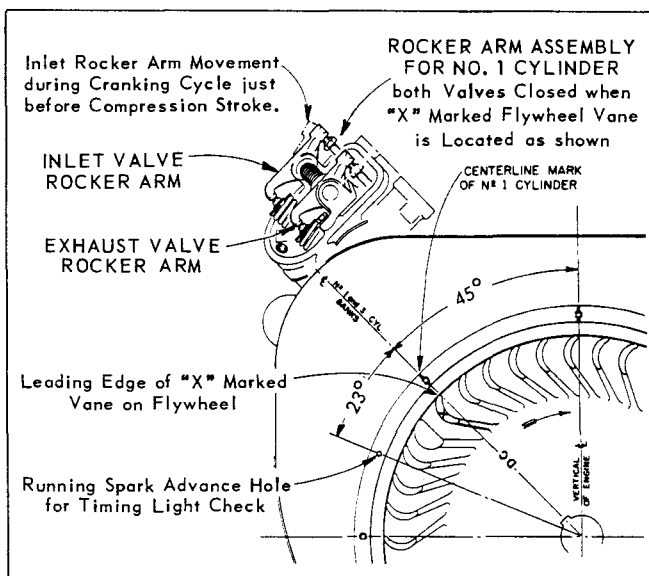


Fig. 6

cylinders are numbered from 1 to 4 on the cylinder head covers.

TIMING MARKS (Refer to Fig. 6)

Remove screen over flywheel air intake opening by taking out the screws holding screen in place. This will expose the timing marks on flywheel shroud, also the vane on flywheel marked by an 'X' and the letters 'DC'.

NOTE: On engines equipped with a rotating screen attached to the flywheel, the *leading edge* of the 'X' marked vane is identified by an 'I' stamped on the outer rim of the screen, thereby not requiring removal of the rotating screen when timing the engine.

TIMING INSTRUCTIONS: The No. 1 piston must be on top dead center of the compression stroke before distributor can be mounted. With reference to Fig. 6, this can be accomplished as follows:

1. Remove rocker arm cover from No. 1 cylinder bank.
2. Turn engine over with hand crank until the *inlet valve* opens and then *closes*.
3. Continue turning the engine over until the *leading edge* of the 'X' marked vane on the flywheel is in line with the *centerline mark* of the No. 1 and 3 cylinder-banks.
4. **DISTRIBUTOR TIMING:** With the No. 1 piston now on *TDC* of the compression stroke, refer to Fig. 7 for the revised *Delco-Remy* distributor or Fig. 7A for *Prestolite*, and mount distributor as follows:
 - a. Before mounting distributor to housing, take off distributor cap, remove rotor and dust cover.
 - b. Hold distributor with face up and *terminal wire* or *terminal stud*, away and in a 12 o'clock position as shown. Mount rotor on shaft and turn until the *rotor contact* points in an approximate 2 o'clock position as illustrated in Fig. 7, or 1 o'clock position as in Fig. 7A.
 - c. Assemble distributor to housing, properly meshing the gears while retaining the terminal wire

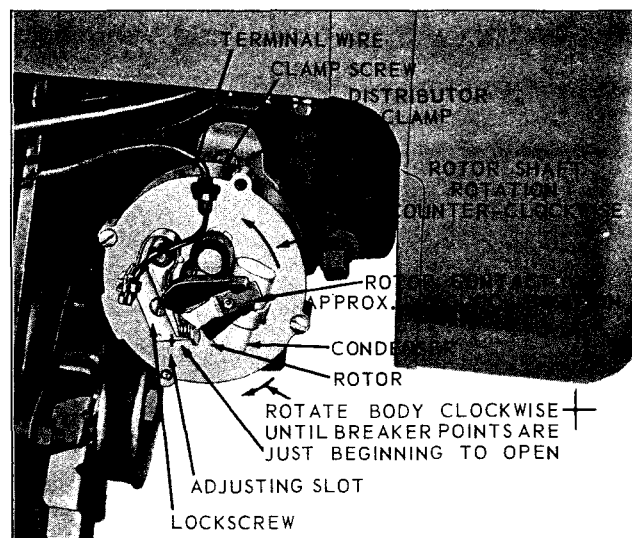


Fig. 7, DELCO-REMY DISTRIBUTOR

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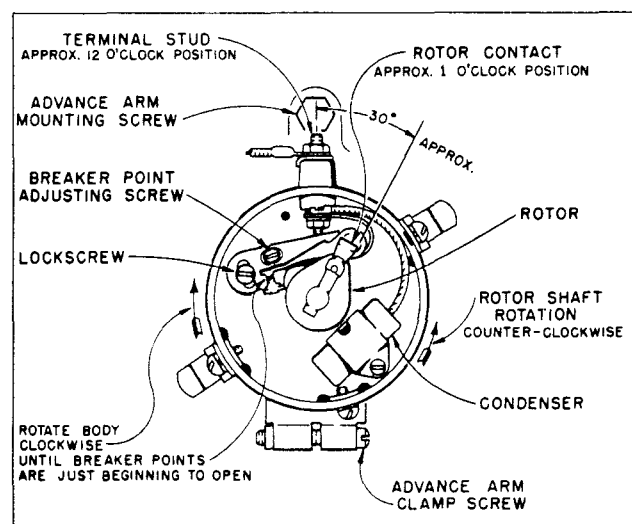


Fig. 7A, PRESTOLITE DISTRIBUTOR

or stud in an approximate 12 o'clock position.

- d. Mount *distributor clamp* to drive housing, Fig. 7, but do not tighten screw. If applicable, as per Fig. 7A, tighten *advance arm mounting screw* to the drive housing.
- e. Adjust breaker point gap to *0.020 inch maximum* opening, see 'Distributor Maintenance'.
- f. With the *clamp screw loose*, turn distributor body slightly in a counter-clockwise rotation so that breaker points are firmly closed. Then turn distributor body in a *clockwise* rotation until *breaker points* are just *beginning to open*. At this point a slight resistance can be felt as the breaker point cam strikes the breaker arm.
- g. Tighten *clamp screw*. The No. 1 cylinder is now ready to fire in the retarded position.

The breaker point gap of 0.020 of an inch should be checked and adjusted per paragraph (e), before distributor body is set and locked in place, as per paragraphs (f) and (g), because any change in gap opening will affect the ignition advance. Mount dust cover and distributor cap.

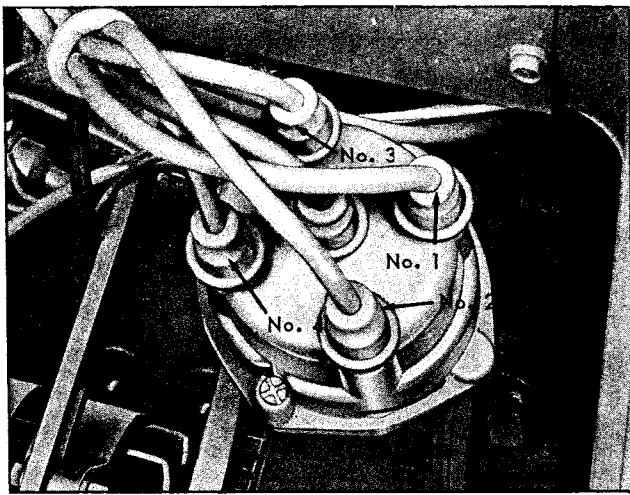


Fig. 7B, DELCO-REMY DISTRIBUTOR MOUNTING 313024C

If care is exercised in the preceding instructions, the spark timing should be accurate enough for satisfactory starting, however, *checking spark advance with a neon lamp, as described in 'Neon Lamp Timing' is necessary.*

The **No. 1 terminal tower** for the **Delco-Remy** distributor is located in an approximate 2 o'clock position on the distributor cap, as illustrated in Fig. 7B, and in an approximate 1 o'clock location for the **Prestolite** distributor. The terminal sequence is **1-3-4-2** in a counter-clockwise direction. Mount ignition cables to spark plugs of like numbers, with the center terminal tower connected to the ignition coil. See *Wiring Diagram*, Fig. 9. The cylinder shroud covers are marked for spark plug identification.

NEON LAMP TIMING (Fig. 8)

The engine should be timed to the **23° advanced position** at not less than **2000 R.P.M.** Check timing with a neon lamp as shown in Fig. 8; insert a small screw driver into the No. 1 terminal tower on the distributor cap, making contact with the spark plug wire terminal.

Connect the red terminal clip, from a conventional type timing lamp, to the metal portion of the screw driver. One of the other two timing lamp wires is connected to the battery, and the other to ground.

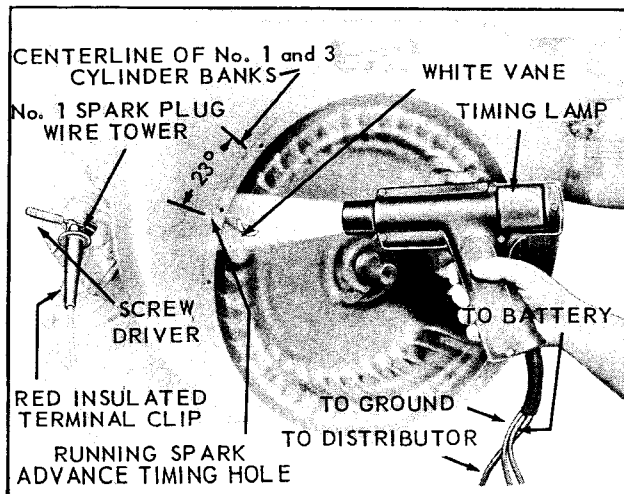


Fig. 8

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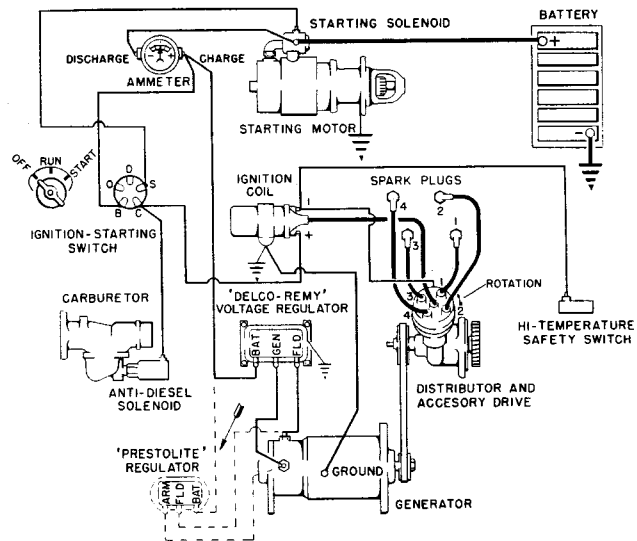


Fig. 9
DISTRIBUTOR IGNITION - WIRING DIAGRAM

Chalk or paint the end of the 'X' marked vane on the flywheel, white. Then with the engine operating at **2000 R.P.M.** or over, allow the flash from the neon lamp to illuminate the whitened vane. At the time of the flash, the leading edge of the vane should line up with the **running spark advance timing hole** on the flywheel shroud, see Fig. 8. If it does not, the distributor **clamp screw** should be loosened and the distributor body turned slightly clockwise or counter-clockwise, as required, until the **white flywheel vane** matches up with the **advance timing hole**. Be sure **clamp screw** is then carefully tightened.

If the engine is running below **2000 R.P.M.** when timing, the automatic advance in the distributor will not be in the "full advance position" and thus the timing would not be accurate.

DISTRIBUTOR MAINTENANCE

The normal breaker point gap is **0.020 inch** at full separation and can be adjusted in the following manner, with reference to Fig's. 7 or 7A; Turn engine over by means of the starting crank until the distributor breaker arm **rubbing block** is on a high point of the **cam**. Loosen the stationary contact **lockscrew** very slightly and insert a feeler gauge between the points. By means of a screw driver inserted into the **adjusting slot** of the **Delco-Remy** distributor or by the **adjusting screw** of the **Prestolite** distributor, open or close points as required until a slight drag is felt when sliding feeler gauge between the points. Tighten lockscrew and recheck gap.

Every 50 hours of operation, the oiler on the side of the **Prestolite** distributor base should have 3 to 5 drops of medium engine oil added. The old style **Delco-Remy** distributor has a built-in oil reservoir. Every 200 hours of operation, remove oil plug in base and refill with No. 20W oil. Seal plug in reassembly. The **new style Delco-Remy** distributor does not have an external oil plug, since it is self-lubricated by oil in the accessory drive housing.

Every 100 hours, apply 3 to 5 drops of light engine oil (10W), to the felt in the top of the cam sleeve, and 1 or 2 drops to the breaker arm pivot.

Every 200 hours, add a small amount of high melting point grease to breaker arm rubbing block, or oil the cam wick.

Avoid excessive lubrication. Oil that may get on the contact points will cause them to burn.

GENERATOR

A 12 volt, 17 amp. generator is furnished as standard equipment, unless otherwise specified. The generator is manufactured by either the Delco-Remy Company or Prestolite Company.

Every 50 hours of operation, add 3 to 5 drops of medium engine oil into the oil cap at both ends of the generator.

ELECTRICAL WIRING CIRCUITS

Beginning with engine serial No. 3979807, the standard wiring circuits for all electrical equipment is for **negative ground polarity**, instead of the previously furnished positive ground.

The wiring diagram, Fig. 9, illustrates a negative ground circuit. To wire equipment that has a positive ground polarity; reverse terminal connections at the ammeter, coil and battery. **Be sure polarity of generator and regulator is known when re-wiring.**

Do not use positive ground generator and regulator in a negative ground circuit, or vice versa. Polarity does not affect starting motor, coil and distributor.

MAGNETO TIMING

For engines furnished with magneto ignition in place of distributor ignition, timing is accomplished in the following manner:

1. Expose timing marks on flywheel and shroud. Refer to 'Timing Marks' paragraphs on Page 13.
2. Position No. 1 piston on compression stroke, as per 'Timing Instructions' paragraphs on Page 13.
3. With No. 1 piston on compression stroke turn engine over past top dead center, until the **leading edge** of the 'X' marked vane on the flywheel is in line with the **vertical centerline mark** on the shroud, as shown in Fig. 10. Leave flywheel in this position (flywheel keyway will be on top).
4. Remove **inspection hole** plug, located in gear cover at magneto mounting flange.
5. Assuming the magneto is removed from the engine; set magneto for spark discharge to the No. 1 terminal. This is accomplished by use of a short stiff length of wire placed into the No. 1 terminal socket and bent to within 1/8 inch of the magneto frame. Then turn the magneto gear in a clockwise rotation, tripping the impulse coupling, until a spark is observed between the wire and frame. Retain gear in this position.
6. Place gasket on flange and mount magneto to engine, meshing the gears so that when magneto is assembled, the gear tooth marked with an 'X' will be visible through the **lower half** of the **inspection**

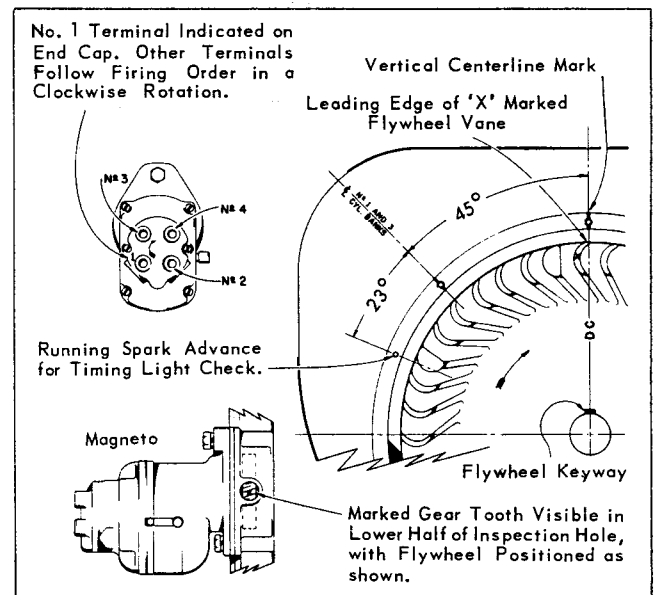


Fig. 10
MAGNETO TIMING DIAGRAM

hole in gear cover. See Magneto Timing Diagram, Fig. 10. Securely tighten nut and capscrew for mounting magneto.

The No. 1 terminal is identified on the magneto cap. The terminals follow the proper firing order of 1-3-4-2 in a clockwise direction viewing the cap end. The leads from the magneto should be connected to spark plugs of corresponding numbers, see *Firing Order* paragraph page 12 and *Wiring Diagram*, Fig. 11.

When magneto is properly timed the impulse coupling will snap when the 'DC' - 'X' marked vane of the flywheel lines up with the **mark** on flywheel, which indicates the **centerline** of the No. 1 and 3 cylinders. This can be checked by turning crankshaft over slowly by hand. The impulse will also snap every 180° of flywheel rotation thereafter.

The running spark advance is 23°. To check timing with a **neon light**, the advance is indicated by a hole on the flywheel shroud, 23° before **centerline** of the No. 1 and 3 cylinders. See Fig. 10.

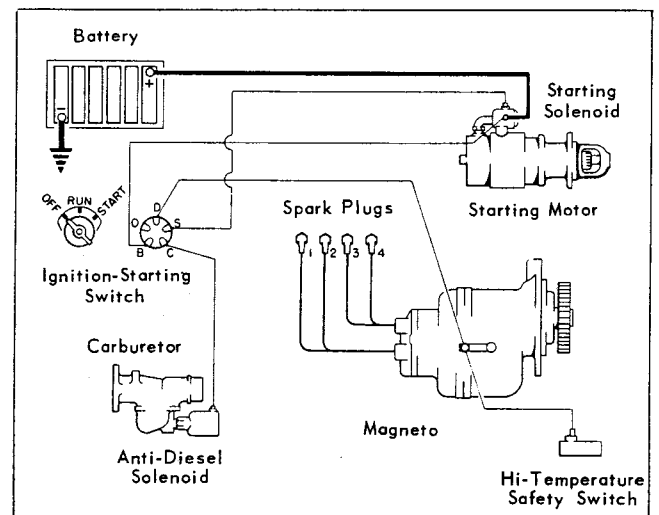


Fig. 11
MAGNETO IGNITION - WIRING DIAGRAM

The magneto is driven at crankshaft speed in clockwise direction when viewing gear end of magneto. The magneto *distributor rotor* turns at *half engine speed*.

Magneto *breaker point gap* is *0.015 inch* at full separation. If the ignition spark becomes weak after continued operation, the breaker points may have to be readjusted or replaced. Refer to Manufacturer's Bulletin in rear of manual for service and adjustment of breaker points.

IGNITION SPARK (Fig. 12)

If difficulty is experienced in starting the engine or if engine misses firing, the strength of the ignition spark may be tested as follows: **Disconnect** the cables from all towers on the distributor cap, except the center coil tower. Insert a stiff piece of wire or metal rod into one of the sockets. Hold the terminal for this tower $\frac{1}{8}$ inch from the wire or rod, as shown in Fig. 12. Turn engine over slowly, two complete revolutions with the hand crank and watch for a spark to discharge during the cranking cycle.

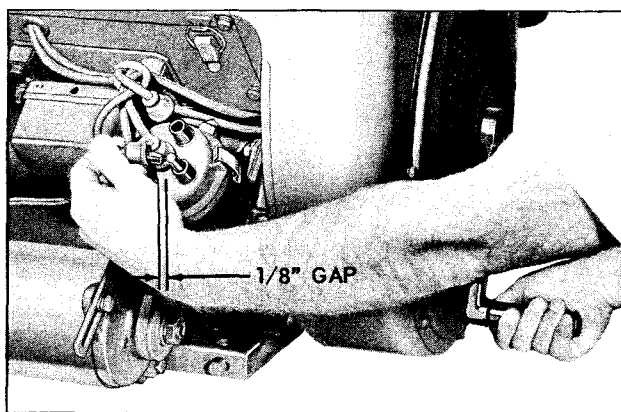


Fig. 12

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Repeat this check with each of the other ignition cables. A good spark at each of the towers will eliminate the ignition coil and distributor as the source of trouble. If there is a weak spark, or none at all, check breaker point opening for *0.020 inch* gap. It may be necessary to install a new condenser, or the ignition coil may be faulty.

SPARK PLUGS (Fig. 13)

The spark plugs should be removed periodically, cleaned and re-gapped. Approximately every 350 hours of operation, replace spark plugs with new plugs of correct heat range, like Champion 14 mm, No. UN-12Y or equal.

The width of the gap between the points of the two electrodes must be very carefully and precisely set, because incorrect settings will have an adverse affect on engine operation. Check spark plug gap with a wire type gauge and regap as shown in Fig. 13.

Spark plug gap – 0.030 of an inch.

Use a new gasket when mounting either old or new plugs and thoroughly clean threads in cylinder head before installation. Tighten spark plugs to *22 foot pounds torque*. If torque wrench is not available,

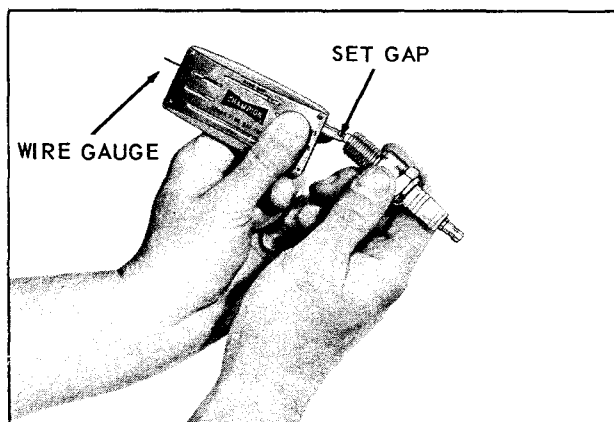


Fig. 13

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tighten plug until it begins to seat on the gasket, then turn $\frac{1}{2}$ to $\frac{3}{4}$ of a turn more.

RESTORING COMPRESSION

On a new engine or on one which has been out of operation for some time, the oil may have drained off the cylinder so that compression will be weak. This may cause difficulty in starting. To remedy this condition, remove the spark plugs and squirt about a fluid ounce of crankcase oil through the spark plug hole into each cylinder.

Turn the engine over several times with the starting crank to distribute the oil over the cylinder walls. Then reassemble spark plugs and compression should be satisfactory.

VALVE TAPPET ADJUSTMENT (Fig. 14)

The clearance between the valve and rocker arm, with the tappet in its lowest position (valve completely closed) and the engine cold:

Inlet – 0.008 inch
Exhaust – 0.014 inch

The rocker arms can be identified as follows: When facing the side of the engine, the *exhaust rocker arm*

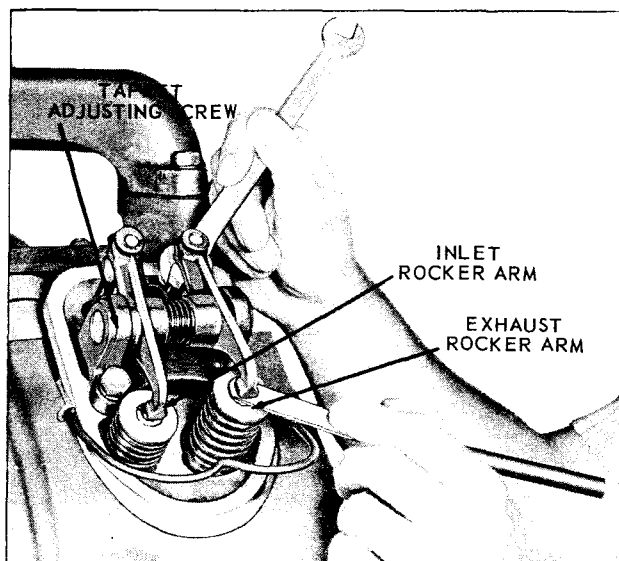


Fig. 14

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is to the right in the cylinder head and the *inlet rocker arm* to the left.

Measure the clearance between the top of the valve and the nose of the rocker arm with a feeler gauge, as shown in *Fig. 14*. By means of a $\frac{1}{2}$ inch tappet wrench, turn the *tappet adjusting screw* clockwise to decrease valve clearance and counter-clockwise to increase the clearance.

The sequence in which the tappets are adjusted is determined by the 1-3-4-2 firing order. Start by adjusting No. 1 inlet valve clearance first, then by just a short turn of the crank, No. 3 inlet can be adjusted. Return to No. 1 cylinder and adjust the exhaust clearance, then adjust the No. 3 exhaust.

The same procedure applies to the No. 2 and No. 4 bank of cylinders, starting with No. 4 inlet valve. Mark each rocker arm with chalk as adjustment is completed, to prevent repetition. With spark plugs removed, turning crankshaft is made easier.

ROCKER ARM COVERS (Fig. 15)

When reassembling rocker arm covers, after timing or valve tappet adjustment, *carefully* replace the cover gaskets to prevent oil leaks.

If oil does appear around the rocker arm covers, reassemble in the following manner:

1. Check gasket face surface of rocker arm cover, at the rounded end, for paint accumulation, *see Fig. 15*. Scrape off any paint that forms a hump. Smooth scraped area with emery cloth or steel wool.
2. Clean gasket faces on the cylinder head and rocker arm covers.
3. Spread a thin coat of perma-tex into the rocker arm cover, to hold gasket in place. This will prevent gasket slippage or deformation when mounting cover to cylinder head.
4. Use new gaskets. Old gaskets harden, take a "set" and will very likely leak.

GOVERNOR

OPERATION

The centrifugal flyball governor rotates on a stationary pin pressed into the upper part of the timing gear cover. The governor is driven off the camshaft gear and turns $1/8$ faster than crankshaft speed.

Flyweights are hinged to lugs on the drive gear. Hardened pins on the flyweights bear against a flanged sliding sleeve, moving it back and forth as the flyweights move in or out. The motion of the sleeve is transmitted through a ball thrust bearing to the governor lever, which in turn is connected to the carburetor throttle lever. A spring connected to the governor lever tends to hold the governor flyweights to their *inner* position, also to hold the carburetor throttle open. As the engine speed increases, centrifugal force in the flyweights acts against the spring and closes the throttle to a point where the engine speed will be maintained practically constant under varying load conditions. This speed can be varied to

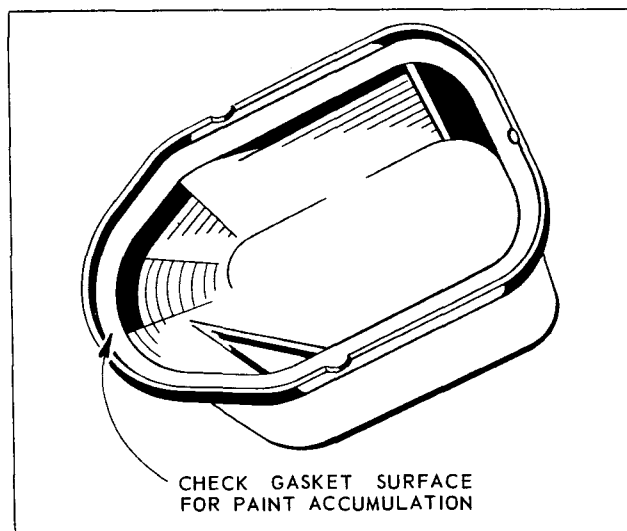


Fig. 15

suit conditions by adjusting the governor spring tension.

GOVERNOR ADJUSTMENT (Fig. 16, Fig. 17)

The governor rod connection to the carburetor must be very carefully adjusted for length, otherwise the governor will not function properly and cause the engine to surge badly. With the engine at rest, the governor spring will keep the flyweights *in*, and the control rod must be of such length as to hold the carburetor throttle wide open at that point.

With the *control rod* disconnected from the *governor lever*, as illustrated in *Fig. 16*, push the rod toward the carburetor as far as it will go. This will put the *carburetor throttle lever* in a wide open position. The governor lever should then be moved as far as possible in the same direction. Holding both parts in the above position, the rod should be screwed in or out of the *swivel block* on the carburetor, until the bent end of the rod will register with *hole* in lever, then screw rod in one more turn. The extra turn will shorten

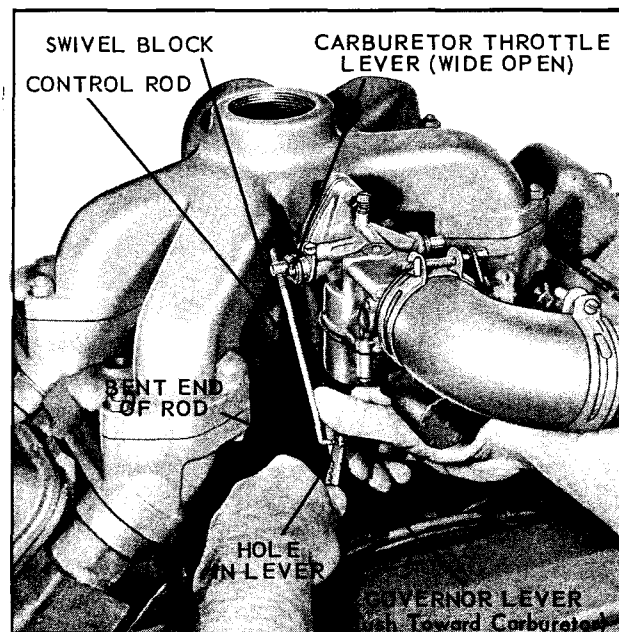


Fig. 16

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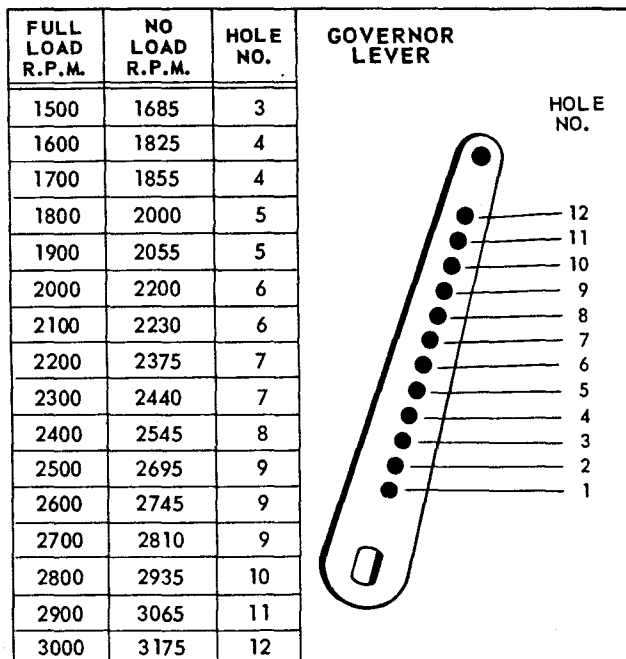


Fig. 17

the linkage slightly and will enable the carburetor throttle lever to bounce back from the stop pin rather than jam against the pin, when a load is suddenly applied to an idling engine. This will eliminate excessive wear on the threads in the carburetor throttle swivel block.

The governor lever, Fig. 17, is furnished with 12 holes for attaching the governor spring. It is very important that the spring is hooked into the proper hole to suit the speed at which the engine is to be operated. The Governor Lever Chart shows the full load and no load speeds of the engine and the hole corresponding thereto, for either a fixed speed, a variable speed or two speed (over-center idle control) governor. Note that the **full load** speed is less than the **no load** speed and this must be taken into consideration when readjusting the governor. As an example; if the engine is to be operated at 2000 revolutions per minute under load, the spring should be hooked into the 6th hole in the governor lever and the spring tension adjusted, by means of the adjusting screw, to run 2200 R.P.M. under no load. The speed at full load will then be approximately 2000 revolutions per minute.

A tachometer or revolution counter should be used against the crankshaft to check speed while adjusting the governor spring tension. Tightening the adjusting screw locknut will give higher speeds, while loosening the locknut will lower the spring tension and reduce the R.P.M.

CLUTCH AND REDUCTION UNITS

CLUTCH POWER TAKE-OFF (Fig. 18)

The clutch available on this engine is of the dry disc type. No oil should be put into the clutch housing, but grease gun fittings are provided for periodic bearing lubrication. The **housing bearing** should be greased every fifty hours of operation and the clutch **throwout**

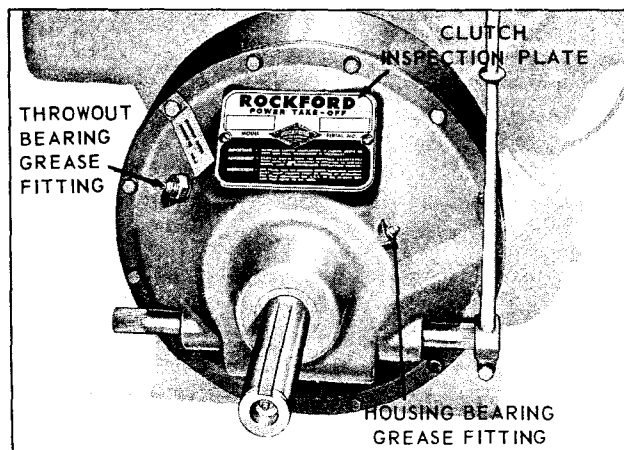


Fig. 18

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bearing greased every day before starting. Use Mobil Gargoyle grease BRB No. 3, Sinclair AF-1 grease, or equal.

Rockford PTA-4856 units have a sealed pilot bearing and require no external lubrication. *Obsolete* PTA-4819 units have a pilot bearing grease fitting at the end of the drive shaft and are lubricated same as the housing bearing.

CLUTCH ADJUSTMENT (Fig. 19 or Fig. 20)

If the clutch begins to slip it should be readjusted, otherwise it will become overheated and damaged. First, remove the clutch inspection plate and release the **clutch operating lever**. For the **Rockford clutch**, turn engine over by means of the hand crank until the **clutch adjustment lock** is visible thru the inspection opening in the clutch housing, see Fig. 19. The clutch must be held stationary, either by means of a drift punch wedged in place as shown, or by some convenient method of keeping the take-off shaft from turning. Loosen screw holding the **adjustment lock** in place. Insert a screw driver in one of the notches and turn the **adjusting ring** in a **counter-clockwise** direction, one notch at a time, until a very firm pressure is required to engage the clutch with the **operating lever**. Tighten adjusting lock screw and mount inspection cover.

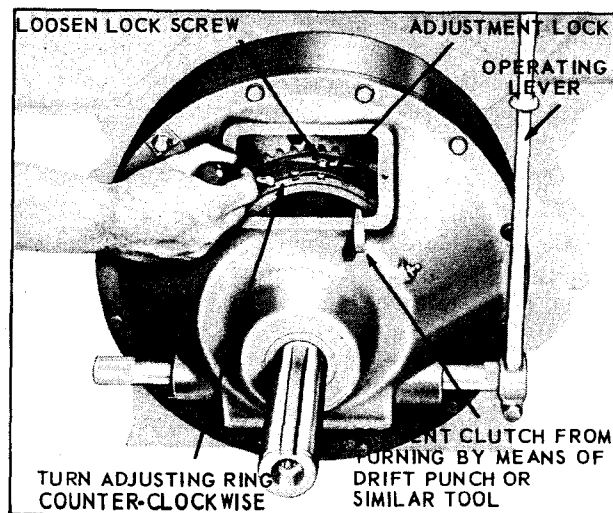


Fig. 19

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ROCKFORD CLUTCH ADJUSTMENT

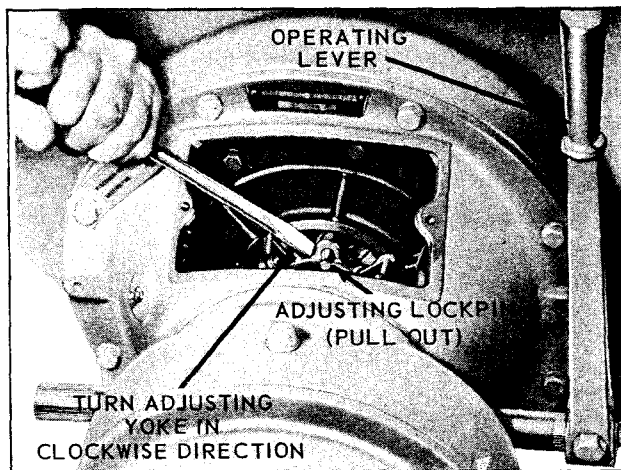


Fig. 20 104578C
TWIN DISC CLUTCH ADJUSTMENT

For the *Twin Disc* clutch, pull *adjusting lockpin* out and insert a piece of 1/16" diameter wire into the hole on the side of the lockpin to keep pin in outer position. See Fig. 20. Turn the *adjusting yoke* in a clockwise direction as shown, or wedge a screw driver into the adjusting yoke and against the side of the inspection hole opening to keep yoke from turning, and then turn the take-off shaft counter-clockwise. Tighten yoke enough so that the *operating lever* requires a distinct pressure to engage. Remove wire from lockpin and turn adjusting yoke slightly, to allow lockpin to snap into hole in floating plate.

A new clutch requires several adjustments until friction surfaces are worn in. **Do not let a new clutch slip**, this may ruin the friction surfaces.

CLUTCH REDUCTION UNIT (Fig. 21)

The clutch in the clutch reduction units is of the dry disc type, the same as is used in the power take-off units. Therefore, **no oil should be put in the clutch housing**.

The *throwout bearing* should be lubricated once a day before starting. Add grease to fitting thru opening on side of housing, as illustrated in Fig. 21, using the

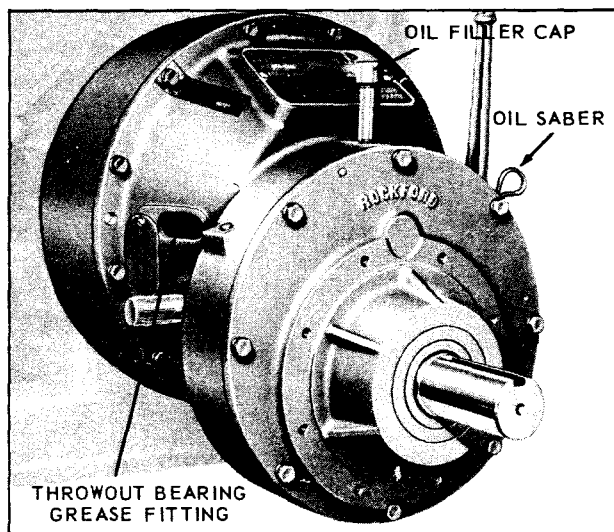


Fig. 21 226226C
ROCKFORD CLUTCH REDUCTION UNIT

same type grease as used in the clutch power take-off units. *Twin Disc* units have an external grease fitting for the throwout bearing.

The shifter shaft should be lubricated periodically, if external oil fittings are provided for this purpose.

The reduction unit is operated in oil and the gear case oil level must be maintained to the oil *saber gauge mark* or *plug opening*, see Fig. 21. In *Twin Disc* units, high grade transmission oil S.A.E. No. 90 to No. 110 Viscosity must be used. For *Rockford* units, use No. 30 S.A.E. crankcase oil. Change oil every 2000 hours of service, while unit is warm.

If clutch slips, heats, or operating lever jumps out, the clutch must be adjusted. Release clutch operating lever and remove hand hole plate. The *clutch* in the clutch reduction units is the same as is used in the clutch power take-off units. Refer to "Clutch Adjustment" paragraph for adjustment of the clutch in the *Twin Disc* and *Rockford* clutch reduction units. A new clutch generally requires several adjustments until the friction surfaces are worn in.

HIGH TEMPERATURE SAFETY SWITCH (Fig. 22)

The high temperature safety switch is mounted on the cylinder head near the *No. 4* spark plug. This safety switch will automatically stop the engine when head temperatures become critically high.

If an extreme cylinder head temperature causes the switch to automatically short out the ignition system and stop the engine, a waiting period of about *5 minutes* will be required before the switch has cooled off sufficiently to allow the engine to be re-started. An overheated engine will score the cylinder walls, burn out connecting rod and crankshaft bearings, also warp pistons and valves. The cause of the overheating condition will have to be remedied before the engine is re-started. See *Engine Overheats* paragraph in *Troubles, Causes and Remedies* section.

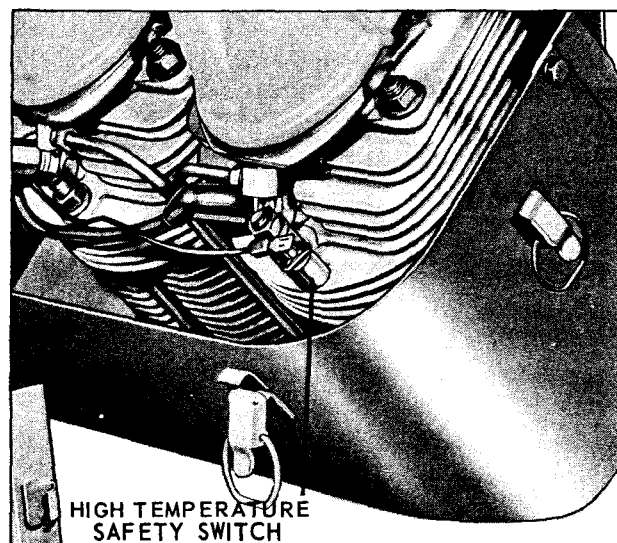


Fig. 22 277793C

TROUBLES CAUSES AND REMEDIES

Three prime requisites are essential to starting and maintaining satisfactory operation of gasoline engines. They are:

1. **A proper fuel mixture** in the cylinder.
2. **Good compression** in the cylinder.
3. **Good spark, properly timed**, to ignite the mixture.

If all three of these conditions do not exist, the engine cannot be started. There are other factors which contribute to hard starting; such as too heavy a load for the engine to turn over at a low starting speed, a long exhaust pipe with high back pressure, etc. These conditions may affect starting, but do not necessarily mean the engine is improperly adjusted.

As a guide to locating any difficulties which might arise, the following causes are listed under the three headings: **Fuel Mixture**, **Compression**, and **Ignition**. In each case, the causes of trouble are given in the order in which they are most apt to occur. In many cases the remedy is apparent and therefore no remedies are suggested.

STARTING DIFFICULTIES

FUEL MIXTURE

No fuel in tank or fuel shut-off valve closed.

Fuel pump diaphragm worn out or punctured.

Carburetor not choked sufficiently, especially if engine is cold. See *'Starting Procedure'*, Page 9.

Water, dirt, or gum in gasoline interfering with free flow of fuel to carburetor.

Anti-diesel solenoid valve ignition wire disconnected, shutting off fuel to main discharge jet.

Poor grade or stale gasoline that will not vaporize sufficiently to form the proper fuel mixture.

Carburetor flooded, due to excessive choking. See *'Starting Procedure'*, Page 9.

Dirt or gum holding float needle valve in carburetor open. This condition would be indicated if fuel continues to drip from carburetor with engine standing idle. Often tapping the float chamber of the carburetor very lightly with the handle of a screw driver will remedy this trouble. Do not strike carburetor with any metal tool.

If due to flooding, too much fuel entered the cylinder in attempting to start the engine, the mixture will most likely be too rich to burn. In that case, starting may be accomplished by continued cranking with the carburetor choke open.

To test for clogged fuel line, loosen fuel line nut at carburetor slightly. If line is open, fuel should drip out at loosened nut.

If the starter is *'dead'* or is unable to turn the engine over, check battery and cable connections at the bat-

tery, starting motor, and starting switch; also check for broken or frayed cables. Test starting switch and starting motor and replace or repair if necessary.

COMPRESSION

If the engine has proper compression, considerable resistance will be encountered in the pull on the starting crank. If this resistance is not encountered, compression is faulty. Following are some reasons for poor compression:

Cylinder dry due to engine having been out of use for some time. See *'Restoring Compression'*, Page 16.

Loose or broken spark plug. In this case, a hissing noise will be heard in cranking engine, due to escaping gas mixture on compression stroke.

Damaged cylinder head gasket or loose cylinder head. This will likewise cause hissing noise on compression stroke.

Valve stuck open due to carbon or gum on valve stem.

Valves adjusted with insufficient clearance under valve stems. See *'Valve Tappet Adjustment'*, Page 16.

Piston rings stuck due to carbon accumulation. If rings are stuck very tight, remove piston and connecting rod assembly and clean parts.

Scored cylinders. This will require reboring the cylinders and fitting with oversize pistons and rings, or replacement of complete cylinder barrels.

IGNITION

No spark may be attributed to the following:

Ignition cable disconnected from coil, distributor, or spark plugs.

Broken ignition cables, causing short circuits.

Ignition cables wet or soaked.

Spark plug insulators broken. Plugs wet or dirty.

Spark plug point gap wrong. See Page 16.

Condensation on spark plug electrodes.

Breaker points pitted or fused. Breaker arm sticking.

Distributor condensor leaking or grounded.

Spark timing wrong. See *'Timing'*, Page 12.

ENGINE MISSES

Spark plug gap incorrect. See Page 16.

Worn and leaking ignition cables.

Weak spark or no spark in one of the cylinders.

Loose connections at ignition cable.

Distributor breaker points pitted, worn or incorrect gap. See *'Distributor Timing'*, Page 13.

Water in gasoline.

Poor compression. See *'Compression'*, Page 20.

Sticky valves.

ENGINE SURGES OR GALLOPS

Carburetor flooded.

Governor spring hooked into wrong hole in lever.
Governor rod incorrectly adjusted. See *'Governor Adjustment'*, Page 17.

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

Gasoline vaporized in fuel lines, due to excessive heat around engine (Vapor Lock). See *'Stopping Engine'*, Page 10.

Vapor lock in fuel lines or carburetor due to using winter gas (too volatile) in hot weather.

Air vent hole in fuel tank cap plugged. Engine scored or stuck due to lack of oil.

Ignition troubles. See *'Ignition'*, Page 20.

Wire from anti-diesel solenoid to starting switch disconnected or damaged.

ENGINE OVERHEATS

Crankcase oil supply low. Replenish immediately.

Ignition spark timed wrong. See *'Neon Lamp Timing'*, Page 14.

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins on cylinder or head.

Engine operated in confined space where cooling air is continually recirculated, consequently becoming too hot.

Carbon in engine.

Dirty or incorrect grade of crankcase oil.

Restricted exhaust.

Engine operated while detonating due to low octane gasoline, or heavy load at low speed.

ENGINE KNOCKS

Poor grade of gasoline or of low octane rating. See *'Fuel'*, Page 9.

Engine operating under heavy load at low speed.

Carbon or lead deposits in cylinder head.

Spark advanced too far. See *'Neon Lamp Timing'*, Page 14.

Loose or burnt out connecting rod bearing.

Engine overheated due to causes under previous heading.

Worn or loose piston pin.

ENGINE BACKFIRES THROUGH CARBURETOR

Water or dirt in gasoline.

Engine cold.

Poor grade of gasoline.

Sticky inlet valves.

Overheated valves.

Spark plugs too hot. See *'Spark Plugs'*, Page 16.

Hot carbon particles in engine.

LOW or NO OIL PRESSURE

Oil pressure gauge defective.

Oil line to gauge clogged up.

Crankcase oil supply low.

Faulty oil pump.

Gears worn or broken.

Cover worn.

Loose cover or body.

Gasket damaged.

Faulty relief valve.

Clogged or leaky oil line connections.

Strainer screen clogged up.

Oil too thin due to dilution or too light of grade used.

Worn rod bearings.

Worn oil collet or collet seal.

'O' rings in oil collet coupling worn or hardened.

HIGH OIL PRESSURE

Oil pressure gauge defective.

Oil too heavy.

Faulty relief valve.

Clogged pressure line.

INSTRUCTIONS FOR PROTECTING ENGINES FOR WINTER OR SHORT STORAGE PERIODS

To protect the cylinders, pistons, rings and valves and keep them from rusting and sticking, a half and half mixture of kerosene and good engine oil, (the same kind of oil as used in the crankcase of the engine), should be injected into the pipe tap opening on the intake manifold while the engine is warm and running at moderate speed. About a quarter of a pint is necessary, or enough so that a heavy bluish smoke will appear at the exhaust. The ignition switch should then be shut off and the engine stopped. This fogging operation will leave a coating of oil on the above mentioned parts, protecting them from the atmosphere.

Drain crankcase oil while the engine is warm, as the oil will flow more freely than when cold.

Drain fuel lines, carburetor, fuel pump and tank of all gasoline, to prevent lead and gum sediment from in-

terfering with future operation. Gasoline fumes from gradual evaporation is a dangerous *fire hazard*.

The air cleaner should be thoroughly cleaned of all oil and accumulated dust, and the sediment removed from the oil cup at the bottom of the cleaner.

Tape or otherwise seal off the air cleaner or carburetor intake, as well as the exhaust and breather openings, for the duration of the storage period.

The outside of the engine, including the cooling fins on the cylinders and heads, should be thoroughly cleaned of all dirt and other deposits.

All exposed unpainted metal parts should be coated with grease or heavy oil.

Before starting the engine after the storage period, remove crankcase drain plug so that any condensation which may have collected may be drained before new crankcase oil is added. It is highly recommend-

ed that the crankcase bottom cover be removed and scrubbed of all sediment which may have collected there. When reassembling the bottom cover, a new gasket should be used.

Fill crankcase with the correct grade of oil to the full mark on the saber. Do not use any oil heavier than SAE No. 30. Also be sure to put oil to the proper level in the air cleaner. (Refer to Lubrication and Air Cleaner.)

It is advisable to use new spark plugs at the beginning of the operating interval, especially if the engine has given considerable service.

Refuel engine and follow the starting instructions as shown on preceding pages of this manual.

It is suggested that machines be stored inside a building. If this is not possible, protect the engine from the weather by a proper covering.

DISASSEMBLY AND REASSEMBLY OF ENGINE

Engine repairs should be made only by a mechanic who has had experience in such work. When disassembling the engine, it is advisable to have several boxes available so that parts belonging to certain groups can be kept together. Capscrews of various lengths are used in the engine, therefore great care must be exercised in reassembly so the right screw will be used in the proper place.

Tighten the capscrews and nuts of the manifolds, cylinder heads, gear cover, oil pan, connecting rods, cylinder barrels, main bearing plate and the spark plugs to the specified torque readings indicated in the paragraphs of reassembly, relative to these parts.

While the engine is partly or fully dismantled, all of the parts should be thoroughly cleaned. Use all new gaskets and 'O' rings in reassembly, and lubricate all bearing surfaces.

The following procedure is for complete disassembly of an engine. As disassembly progresses, the order may be altered somewhat, as will be self-evident to the mechanic. Reassembly of the engine should be made in the reverse order.

TESTING REBUILT ENGINE

An engine that has been rebuilt with new connecting rod shell bearings and having cylinders rebored or replaced, and fitted with new pistons, rings and valves, should go through a thorough "run-in" period before any load is applied to it.

The engine should be started and allowed to run for about one-half hour at about 1200 to 1400 R.P.M. without load. The R.P.M. should then be increased to engine operating speed, still without load, for an additional three and one-half to four hours.

The proper "running-in" of the engine will help to establish polished bearing surfaces and proper clearances between the various moving parts and thus add years of trouble free service to the life of your engine.

ACCESSORIES

Remove *clutch* or *clutch reduction* unit if engine is equipped with either of these accessories.

AIR CLEANER can be removed as a complete unit when flywheel shroud is removed. Disconnect tubing and elbow connection from carburetor to air cleaner.

CONTROL PANEL can remain on flywheel shroud, but disconnect: ignition wires from anti-diesel solenoid, starting solenoid, choke wire at carburetor, hose at oil pressure gauge, variable speed control, ignition wires at coil and voltage regulator (battery terminal).

OIL FILTER is removed by tapping side of cartridge with a mallet to break the seal. Then pierce can with screw driver or similar pointed tool to serve as a handle for unscrewing filter from case. Place a pan under the filter to catch oil leakage when filter is removed. Refer to "Oil Filter", Page 10, for replacement instructions.

STARTING MOTOR is removed by disconnecting ignition wires at solenoid and taking out the three capscrews holding starter to flange on gear cover. **Note:** The rubber Bendix cover will drop off when flywheel shroud is removed.

FLYWHEEL (Fig. 23, Fig. 24)

After the flywheel screen has been removed, drive out the starting crank pin in the crankshaft and straighten out the bent tabs on lockwasher. By means of a 2 1/4" socket power wrench or 2 1/4" offset box wrench, as shown in Fig. 23, remove flywheel nut. Strike the handle of the wrench a sharp blow with a soft hammer to loosen nut. Do not use an open end, monkey or pipe wrench.

The flywheel is mounted to a taper on the crankshaft. Take a firm hold on the flywheel fins, pull outward and at the same time strike the end of the crankshaft several times with a babbitt hammer, see Fig. 24. The flywheel will slide off the taper of the crankshaft. Do not use a hard hammer as it may ruin the crankshaft and bearings. Remove Woodruff key from crankshaft.

In reassembly; be sure the Woodruff key is in position on the shaft and that the keyway in the flywheel is

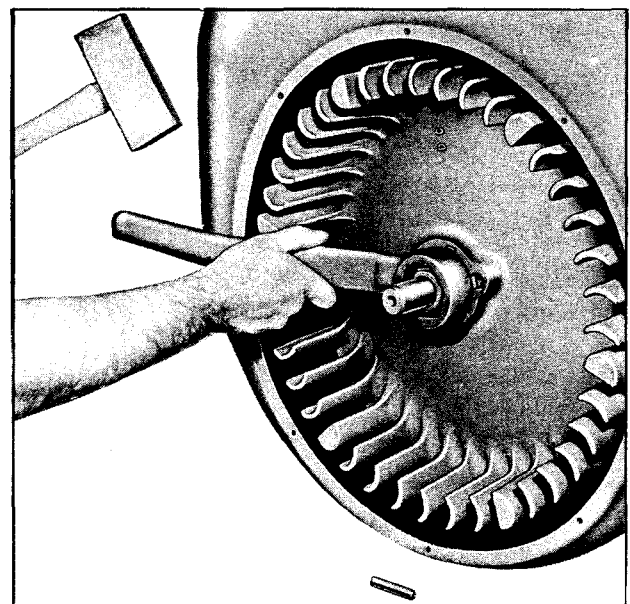


Fig. 23

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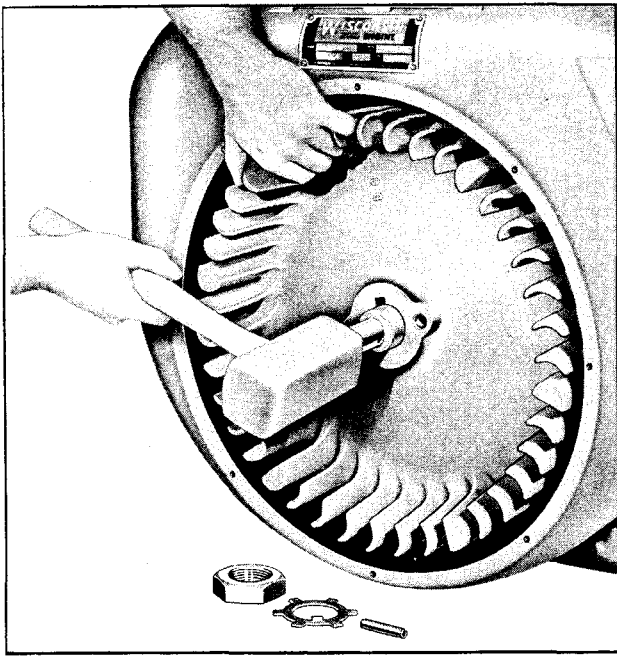


Fig. 24

277788C

lined up accurately with the key. After mounting; seat flywheel on crankshaft taper by slipping a piece of pipe over the end of the crankshaft and against the hub of the flywheel, and striking the end of the pipe a sharp blow with a hammer.

FLYWHEEL SHROUD (Fig. 25)

Remove *cylinder head covers* by dis-engaging 3 clips and taking out the thumb screw.

Disconnect No. 2 and No. 4 spark plug wires and hi-temperature switch wire. Slip wires thru grommet in shroud.

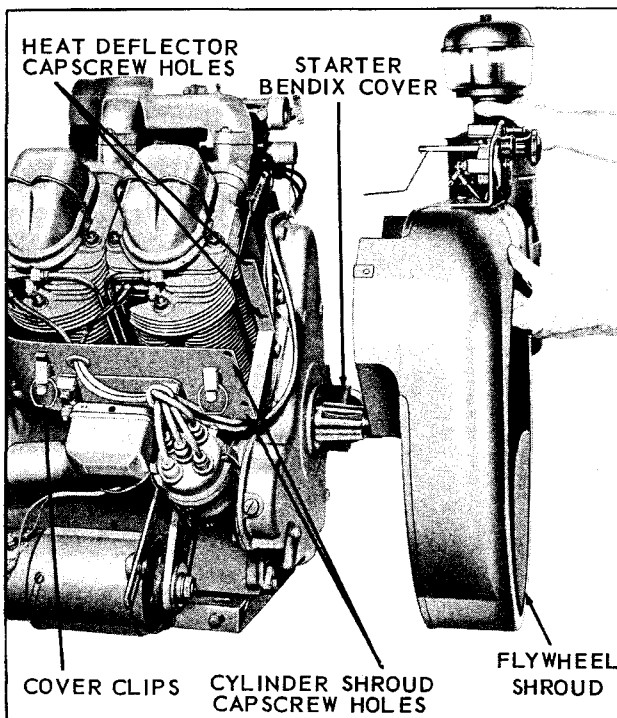


Fig. 25

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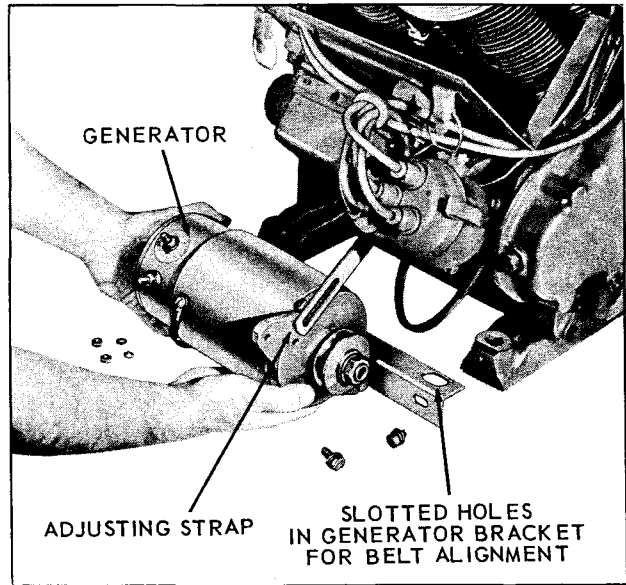


Fig. 26

277791C

Take out the following capscrews: 4 from flywheel shroud to cylinder shrouds, 4 from heat deflectors and 6 from inside flywheel shroud to gear cover. The *flywheel shroud*, air cleaner and control panel assembly can be removed as illustrated in Fig. 25.

In reassembly; insert rubber Bendix cover between flywheel shroud and starter pad on gear cover.

GENERATOR (Fig. 26)

Disconnect ignition wires from field and armature terminals. Take out the capscrew holding the adjusting strap to generator. By taking out the 2 capscrews which hold the bracket to the engine supports, the generator can be removed as shown in Fig. 26.

Note that the holes in the generator bracket are slotted for belt alignment in reassembly.

DISTRIBUTOR AND ACCESSORY DRIVE (Fig. 27)

Disconnect ignition wire at distributor and take off distributor cap, leaving high tension cables in place. Remove 2 capscrews holding the accessory drive housing to the gear cover. As illustrated in Fig. 27, the distributor and accessory drive housing can be withdrawn from the gear cover as a complete unit.

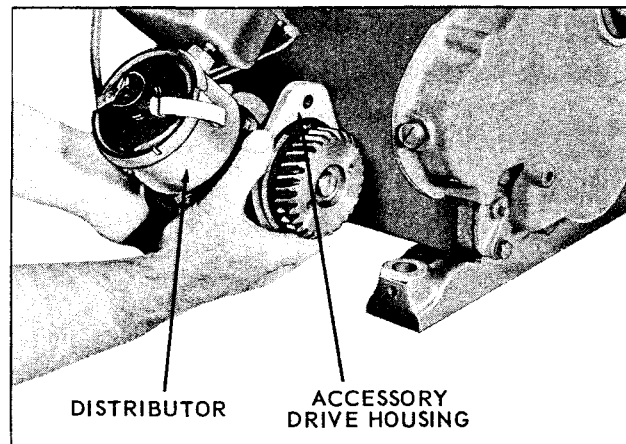


Fig. 27

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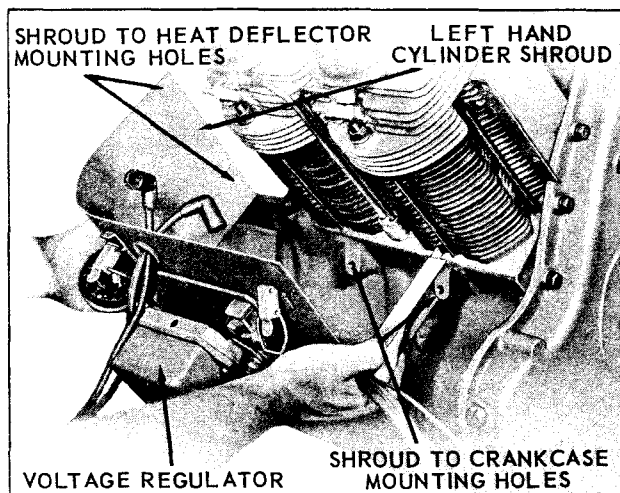


Fig. 28

277800C

CYLINDER SHROUDING (Fig. 28)

Remove ignition coil and generator adjusting strap from left hand side of engine. Disconnect No. 1 and No. 3 wires at spark plugs and remove spark plug wire clamps at top of governor housing. Take out the 2 capscrews which attach the cylinder shroud to the heat deflector at the take-off end of the engine and the 2 screws mounting the shroud to the crankcase. The left hand cylinder shroud with voltage regulator and spark plug wires attached can be removed as shown in Fig. 28. Right hand cylinder shroud is removed in like manner.

MANIFOLD AND CARBURETOR (Fig. 29)

Disconnect fuel line at carburetor and control rod at governor lever. Unhook governor spring and remove the 4 nuts and clamp washers which secure the manifold to the cylinder heads. The two manifold branches, carburetor and speed control bracket assembly can be lifted off as a complete unit. See Fig. 29.

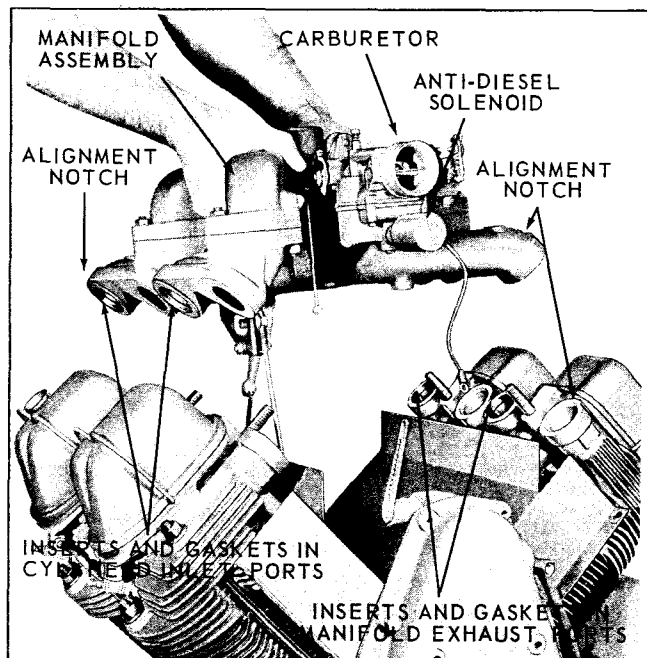


Fig. 29

277792C

Note that the exhaust manifold gaskets and inserts will remain in the cylinder head ports, whereas the inlet gaskets will stay in the manifold ports. New gaskets should be mounted accordingly in reassembly.

To prevent restriction in ports because of misalignment between the manifold and cylinder heads, there is a cast notch on top of the No. 2 and the No. 3 inlet ports of the manifold. These notches are to match up with a similar notch on the inlet port of the cylinder heads in reassembly. Tighten manifold to cylinder head nuts to **25 foot pounds torque**. The upper to lower manifold nuts are tightened to **15 ft. lbs. torque** and the anti-diesel solenoid mounted to the carburetor is tightened to **100 inch pounds torque**.

FUEL PUMP

Loosen screw on heat deflector at fuel pump. Remove 2 capscrews holding pump adapter to crankcase. Swing heat deflector bracket to one side and remove complete pump adapter and strainer assembly.

GOVERNOR

Remove the 2 bottom screws holding the governor housing to the gear cover and spacer plate. Top 2 screws were removed when spark plug wire clamps were taken off. After removing governor housing, the gear and flyweight assembly can be slipped off shaft in gear cover.

In reassembly; refer to "Governor Adjustment" in 'Operating Instruction Section' of manual, for setting engine operating speed.

GEAR COVER (Fig. 30)

Remove capscrews from front face of gear cover and 2 screws from rear at No. 2 cylinder. Tap gear cover

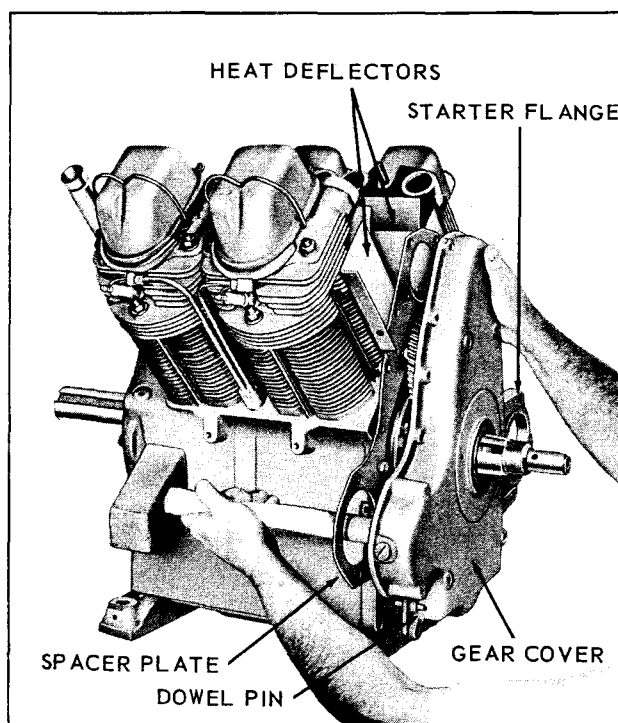


Fig. 30

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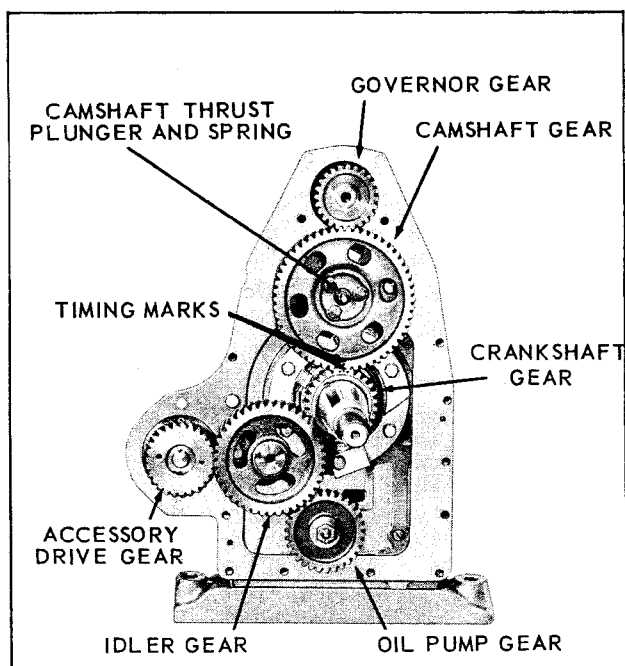


Fig. 31

277784C

alternately, from starter flange to accessory drive housing opening, and remove as illustrated in Fig. 30. Note that dowel pins will remain in cover. Cylinder heat deflectors can now be removed.

In reassembly; tighten gear cover capscrews to 18 foot pounds torque.

GEAR TRAIN (Fig. 31)

With the removal of gear cover and oil sling, the gear train will be exposed as shown in Fig. 31. Remove camshaft thrust plunger and spring to prevent their being lost.

Future reference can be made to Fig. 31 when assembling crankshaft and camshaft, as accurate location of the timing marks is essential for proper engine operation.

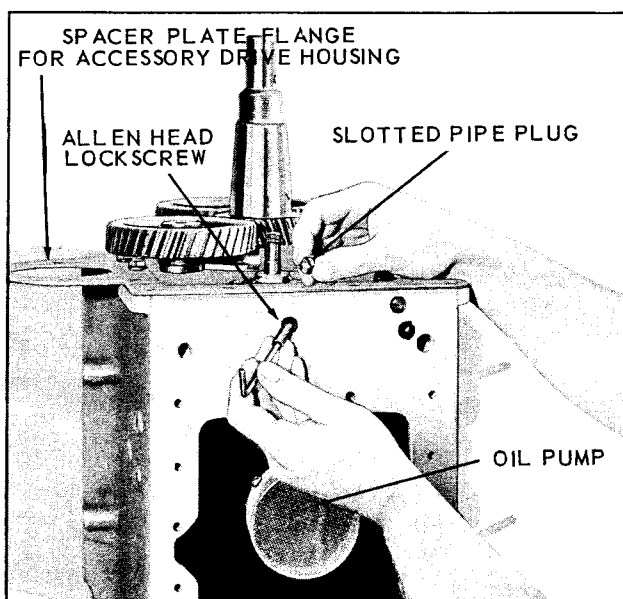


Fig. 32

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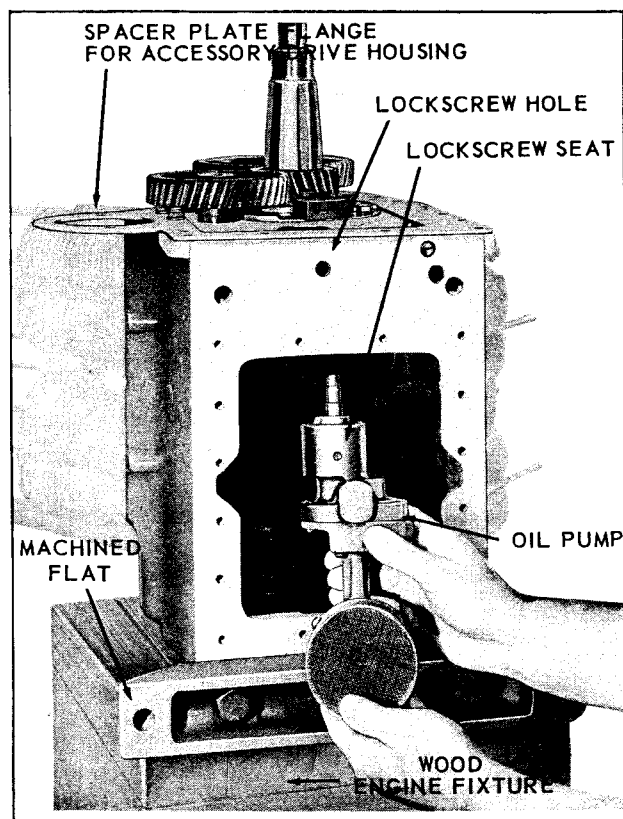


Fig. 33

277783C

ENGINE SUPPORTS AND OIL PAN (Fig. 33)

Use a work bench with a clearance hole of at least 2¼ inches in diameter for the engine crankshaft to extend thru, and tip the engine over to rest on the main bearing plate — or, if convenient, construct an engine fixture by making a box from 2 x 6 lumber as illustrated in Fig. 33. Make the box about 16 inches square x 8 inches high with a 2¼ inch clearance hole in the top, and open at the bottom.

With engine tipped over on take-off end, remove engine supports and oil pan. *In reassembly;* use a new gasket underneath oil pan, mount with oil drain toward side opposite flange on spacer plate for accessory drive housing, and tighten capscrews to 18 foot pounds torque.

Mount engine supports with machined flats toward flange side of spacer plate where accessory drive housing is mounted. Use Perma-tex on capscrews for both engine supports and oil pan. Tighten capscrews for engine supports to 40 foot pounds torque.

OIL PUMP (Fig. 32, Fig. 33)

Remove locknut and driver gear from shaft. If gear is too tight to remove by hand, use a pulley; hammering on end of shaft to loosen gear will damage pump.

Take out slotted pipe plug from bottom of crankcase, and with a 5/32 inch Allen wrench, remove lock screw as shown in Fig. 32. Withdraw the oil pump from inside the crankcase, as illustrated in Fig. 33. If pump fits too tight to remove by hand, tap front of pump housing (not shaft), with hammer and brass rod.

In reassembly; be sure lock screw seat in pump housing lines up with lock screw hole in crankcase.

SPECIAL FEATURE

Individual cylinder heads, barrels, pistons and rings can be removed for replacement without a major engine disassembly, by means of a special piston sleeve.

Refer to Fig's. 34, 36, 37 and

Cylinder Head, Cylinder Barrel paragraphs.

CYLINDER HEAD (Fig. 34, Fig. 35)

Remove rocker arm cover by means of a screw driver wedged under the bail wire. Take off the 4 nuts and washers from cylinder barrel studs. Lift cylinder head and rocker arm assembly off cylinder. The oil drain line will slip out of adapter in crankcase. Pull out push rods and rod housings. See Fig. 34.

In reassembly; place a new 'O' ring under collar of push rod housing. Press collar end of tube into tappet hole by hand; do not drive tubes in place with a hammer. Use new 'O' ring for push rod housing to recess in cylinder head. Spread a light film of grease on cylinder head gasket so it will stick in place during reassembly. Place new 'O' ring on oil drain tube.

Note: When reassembling cylinder heads on a complete overhaul, it will be necessary to square up the inlet and exhaust port flanges with those of the manifold. See Fig. 35. Place a parallel steel bar across the ports and tap the heads lightly with a rubber mallet to rotate them until they are square. Turn cylinder head nuts to a snug fit and re-check alignment.

Torque cylinder head nuts alternately and in 3 steps. First 8, then 15, and finally 20 foot pounds torque.

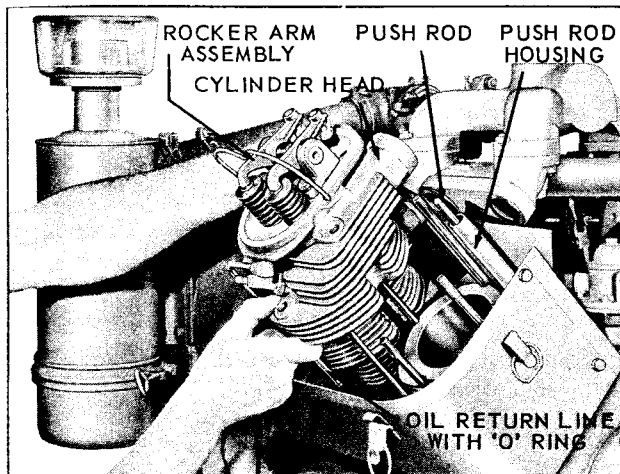


Fig. 34

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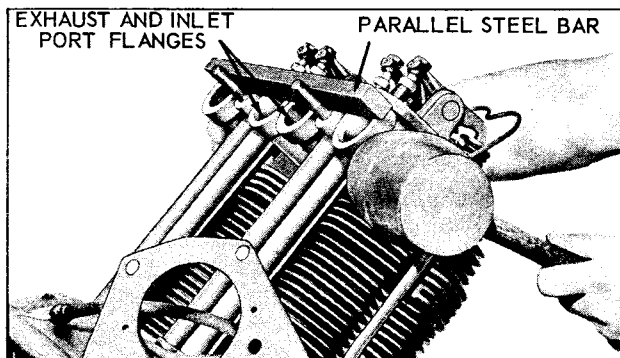


Fig. 35

277794C

Rocker arm assembly can be left bolted to the cylinder head, unless head or rocker arms need replacing.

CYLINDER BARREL (Fig. 36, Fig. 37)

Turn crankshaft over until piston, in the cylinder barrel that is to be replaced, is at the top of its stroke. **Remove;** top cylinder stud (flanged) on Model V-461D, or hold down clip as used on Model V-465D. The remaining studs can be disassembled after cylinder is taken off.

In reassembly; place a new gasket at bottom of cylinder barrel. It will be necessary to compress the piston rings in order to slip the cylinder over the piston, as shown in Fig. 37. A **piston sleeve** can be made from the lower portion of a scrap cylinder. The sleeve is 2¼ inches long with a 7/8 inch wide slot. The inside diameter is tapered from the middle to the bottom;

3.750" to 4.000 for V-465D

3.500" to 3.750 for V-461D, V-460D

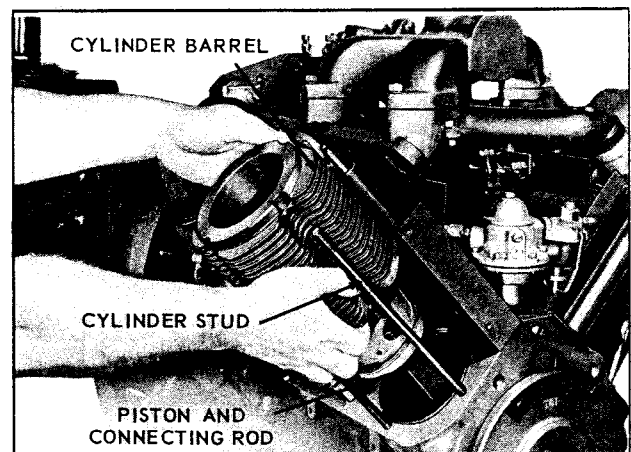


Fig. 36

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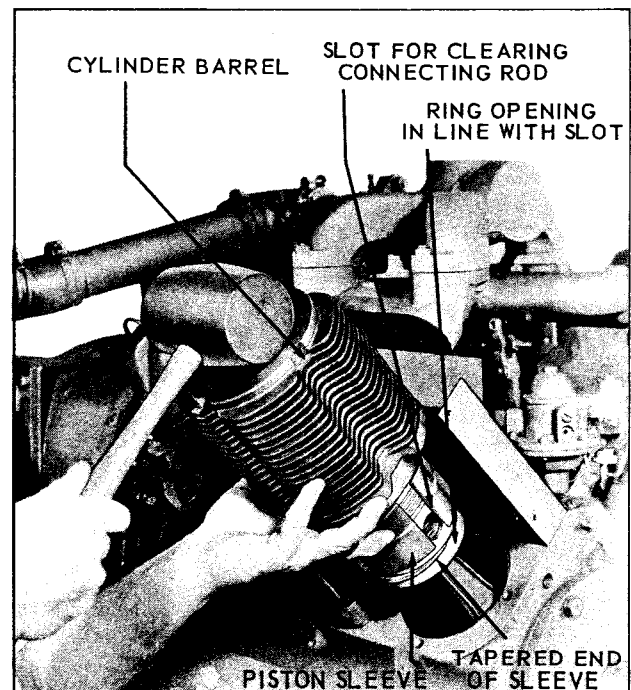


Fig. 37

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Slip sleeve over and slightly below top of piston. Extension of piston out of sleeve will act as a pilot for mounting cylinder. Lubricate cylinder bore and press barrel on to piston and against sleeve. Force piston into bore by tapping cylinder barrel with a rubber mallet, as illustrated in Fig. 37. When bottom ring of piston is securely in cylinder, lower sleeve and remove thru slot. Continue to press barrel over piston until it is snug against crankcase. Mount cylinder studs and remainder of parts per 'Cylinder Head' paragraphs of reassembly.

CYLINDER, PISTON and CONNECTING ROD (Fig. 38, Fig. 39)

After removing cylinder heads and before attempting to loosen connecting rod caps, it is advisable to hold down both banks of cylinder barrels, lest they become loosened and damaged when rotating the crankshaft. This can be accomplished by means of a steel **retainer bar** and the cylinder hold down studs, as shown in Fig. 38.

Insert a drift punch in crankshaft crank pin hole, and turn shaft over so that the nuts for the No. 1 connecting rod cap are accessible. Take off the 2 nuts, loosen

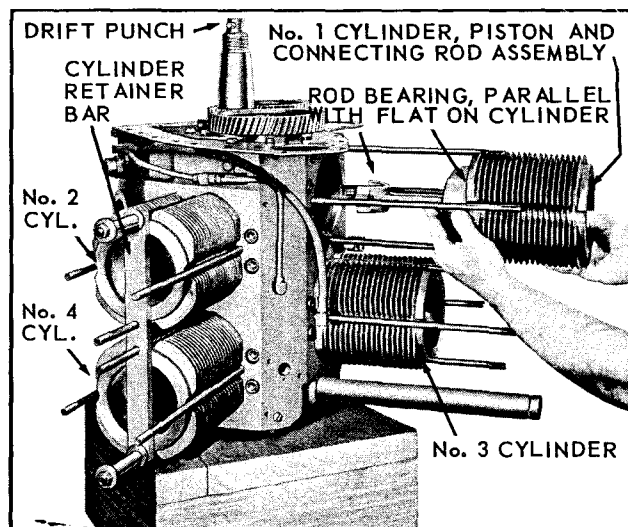


Fig. 38

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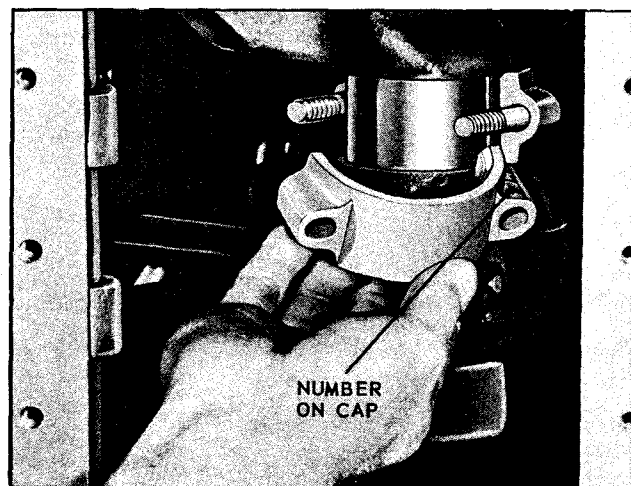


Fig. 39

281382C

and remove connecting rod cap by tapping lightly on the end of the bolts. Use a brass rod so as not to upset bolt threads. Remove cylinder retainer bar and withdraw cylinder barrel, piston and connecting rod, as illustrated in Fig. 38. Place cap on rod immediately so that it will not be mismatched in reassembly. Remove No. 3 cylinder assembly, and then do likewise with the No. 2 and 4 cylinder bank.

Identical numbers are stamped on the side of the rod with its corresponding cap. These numbers must be on the same side of the connecting rod in reassembly. See Fig. 39. Install new nuts on connecting rod bolts and torque to 32 foot pounds.

Cylinder barrels should be put back on the crankcase in the same location they were removed from. Use a new gasket at bottom of barrel. Clean all dirt and chaff from between fins and bottom of flange.

If the cylinders are worn more than .005 inch over-size, they should be reground and fitted with over-size pistons and rings. This work should be done by an authorized service station.

If in the opinion of the service station attendant, a chrome re-ring is necessary, use **Wisconsin TriCrome** piston ring set indicated in Parts List Section.

PISTON RINGS (Fig's. 40, 41, 42)

If a ring expander tool is not available, install rings by placing the open end of the ring on piston first, as shown in Fig. 40. Spread ring only far enough to slip over piston and into correct groove, being careful not to distort ring. Assemble bottom ring first and work upward, installing top ring last. The outer diameter of the top compression ring is **chrome plated**. Mount scraper ring with scraper edge down, otherwise oil pumping and excessive oil consumption will result. Refer to Fig. 41 for correct placement of rings for the V-460D, V-461D and V-465D.

PISTON (Fig. 42, Fig. 43)

The piston skirt is **cam-ground** to an elliptical contour. Clearance between the piston and cylinder must be measured at the bottom of the piston skirt thrust face. Refer to Chart, Fig. 42, for proper clearance. The thrust face on the piston skirt is 90° from the axis of the piston pin hole.

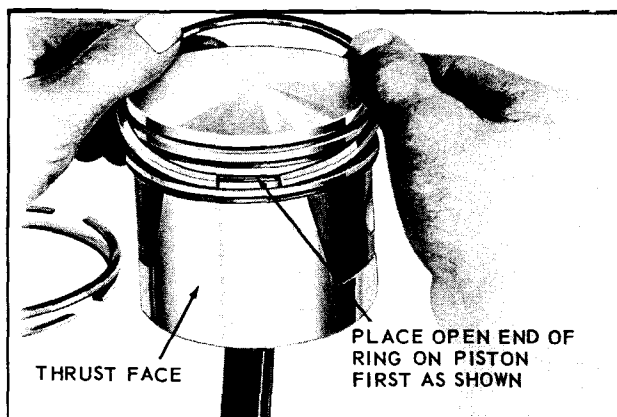


Fig. 40

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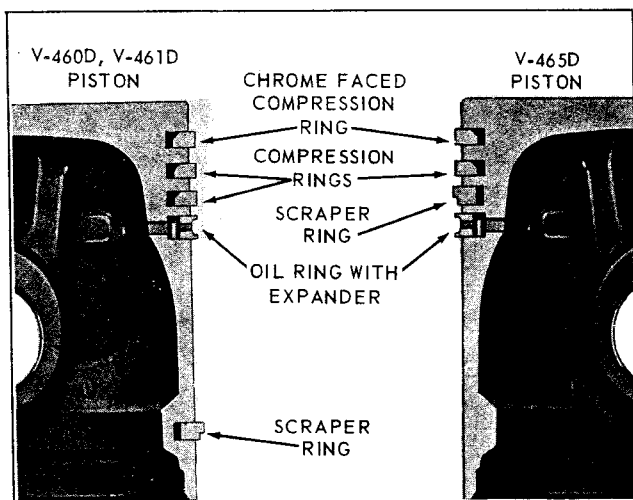


Fig. 41

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CYLINDER BORE	Models V-460D, V-461D 3.498 to 3.499"	Model V-465D 3.748 to 3.749"
PISTON TO CYLINDER AT PISTON SKIRT THRUST FACES		.0025 to .003"
Piston Ring Compressed Gap		.008 to .024"
PISTON RINGS - SIDE CLEARANCE IN GROOVES		.002 to .004"
CONNECTING ROD TO CRANK PIN - SIDE CLEARANCE		.008 to .016"
CONNECTING ROD SHELL BEAR- ING TO CRANK PIN		.0005 to .0018"
PISTON PIN TO CONNECTING ROD BUSHING		.0005 to .0011"
PISTON PIN TO PISTON		.0000 to .0008" tight

STANDARD CRANK PIN DIMENSIONS	
1.072	1.355
1.062	1.350 WIDTH
2.1238	
2.1233	DIA. GRIND ALL CRANK PINS
2.3005	
2.3000	DIA. GRIND CENTER MAIN BEARING

Fig. 42, PISTON, RING AND ROD CLEARANCE
CRANKPIN AND CENTER BEARING DIMENSIONS

Piston and connecting rod is sub-assembled to the cylinder barrel and the complete unit is mounted to the crankcase. Lubricate the piston assembly and cylinder walls with No. 30 S.A.E. oil, and stagger the ring gaps 90° around the piston. Use a standard

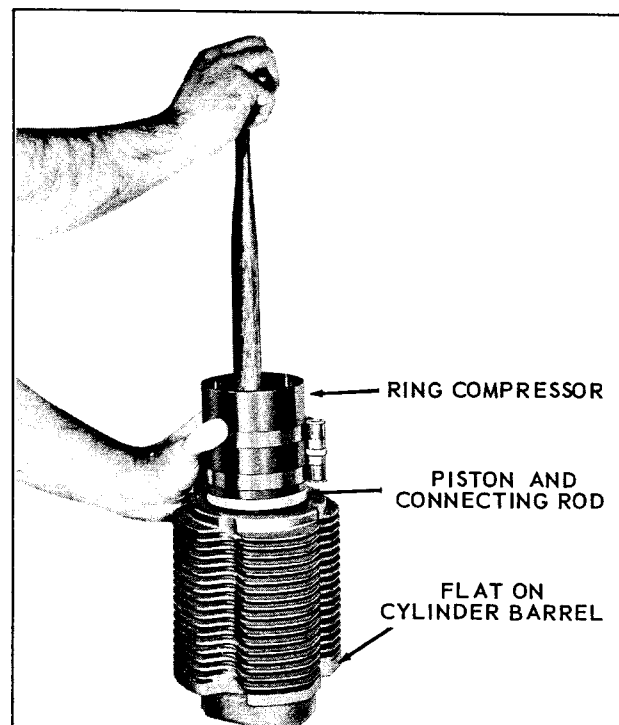


Fig. 43

277789C

automotive type ring compressor, and insert rod end into cylinder from cylinder head end. **Note:** Rod bearing should be parallel to flats at base of cylinder barrel for correct assembly to crankshaft, see Fig. 38. Gently tap piston into cylinder and to bottom of bore. Use the wooden handle end of hammer, as shown in Fig. 43.

VALVES (Fig. 44)

Replace valves that are burned or pitted. A leaky valve can usually be determined by a 'hissing' noise in the exhaust or intake manifold when cranking the engine slowly by hand.

The exhaust valves are furnished with **positive type rotators**. Refer to *Parts Section* for mounting. The valve rotates slightly each time it opens, and thereby prevents the build up of foreign deposits on the valve face and stem.

Valve grinding should be done by an authorized service dealer, since he has the necessary equipment and experience to do a good job. To remove valves; use a standard automotive valve lifter as illustrated in Fig. 44, and remove spring seat locks. Release valve lifter and take out valve, spring and exhaust rotator or spring seat.

The valve face is ground at 45° to the vertical center line of the valve stem and the valve seat insert should also be ground at a 45° angle. After grinding, valves and inserts should be lapped with a suitable lapping compound or they will leak due to improper seating, within the first few hours of operation. While lapping, occasionally lift the valves and reset them

in a different position to insure a uniform seat which will show entirely around the valves. After valves have been lapped in evenly, remove them from the head and wash the valves and head thoroughly with gasoline or kerosene and reassemble.

Valve guides in the cylinder head are replaceable. The valve stem has a clearance of .002" to .004" in the guide. When the clearance becomes .006", the guide should be driven out and a new guide pressed in place. Allow 1/32" to 1/64" clearance between

the valve guide boss and the bottom of the valve guide shoulder. Check guide for .3440/.3445 dia. after pressing in place. Ream if necessary.

VALVE SEAT INSERTS are not replaceable, due to method of installing. If seat inserts become worn and ground down to the extent that the seats are wider than the valve face, the cylinder head will have to be replaced.

ROCKER ARM ASSEMBLY (Fig. 44)

Very little wear will occur to the rocker arms as long as they are adequately lubricated. If replacement is

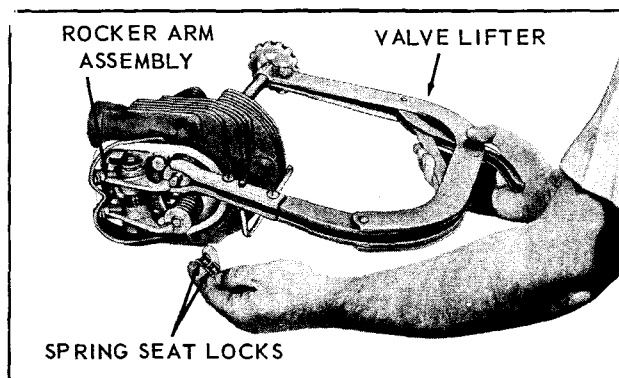


Fig. 44

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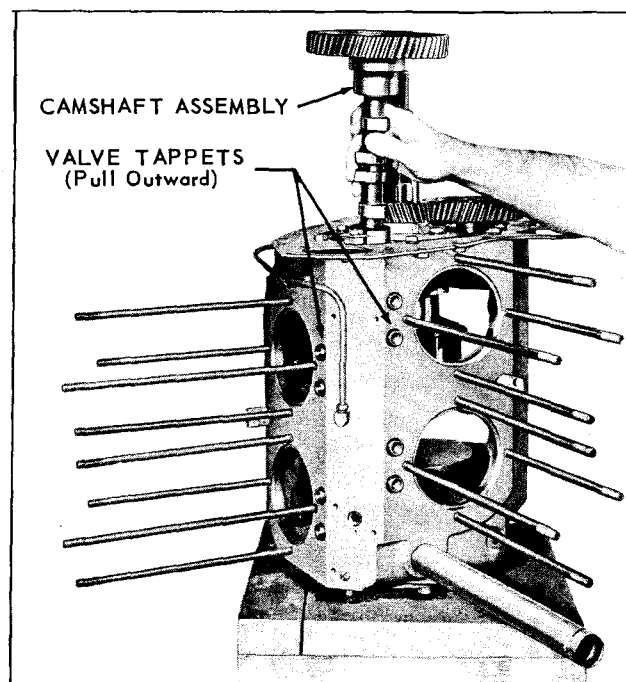


Fig. 45

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necessary, remove the complete rocker arm bracket assembly, shown in Fig. 44, from the cylinder head. Take out shaft setscrew from bottom of bracket with a 1/8" Allen wrench, and tap shaft out toward set screw end of bracket, using a brass rod.

In reassembly be sure set screw seat in shaft is lined up with tapped hole in bracket. After tightening set screw in place, prick punch threads to prevent screw from falling out. Lubricate shaft so that rocker arm bearings won't operate 'dry' when engine is started.

CAMSHAFT (Fig. 45, Fig. 46)

Pull tappets outward to clear lobes on camshaft while it is being removed, as illustrated in Fig. 45. Withdraw tappets from inside the crankcase. *In reassembly*, clean and lubricate tappets. Insert thrust plunger and spring into end of camshaft, as these hold shaft in place endwise. See Fig. 46.

The *camshaft gear*, shown in Fig. 46, has offset mounting holes to provide accurate assembly for valve timing. The gear can only be put on the correct way for matching up the timing mark with that of the crankshaft. See *Gear Train*, Fig. 31, or Fig. 46.

CRANKSHAFT (Fig's. 47, 48, 49)

With reference to Fig. 47, remove oil coupling from crankshaft oil collet by taking out the capscrew

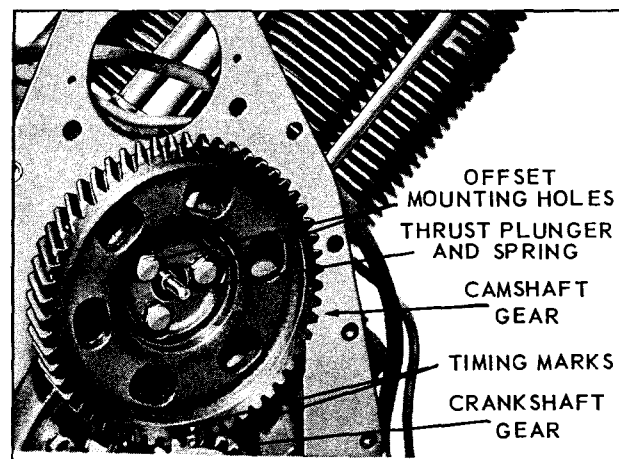


Fig. 46

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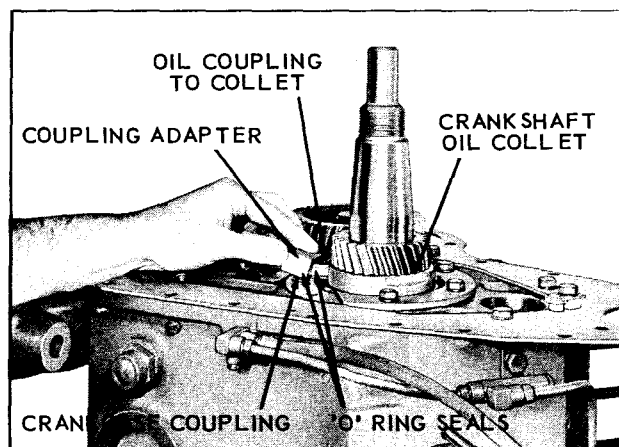


Fig. 47

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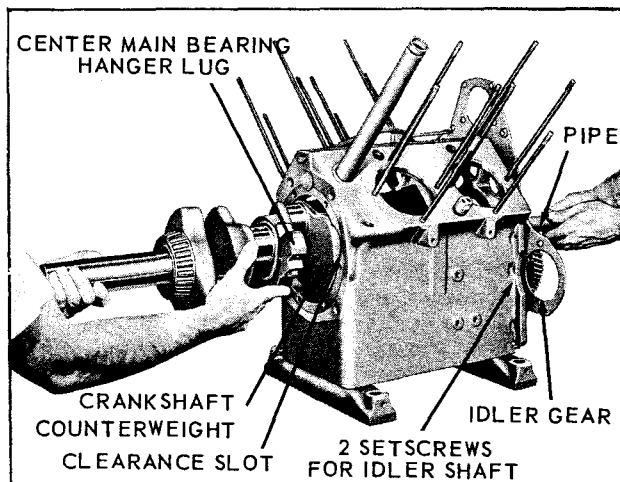


Fig. 48

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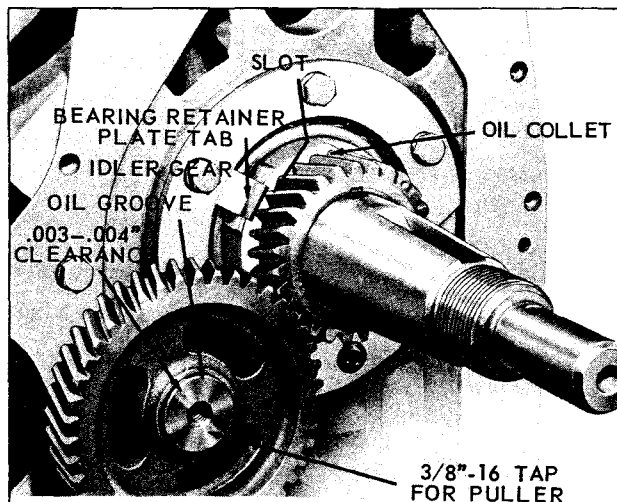


Fig. 49

277802C

which holds the coupling adapter to crankcase face. Slip oil coupling out of collet. *In reassembly*; use new 'O' ring seals at both ends of the coupling and on the shoulder of the coupling pressed into the crankcase. Lubricate 'O' rings for ease in assembly.

Take off the 2 capscrews and 2 spacers (used with 3" long capscrews), holding the center main bearing hanger to crankcase, and then tip the case back on the engine supports. Remove the main bearing plate, gaskets and shims from take-off end of engine. Slip a length of pipe over the gear end of the crankshaft and with the assistance of another person, withdraw the shaft thru the main bearing plate opening, as illustrated in Fig. 48.

Note: It will be necessary to rotate the crankshaft when withdrawing it so counterweights clear the lugs in the crankcase for the center main bearing, and the lugs on the center bearing hanger will have to line up with the clearance slots in the crankcase face.

In reassembly; rotate crankshaft oil collet so that slot engages with tab on bearing retainer plate, as illustrated in Fig. 49. Mount main bearing plate, gaskets and shims, and torque capscrews to 32 foot pounds. Check end play and add or remove gaskets to give the necessary .002 to .004 inch movement,

with engine cold. Refer to **Center Main Bearing** paragraphs for resumption of assembly.

IDLER GEAR AND SHAFT (Fig. 48, Fig. 49)

With a 5/32 inch Allen wrench, remove the 2 set screws mounted in side of crankcase shown in Fig. 48, that lock the idler gear shaft in place. Use a puller to remove idler shaft from crankcase. A 3/8"-16 tapped hole in the end of the shaft is provided for this purpose.

In reassembly; be sure oil groove in shaft is facing up. Drive shaft into crankcase with soft metal hammer and maintain a .003 to .004 inch clearance between idler gear and shoulder of shaft, see Fig. 49. Lock shaft in place with the 2 Allen set screws.

CENTER MAIN BEARING (Fig's. 50, 51, 52, 53)

Loosen and back out bearing hanger capscrews approximately 1/2 inch. Tap capscrew heads lightly and alternately with a hammer, as illustrated in Fig. 50, to break cap away from hanger body. **Do not pry cap and body apart.** Remove capscrews and separate hanger and cap from bearing. Take off retaining ring from outer bearing race and remove bearing halves and rollers from crankshaft.

In reassembly; coat inside of bearing halves with a low melting point grease or petroleum jelly. **Do not use a standard lubricating grease.** With reference to Fig. 51, press 16 rollers into the grease of each of the bearing halves; assemble to crankshaft and clip

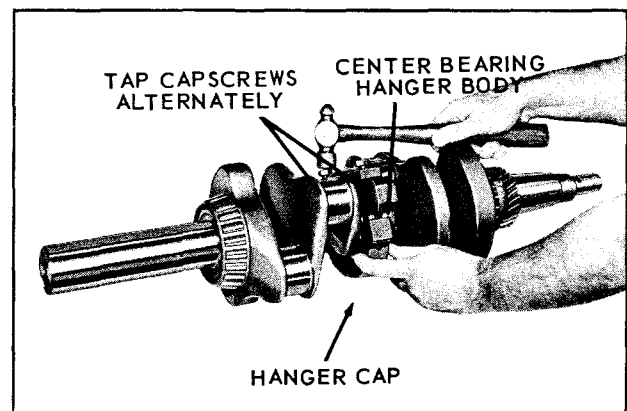


Fig. 50

277776C

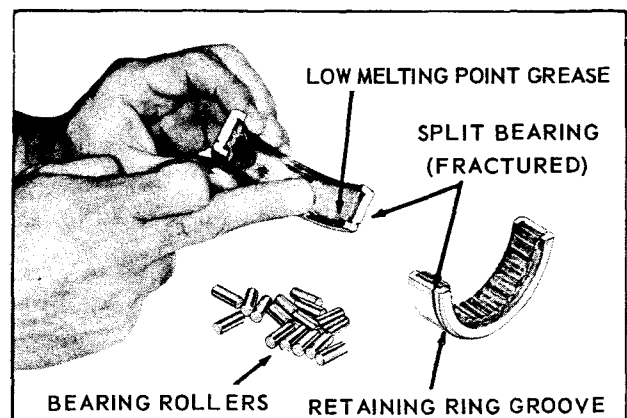


Fig. 51

277778C

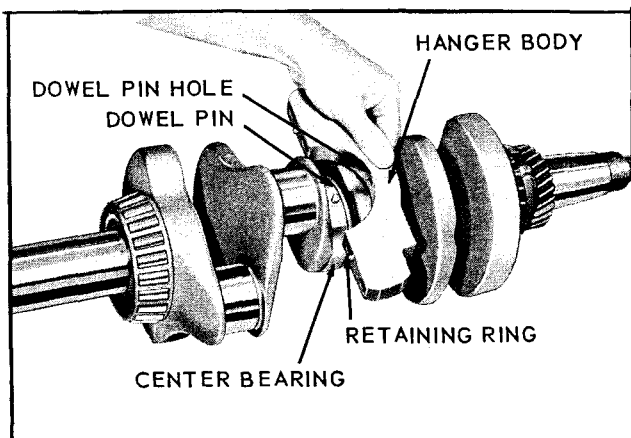


Fig. 52

277777C

together with retaining ring. The ring must overlap both mating edges of the bearing. Insert shouldered dowel pin into either hole of the bearing race and place the hanger body against the bearing so the dowel slips into the dowel pin hole, *see Fig. 52*. Hold hanger body against bearing, place cap in position and draw the capscrews finger tight until the 2 dowels are just entering holes. With a hand wrench, alternately turn each screw $\frac{1}{2}$ to $\frac{3}{4}$ turns to evenly draw cap tight to hanger body. **Torque** capscrews to **40 foot pounds**, alternately in 3 stages; 15, 30 and 40 ft/lbs. A few squirts of oil in the hanger cap oil hole will help to dissolve the bearing grease.

Secure **bearing hanger to crankcase** after crankshaft end play is adjusted. **Note:** Beginning with engine serial No. 4052826, the capscrews for mounting the bearing hanger to crankcase were lengthened to 3 inches, and a spacer added under the screw heads, *see Fig. 53*. Thus all 4 screws for the center main bearing hanger assembly are the same, minimizing the possibility of improper assembly. Install hanger capscrews, with spacers, finger tight and position bearing hanger so that there is a minimum of .040

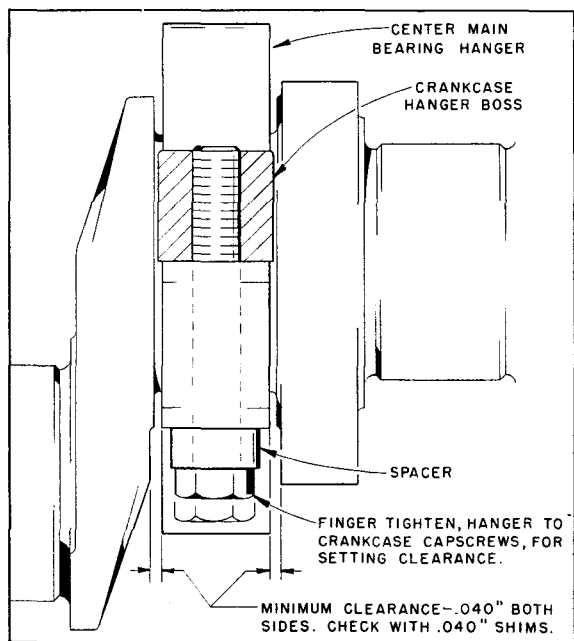


Fig. 53

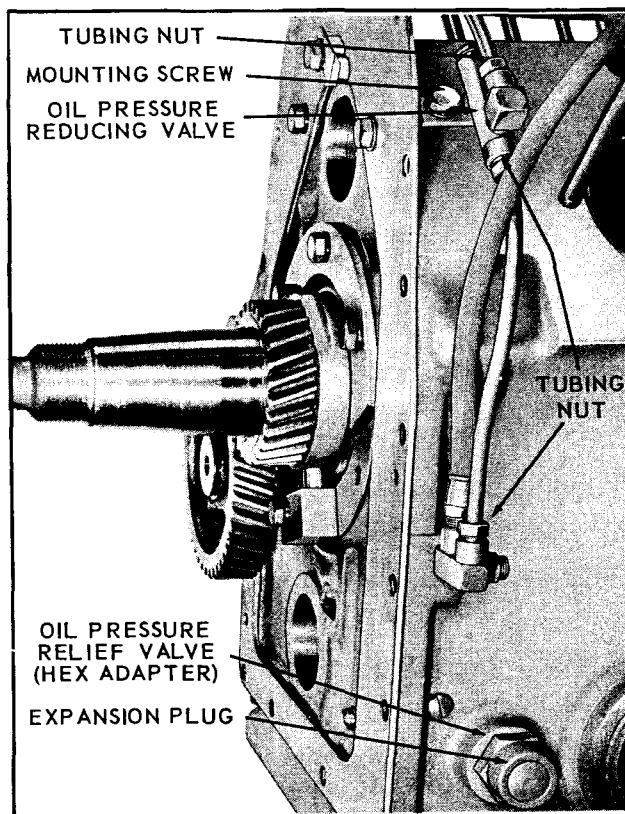


Fig. 54

277780C

inch clearance between the sides of the bearing hanger and crankshaft cheeks. Tighten hanger to crankcase capscrews, **60 foot pounds torque**.

OIL PRESSURE RELIEF VALVE (Fig. 54)

If it becomes necessary to remove the oil pressure relief valve, illustrated in *Fig. 54*, either for cleaning or replacement; first unscrew hex adapter and remove expansion plug from adapter. With a $\frac{3}{16}$ inch Allen wrench, remove outer adjustment lockscrow, *see Fig. 3*. Insert a $\frac{1}{4}$ inch rod into the cross hole in valve body and turn counter-clockwise for removal. **Do not** use a pipe wrench or pliers to remove valve body.

In reassembly; use new 'O' ring in valve body and apply sealer to threads of hex adapter. Assemble expansion plug after adjusting pressure as per "**Oil Pressure Adjustment**" instructions at front of manual.

OIL PRESSURE REDUCING VALVE (Fig. 54)

To replace the oil pressure reducing valve, illustrated in *Fig. 54*, loosen the 4 oil line nuts; at the valve and at the fittings on top and side of crankcase. Remove valve mounting capscrew and lift valve away from crankcase. The oil lines will become unseated without being deformed.

In reassembly; hold valve in proper location but do not mount. Place oil lines in position and engage tubing nuts 2 to 3 turns. Secure valve in place with capscrew and then tighten tubing nuts.

After completing reassembly, operate engine in accordance with "**Testing Rebuilt Engine**" procedure, outlined at the beginning of the disassembly and reassembly section of this manual.

REPAIR PARTS LIST

READ THESE INSTRUCTIONS BEFORE ORDERING PARTS

THE MODEL, SPEC AND SERIAL NUMBER OF YOUR ENGINE, SHOWN ON THE NAME PLATE ATTACHED TO THE AIR SHROUD, MUST BE GIVEN WHEN ORDERING PARTS.

FILL IN THE ABOVE INFORMATION ON THE PHOTO OF THE NAME PLATE SO THAT IT WILL BE AVAILABLE TO YOU WHEN ORDERING PARTS

WISCONSIN
HEAVY-DUTY
Air-Cooled **ENGINE**®

MODEL SERIAL NO.

SIZE R.P.M. SPEC. NO.

WISCONSIN MOTOR CORPORATION
MILWAUKEE, WISC. U.S.A.

278228C

TO INSURE PROMPT AND ACCURATE SERVICE, THE FOLLOWING INFORMATION MUST ALSO BE GIVEN

1. State exactly, quantity of each part and part number.
2. State definitely, whether parts are to be shipped by express, freight or parcel post.

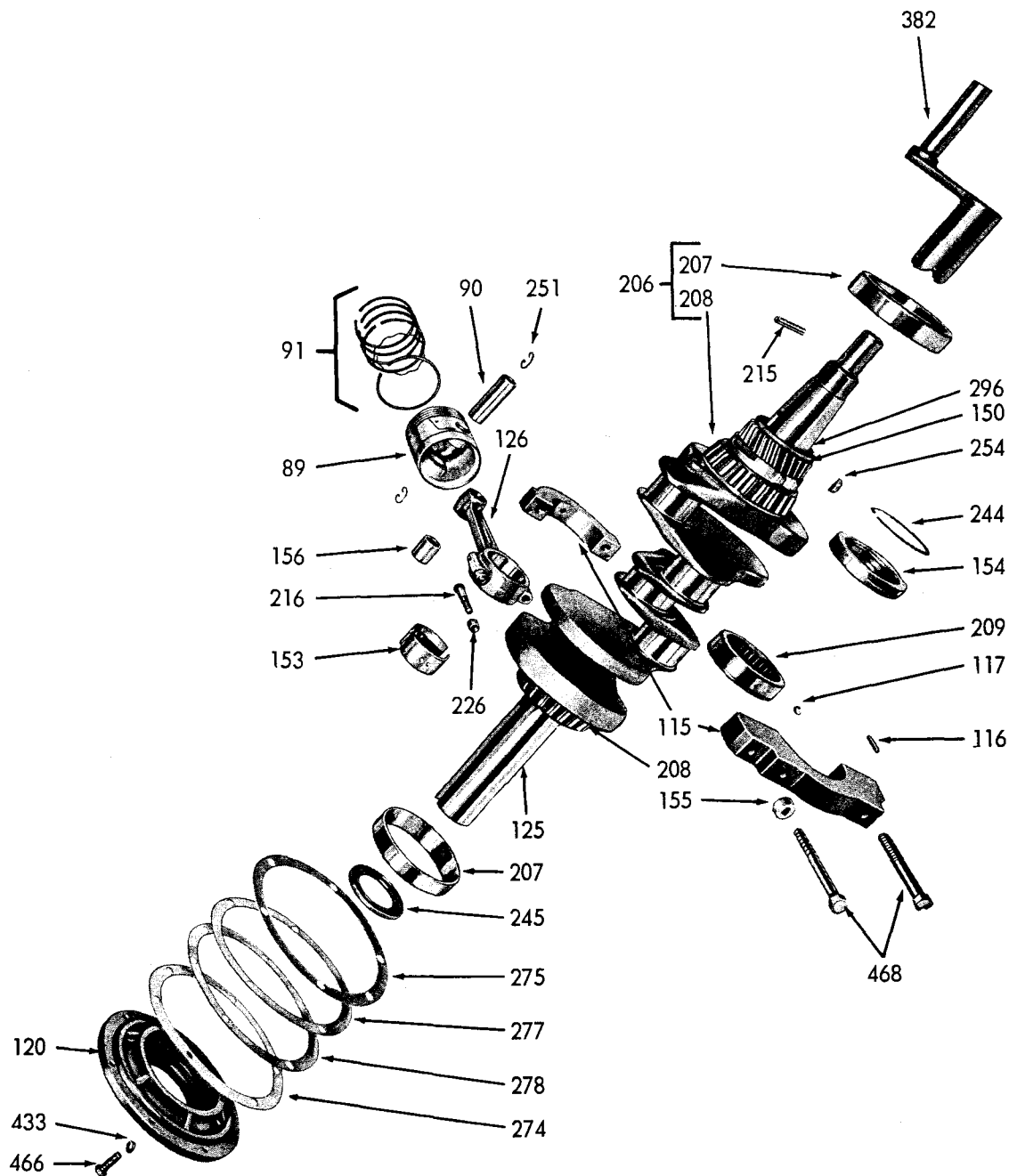
SERVICE FACILITIES

Approved engine service stations, located throughout the U.S. and foreign countries, have been carefully selected by the WISCONSIN MOTOR CORPORATION in order to assure complete and efficient repair and inspection service to owners of Wisconsin Air Cooled Engines. These service stations, equipped and trained for complete engine repair, also stock parts to facilitate immediate delivery for all Wisconsin Air Cooled Engines.

A DIRECTORY OF SERVICE STATIONS CAN BE FOUND IN THE BACK OF THIS MANUAL.

PARTS RETURNED FOR CREDIT

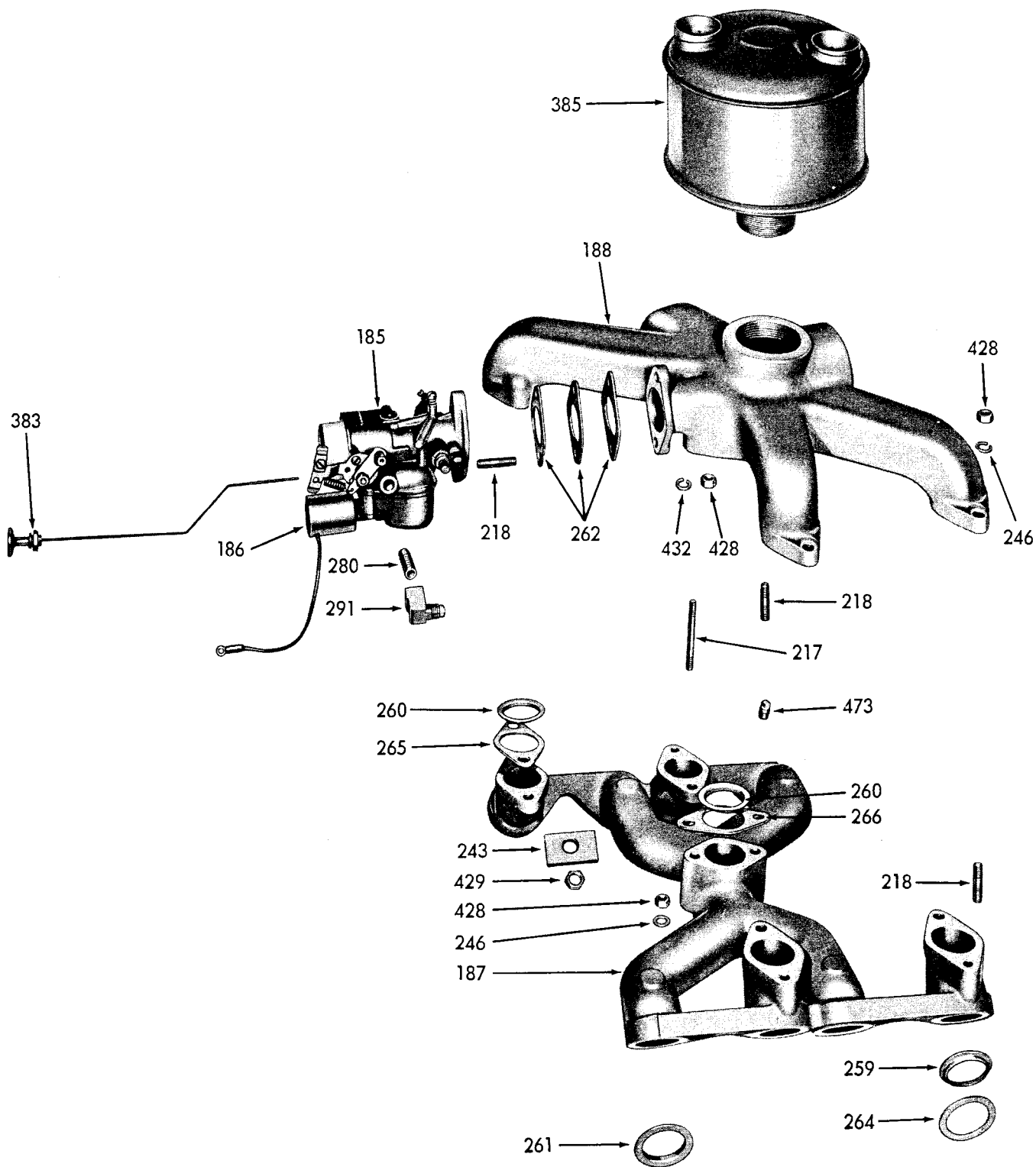
Before returning any parts, write a letter to the company from whom the parts were purchased, giving an exact list and description of the materials, why you wish to return them, whether for repairs, credit, or replacement, and also the model, specification and serial numbers of the engine from which the parts were taken. If authority is granted for their return, transportation charges must be prepaid and sender's name marked on the outside of the box or package.



CRANKSHAFT, PISTON AND CONNECTING ROD GROUP

Parts are identified by reference number. See parts list for correct part number.

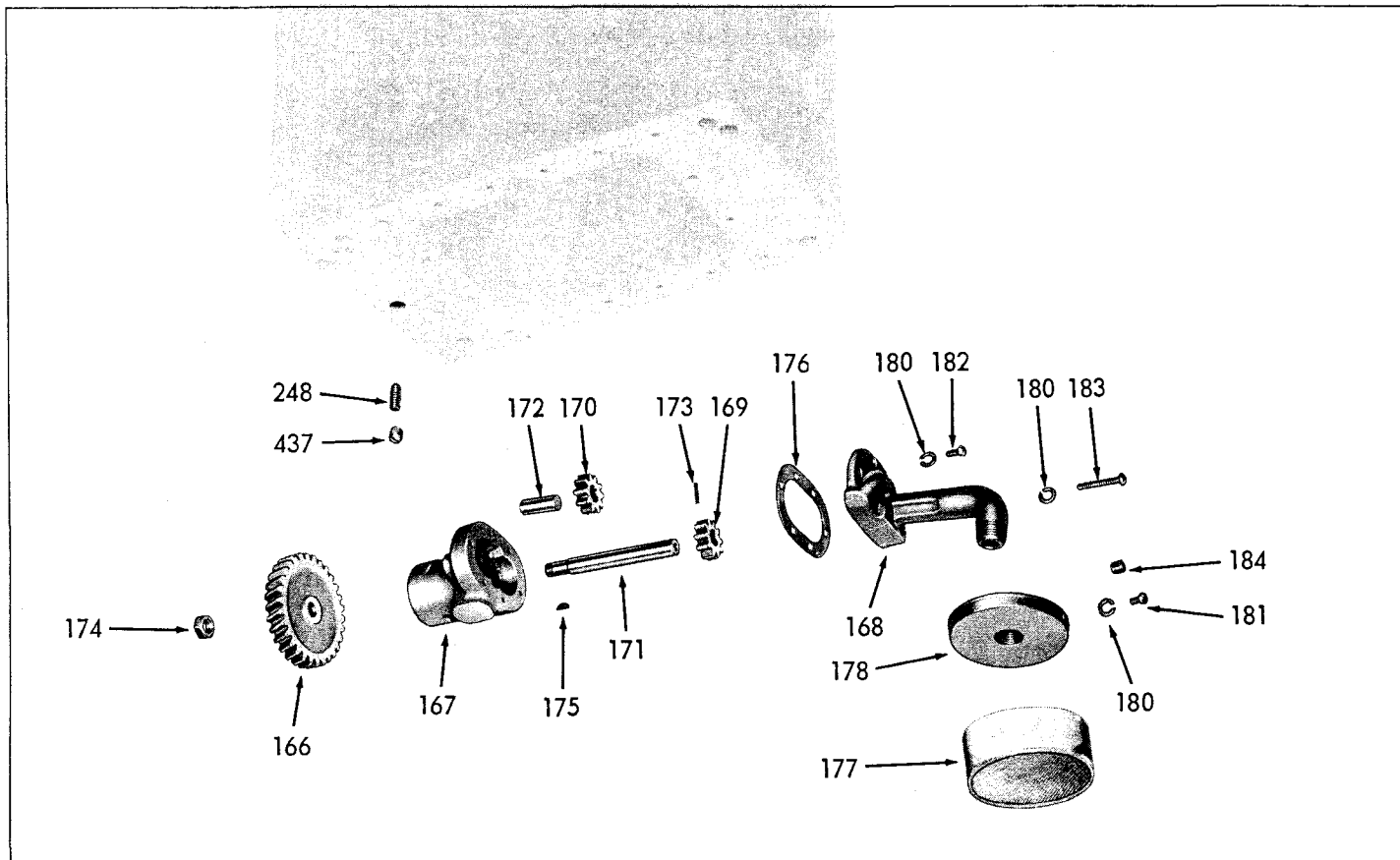
281153C-1



CARBURETOR AND MANIFOLD GROUP

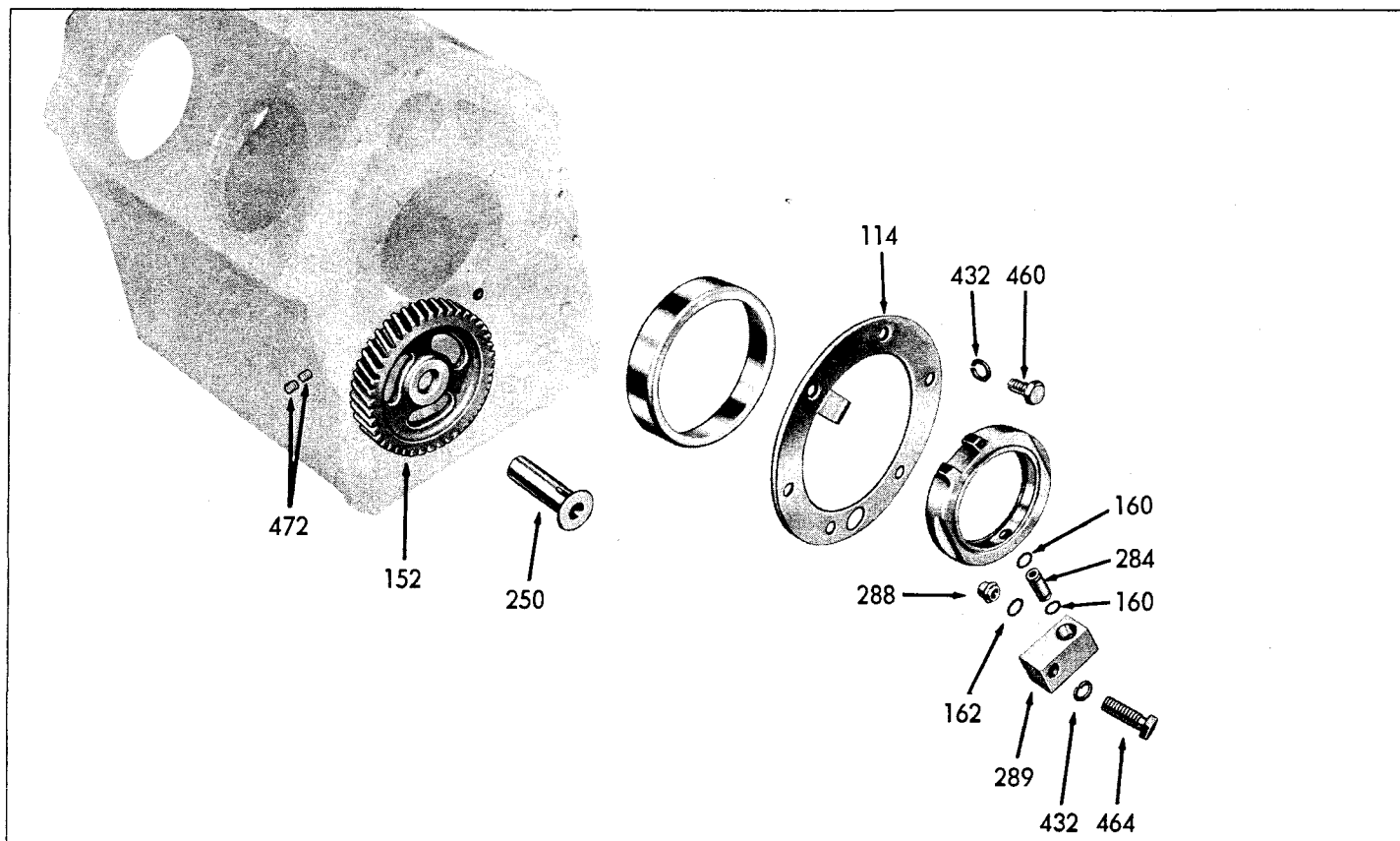
Parts are identified by reference number. See parts list for correct part number.

281149C



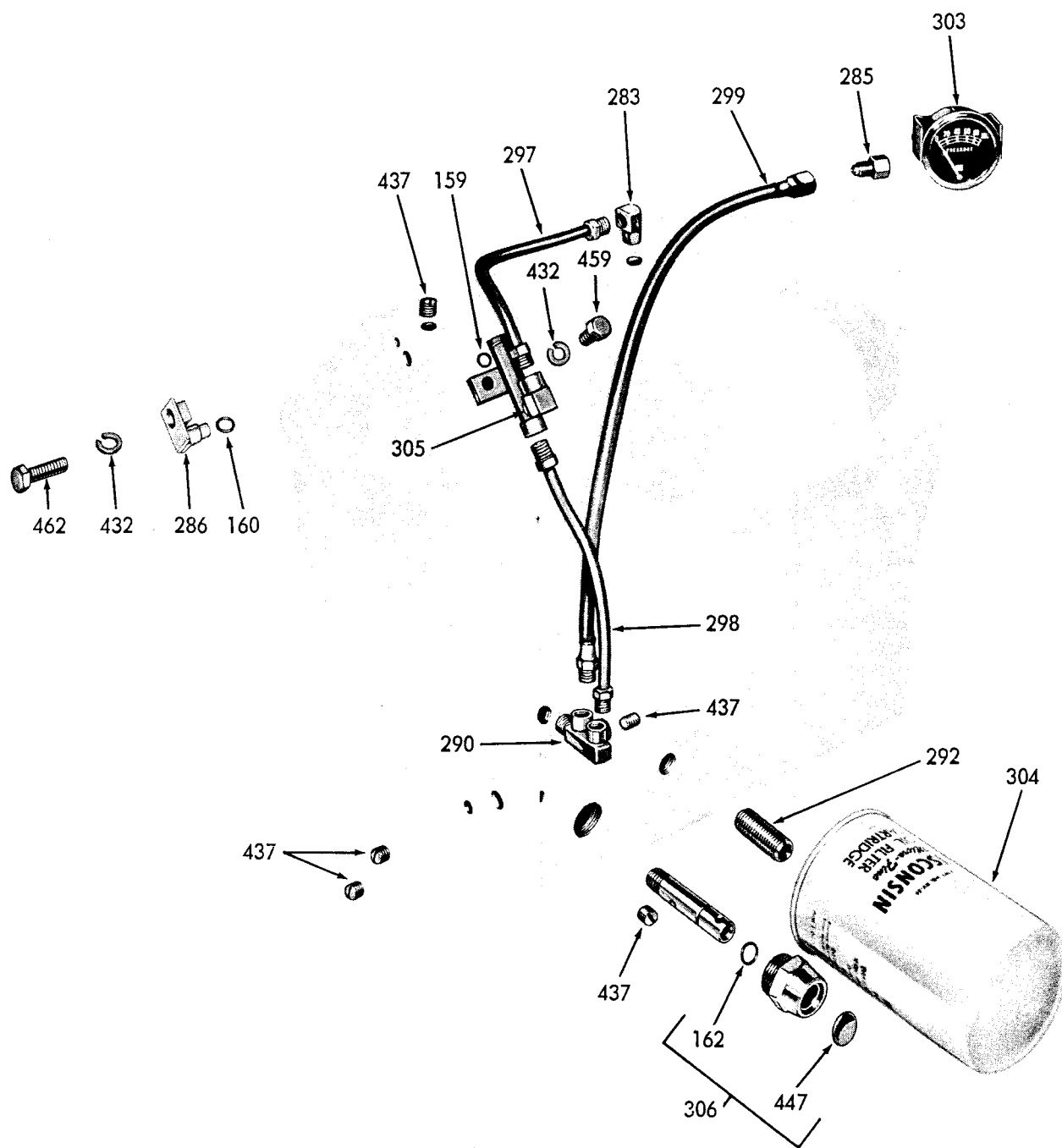
Ref. No. 165, OIL PUMP ASSEMBLY

281144C



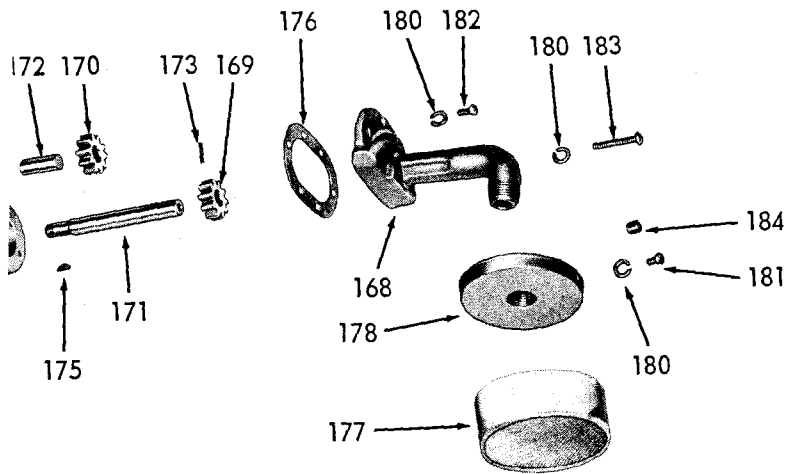
IDLER GEAR, BEARING RETAINER AND OIL COLLET GROUP
Parts are identified by reference number. See parts list for correct part number.

281148C



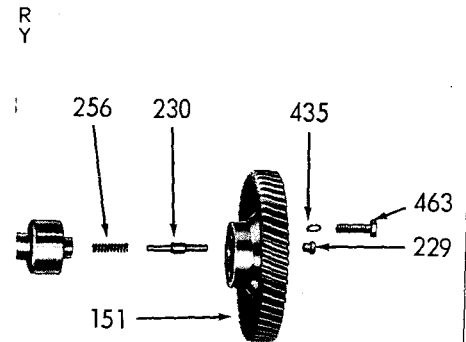
OIL LINES PRESSURE VALVE RELIEF VALVE AND OIL FILTER
 Parts are identified by reference number. See parts list for correct part number.

281145C



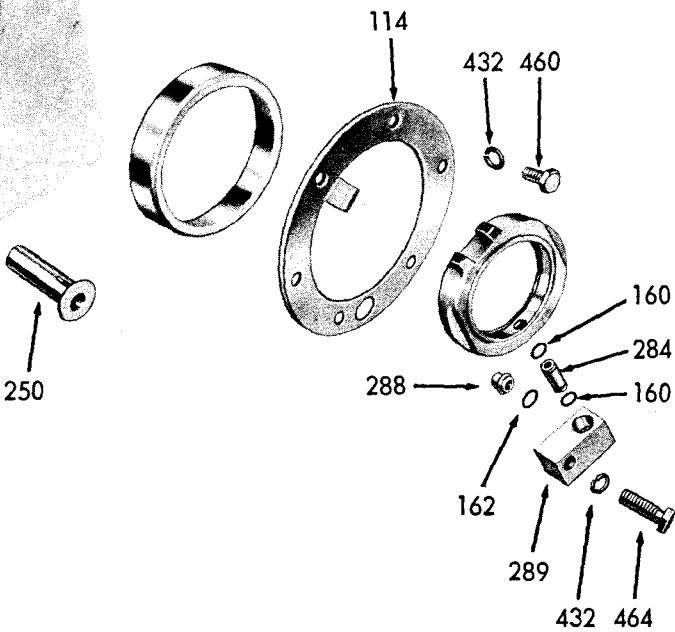
Ref. No. 165, OIL PUMP ASSEMBLY

281144C



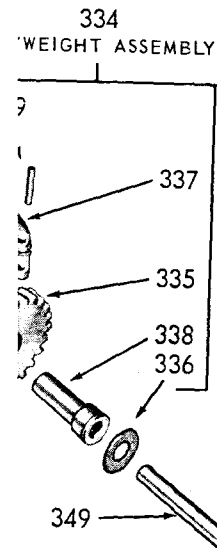
OIL PUMP

281143C-1



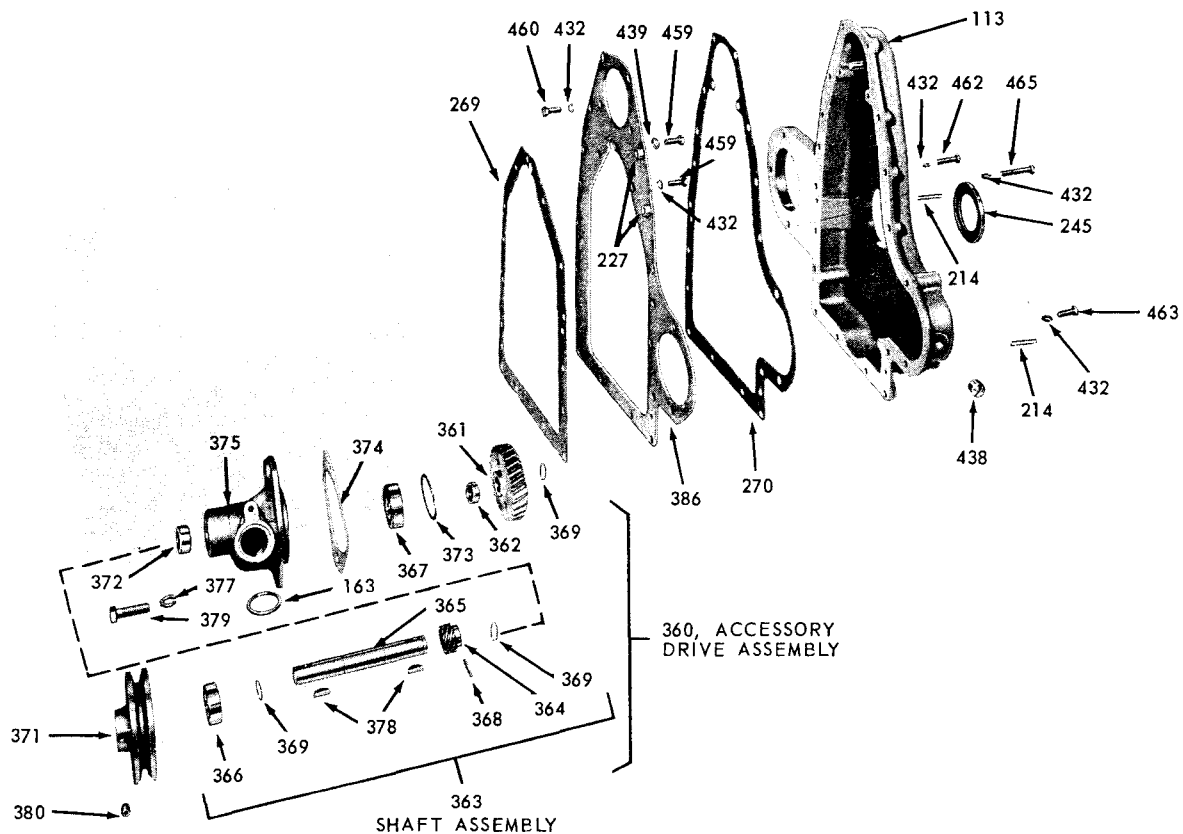
R, BEARING RETAINER AND OIL COLLET GROUP
identified by reference number. See parts list for correct part number.

281148C



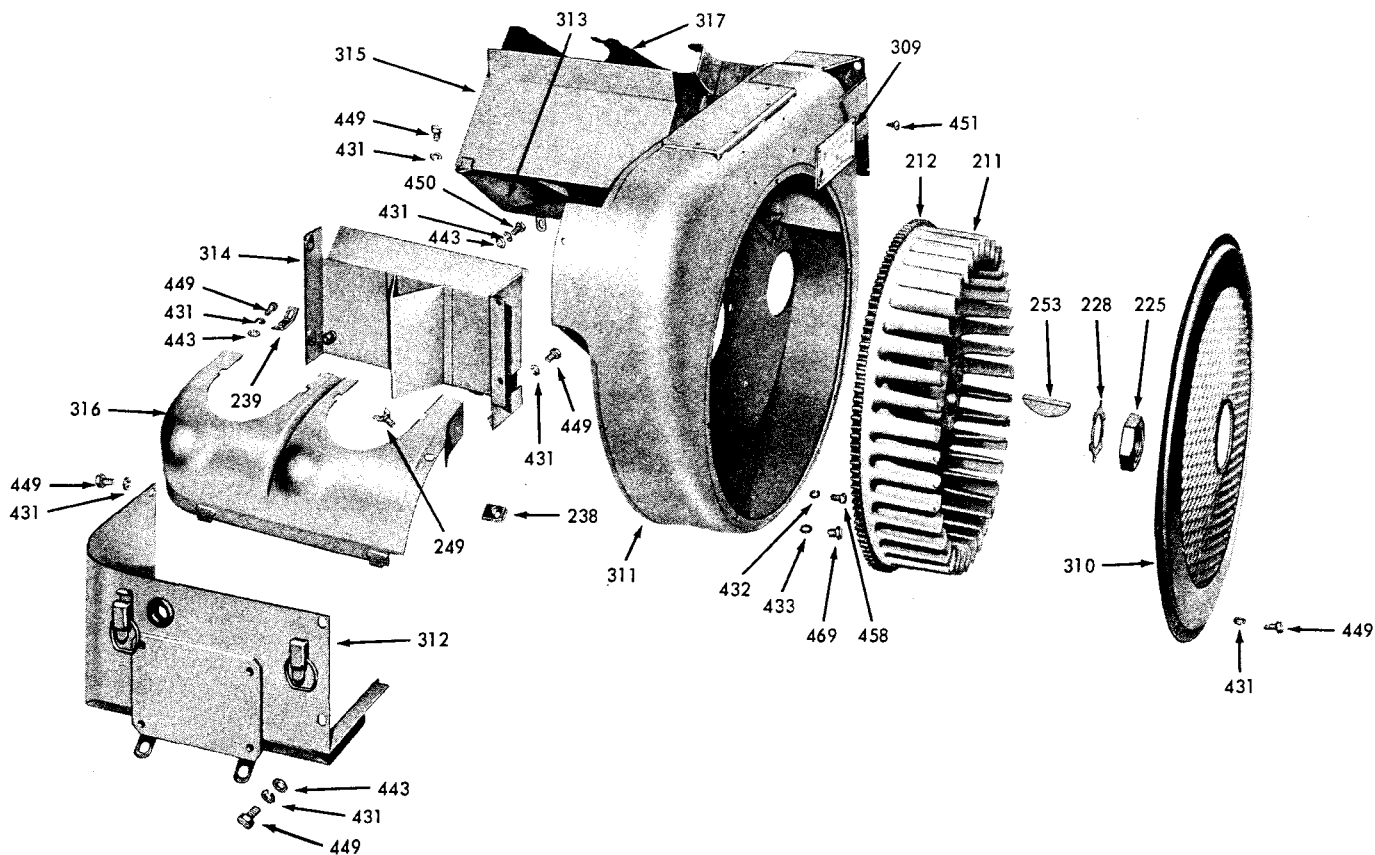
Weight Assembly

282432C



GEAR COVER AND ACCESSORY DRIVE ASSEMBLY

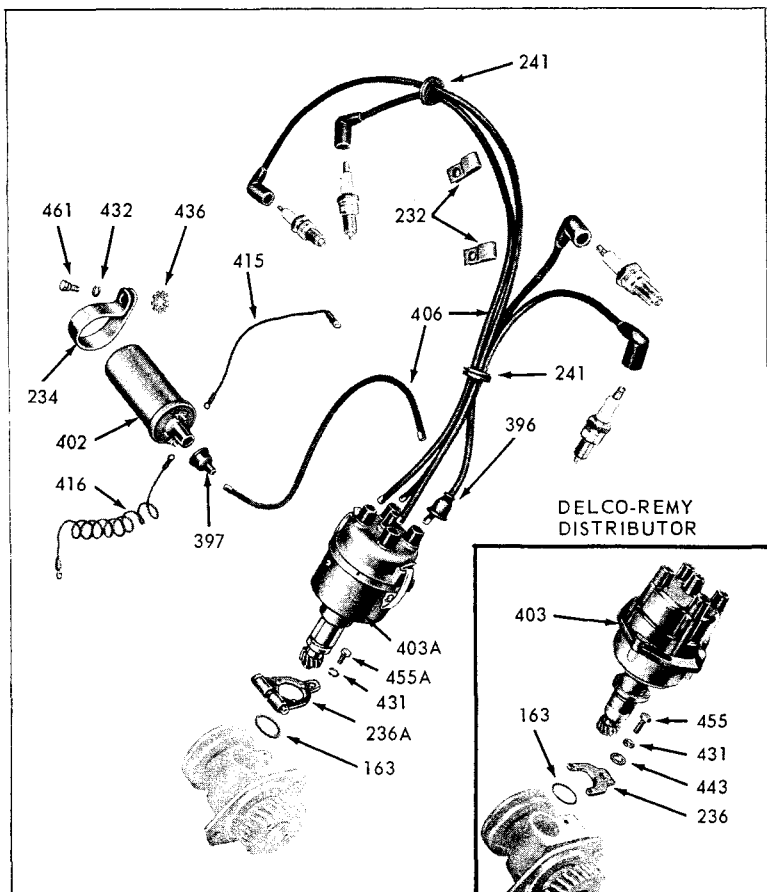
281147C



FLYWHEEL AND AIR SHROUDING GROUP

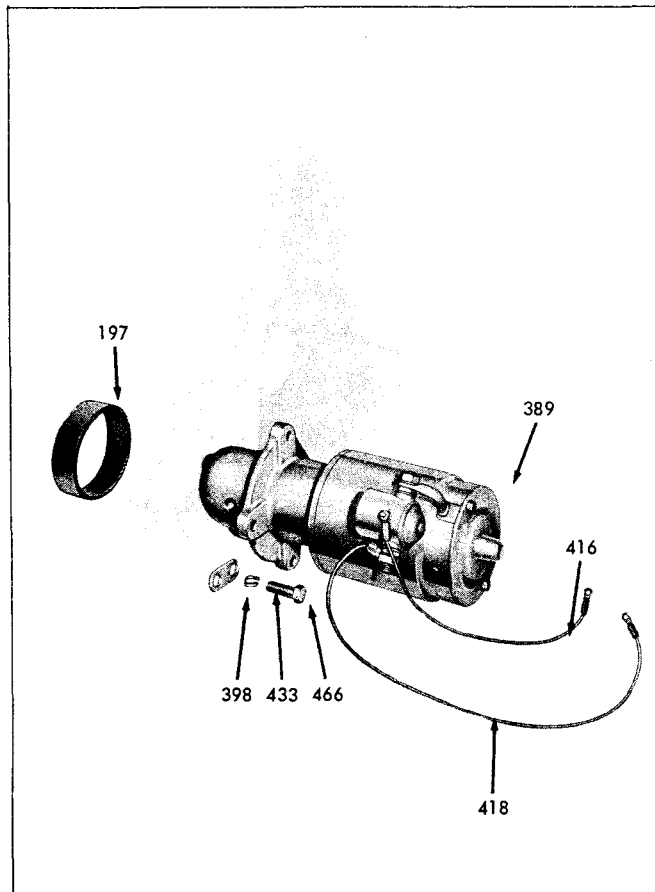
Parts are identified by reference number. See parts list for correct part number.

281212C



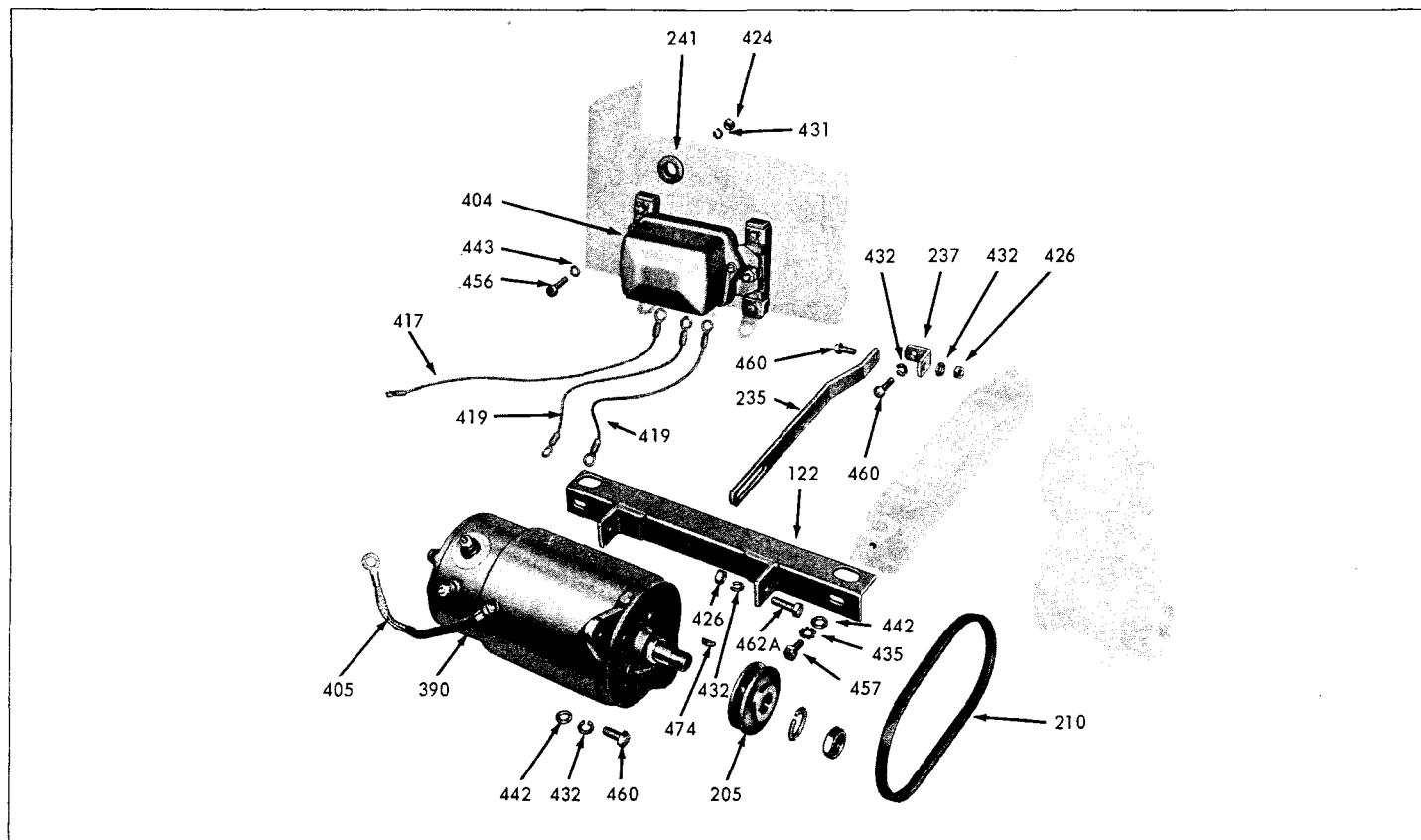
DISTRIBUTOR AND COIL

281214C-1



STARTING MOTOR MOUNTING

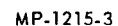
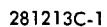
281151C



GENERATOR AND REGULATOR MOUNTING GROUP

281152C-1

Parts are identified by reference number. See parts list for correct part number.



PARTS LIST

FOR STANDARD ENGINE

Models V-460D, V-461D, V-465D

ACCESSORIES COMMONLY SUPPLIED ON THESE ENGINE MODELS BEGIN ON PAGE 54.

*NOTE: If weights differ, V-461D weight is shown first.

REF. NO.	PART NUMBER		DESCRIPTION	NO. REQ.	*NET WEIGHT	
	MODELS V-460D, V-461D	MODEL V-465D			LBS.	OZ.
85	AA-99	AA-111	CYLINDER BARREL	4	11	8
86	AB-105-S1	AB-105A-S1	CYLINDER HEAD ASSEMBLY, consisting of: 1 Head 2 AF-51 Springs 1 HG-150E Insert 2 AD-44B Guides 1 AG-26A Seat 1 HG-264 Insert 1 AE-88D Valve 1 AG-41 Rotator 1 PC-532 Stud 1 AE-89 Valve 2 AH-19 Locks 1 RF-1319 Elbow NOTE: Order Rocker Arm assembly separately.	4	12 6	8 8
87	See Fig. A	See Fig. A	CRANKCASE ASSEMBLY, includes: 1 LJ-300AD Tube 1 RF-1378 Coupling 1 LJ-415 Tube 1 RF-1420 Fitting 1 ME-137-1 Brg. cup 1 RF-1423 Nipple 2 PA-291 Pins 1 RJ-163 Saber 8 PF-18 Plugs 1 RJ-163A Saber 1 RC-91 Screen 1 RV-34A Valve 1 RF-1319 Elbow 1 SA-58 Plug 2 RF-1377A Fitting 1 XK-1 Plug NOTE: The basic standard crankcase part number is BA-55 for Models V-460D, V-461D, and BA-55-B for Model V-465D. Any special machining is indicated by a number stamped on the crankcase in the location shown in Fig. A. Add this number to the basic crankcase part number. Order by complete number and by giving the Model, Specification and Serial Numbers of the engine.	1	87	
89	DB-223	DB-232	PISTON, cam ground, standard size NOTE: Pistons are also furnished .010", .020", .030" oversize.	4		15 5
90	DE-76	DE-80	PISTON PIN, standard size NOTE: Piston Pins are available .005" and .010" oversize.	4		4
91	DR-48-A DR-49	DR-60	PISTON RING SET, standard size (for 4 pistons)..... DR-48, replaced by DR-48-A. TRI-CROME RE-RING SET, standard size NOTE: Ring Sets are available .010", .020" and .030" oversize.	1	1 1	
93	LO-115-A (PBH00-0453)	LO-127-A (PBH00-0234)	PRE-CLEANER, Donaldson Co. Service Parts: Cover Assembly Body Sleeve Assembly	1 1 1 1	1 2	8 8
93A	P-10-3587	P-20648				
93B	P-20115	P-20227				
93C	P-10-3589	P-20650				
94	LO-159-4-S1 (FGA05-2522)	LO-185-S1 (FGA06-0022)	OIL BATH AIR CLEANER, Donaldson Co. Service Parts: Clamp Assembly Inner Oil Cup Outer Oil Cup Decal Body Assembly — not serviced separately LO-90-5-S1 Air Cleaner, No. A-552, for V-460D and V-461D engines previous to Serial #3477983. Replaced by LO-159-4-S1 (Interchangeable). P-8723 Oil Cup Assembly must be used on LO-90-5-S1 for service.	1	5 6	0 0
94A	P-2706	P-2691				
94B	P-17242	P-17702				
94C	P-17244	P-17703				
94D	SD-161	SD-161				
94E	— — — —	— — — —				

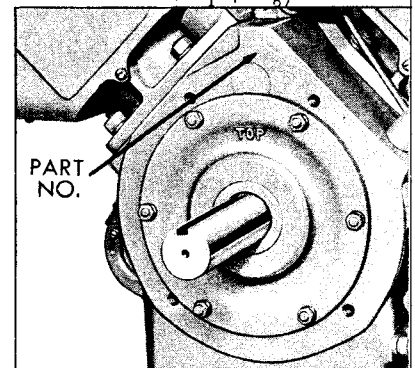


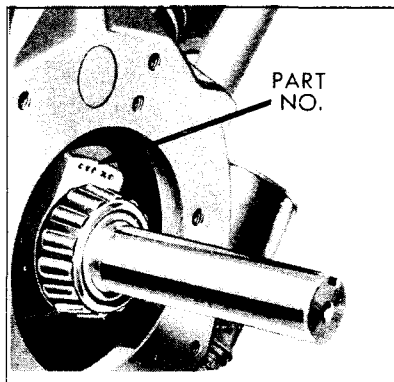
Fig. A 226222C

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

PARTS LIST **MODELS V-460D, V-461D AND V-465D**

REF. NO.	PART NUMBER		DESCRIPTION	NO. REQ.	*NET WEIGHT	
	MODELS V-460D, V-461D	MODEL V-465D			LBS.	OZ.
95		PC-531	STUD for cylinder, head and rocker arm bracket mounting (top center) 11-5/16" long	4		4
95A	PC-531-A		STUD, 11-5/16" with flanged end. For V-461D engines beginning with Serial No. 3685187	4		4
			PC-531 for V-461D engines previous to Serial No. 3685187.			
96	PG-512	PG-456-B	STRAP for mounting air cleaner	1	2	8
97	-	PG-1212	CLAMP for oil filler tube	1		4
98	-	PG-1230	CLIP for cylinder hold down	4		1
99	QD-841	QD-839	GASKET for cylinder base	4		1
			JK-65 'O' Ring for V-461D, replaced by QD-841.			
101	-	SE-286	HEAT SHIELD for fuel pump	1	1	

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D and V-465D

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Oz	Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Oz
103	AD-44-B	VALVE STEM GUIDE, inlet and exhaust	8		2	121	BH-155-E	OIL PAN	1	2	
104	AE-88-D	VALVE, Stellite exhaust	4		3	122	BI-354B BI-354-A	BRACKET for Delco-Remy generator For Prestolite generator	1	1	8 8
105	AE-89	VALVE, Inlet	4		3	124	BK-72A-1	ENGINE SUPPORT (cast iron)	2	6	2
106	AF-51	VALVE SPRING	8		2	125	See Fig. B	CRANKSHAFT ASSEMBLY	1	62	
107	AG-26-A	SEAT for valve spring, inlet	4		1			Includes:			
108	AG-41	VALVE ROTATOR, exhaust	4		1			1 GA-44-A Gear 1 PH-494 Seal			
108A	AG-35 (Obsolete)	ROTATOR, exhaust (not available)	4					1 HF-568B Collet 1 PL-156 Key			
		Used on V-461D to and including Serial No. . For replacement: use AG-40 guide in its place, and AG-41 rotator at rocker end, in place of AG-26-A seat.						2 ME-168 Bearings 1 RK-179B Oil			
								1 ME-169 Bearing sling			
109	AH-19	LOCK for valve spring seat	8 pr		1	NOTE: The basic crankshaft part number (raised letters on side of No. 2 counterweight), is CA-75 . Dash numbers are added to the basic part number to identify special machining at the take-off end. The dash (-) number will be found stamped on the cheek facing the take-off end of the shaft, as illustrated in Fig. B. Order by complete part number , (dash number added to basic number) and by giving the model, specification and serial numbers of the engine.					
111	AN-41-S1	COVER for rocker arm (includes gasket)	4		8	 <p align="center">Fig. B 71057C</p>					
113	BD-108-S1	GEAR COVER ASSEMBLY	1	18							
		Includes:									
		1 XK-3 Plug 1 PH-496B Oil seal									
		1 PF-52 Button 1 TC-388-1 Shaft									
114	BG-253-A	BEARING RETAINER PLATE, fly-wheel end	1		10						
115	BG-346-S1	CENTER MAIN BEARING HANGER ASSEMBLY for V-465D	1	4							
	BG-304-S1	For V-460D and V-461D, but BG-346-S1 can be used in its place.									
		Both assemblies include:									
116		PA-368 Dowel pins	2		1						
117		PA-376 Bearing dowel pin	1		1						
-		XD-83 Screws (Ref. 468)	2		1						
		NOTE: Hanger assembly does not include center main bearing.									
120	BG-308-S2	MAIN BEARING PLATE ASSEMBLY, std., Take-off end	1	9	8	126	DA-71-S1	CONNECTING ROD ASSEMBLY	4	1	12
		Includes:						Includes:			
		1 ME-137-1 Bearing cup						1 HG-131B Bushing			
		1 PH-496B Oil seal						2 PB-146-2 Bolts			
								2 PD-200 Nuts			
								NOTE: The connecting rod is furnished LESS the shell bearings. Refer to reference number 153 for part number of the standard			

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req	Net Wt.		Ref. No.	Part Number	Description	No. Req	Net Wt.	
				Lb	Oz					Lb	Oz
137	EA-132	CAMSHAFT EA-116-B, replaced by EA-132.	1	4		159	JK-52	*O* RING, 3/16" I.D. x 5/16" O.D. 1-for oil pressure reducing valve. 4-for oil drain lines.	5		1
138	F-67-B	VALVE TAPPET F-67, replaced by F-67-B.	8		2	160	JK-53	*O* RING, 5/16" I.D. x 7/16" O.D. 2-for oil coupling to collet. 1-for governor spray fitting.	3		1
140	FX-166-A	ROCKER ARM and BRACKET ASSEMBLY Consisting of:	4	1	4	161	JK-55	*O* RING, 3/4" O.D. For push rod casing at both ends.	16		1
141	FX-166	Bracket	1		7	162	JK-56	*O* RING, 3/8" I.D. x 1/2" O.D. 1-for collet adapter to crankcase. 1-for pressure relief valve.	2		
142	FX-167A-S1	Rocker arm assembly (exhaust) Includes: PI-194 Adj. screw.	1		4	163	JK-59	*O* RING, 1-1/16" I.D. x 1-5/16" O.D. For distributor mounting.	1		1
143	FX-168A-S1	Rocker arm assembly (inlet) Includes: PI-194 Adj. screw.	1		4	165	K-111-A	OIL PUMP ASSEMBLY complete K-111, replaced by K-111-A. NOTE: Beginning with Serial No. 3795848 the K-111-A oil pump replaces K-111 and utilizes the same internal gears for both the drive and driven gears. Therefore, driven gear and stub shaft for old pumps are not interchangeable since gear bore diameters are not the same.	1	4	2
144	FX-169-A	Rocker arm shaft	1		3			Pump assembly consists of:			
145	PI-194	Tappet adjusting screw	2		1	166		GD-94-C Oil Pump Drive Gear (external)	1		11
146	PM-185	Shaft spring	1		1	167		KA-61-C-S1 Body - Includes:	1	2	
147	XE-73	Lockscrew for rocker arm shaft, 1/4"-20 x 5/8" long, Allen socket head	1		1	168		KC-56A Gear KD-122A Shaft			
149	FX-170	PUSH ROD	8		2	169		KA-61A-2-S1, replaced by DA-61C-S1.			
150	GA-44-A-S1	CRANKSHAFT GEAR and OIL COLLET Consisting of: 1 GA-44-A Gear 1 HF-568-B Oil collet 1 PH-494 Seal Replaces GA-44, std. production gear, for service.	1		2	170		KB-46 Cover	1	1	
151	GB-46-B	CAMSHAFT GEAR (54 teeth)	1	3		171		KC-56-A Drive Gear (inner)	1		1
152	GC-28-B	IDLER GEAR (42 teeth)	1	2	4	172		KC-56-1, replaced by KC-56-A.			
153	HA-120-S	SHELL BEARING (2 halves) For connecting rod, standard size. NOTE: The following undersize shell bearings are also available. HA-120-S1 (.001" undersize) HA-120-S2 (.002" undersize) HA-120-S10 (.010" undersize) HA-120-S20 (.020" undersize)	4		6	173		KC-56-A Driven Gear, .499-.498 I.D. beginning with Serial No. 3795848	1		1
154	HF-568B-S1	COLLET for crankshaft lubrication Includes PH-494 Seal. NOTE: For service replacement order GA-44A-S1 crankshaft gear and oil collet kit.	1		10	174		KC-56-2 (K-111 pump) .5015-.5005 I.D. previous to Serial No. 3795848. For replacement use KC-56A-1.			
155	HF-627	SPACER for center bearing hanger to crankcase screws NOTE: Beginning with Engine Serial No. 4052826, (V-461D) 2 HF-627 spacers replace 2 PH-79 washers, and 2 XD-83 screws replace 2 XD-146. Thus, all four screws for center main bearing hanger will be the same.	2		1	175		KD-121A-S1 Drive shaft with KC-56-A gear	1		5
156	HG-131-B	PISTON PIN BUSHING	4		1	176		KD-122-A Stub Shaft, for engines beginning with Serial No. 3795848	1		2
157	---	VALVE SEAT INSERT, inlet - not recommended for service replacement	4		1	177		KD-122 (K-111 pump) previous to engine No. 3795848, no longer available, order KA-61C-S1 Body Assembly.			
158	---	VALVE SEAT INSERT, exhaust - not recommended for service replacement	4		1	178		PA-64 Pin, 1/8" dia. x 3/4" long, for driver gear	1		1
						179		PD-195 Jam Lock-nut, 7/16"-20 thread, for gear mounting	1		1
						180		PL-137 Key, No. 1 Woodruff	1		1
						181		For drive gear.			
						182		QD-535-A Cover gasket	1		1
						183		RD-125-A Screen	1		2
						184		RD-126-A Screen adapter	1		4
								OIL PUMP STANDARD HARDWARE			
								PE-14 Lockwasher, No. 10 Positive	8		1
								6-for cover 2-for screen			
								XA-7 Screw for screen, No. 10-32 thread x 3/8" long steel round head.	2		1
								XA-8 Screw for cover, No. 10-32 thread x 1/2" long steel round head.	4		1
								XA-56 Screw for cover, No. 10-32 thread x 1-1/4" long steel round head.	2		1
								XE-61 Set screw for screen adapter	1		1
								No. 10-32 thread x 3/16" long.			

Order parts from nearest **SERVICE STATION** shown in directory following parts list.

IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb	Oz	Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb	Oz
185	LZ-77-B-S1	CARBURETOR ASSEMBLY Zenith outline No. 12708. Wisconsin assembly includes: Anti-diesel solenoid valve, 3 QC-12-A gaskets, 2 PC-171 studs. LZ-77-S1, replaced by LZ-77-B-S1. LQ-37 Repair Kit for carburetor. NOTE: Specify the part number or model designation, stamped on carburetor, when ordering replacement carburetor or parts. See carburetor bulletins in back of manual for service replacement parts list.	1	3		198	LO-60-1	OIL FILLER and BREATHER CAP 1 6	1		6
186	YC-83A-S1	ANTI-DIESEL SOLENOID VALVE 1 4 Mounted in carburetor bowl. Includes PK-162 locking tab. LQ-41 Valve and Bowl Kit , no longer required. Use YC-83A-S1 Valve Kit and refer to carburetor parts list if bowl is required.	1	4		202	LP-19-B	FUEL STRAINER , Tillotson OW-444 1 6 NOTE: See illustration in back of manual for service parts list of fuel strainer. LQ-32 REPAIR KIT 2	1		6
187	LD-257C-S1	MANIFOLD ASSEMBLY , lower branch — inlet 1 14 8 Includes: 4 PC-171 Studs XK-1 Plug LD-257A-S1 and LD-257B-S1, replaced by LD-257C-S1.	1	14	8	203	LP-38-3-S1	FUEL PUMP with flange gasket 1 1 11 (LP-38-S1 pump with cover rotated one hole in counter-clockwise direction and optional inlet used.) LQ-30 REPAIR KIT for fuel pump 1 2 NOTE: Refer to LP-38 fuel pump instruction sheet in back of manual for maintenance and repair.	1	1	11
188	LD-258D-S1	MANIFOLD ASSEMBLY , upper branch — exhaust 1 16 Includes: 2 PC-159 Studs (loose) 4 PC-171 Studs LD-258B-S1, replaced by LD-258D-S1.	1	16		205	MD-390	PULLEY for generator 1 6	1		6
189	LJ-131	TUBE for air cleaner connection 1 1 6	1	1	6	206	ME-168	MAIN BEARING ASSEMBLY (both ends) 2 2 8 Consisting of:	2	2	8
190	LJ-300-AD	OIL FILLER TUBE 1 12	1		12	207	ME-137-1	Bearing cup — 39520 1 12	1		12
191	LJ-392-A	PUSH ROD CASING ASSEMBLY 8 3 Consisting of: HF-585 Collar LJ-392 Casing	8	3		208	ME-168-1	Bearing cone — 39590 1 1 12	1	1	12
192	LJ-415	TUBE for oil saser below oil tube 1 2 For engines beginning with Serial No. 3655793.	1	2		209	ME-169 (Std. Size)	CENTER MAIN BEARING ASSEMBLY .. 1 12	1		12
193	LK-24	HOSE CLAMP , 2-1/4" I.D. 3 1 For air cleaner connection — at carburetor and air cleaner ends. LK-8 (2-1/8"), replaced by LK-24.	3	1			ME-169-S30	.030" undersize bearing assembly 12			12
194	LK-9	HOSE CLAMP , 2-3/8" I.D. 1 1 For air cleaner tube to elbow.	1	1		210	MH-184-A	GENERATOR BELT 1 3 MH-184, replaced by MH-184-A.	1		3
195	LL-30-A	RUBBER HOSE 1 2 For air cleaner tube.	1	2		211	NC-194-S1	FLYWHEEL ASSEMBLY , standard 1 51 Includes:	1	51	
196	LL-89	RUBBER ELBOW 1 6 For air cleaner tube.	1	6		212		GH-43 Ring gear 1 2 10 NOTE: Because of the numerous variations in flywheels; for mounting rotation screens, stub shafts, etc. only the standard ring gear flywheel is listed. Therefore, give Model, Specification and Serial Numbers of engine when ordering new flywheel.	1	2	10
197	LL-146	RUBBER SLEEVE 1 2 For starter Bendix housing.	1	2		214	PA-291	DOWEL PIN for gear cover 2 1	2		1
						215	PA-334	PIN for cranking 1 1	1		1
						216	PB-146-2	CONNECTING ROD BOLT 8 2	8		2
						217	PC-159	STUD , 5/16" x 2-13/16" long 2 2 Upper to lower manifold, center flange.	2		2
						218	PC-171	STUD , 5/16" x 1-5/16" long 10 1 8-for upper to lower manifold. 2-for carburetor mounting.	10		1
						219	PC-529	STUD for cylinder and head mounting, 8-3/8" long, for outer boss of No. 1, 2 and 3 cylinders 3- 3	3-		3
						220	PC-529-A	STUD for cylinder, head and Hi-Temp. switch mounting, 8-13/16" long, for outer boss of No. 4 cylinder 1 3	1		3
						221	PC-530	STUD for cylinder and head mounting, 10" long, for middle head bosses 8 4	8		4

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req.	Net Wt.		Ref. No.	Part Number	Description	No. Req.	Net Wt.	
				Lb	Oz					Lb	Oz
223	PC-532	STUD in cylinder head for manifold mounting, 7/16" x 2-3/8" long	4	2		252	PK-138	WIRE BAIL for rocker arm cover	4	1	
225	PD-193-2	NUT for flywheel mounting	1	10		253	PL-145	WOODRUFF KEY (special) for flywheel mounting	1	1	
226	PD-200	NUT, 3/8"-24 thread, elastic stop	8	1		254	PL-156	WOODRUFF KEY, No. 91	1	1	
		For connecting rod bolt.						For crankshaft gear.			
227	PD-228	FASTENER, self clinching, for spacer plate	2	1		256	PM-108	SPRING for camshaft thrust plunger	1	1	
228	PE-85	LOCKWASHER for flywheel nut	1	1		257	Q-32-C	ENGINE GASKET SET with 'O' rings .	1	1	
229	PF-52	BUTTON for camshaft thrust plunger	1	1				For Models V-465D, V-461D, V-460D. Refer to Ref. No. 257 Line Drawing for contents.			
230	PF-101	THRUST PLUNGER for camshaft	1	1				Q-32-A, Q-32B for V-461D, V-460D, replaced by Q-32-C.			
232	PG-314	CLAMP for ignition wires	2	1		-	Q-34-A	GASKET SET for valve grinding	1	4	
		PG-1042, replaced by PG-314.						Consisting of:			
234	PG-556-B	CLAMP for Delco-Remy ignition coil	1	3				4 JK-52 4 QB-85-B 4 QD-757-B			
	PG-556	CLAMP for Prestolite coil		3				8 JK-55 4 QC-66 4 QD-758			
								4 QB-83			
235	PG-792-B	ADJUSTING STRAP for generator	1	6				Q-34, replaced by Q-34-A.			
236	PG-1205	CLAMP for YF-34 Delco-Remy distributor on engines beginning with Serial No. 4420865.	1	4		259	QB-83	INSERT BUSHING, 1 1/4" I.D. x 1 1/4" O.D. For exhaust port in cylinder head.	4	1	
236A	PG-920-A	CLAMP for YF-10-A Prestolite distributor and obsolete YF-25 Delco-Remy distributor.	1	2		260	QB-85	INSERT BUSHING, 1-3/8" I.D. x 1 1/4" O.D. 4-for exhaust, upper to lower manifold gasket. 1-for upper to lower manifold, center flange.	5	1	
237	PG-959	BRACKET for generator adjusting strap	1	1							
238	PG-1039	SPEED NUT for cylinder head cover thumb screws	2	1		261	QB-85-B	GASKET with INSERT	4	1	
								For inlet manifold port to cylinder head. QB-85-A, QC-65, replaced by QB-85-B.			
239	PG-1050	BRACKET for heat defl. (L.H. side)	1	1		262	QC-12-A	GASKET for carburetor flange	3	1	
241	PH-198	RUBBER GROMMET	3	1		264	QC-66	GASKET, 1 1/4" I.D. x 1 1/4" O.D.	4	1	
		2-In shroud for ignition wires. 1-for grouping ignition wires at distr.						For exhaust port in cylinder head.			
-	PH-442	WASHER (rubber faced) not illustrated. For cylinder head cover thumb screw.	2	1		265	QC-67	GASKET, exhaust, upper to lower manifold	4	1	
243	PH-484	CLAMP WASHER for manifold mounting	4	1		266	QC-70	GASKET for upper to lower manifold, center flange	1	1	
244	PH-494	SEAL for crankshaft oil collet	1	1		267	QD-67	GASKET for fuel pump adapter	1	1	
245	PH-496-B	OIL SEAL for crankshaft (both ends)	2	2		268	QD-538-A	GASKET for fuel pump mounting	1	1	
		PH-496, replaced by PH-496B.				269	QD-633-1	GASKET for spacer plate to crankcase	1	1	
246	PH-501	PLAIN WASHER (special) for manifold mounting	10	1		270	QD-634	GASKET for gear cover to spacer	1	1	
248	PI-143-B	LOCKSCREW for oil pump	1	1		271	QD-635-A	GASKET for oil pan	1	1	
249	PI-148	THUMB SCREW for cylinder head covers to shroud (use with PH-442 washer)	2	1		272	QD-757-B	GASKET for cylinder head	4	1	
								QD-757, replaced by QD-757-B.			
250	PJ-105-D	STUD for idler gear	1	5		273	QD-758	GASKET for rocker arm cover	4	1	
251	PK-37-A	RETAINING RING for piston pin	8	1		274	QD-761	GASKET for main bearing plate - .003" thick	2	1	
		PK-37, replaced by PK-37-A.									

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IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req	Net Wt.	
				Lb	Oz
275	QD-761-A	GASKET for main bearing plate — .006" thick	2	1	
277	QF-93	SHIM for main bearing plate—.006" thick Used in V-460D engines only.	3	1	
278	QF-93-A	SHIM for main bearing plate—.014" thick	1	1	
279	RC-91	SCREEN for oil filler tube	1	1	
280	RF-934-1	1/8" PIPE NIPPLE, 1" long, in carburetor fuel inlet	1	1	
281	RF-1096	ELBOW	2	1	
		1-in fuel pump outlet.			
		1-for low oil pressure check (on engines with bell housing at T.O. end)			
283	RF-1319	MALE ELBOW, 1/8" P.T. x 1/4" inverted flare tubing nut	5	1	
		4-in cylinder heads for oil return line.			
		1-in top of crankcase.			
284	RF-1368	OIL COUPLING to crankshaft collet	1	1	
285	RF-1374	ADAPTER FITTING for oil line to gauge	1	1	
286	RF-1375-A	OIL SPRAY ELBOW for governor	1	1	
287	RF-1377-A	*Y* FITTING for oil return line to case. RF-1377, replaced by RF-1377A.	2	1	
288	RF-1378	COUPLING for collet adapter	1	1	
289	RF-1392	ADAPTER for collet couplings	1	2	
290	RF-1420	FITTING for oil line connections to case	1	2	
291	RF-1421	ELBOW in carburetor fuel inlet	1	1	
292	RF-1423	NIPPLE for oil filter mounting	1	2	
294	RJ-163	OIL SABER, below oil filler tube	1	4	
		Beginning with Serial No. 3655793.			
		RJ-153B-S1 with PH-245 cork, for engines previous to Serial No. 3655793.	1	4	
295	RJ-163-A (Optional)	OIL SABER, starter side, for engines beginning with Serial No. 3655793.	1	3	
		RJ-159-J for engines previous to Serial No. 3655793.	1	2	
296	RK-179-B	OIL SLING for crankshaft	1	2	
		RK-170B, replaced by RK-179-B.			
297	RM-845-A	OIL LINE, 1/4" tubing, 8 1/2" long, with nuts	1	2	
		Reducing valve to upper oil header.			
		RM-666A, replaced by RM-845-A.			
298	RM-850-A	OIL LINE, 1/4" tubing, 7 1/2" long, with nuts	1	2	
		Oil header to reducing valve.			
		RM-1122B, replaced by RM-850-A.			
299	RM-1049-E	FLEXIBLE HOSE, 19" long, with fittings	1	8	
		For header to oil pressure gauge.			
300	RM-1049-K	FLEXIBLE HOSE, 13" long, with fittings	1	6	
		For fuel line, pump to carburetor.			
301	RM-1351-A	OIL RETURN LINE, cylinder to case, Includes: JK-52 'O' ring. RM-1351-S1, used previous to Serial No. 3477845 (not available) — use 2 RM-1351-A and 1 RF-1377-A.	4	2	
303	RS-56-S1	OIL PRESSURE GAUGE with decal	1	6	
304	RV-38-S3	OIL FILTER CARTRIDGE (3 pack)	1	1	
305	RV-41-A-S1	OIL PRESSURE REDUCING VALVE With JK-52 'O' ring, for engines beginning with Serial No. 3488820. RV-41 and RV-33-B for engines to and including Serial No. 3488819, for replacement use RV-41-A-S2 (includes oil lines).	1	4	
306	RV-34-A	OIL PRESSURE RELIEF VALVE ASS'Y.	1	6	
307	SD-255	TAG for YC-27-B ignition starting switch	1	1	
308	SD-265	TAG for choke instructions	1	1	
309	SD-249	ENGINE NAME PLATE	1	1	
		NOTE: When ordering name plate, give Model, Specification Number and Serial Number for correct stamping.			
-	SD-250-B	ENGINE INSTRUCTION TAG (not illust.)	1	1	
310	SE-48	SCREEN for flywheel shroud	1	1	
311	SE-239-A	FLYWHEEL SHROUD	1	16	8
312	SE-240-B	CYLINDER SHROUD, L.H. side	1	1	12
313	SE-240-A	CYLINDER SHROUD, R.H. side	1	1	12
314	SE-241-4	HEAT DEFLECTOR, L.H. side (V-465D)	1	1	12
	SE-241	For Models V-460D and V-461D	1	1	12
315	SE-241-A	HEAT DEFLECTOR, R.H. side	1	1	12
316	SE-242	CYLINDER HEAD COVER, L.H. side ..	1	1	2
317	SE-242-A	CYLINDER HEAD COVER, R.H. side ..	1	1	2
320	T-89-F-S1	GOVERNOR ASSEMBLY	1	3	8
		Consisting of:			
321	PM-173	Governor spring	1	1	
322	TC-391-B	Thrust sleeve and bearing	1	3	
323	TC-395-S7	HOUSING ASSEMBLY	1	2	
		Consisting of:			
324	PF-18A	Pipe plug—1/8" slotted	2	1	
326	PH-571	Oil seal—replaces PF-118 ... Retainer and PH-318-A Seal	1	1	
327	QD-615A	Housing gasket	1	1	
328	SA-52	Plug—1/2" expansion	1	1	
329	TC-395	Housing	1	1	14
330	TC-398	Cross shaft and lever	1	2	
331	VB-151	Yoke	1	3	
332	XH-1	Pin for yoke—No. 0 x 3/4" long taper	1	1	

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INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Reg	Net Wt. Lb Oz	Ref. No.	Part Number	Description	No. Reg	Net Wt. Lb Oz
334		TC-405-B GEAR & FLYWEIGHT ASS'Y. Consisting of:	1	1			ACCESSORY DRIVE ASSEMBLY STANDARD HARDWARE		
335		GD-100B Gear	1	7	377		PE-5 Lockwasher, 3/8" Positive	2	1
336		PH-313A Bushing washer	1	1			For mounting housing.		
337		TC-322D-S1 Flyweight assembly	2	3	378		PL-55 Key, No. 6 Woodruff	2	1
		Includes TC-328D Thrust pin.					1-for drive pulley.		
338		TC-389A-1 Gear bushing	1	2			1-for drive gear.		
		TC-389-1, replaced by TC-389A-1.			379		XD-29 Screw, 3/8"-16 thread x 1-1/4" long, hexagon head	2	1
339		PA-442 Flyweight roll pin	2	1			For mounting housing. (Blind holes)		
		PA-340, replaced by PA-442.					XD-32 (2" long) and PD-79 Nut, used with thru holes in gear cover.		
340		VE-549-B Control rod to carburetor	1	1	380		XE-65 Screw, No. 10-32 thread x 1/2" long, Allen head set. For drive pulley.	1	1
		GOVERNOR STANDARD HARDWARE							
343		PE-4 Lockwasher, 5/16", for housing	4	1					
344		PH-332 Washer, 1/8" I.D. x 5/16" O.D. x 1/16" thick steel between control rod and lever	1	1	382	U-226	STARTING CRANK	1	2
345		XD-16 Screw, 5/16"-18 thread x 7/8" long, hexagon head	4	1	383	VE-693-A	CHOKE CONTROL	1	1
		For governor housing.			384	VE-731	CONTROL PANEL	1	1 8
346		XI-32 Cotter pin, 3/64" dia. x 3/8" long, for control rod	1	1	385	WD-58-A	EXHAUST MUFFLER	1	4
		NOTE: The following governor parts are not included in the T-89-F-S1 governor assembly for service.			386	WE-243-2-S1	GEAR COVER SPACER PLATE	1	2 4
347		PD-173A Adjusting screw nut	1	1			Includes 2 PD-228 Fasteners.		
348		PI-145 Adjusting screw (6-3/4" long)	1	1	388	XK-7-A	PIPE PLUG for oil drain	1	1
349		TC-388-1 Governor shaft	1	3			3/4" - magnetized.		
351	TF-96-16	FUEL PUMP ADAPTER and PRIMER ASSEMBLY	1	1			NOTE: The starting motor, distributor, generator, regulator and ignition coil furnished on this model engine are products of either the Delco-Remy Company or Prestolite Company. It is suggested that when replacement of any of these parts becomes necessary, that the replaced part be of the same manufacture as the other components.		
		Consisting of:			389	YA-42	STARTING MOTOR (12 volt) Delco-Remy No. 1107246, with solenoid switch	1	22
352		JK-50 'O' Packing ring	1	1		YA-26-A	Prestolite No. MDY-7006	22	8
353		PM-145 Spring	1	1			NOTE: For starting motor service parts, refer to illustrations immediately following this parts list.		
354		TA-111D Plunger (TA-116 must also be ordered)	1	1					
355		TA-114-S1 Shaft with JK-50 packing	1	1	390	YB-62-B	GENERATOR (negative ground)	1	21 8
356		TA-115 Handle	1	1		YB-60-A	Delco-Remy No. 1102343.		
357		TA-116 Cap	1	1			Prestolite No. GJY-7401-SN.	20	
358		- - - Adapter, not serviced separately, order complete TF-96-16 Adapter assembly.					Either generator is used on engines beginning with Serial No. 3979807. (See Ref. 122 for mounting bracket)		
360	TF-122H-1	ACCESSORY DRIVE ASSEMBLY	1	7			The following (positive ground) generators were used previous to Engine Serial No. 3979807:		
		TF-112L-1, replaced by TF-122H-1.					YB-62, Delco-Remy No. 1102225.		
		Consists of:					YB-60, Prestolite No. GJY-7401-S.		
361		GD-120A Drive gear	1	14			For replacement use corresponding manufacturers negative ground generator and negative ground voltage regulator.		
362		HF-470 Spacer for drive gear	1	1			NOTE: For generator service parts, refer to illustrations immediately following this parts list.		
363		JJ-320-G Drive shaft assembly	1	1 4					
		JJ-320, replaced by JJ-320-G.							
		Consists of:							
364		GF-90 Gear for distributor drive	1	2					
365		JD-362-1 Shaft (Replaces JD-362)	1	10					
366		ME-112 Bearing, No. 1623-NS	1	3					
367		ME-139 Bearing, No. 1633-NS	1	4					
368		PA-281 Pin for distributor gear, 1/8" x 7/8" long, taper groove	1	1					
369		PK-108 Lock rings	3	1					
371		MD-363-1 Drive pulley	1	1					
372		PH-541 Oil seal (Replaces PH-274)	1	1					
373		PK-107 Lock ring for bearing, in housing	1	1					
374		QD-616 Gasket for housing	1	1					
375		TB-141C-S1 Housing assembly	1	3 8					
		Includes: JK-59 'O' Ring							
		PH-541 Oil seal							
		Replaces TB-130A-1-S1, TB-141-S2.							

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INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No.			Ref. No.	Part Number	Description	No.		
			Req	Lb	Oz				Req	Lb	Oz
391	YC-27B-S1	IGNITION - STARTING SWITCH Includes: SD-255 Tag. For engines beginning with Serial No. 3655572. YC-9B-S1 Ignition switch YC-19 Starting switch For engines previous to Serial No. 3655572.	1		4	406	YL-349	DISTRIBUTOR IGNITION CABLE SET .. Consisting of: PH-198 Grommet YL-358-15 Cable, coil to distributor YL-339-14 Cable for No. 1 cylinder YL-339-16 Cable for No. 3 cylinder YL-339-42 Cable for No. 2 cylinder YL-339-44 Cable for No. 4 cylinder	1	1	
393	YC-66D-S1	HIGH TEMPERATURE SAFETY SWITCH KIT Consisting of: SD-233 Decal YC-66-D Switch, mounted to outer boss at No. 4 cylinder head YL-357-42 Wire assembly Replaces YC-66B-S1, YC-66-S9.	1		6	414	YL-352-8	IGNITION WIRE ASSEMBLY Ignition switch to ammeter.	1		1
396	YD-20	RUBBER NIPPLE for distributor towers	5		1	415	YL-352-11	IGNITION WIRE ASSEMBLY Ignition coil to Prestolite distributor. NOTE: Coil wire is an integral part of YF-34. See Delco-Remy Distributor Parts List for service number.	1		1
397	YD-20-A	RUBBER NIPPLE for coil terminal tower	1		1	416	YL-352-26	IGNITION WIRE ASSEMBLY 1-for starter solenoid to switch. 1-for coil to ignition switch.	2		1
398	YD-296	GROUND STRAP TERMINAL	1		1	417	YL-352-30	IGNITION WIRE ASSEMBLY Regulator to ammeter (batt. term.)	1		1
399	YD-301-S1	SPARK PLUG , Champion No. UN-12Y, 14mm, with gasket	4		2	418	YL-353A-27	IGNITION WIRE ASSEMBLY Ammeter to solenoid.	1		1
401	YE-2	AMMETER	1		6	419	YL-355-10	IGNITION WIRE ASSEMBLY 1-for generator to regulator (field term.) 1-for generator to regulator (arm. term.)	2		1
402	YF-18-A or YF-5-B	IGNITION COIL (12 volt), Delco-Remy No. 1115072 Prestolite No. 200687, 200562	1	1	8 12	420	YL-357-42	IGNITION WIRE ASSEMBLY Safety switch in distributor.	1		1
403	YF-34-S1 or 403A YF-10C-S1	DISTRIBUTOR , Delco-Remy No. 1112695 With clamp, beginning with Engine Serial No. 4420865 YF-25 Delco-Remy No. 1112596 used previous to Serial No. 4420865, no longer available. For interchangeable replacement, use Prestolite distributor. Prestolite No. 1AD-6004-2N YF-10A-S1 (1AD-6004-2F), replaced by YF-10C-S1. NOTE: For distributor service parts, refer to illustrations immediately following this parts list.	1	3		MISCELLANEOUS STANDARD HARDWARE					
404	YJ-41-D or YJ-39-C	VOLTAGE REGULATOR (negative ground) Delco-Remy No. 1119257 YJ-41 (positive ground) Delco-Remy No. 1119152D, used with obsolete YB-62 gen. Prestolite No. VBO-4201AD-3 (neg. grd.) YJ-39 (positive ground) Prestolite No. VBO-4201W3, used with obsolete YB-60 generator. NOTE: Refer to rear of manual for service parts list of Delco-Remy voltage regulator. Component parts of Prestolite regulator, not available for service.	1	1	6	424	PD-77	NUT , 1/4"-20 thread, hexagon steel For voltage regulator mounting.	2		1
405	YL-378-12	GROUND WIRE generator to coil clamp. YL-191-C, replaced by YL-378-12.	1		2	425	PD-249	LOCK NUT , 1/4"-20 thread For air cleaner strap. (Replaces PD-77)	2 (V-461D) 3 (V-465D)		
						426	PD-78	NUT , 5/16"-18 thread, hexagon steel 2-for generator mounting. 1-for generator adjusting strap. 3-for air cleaner strap to shroud.	6		1
						427	PD-252	NUT , 3/8"-16 thread, hex. (grade 5) For cylinder studs. PD-79, replaced by PD-252.	16		1
						428	PD-205	NUT , 5/16"-24 thread (Seez-proof) 10-for manifold, upper to lower branch. 2-for carburetor mounting.	12		1
						429	PD-207	NUT , 7/16"-20 thread (Seez-proof) For manifold to cylinder heads.	4		1

Order parts from nearest **SERVICE STATION** shown in directory following parts list.

IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req.	Net Wt.		Ref. No.	Part Number	Description	No. Req.	Net Wt.	
				Lb	Oz					Lb	Oz
431	PE-3	LOCKWASHER, 1/4" Positive 2-for fuel pump adapter. 2-for flywheel screen. 26-for air shrouding. 4-for control panel. 1-for distributor clamp. 4-for mounting voltage regulator. 1-for heat defl. bracket (L.H. side). 1-for oil tube clamp (V-465D). 4-for cyl. hold down clips (V-465D).	51		1	442	PH-77-A	WASHER, 5/16" I.D. x 5/8" O.D., plain, steel 1-for generator adjusting strap. 2-for generator bracket mounting.	3		1
432	PE-4	LOCKWASHER, 5/16" Positive 4-for air cleaner strap to shroud. 16-for oil pan. 4-for air shroud to gear cover. 18-for gear cover and spacer to case. 2-for fuel pump mounting. 2-for carburetor mounting. 5-for bearing ret. plate - flywheel end. 1-for brg. plate and collet coupling adapter. 1-for governor oil spray elbow. 1-for generator adjusting strap bracket. 8-for rocker arm bracket mounting. 2-for generator mounting screws. 2-for generator adjusting strap. 1-for oil press. red. valve. 1-for ignition coil clamp.	68		1	443	PH-84	WASHER, 1/4" I.D. x 1/2" O.D. x 1/16" thick steel 4-for cylinder shrouds to air shroud. 2-for R.H. cylinder shroud to case. 1-for cylinder shroud clip to pump. 4-for voltage regulator mounting. 1-for Delco-Remy distr. clamp.	12		1
433	PE-5	LOCKWASHER, 3/8" Positive 6-for main bearing plate - T.O. end. 3-for starting motor mounting.	9		1	444	PH-513	WASHER, 13/32" I.D. x 13/16" O.D. x 1/8" thick, steel, hardened For cylinder head mounting.	15		1
433	PE-80-A	LOCKWASHER, 3/8" internal tooth For air shroud to gear cover.	2		1	446	RF-794	PIPE NIPPLE, 1/8" x 3/4" long For fuel strainer mounting.	1		1
434	PE-37	LOCKWASHER, 5/8" Positive For engine supports to crankcase.	4		1	447	SA-13	PLUG, 3/4" expansion For oil pressure relief valve.	1		1
435	PE-46	LOCKWASHER, 5/16" external 'Everlock' 3-for mounting camshaft gear. 2-for generator bracket.	5		1	448	SA-58	PLUG, 1-3/8" expansion For camshaft end hole.	1		1
436	PE-75	LOCKWASHER, 5/16" IET 'Everlock' .. For coil clamp and ground wire.	1		1	449	XA-33	SCREW, 1/4"-20 thread x 3/8" long, indented hexagon head 8-for flywheel screen. 3-for heat deflectors to case. 4-for cylinder shroud to heat deflectors. 4-for heat deflectors to shroud. 4-for cylinder shroud to air shroud. 4-for control panel. 1-for heat defl. brkt. (L.H. side).	28		1
437	PF-18	PIPE PLUG, 1/8" slotted, steel 2-for upper oil header. 1-for oil pump lockscrew hole. 4-for lower oil header. 1-for oil line fitting in case.	8		1	450	XA-34	SCREW, 1/4"-20 thread x 1/2" long, indented hexagon head 2-for R.H. cylinder shroud to case. 1-for oil tube clamp (V-465D).	3		1
438	XK-3	PIPE PLUG, 3/8" square head For timing hole in gear cover.	1		1	451	XA-67	SCREW, No. 4 x 1/4" long stove-head, self-tapping sheet metal For mounting name plate.	4		1
439	PH-14	WASHER, 5/16" I.D. x 19/32" O.D., plain, copper For spacer plate to case, upper R.H.	1		1	452	XA-74	SCREW, 1/4"-20 thread x 2-1/4" long, steel round head (2 req'd. for V-461D) .. For air cleaner strap clamp.	3		1
440	PH-22-A	WASHER, 3/8" I.D. x 11/16" O.D. x 3/32" thick, plain, hardened steel For cyl. head at Hi-temperature switch.	1		1	455	XD-7	SCREW, 1/4"-20 thread x 1" long, hexagon head 4-for cylinder hold down clips. 1-for Delco-Remy distr. clamp.	5		1
441	PH-30	WASHER, 1/4" I.D., plain, copper For fuel pump heat shield.	1		1	455A	XD-4	SCREW, 1/2" long, for Prestolite clamp			1
						456	XD-8	SCREW, 1/4"-20 thread x 1-1/4" long, hexagon head For Delco-Remy voltage regulator mt'g.	4		1
							XD-9	SCREW, 1/4"-20 x 1-1/2" long For Prestolite regulator mt'g.			1
						457	XD-13	SCREW, 5/16"-18 thread x 1/2" long, hexagon head For generator bracket.	2		1

Order parts from nearest **SERVICE STATION** shown in directory following parts list.

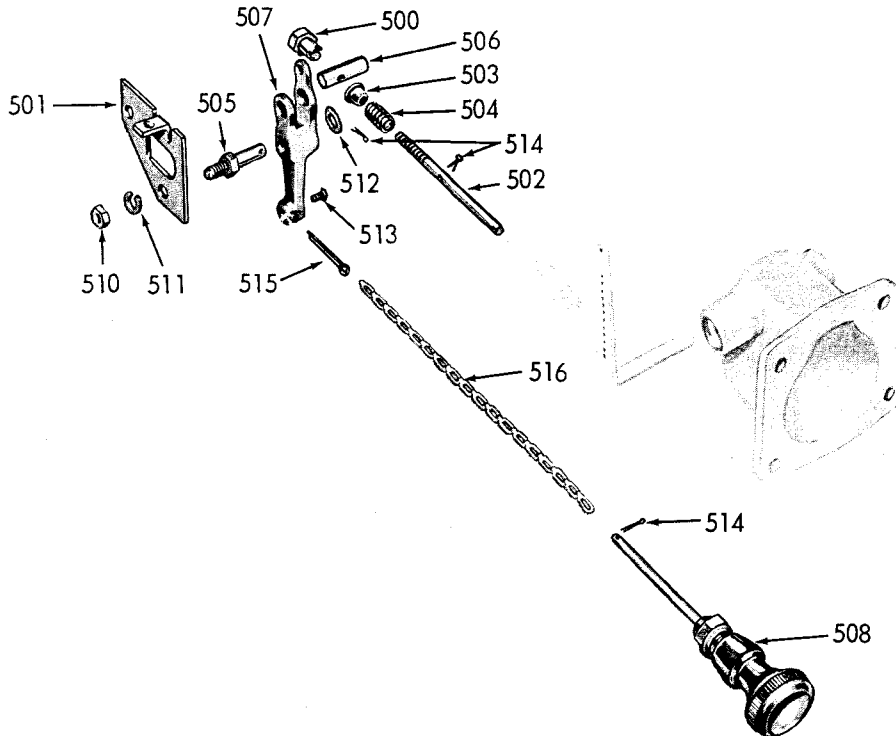
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

INTERCHANGEABLE PARTS FOR MODELS V-460D, V-461D AND V-465D

Ref. No.	Part Number	Description	No. Req	Net Wt.	
				Lb	Oz
458	XD-172	SCREW, 5/16"-18 thread x 1/2" long, 1/8" thick, hexagon head For flywheel shroud to gear cover. XD-13-1, replaced by XD-172.	4	1	
459	XD-14	SCREW, 5/16"-18 thread x 5/8" long, hexagon head 16-for oil pan. 2-for fuel pump mounting. 4-for air cleaner strap mounting. 4-for spacer plate to case. 1-for oil pressure red. valve.	27	1	
460	XD-15	SCREW, 5/16"-18 thread x 3/4" long 2-for generator adjusting strap. 2-for spacer plate to gear cover. 5-for bearing retainer plate - fan end.	10	1	
461	XD-16	SCREW, 5/16"-18 thread x 7/8" long, hexagon head, for coil clamp	1	1	
462	XD-17	SCREW, 5/16"-18 thread x 1" long, hexagon head 1-for governor spray elbow. 8-for rocker arm bracket. 2-for gear cover to spacer.	11	1	
462A	XD-17-B	SCREW, 5/16"-18 thread x 7/8" long, hexagon head, steel grade 5 For generator to bracket.	2	1	
463	XD-19	SCREW, 5/16"-18 thread x 1-1/4" long, hexagon head 3-for camshaft gear. 8-for gear cover to crankcase.	11	1	
464	XD-21	SCREW, 5/16"-18 thread x 1-1/2" long, hexagon head For collet coupling adapter.	1	1	
465	XD-22	SCREW, 5/16"-18 thread x 1-3/4" long, hexagon head For gear cover mounting.	2	1	
466	XD-29	SCREW, 3/8"-16 thread x 1-1/4" long, hexagon head 6-for main bearing plate - T.O. end. 3-for starter motor mounting.	9	1	
467	XD-52	SCREW, 5/8"-11 thread x 1-3/4" long, hexagon head For mounting engine supports.	4	2	
468	XD-83	SCREW, 7/16"-14 thread x 3" long, hexagon head 2-for center bearing cap to hanger. 2-for center bearing hanger to case. Replaces XD-146 (2-3/4" long) but add 2 HF-627 spacers (hanger to case).	4	1	
469	XD-171	SCREW, 3/8"-16 thread x 1/2" long, hexagon head For flywheel shroud to gear cover. XD-114-1, replaced by XD-171.	2	1	
471	XD-175	SCREW, 1/4"-20 thread x 7/8" long, hexagon head For fuel pump adaptor mounting. XD-6, replaced by XD-175.	2	1	
472	XE-55	SCREW, 5/16"-18 thread x 3/8" long, Allen head set For locking idler stud.	2	1	
473	XK-1	PIPE PLUG, 1/8" square head 1-for upper header on case face. 1-for inlet manifold tap.	2	1	
474	- - -	KEY, No. 5 Woodruff Furnished with generator.	1	1	
475	- - -	DOME BOLT for shield support Furnished with fuel pump.	1	1	

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

TT-90 VARIABLE SPEED GOVERNOR CONTROL ASSEMBLY



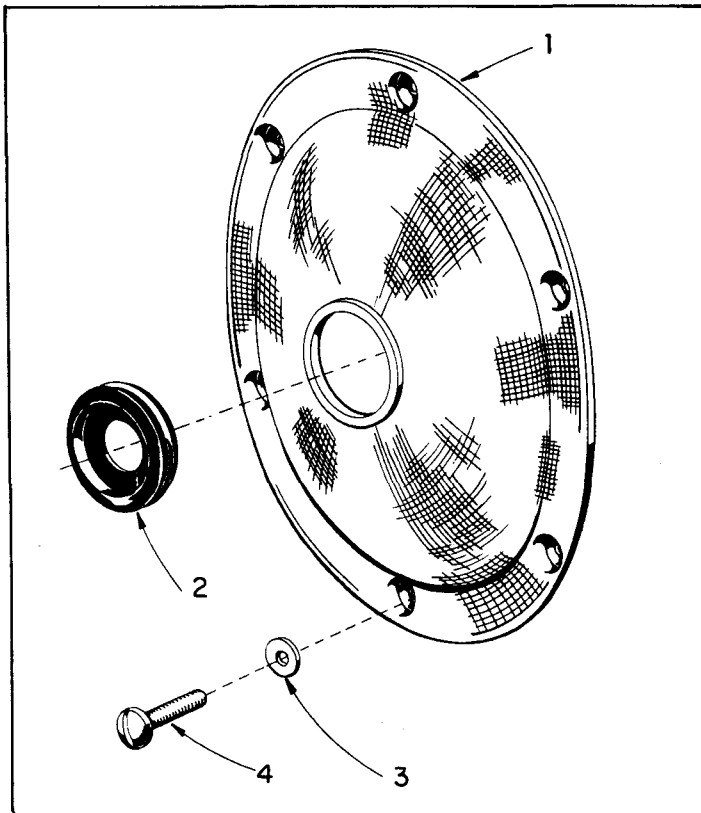
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Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb Oz
500	PD-173-A	LOCKNUT for adjusting screw (Part of standard engine. Not part of this assembly.)	1	1
501	PG-914-A	BRACKET for control lever	1	4
502	PI-145-3	ADJUSTING SCREW, 6-3/4" long	1	2
503	PK-121	RETAINER for adjusting screw spring	1	1
504	PM-111	SPRING for adjusting screw	1	1
505	TC-365-F	FULCRUM PIN for lever support	1	1
506	TC-368-G	PIN for adjusting screw swivel.....	1	1
507	VB-134-D	VARIABLE SPEED LEVER	1	4
508	VE-527-W	CONTROL	1	8

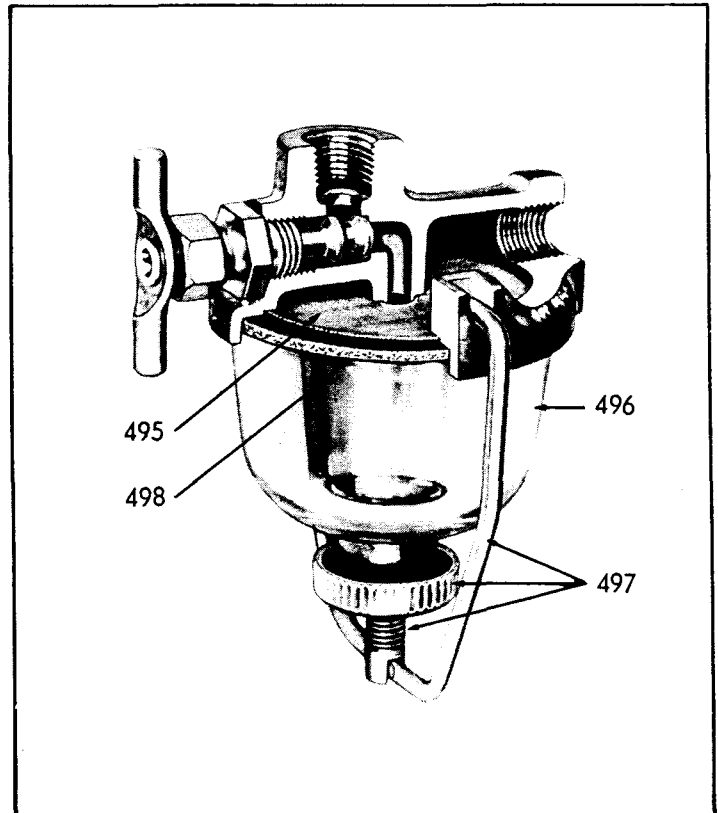
Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb Oz
STANDARD HARDWARE				
510	PD-77	NUT, 1/4"-20 thread, hexagon steel..... For fulcrum pin to bracket.	1	1
511	PE-3	LOCKWASHER, 1/4" Positive	1	1
512	PH-77-A	PLAIN WASHER, 5/16" I.D. x 5/8" O.D. x 1/16" thick steel..... For variable speed lever.	1	1
513	XA-80	SCREW, 8-32 thread x 1/4" long, round head For cotter pin in lever.	1	1
514	XI-1	COTTER PIN, 1/16" x 1/2" long	3	1
		1-for variable speed lever pin. 1-for adjusting screw spring. 1-for chain at control.		
515	XI-7	COTTER PIN, 3/32" x 3/4" long	1	1
		For chain at lever.		
516		No. 1/0 GALVANIZED SAFETY CHAIN 12-1/2" long. For control to lever.	1 pc	2

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

ROTATING SCREEN



FUEL STRAINER ASSEMBLIES



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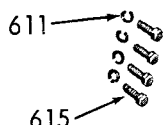
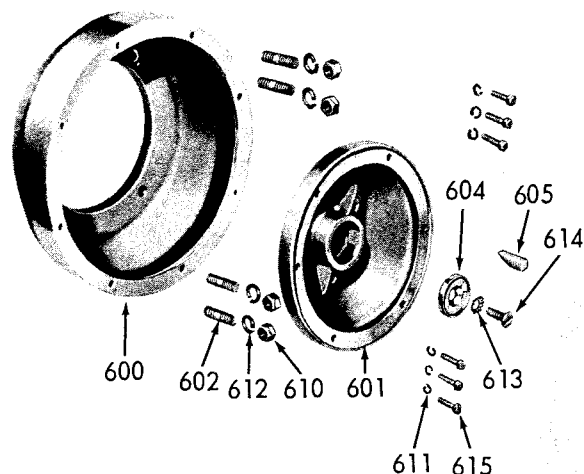
Ref. No.	Part Number	Description	No. Req.	Net Wt.	
				Lb	Oz
1	SE-205A-S2	ROTATING SCREEN ASSEMBLY.....	1	3	8
		Consisting of:			
2	PH-426	Grommet	1	1	
3	PH-442	Washers	6	1	
-	SE-205-A	Screen	1	3	
4	XA-104	Lok-Thread screws.....	6	1	
		THE FOLLOWING REPLACE STANDARD PARTS:			
	NC-194-1-S1	FLYWHEEL — Includes GH-43 Ring Gear and tapped holes for mounting rotating..	1		
	U-226-A	STARTING CRANK ASSEMBLY.....	1		

Ref. No.	Part Number	Description	No. Req.	Net Wt.	
				Lb	Oz
	LP-19	FUEL STRAINER ASSEMBLY (With shut-off valve in cover, and glass bowl). Tillotson No. OW-418-T.	1		8
	LP-19-A	FUEL STRAINER ASSEMBLY (With shut-off valve in cover, and metal bowl). Tillotson No. OW-449-T.	1		7
	LP-19-B	FUEL STRAINER ASSEMBLY (Without shut-off valve in cover, and glass bowl). Tillotson No. OW-444.	1		6
	LP-19-C	FUEL STRAINER ASSEMBLY (Without shut-off valve in cover, and metal bowl). Tillotson No. OW-476-T.	1		5
		The following serviceable parts are interchangeable for all the above fuel strainers.			
495	OW-352	FILTER SCREEN	1		1
496	OW-363	GLASS BOWL	1		2
	06137	METAL BOWL.....	1		1
497	OW-447	CLAMP WIRE and THUMB NUT ASSEMBLY	1		1
498	06096	BOWL GASKET (Wisconsin No. QD-653)	1		5
	LQ-32	GLASS BOWL REPAIR KIT			

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

WW-165 DRIVE HUB AND HOUSING ASSEMBLY FOR CLUTCH POWER TAKE-OFF AND CLUTCH REDUCTION UNITS

NOTE: The drive hub and housing assembly part number is stamped on this tag.



OPTIONAL:
CLUTCH POWER TAKE-OFF
OR
CLUTCH REDUCTION UNIT

The above assembly is suitable for mounting the following Clutch Power Take-Off and Clutch Reduction Units.

229451C-A

WISCONSIN MOTOR PART NUMBER	MANUFACTURER'S PART NUMBER	DESCRIPTION	REDUCTION RATIO	ROTATION AT TAKE-OFF SHAFT
WC-328-A	ROCKFORD PTA-4856	Clutch Power Take-Off	---	Enginewise
WC-329	ROCKFORD GRA-4812	Clutch Reduction Unit	2.77 to 1	Counter-Enginewise
WC-330	ROCKFORD GRA-4813	Clutch Reduction Unit	2.00 to 1	Counter-Enginewise
WC-360	TWIN DISC C108-E3.6-RG4	Clutch Reduction Unit	3.60 to 1	Enginewise

REFER TO ROCKFORD OR TWIN DISC ILLUSTRATIONS FOR PARTS LIST OF CLUTCH POWER TAKE-OFF AND CLUTCH REDUCTION UNITS.

NOTE: Engines equipped with a Clutch Power Take-Off or Clutch Reduction Unit require a special crankshaft, CA-75-1-S1.

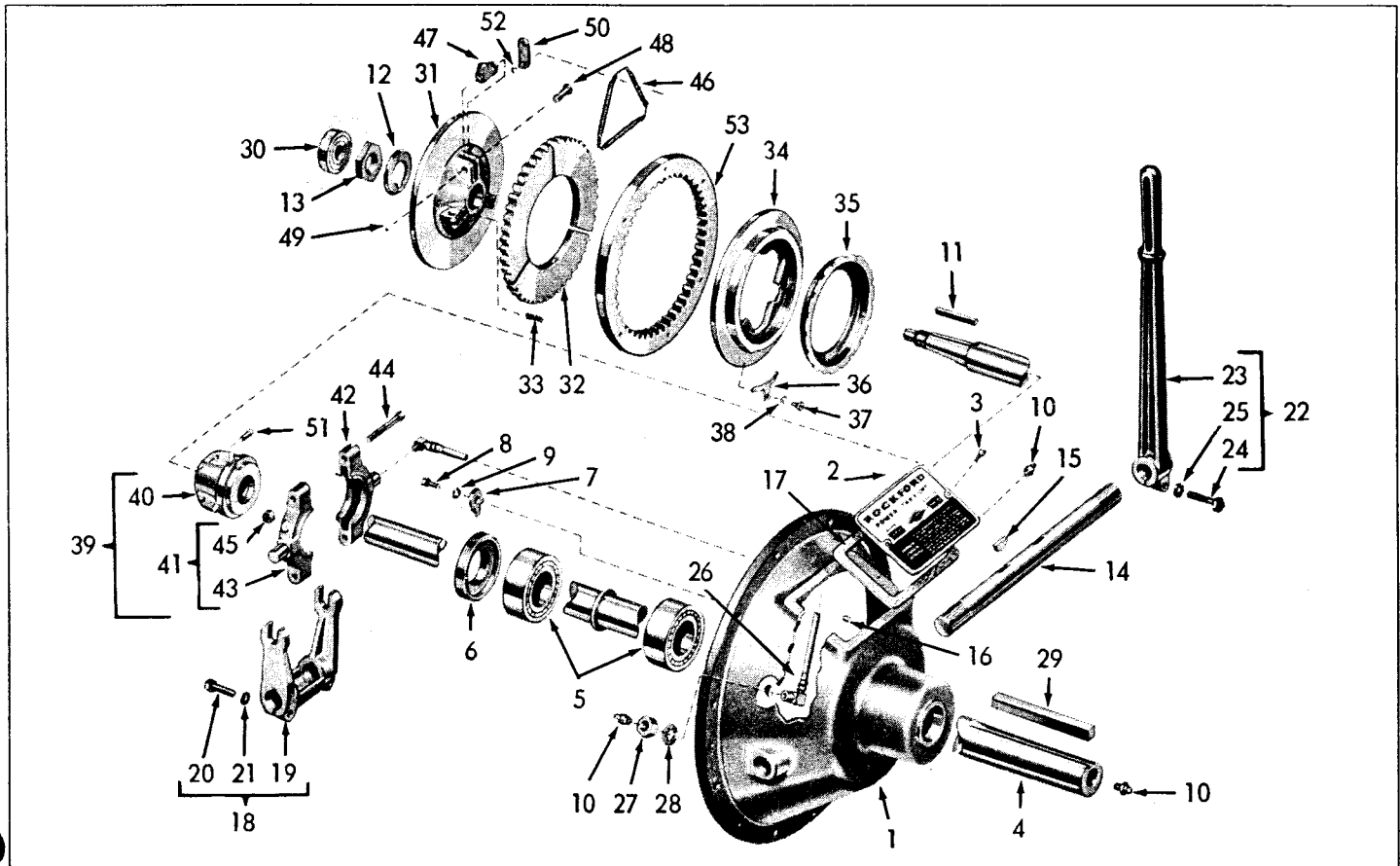
Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb. Oz.
	WW-165	DRIVE HUB and HOUSING ASSEMBLY Consisting of the following parts:		
600	BO-188-B	HOUSING for drive hub (No. 4 S.A.E.) ..	1	40
601	NC-163-2	DRIVE HUB	1	15
602	PC-464	STUD for housing to crankcase mounting	4	3
604	PH-489	RETAINER for drive hub	1	2
605	PL-150-1	KEY for drive hub	1	1
607	SD-79-B	ASSEMBLY NUMBER TAG	1	1
		STANDARD HARDWARE		
610	PD-15	NUT, 5/8"-18 thread, hexagon steel For mounting housing to crankcase.	4	1
Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb. Oz.
611	PE-5	LOCKWASHER, 3/8" Positive	18	1
		6-for mounting clutch to drive hub. 12-for mounting unit to housing. (Not part of WW-165 Assembly.)		
612	PE-37	LOCKWASHER, 5/8" Positive	4	1
		For mounting housing to crankcase.		
613	PE-86	LOCKWASHER, 1/2" Countersunk	1	1
		For mounting hub retainer.		
614	XC-59	SCREW, 1/2"-13 thread x 1-1/4" long, socket flat head	1	1
		For mounting hub retainer.		
615	XD-29	SCREW, 3/8"-16 thread x 1-1/4" long, hexagon head	18	1
		12-for mounting unit to housing. 6-for mounting clutch to drive hub. (Not part of WW-165 Assembly.)		
	RF-1096	ELBOW for checking oil press. (not illustrated) in oil header, upper crank- case face.		

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

ROCKFORD No. PTA-4856 POWER TAKE-OFF ASSEMBLY

WISCONSIN MOTOR PART No. WC-328-A

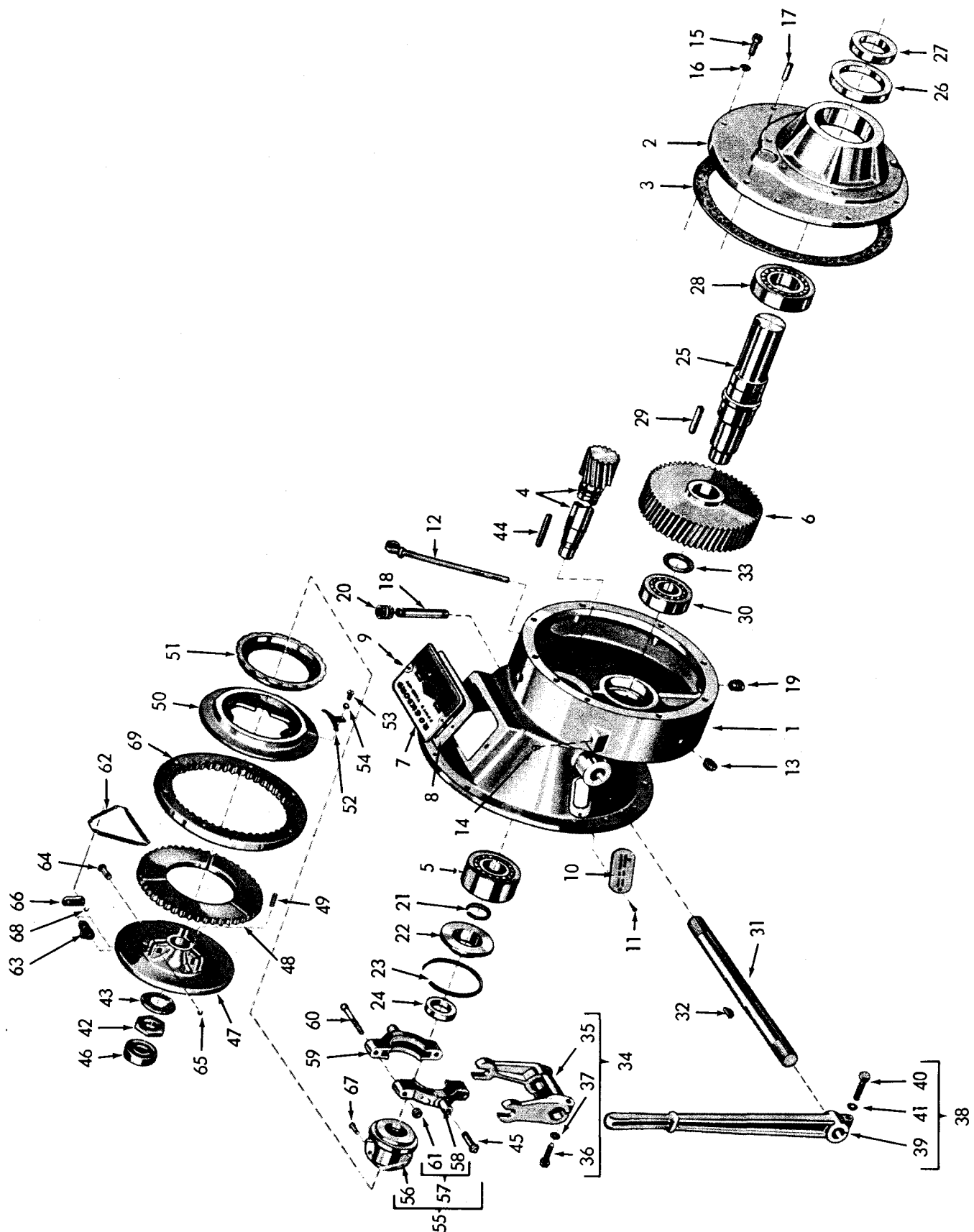
Replaces PTA-4819, Wisconsin Motor No. WC-328. Sealed pilot bearing in PTA-4856 eliminates grease fitting as used at end of drive shaft in PTA-4819. Parts are identical for both units, except where indicated by unit Part No.



229635C

Ref No	Rockford Part Number	Description	No Req	Ref No	Rockford Part Number	Description	No Req
	PTA-4M141	HOUSING ASSEMBLY less clutch (PTA-4856) PTA-4M56 (PTA-4819).	1	26	PT-1026-3	FLEXIBLE TUBE ASSEM., rep'l UPT-1014	1
1	PT-300-30	Consisting of: HOUSING, No. 4 S.A.E. (PTA-4856)	1	27	CL-4355	JAM NUT, 5/8"-18, for grease tube	1
2	PT-1593	PT-300-19 (PTA-4819).	1	28	PT-359	LOCKWASHER, 1228 Shakeproof, for jam nut	1
3	PT-347	INSTRUCTION PLATE (PTA-4856)	1	29	PT-1001	KEY for take-off shaft, 1/2" x 1/2" x 4-7/8"	1
4	PT-1068	PT-897-2 (PTA-4819).	1	30	ME-203	PILOT BEARING, sealed (PTA-4856)	1
5	PT-832	SCREW, 1/4"-20 x 3/8" round head	2		(Wis. Motor No.)	ME-192 (PTA-4819)	
6	PT-1059	For instruction plate.			CLA-2175-35	CLUTCH ASSEMBLY, 8" Model HE	1
7	PT-44	DRIVE SHAFT	1			CLA-2175-7A, replaced by CLA-2175-35.	
8	PT-349	MAIN BEARING, order Wis. Motor ME-188 ..	2	31	CL-8512-10	Consisting of:	
9	PT-350	BEARING RETAINER	1	32	CL-7039-1	CLUTCH BODY	1
10	PT-989	LOCK PLATE	1	33	CL-8575	FACING, Amco No. 796 (Set of 3 segments) ..	1
11	PT-808-1	SCREW, 5/16"-18 x 1/2", hexagon head	1	34	CL-8513-1	SEPARATOR SPRING	3
12	PT-718-1	For lock plate.		35	CL-8515-1	PRESSURE PLATE	1
13	PT-706	LOCKWASHER, 5/16", for lock plate	1		CL-11905	ADJUSTMENT NUT	1
14	PT-200	GREASE FITTING (1 in shaft of PTA-4819) ..	2	36	CL-9216	ADJUSTMENT NUT PLATE (not illust.)	1
15	PT-351	PIPE PLUG, 1/8" (in shaft of PTA-4856) ..	2	37	CL-8807-1	ADJUSTMENT LOCK, replaces CL-8516	1
16	PT-744	DRIVE KEY	1	38	CL-3468	SCREW for adjustment lock	1
17	PT-770	NUT for clutch body	1	39	UCL-4-8611-1	LOCKWASHER for adjustment lock.	
18	UPT-811	YOKE SHAFT	1			RELEASE SLEEVE and BEARING	
19	PT-352	KEY for yoke, No. 15 Woodruff	2	40	CL-8611-1	ASSEMBLY, replaces UCL-8611-1	1
20	PT-353	SET SCREW, 5/16"-18 x 1/4" flat point	1	41	UCL-7-7392	Consisting of:	
21	PT-353	For grease hole plug.				RELEASE SLEEVE	1
22	UPT-769	GASKET for instruction plate	1			RELEASE BEARING ASSEMBLY	1
23	PT-604	CLUTCH YOKE ASSEMBLY	1			UCL-7392, replaced by UCL-7-7392.	
24	PT-353	Consisting of:		42	CL-3335-1	Consisting of:	
25	PT-353	CLUTCH YOKE	1	43	CL-7356	BEARING HALF (not serviced separately) ..	1
		SCREW, 3/8"-16 x 1 1/4" hexagon head	2	44	CL-9464	BEARING HALF (not serviced separately) ..	1
		LOCKWASHER, 3/8"	2	45	CL-8556-1	SCREW, 5/16"-24 x 1 1/4" hexagon head	2
		SHIFTER LEVER ASSEMBLY	1	46	CL-8484	ELASTIC STOP NUT, 5/16"-24 thread	2
		Consisting of:		47	CL-7107	LEVER SPRING SET	1
		SHIFTER LEVER	1	48	CL-8557	LEVER	3
		SCREW, 3/8"-16 x 1 1/4" hexagon head	1	49	CL-8400	CLEVIS PIN for lever to body	3
		LOCKWASHER, 3/8"	1	50	CL-7130	RETAINING RING for lever clevis pin	3
				51	CL-6965	CONNECTING LINK	6
				52		CLEVIS PIN for connecting link	6
				53		RETAINING RING for link clevis pin	6
						DRIVING RING	1

ROCKFORD CLUTCH REDUCTION UNIT ASSEMBLIES
WISCONSIN MOTOR No's. WC-329 and WC-330, ROCKFORD No's. GRA-4812 and GRA-4813
ADAPTABLE TO WW-165 DRIVE HUB and HOUSING ASSEMBLY



Parts are identified by reference number. See parts list for correct part number.

229636C

ROCKFORD CLUTCH REDUCTION UNIT ASSEMBLIES

**ROCKFORD
PART NO.**

**GRA-4812
GRA-4813**

**WISCONSIN MOTOR
PART NUMBER**

**WC-329
WC-330**

**REDUCTION
RATIO**

**2.77 to 1
2.00 to 1**

PARTS LIST

Rockford Assembly No. (with Clutch)	Rockford Assembly No. (less Clutch) Ref. No. 1 to 46	REF. No. 1 Housing	REF. No. 2 Cover	REF. No. 3 Cover Gasket	REF. No. 4 Drive Gear and Shaft	REF. No. 5 Drive Shaft Bearing	REF. No. 6 Driven Gear
GRA-4812	GRA-4M12	* GR-851	* GR-101-3	GR-111	GR-852-1 (18 teeth)	GR-856 Wis. Motor ME-200	GR-853 (50 teeth)
GRA-4813	GRA-4M13	* GR-851	* GR-101-3	GR-111	GR-852-2 (23 teeth)	GR-856 Wis. Motor ME-200	GR-853-2 (46 teeth)

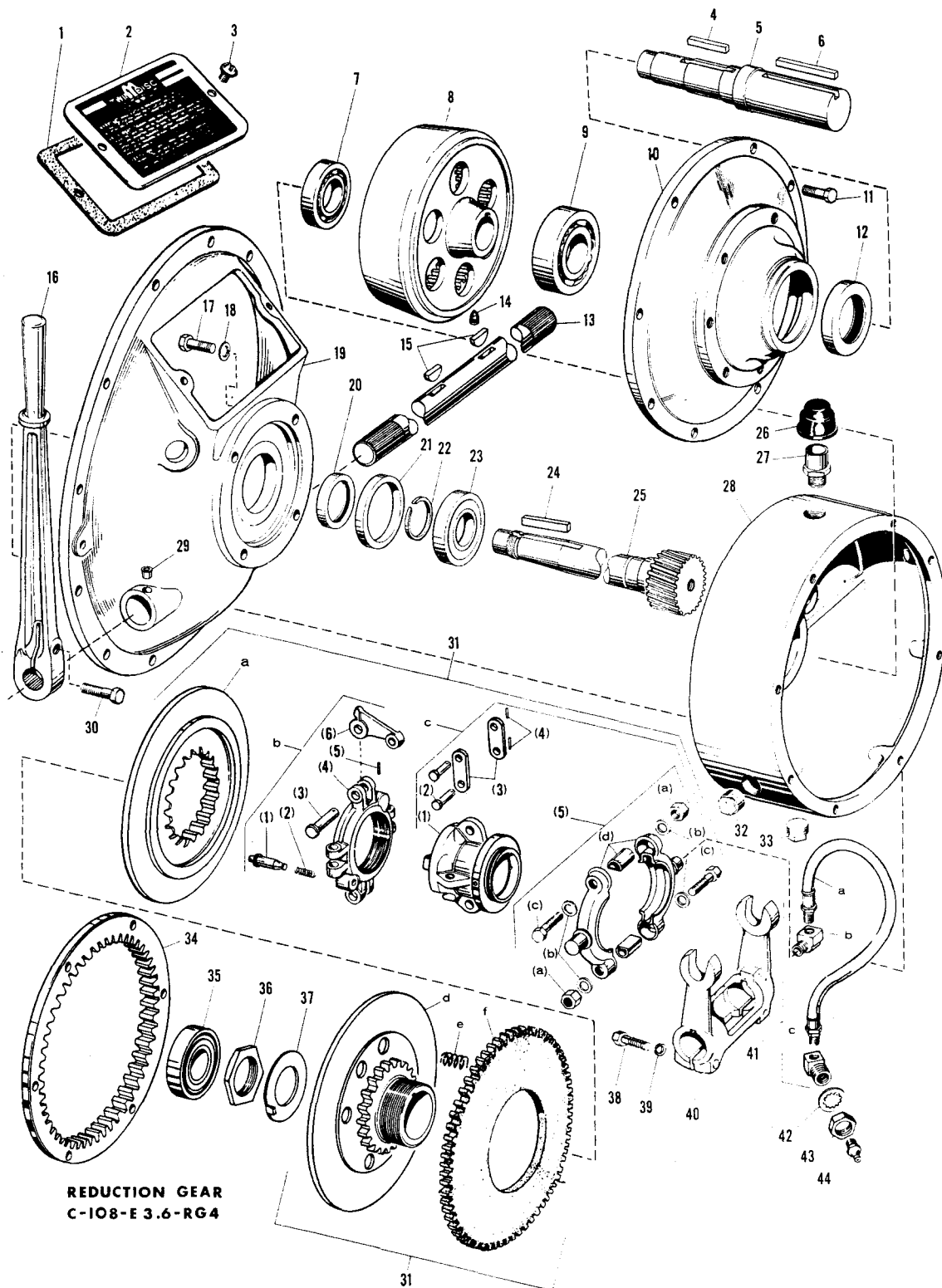
* Not serviced individually – order **UGR-1-851** Housing and Cover Assembly.

THE FOLLOWING PARTS ARE IDENTICAL FOR THE ABOVE ASSEMBLIES EXCEPT WHERE NOTED

Ref No	Rockford Part Number	Description	No Req	Ref No	Rockford Part Number	Description	No Req
7	PT-1593	INSTRUCTION PLATE	1	43	PT-718-1	LOCKWASHER for clutch body	1
9	PT-347	SCREW, 1/4"-20 x 3/8" round head	2	44	PT-808-1	DRIVE KEY	1
		For instruction plate.		45	PT-1060	GREASE FITTING for release bearing, Lincoln No. 5007	1
10	PT-819	LUBRICATION COVER (on older models)	1	46	GR-882	PILOT BEARING	1
11	PT-576	SCREW, No. 10-24 x 3/8" round head	1			Order Wisconsin Motor No. ME-202 .	
		For lubrication cover. (on older models)			CLA-2175-7A	CLUTCH ASSEMBLY, 8" MODEL HE	1
13	GR-117	OIL LEVEL PLUG, 3/8" P.T.	1			Consisting of: Ref. No. 47 to 69	
15	PT-469	SCREW, 3/8"-16 x 1" hexagon head	8	47	CL-8512-10	CLUTCH BODY	1
		For mounting cover to housing.		48	CL-7039-1	FACING, Amco No. 796 (Set of 3 segments) .	1
16	PT-353	LOCKWASHER, 3/8", for cover to housing ...	8	49	CL-8575	SEPARATOR SPRING	3
17	GR-114	DOWEL PIN, 3/8" x 1" long	1	50	CL-8513-1	PRESSURE PLATE	1
18	GR-753	OIL FILLER, 3/8" pipe nipple	1	51	CL-8515-1	ADJUSTMENT NUT	1
19	GR-117	OIL DRAIN PLUG, 3/8" P.T.	1		CL-11905	ADJUSTMENT NUT PLATE(not illustrated)	1
20	GR-236	CAP for oil filler pipe	1	52	CL-9216	ADJUSTMENT LOCK (replaces CL-8516)	1
21	PT-189	SNAP RING for drive shaft bearing	1	53	CL-8807-1	SCREW, 1/4"-20 x 3/8" hexagon head	1
22	GR-855	SEAL RETAINER for drive shaft	1			For adjustment lock. (replaces CL-3917-1)	
23	GR-243	SNAP RING for bearing, in housing	1	54	CL-3468	LOCKWASHER, 1/4" Shakeproof	1
24	GR-758	OIL SEAL for drive shaft	1			For adjustment lock.	
25	GR-854	OUTPUT SHAFT	1	55	UCL-3-8611-1	RELEASE SLEEVE and BEARING ASSEM.	1
26	GR-105	SEAL RETAINER for output shaft	1			Consisting of:	
27	GR-232-2	OIL SEAL for output shaft	1	56	CL-8611-1	RELEASE SLEEVE	1
28	GR-762	BEARING for output shaft	1	57	UCL-4-7392	RELEASE BEARING ASSEMBLY	1
		Order Wisconsin Motor No. ME-199 .				Consisting of:	
29	GR-106	KEY for driven gear	1	58		BEARING HALF (not serviced separately)	1
30	GR-857	BEARING for output shaft	1	59		BEARING HALF (not serviced separately)	1
		Order Wisconsin Motor No. ME-201 .		60	CL-3335-1	SCREW, 5/16"-24 x 1 1/4" hexagon head	2
31	PT-200	YOKE SHAFT	1	61	CL-7356	ELASTIC STOP NUT, 5/16"-24 thread	2
32	PT-351	KEY for yoke, No. 15 Woodruff	2	62	CL-9464	LEVER SPRING SET	1
33	GR-877	WASHER for driven gear	1	63	CL-8556-1	LEVER	3
34	UPT-811	CLUTCH YOKE ASSEMBLY	1	64	CL-8484	CLEVIS PIN for lever to body	3
		Consisting of:		65	CL-7107	RETAINING RING for lever clevis pin	3
35		CLUTCH YOKE	1	66	CL-8557	CONNECTING LINK	6
36	PT-352	SCREW, 3/8"-16 x 1 1/2" hexagon head	2	67	CL-8400	CLEVIS PIN for connecting link	6
37	PT-353	LOCKWASHER, 3/8"	2	68	CL-7130	RETAINING RING for link clevis pin	6
38	UPT-769	SHIFTER LEVER ASSEMBLY	1	69	CL-6965	DRIVING RING	1
		Consisting of:			GR-230	KEY for output shaft (not illustrated)	1
39		SHIFTER LEVER	1				
40	PT-604	SCREW, 3/8"-16 x 1 1/2" hexagon head	1				
41	PT-353	LOCKWASHER, 3/8"	1				
42	PT-706	NUT for clutch body	1				

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

TWIN DISC CLUTCH REDUCTION UNIT ASSEMBLY
C-108-E3.6-RG4 **WISCONSIN MOTOR No. WC-360**
ADAPTABLE TO WW-165 DRIVE HUB and HOUSING ASSEMBLY



TWIN DISC CLUTCH REDUCTION UNIT ASSEMBLY

TWIN DISC PART NO.
C-108-E3.6-RG4

WISCONSIN MOTOR PART NO.
WC-360

REDUCTION RATIO
3.6 to 1

ROTATION
Engine wise

PARTS LIST

Item	Twin Disc Part Number	Description	No Req	Item	Twin Disc Part Number	Description	No Req
1	A1339	GASKET, plate, specification	1	29	M102	CUP, oil	2
2	1965R	PLATE, specification	1	30	M2004R	SCREW, cap, hex-head, 1/2-13 x 1-3/4	1
3	M2023F	SCREW, cap, button-head, 1/4-20 x 1/2	2	31	XA5079	CLUTCH, C-108, assembly	1
4	M2032AZ	KEY, 3/8 x 3/8 x 1-5/8	1	a	A3169	PLATE, floating	1
5	A3115	SHAFT, counter	1	b	A-60	YOKE, adjusting	1
6	M2033T	KEY, 1/2 x 1/2 x 2-7/8	1	(1)	2245	PIN, lock, adjusting	1
7	M166	BALL BEARING	1	(2)	115	SPRING, pin, lock, adjusting	1
8	A5001	GEAR, internal, shaft, counter	1	(3)	B1621D	PIN, lever, finger	4
9	M178	BALL BEARING	1	(4)	1990	YOKE, adjusting	1
10	8533	PLATE, cover	1	(5)	M1927AD	PIN, roll	4
11	M2002U	SCREW, cap, hex-head, 3/8-16 x 1	8	(6)	103F	LEVER, finger	4
12	M510	SEAL, oil, shaft, counter	1	c	S-385	SLEEVE, sliding, assembly	1
13	2757	SHAFT, operating	1	(1)	2137A	SLEEVE, sliding	1
14	M2039J	SETSCREW, half-dog-point, 1/2-13 x 3/4	1	(2)	B1527D	PIN, link, lever	8
15	M2022V	KEY, Woodruff	2	(3)	119B2	LINK, lever	8
16	3799	LEVER, hand	1	(4)	M1927AS	PIN, roll	8
17	M2006H	SCREW, cap, hex-head, 5/8-11 x 1-1/2	4	(5)	X117C8S	COLLAR, split, assembly	1
18	M2046AF	WASHER, lock, 5/8-inch	4	(a)	M1930F	NUT, hex, 3/8-24	2
19	7583	HOUSING, clutch	1	(b)	1395A	WASHER, plain, 3/8-inch	4
20	M105	SEAL, oil, shaft, clutch	1	(c)	M2002AS	SCREW, cap, hex-head, 3/8-24 x 1-3/4	2
21	2510	SPACER	1	(d)	117C8S	COLLAR, split (not serviced separately) ..	1
22	2923	RING, snap	1	d	A3177	PLATE, hub-and-back	1
23	M171	BALL BEARING	1	e	1473	SPRING, release	6
24	M2032X	KEY, 1/4 x 1/4 x 1-7/8	1	f	6479	PLATE, driving	1
25	A3113	SHAFT, clutch (and pinion)	1	32	M2051AD	PLUG, pipe, square-head, 3/4-inch	1
26	M639	BREATHER, oil	1	33	M2051AD	PLUG, pipe, square-head, 3/4-inch	1
27	2830A	PIPE, breather, oil	1	34	5805	RING, driving	1
28	8531	HOUSING, gear	1	35	M163	BALL BEARING, pilot	1
				36	2727	NUT, hub	1
				37	A1587	WASHER, lock	1
				38	M2002AG	SCREW, cap, hex-head, 3/8-16 x 1-1/2	2
				39	M2046S	WASHER, lock, 3/8-inch	2
				40	1037	FORK, throwout	1
				41	A1663	HOSE, flexible, assembly	1
				a	M1292A	HOSE, flexible	1
				b	M1284	FITTING, 90-degree	1
				c	M1283	FITTING, straight	1
				42	M2046AF	WASHER, lock, 5/8-inch	1
				43	M2027AN	NUT, jam, 5/8-18	1
				44	M268	FITTING, hydraulic, 1/8-inch	1

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

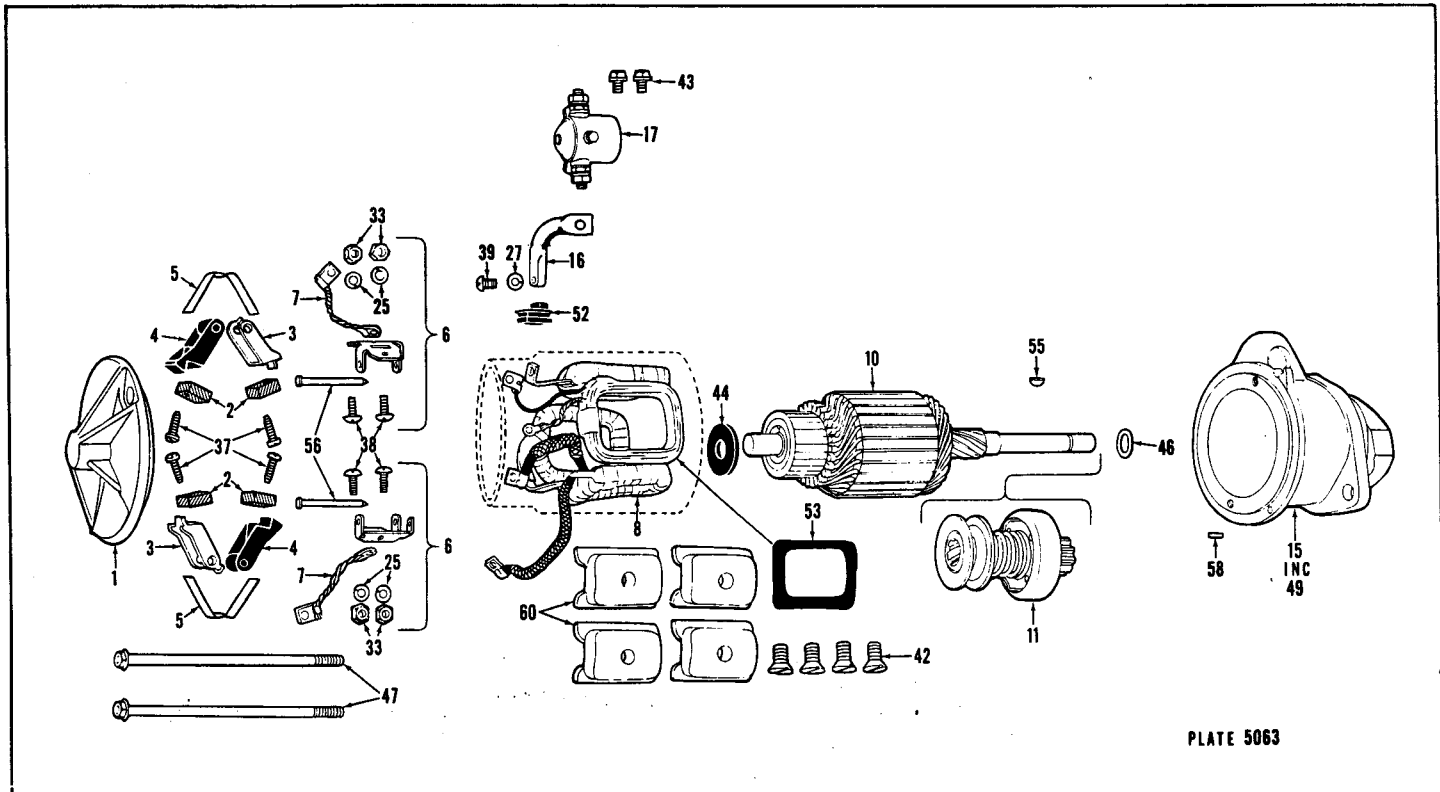


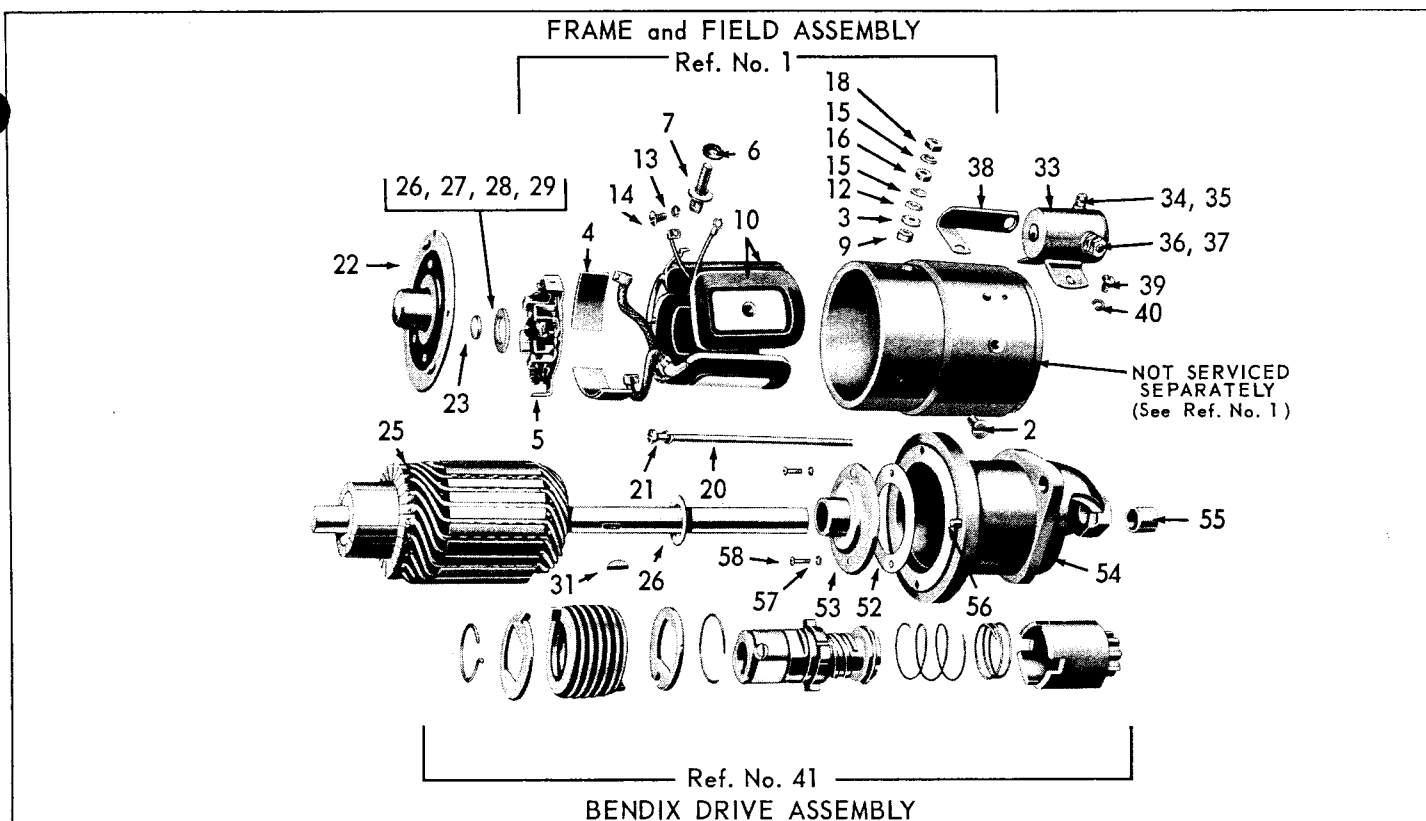
PLATE 5063

Ref No	Delco-Remy Part No.	Description	No Req	Ref No	Delco-Remy Part No.	Description	No Req
1	1928966	FRAME, C.E. (Includes bushing).....	1	39	453478	SCREW, field lead attach. to connector..	1
2	1906945	BRUSH	4	42	1913960	SCREW, pole shoe	4
3	1926617	BRUSH HOLDER (grounded).....	2	43	1917084	SCREW, switch attaching	2
4	1938587	BRUSH HOLDER (insulated).....	2	44	833602	WASHER, thrust - C.E.	1
5	1926622	SPRING, brush.....	2	46	1853917	THRUST WASHER, D.E.	1
6	1928015	SUPPORT (pkg.) BRUSH HOLDER..... Includes Ref. Nos. 7, 25, 33, 38, 56.	2	47	1926625	THRU BOLT.....	2
7	1926605	LEAD, brush ground.....	2	49	810620	BUSHING, D.E. (not illustrated)	1
8	1937548	FIELD COIL ASSEMBLY (4 coils)	1	52	1926604	GROMMET (in field frame)	1
10	1947996	ARMATURE	1	53	1927853	INSULATOR, field coil.....	4
11	1958452	DRIVE ASSEMBLY (Service by complete replacement)	1	55	124546	WOODRUFF KEY, D.E.	1
15	1958451	DRIVE HOUSING, includes Ref. No. 49.	1	56	1926600	PIN, brush holder	2
16	1935706	CONNECTOR, switch	1	58	809593	DOWEL PIN, D.E.	1
17	1467	MAGNETIC SWITCH	1	60	1931129	POLE SHOE.....	4
25	453435	LOCKWASHER, brush support attaching screw	4	<p>THE FOLLOWING PARTS ARE NOT ILLUSTRATED:</p>			
27	453435	LOCKWASHER, field lead attach. screw to connector.....	1				
33	120361	NUT, brush support attaching screw.....	4				
37	1926648	SCREW, brush attaching.....	4				
38	274738	SCREW, brush support attaching	4				
				1958453	CENTER BEARING PLATE.....	1	
				Includes:			
				1880471	BUSHING, center bearing.....	1	
				132900	SCREW, center bearing plate attaching..	4	
				1962276	LOCKWASHER, center bearing plate attaching.....	4	
				1947777	OIL SEAL - center bearing	1	
				802694	WICK - C.E.	1	

Order parts from nearest **SERVICE STATION** shown in directory following parts list.

IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

YA-26-A (12 Volt) STARTING MOTOR – PRESTOLITE No. MHA-7004 (Replaces MDY-7006)



282433C

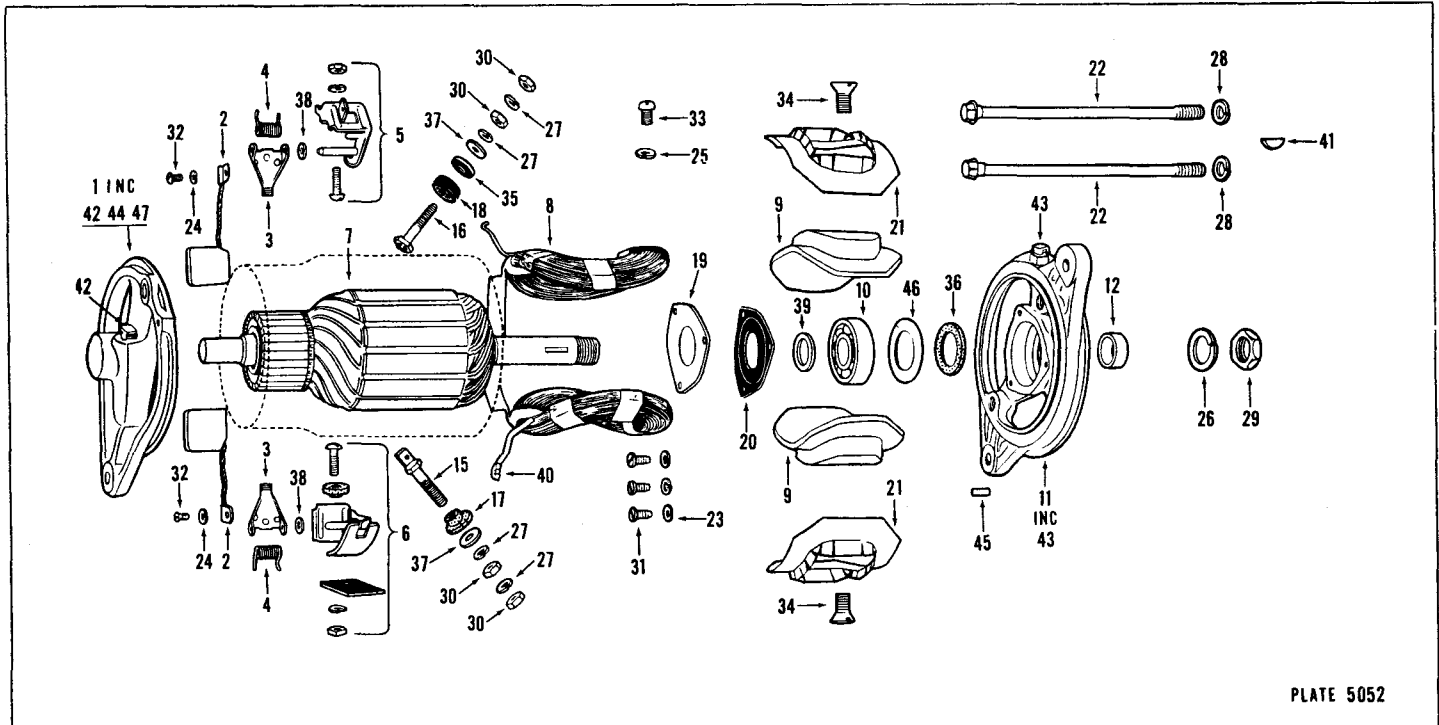
Ref No	Prestolite Part Number	Description	No Req	Ref No	Prestolite Part Number	Description	No Req
1		FRAME and FIELD ASSEMBLY	1	27	***	THRUST WASHER, 3/64" thick (use as required)	—
2		Consisting of:		28	***	THRUST WASHER, .080" thick (use as required)	—
3	**	SCREW for pole shoe	4	29	***	THRUST WASHER, 1/16" thick (use as required)	—
4		INSULATING WASHER for terminal stud (outer)	1	31		KEY for mounting Bendix, Woodruff No. 6	1
5	MDL-1064	INSULATION for field connection	2	33	SAW-4201	SOLENOID STARTING SWITCH	1
		BRUSH PLATE ASSEMBLY ..	1	34		TERMINAL NUT, No. 10-32 thread, hexagon ..	1
		Includes:		35		TERMINAL LOCKWASHER, No. 10	1
	*	GROUNDING BRUSH	2	36		TERMINAL NUT, 5/16"-24 thread, hexagon ...	2
	MZ-195	BRUSH SPRING SET	1	37		TERMINAL LOCKWASHER, 5/16"	2
6	**	INSULATING WASHER for terminal stud (inner)	1	38	SS-6R	CONNECTOR for solenoid switch	1
7	**	TERMINAL STUD	1	39		SCREW for solenoid switch mounting	2
9	**	INSULATING BUSHING for terminal stud	1			No. 10-32 thread x 1/4" long, round head.	
10	MDU-2005AS-1	FIELD COIL PKG.	1	40		LOCKWASHER for solenoid switch mounting ...	2
		Includes:				No. 10 Shakeproof.	
	*	BRUSH	1	41	EBB-40A	BENDIX DRIVE Eclipse No. A-3627	1
12	**	PLAIN WASHER, 5/16", for terminal stud	1	52	MDL-73	GASKET for bearing plate	1
13		LOCKWASHER, No. 8, for terminal stud and ground lead	1	53	MDL-1080A	BEARING ASSEMBLY, intermediate	1
14		SCREW for terminal stud and ground lead	1	54	PS-1375D	PINION HOUSING ASSEMBLY	1
15		No. 8-32 thread x 5/16" long, round head.				Includes:	
16		LOCKWASHER, 5/16", for terminal stud	2	55	MG-77A	BRONZE BEARING for pinion housing	1
17		NUT for terminal stud, 5/16"-18 thread, hex.	1	56		DOWEL PIN	1
18		SCREW for brush plate mtg. (not illustrated).	3	57		LOCKWASHER, No. 10, for bearing plate	2
		NUT for terminal stud, 5/16"-18 thread, hex.	1	58		SCREW for bearing plate mounting	2
20	GJ-205	THRU BOLT PKG.	1			No. 10-32 thread x 7/16" long, round head.	
21		LOCKWASHER, 1/4", for thru bolt	2		*	MDL-2012CS BRUSH SET	
22	MDT-1002	COMMUTATOR END HEAD ASSEMBLY	1		**	P90-711 TERMINAL STUD PKG.	
23		FELT for end head	1		***	P90-263 ARMATURE THRUST WASHER	
25	MDL-2048C	ARMATURE ASSEMBLY	1			PACKAGE	
26	***	THRUST WASHER, 1/32" thick, for armature ..	2			NOTE: Items less part number are not serviced separately.	
		1-internal 1-for commutator end					

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

12 Volt-17 Amp GENERATOR

YB-62-B (Negative Ground)
YB-62 (Positive Ground)

Delco-Remy No. 1102343
Delco-Remy No. 1102225



Ref No	Delco-Remy Part Nos YB-62-B	YB-62	Description	No Req	Ref No	Delco-Remy Part Nos YB-62-B	YB-62	Description	No Req
1	1946595	1935696	FRAME, commutator end Includes: Ref. Nos. 42, 44, 47 and 48.	1	25	9421423	120380	LOCKWASHER (top of field frame)	1
2	1932506	1932506	BRUSH	2	26	1915265	1888439	LOCKWASHER, shaft nut, D.E.	1
3	1944373	1878183	BRUSH ARM	2	27	1914579	1904661	LOCKWASHER, terminal stud	4
4	1908829	1908829	BRUSH SPRING	2	28	9421424	120638	LOCKWASHER, Thru bolt	2
5	1925378	1922288	GROUND BRUSH HOLDER PACKAGE	1	29	1915172	1911324	NUT, shaft, D.E.	1
6	1925379	1922289	INSULATED BRUSH HOLDER PKG. ...	1	30	121743	121743	NUT, terminal stud	4
7	1935778	1952297	ARMATURE	1	31	1914580	1904370	SCREW, bearing retainer plate	3
8	1922701	1936388	FIELD COIL SET	1	32	453460	132688	SCREW, brush lead	2
			Includes: Ref. Nos. 16 and 40.		33	225577	225577	SCREW (top of field frame)	1
9	1939902	1912725	POLE SHOE	2	34	1913960	1843646	SCREW, pole shoe	2
10	954378	954378	BALL BEARING, D.E.	1	35	1858753	1858753	WASHER, insulating, field term. stud	1
11	1873830	1873830	FRAME, D. E., Includes: Ref. No. 43	1	36	809961	809961	WASHER, felt, D.E.	1
12	817224	817224	COLLAR, D.E.	1	37	826319	1881409	WASHER, plain, terminal stud	2
15	1923284	1921369	STUD, armature terminal	1	38	-	1857412	WASHER, brush arm spacer	2
16	1858749	1921860	STUD, field terminal (to brush)	1	39	809945	809945	WASHER, spacer, D.E.	1
17	-	1921362	BUSHING, armature terminal	1	40	-	200382	TERMINAL CLIP	1
18	1858749	1885090	BUSHING, field terminal	1	41	124545	124545	WOODRUFF KEY, D.E.	1
19	1911263	1911263	PLATE, bearing retainer, D.E.	1	42	125609	125609	OILER, C.E.	1
20	1912008	1912008	GASKET, bearing retainer plate	1	43	125609	1880641	OILER, D.E.	1
21	1912073	1912073	INSULATION, field coil	2		823551	-	WICK, D.E. (not illustrated)	1
22	809763	809763	THRU BOLT	2	44	809062	809062	DOWEL PIN, C.E.	1
23	-	1880781	LOCKWASHER, bearing retainer plate	3	45	809593	809593	DOWEL PIN, D.E.	1
24	456413	1904377	LOCKWASHER, brush lead screw	2	46	819104	819104	PLATE, felt washer retainer, D.E. ...	1
					47	1947350	804080	OIL WICK, C.E.	1
					48	1911097	1911097	PLUG, C.E. (not illustrated)	1

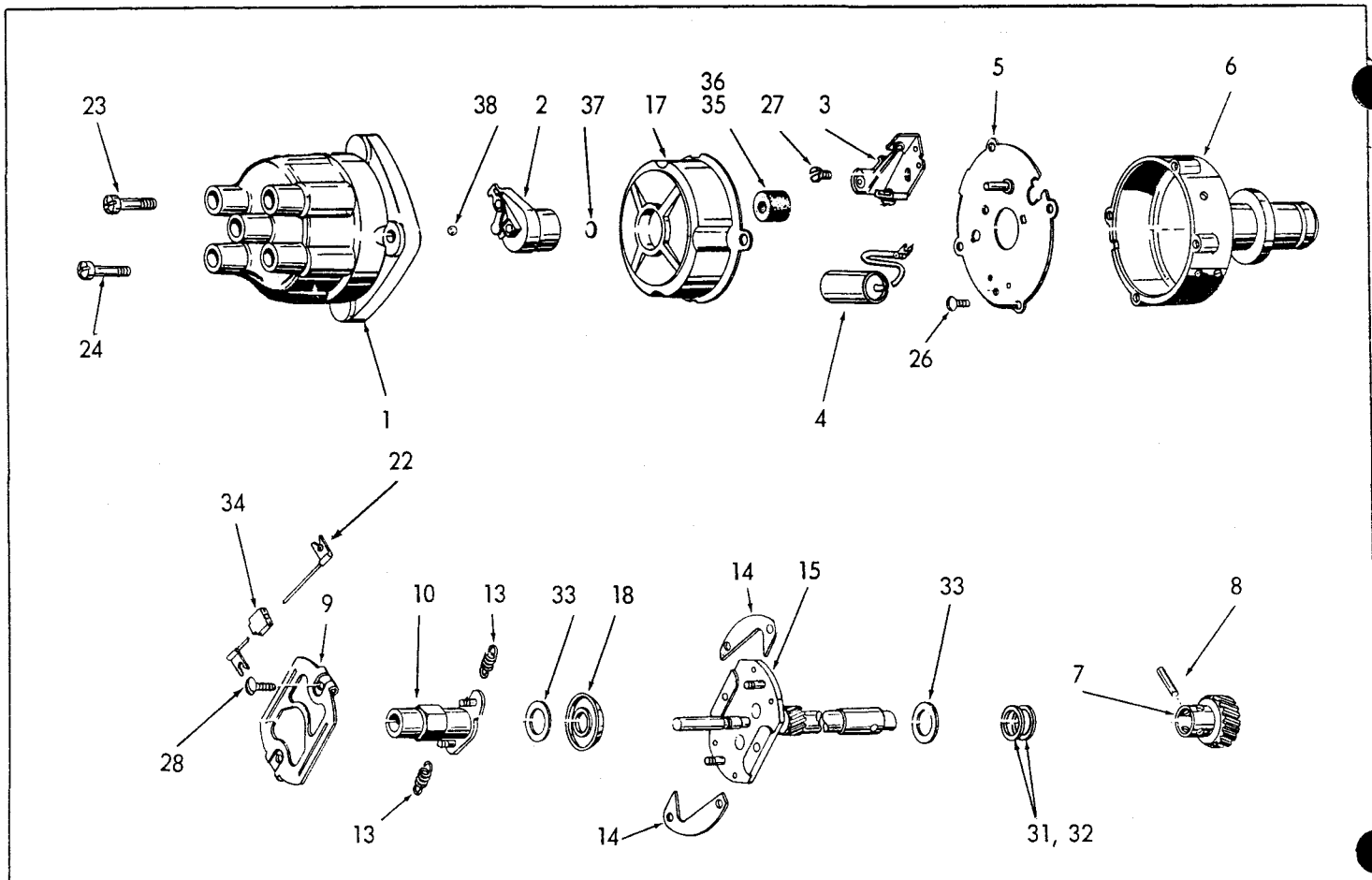
Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

(Service parts are interchangeable on both generators).



MP-1235-2

YF-34 DISTRIBUTOR - DELCO-REMY No. 1112695

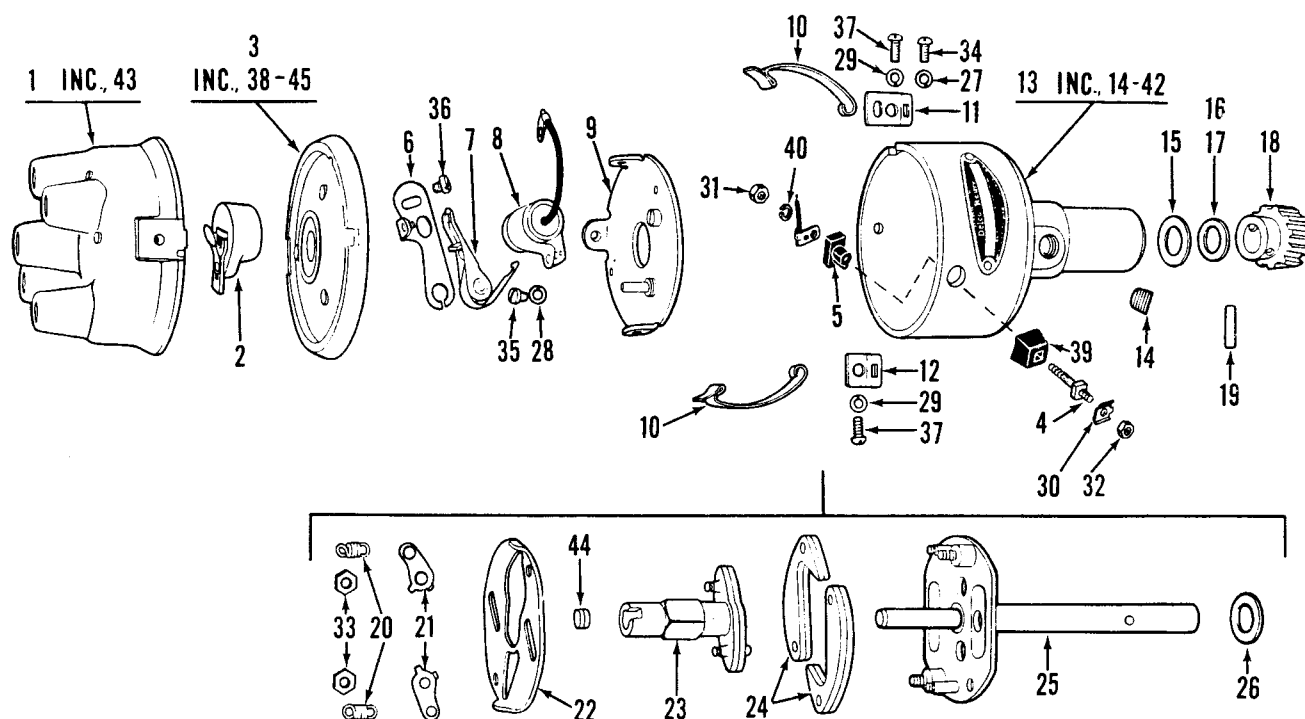


Ref No	Delco-Remy Part Number	Description	No Req	Ref No	Delco-Remy Part Number	Description	No Req
1	1960833	CAP ASSEMBLY Includes Ref. Nos. 23, 24, 38	1	18	1950569	SEAL for housing	1
2	1954566	ROTOR	1	22	1954563	PRIMARY WIRE ASSEMBLY	1
3	1954557	CONTACT POINT SET	1	23	1954571	SCREW for mounting cap (8-32).....	1
4	1928111	CONDENSER	1	24	1957573	SCREW for mounting cap (10-32).....	1
5	1960814	BREAKER PLATE	1	26	453461	SCREW for breaker plate support	2
6	1964208	HOUSING ASSEMBLY Includes Ref. No. 18	1	27	1914916	SCREW for contact adjustment	1
7	1970035	GEAR	1	28	453647	SCREW for hold down plate mounting.....	2
8	9417392	PIN for gear mounting.....	1	31	810074	GEAR SHIM (.005") as needed	
9	1954548	PLATE for flyweight hold down	1	32	1912129	GEAR SHIM (.010") as needed	
10	1970505	CAM AUTOMATIC and BREAKER	1	33	811912	SPACER WASHER 1-for gear	2
13.	1970504	SPRING for flyweight	2			1-for weight plate	
14	1880902	FLYWEIGHT	2	34	1960824	GROMMET in housing for primary wire	1
15	1970032	MAIN SHAFT and WEIGHT PLATE	1	35	1961088	WICK	1
17	1960325	HOUSING COVER	1	36	1963858	RETAINER for wick	1
				37	1963555	CAM FELT WICK	1
				38	1938193	CARBON BUTTON for cap	1

Order parts from nearest **SERVICE STATION** shown in directory following parts list.

IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

Optionally Used On V-460D and V-461D Engines Previously To Serial No. 4427547



Ref No	Delco-Remy Part Number	Description	No Req	Ref No	Delco-Remy Part Number	Description	No Req
1	811735	CAP ASSEMBLY.....	1	19	1862218	PIN for gear mounting.....	1
43	1938193	Includes: CARBON BUTTON (not illustrated).....	1	20	1883121	SPRING for flyweight.....	2
2	820445	ROTOR.....	1	21	1885558	LOCKWASHER for hold down plate.....	2
3	1900119	HOUSING COVER ASSEMBLY.....	1	22	1885557	PLATE for flyweight hold down.....	1
38	1889966	Includes: GASKET (not illustrated).....	1	23	1942038	CAM AUTOMATIC and BREAKER.....	1
45	1914309	FELT SEAL (not illustrated).....	1	24	1873697	FLYWEIGHT.....	2
4	1916806	TERMINAL STUD.....	1	25	1947952	MAIN SHAFT and WEIGHT PLATE.....	1
5	1916805	BUSHING for terminal stud (inside).....	1	26	811912	SPACER WASHER for weight plate.....	1
	1855720	CONTACT POINT SET.....	1	27	453299	LOCKWASHER for breaker plate screw.....	1
6	1848038	Consisting of: CONTACT POINT and SUPPORT.....	1	28	453299	LOCKWASHER for condenser mt'g. screw.....	1
7	813238	BREAKER ARM.....	1	29	453299	LOCKWASHER for spring clip support.....	2
8	1869704	CONDENSER.....	1	30	1914144	LOCKCLIP for terminal stud.....	1
9	1847643	BREAKER PLATE.....	1	31	817363	NUT for terminal stud (inside).....	1
10	1889967	SPRING CLIP for cap.....	2	32	120622	NUT for terminal stud (outside).....	1
11	1889999	SUPPORT for cap spring clip and locator.....	1	33	1923540	NUT for hold down plate mounting.....	2
12	1847289	SUPPORT for cap spring clip.....	1	34	453418	SCREW for breaker plate support.....	1
13	1947954	HOUSING ASSEMBLY.....	1	35	453304	SCREW for condenser mounting.....	1
14	125947	Includes: PIPE PLUG.....	1	36	1914916	SCREW for contact adjustment.....	1
42	1909003	BUSHING (not illustrated).....	1	37	453461	SCREW for spring clip support.....	2
15	811912	SPACER WASHER for gear.....	1	39	1914142	INSULATING BUSHING for terminal stud, (outside).....	1
16	810074	GEAR SHIM (.005") as needed.....		40	1904376	LOCKWASHER for terminal stud (inside).....	1
17	810078	GEAR SHIM (.010") as needed.....		44	819639	CAM FELT WICK.....	1
18	1881717	GEAR.....	1				

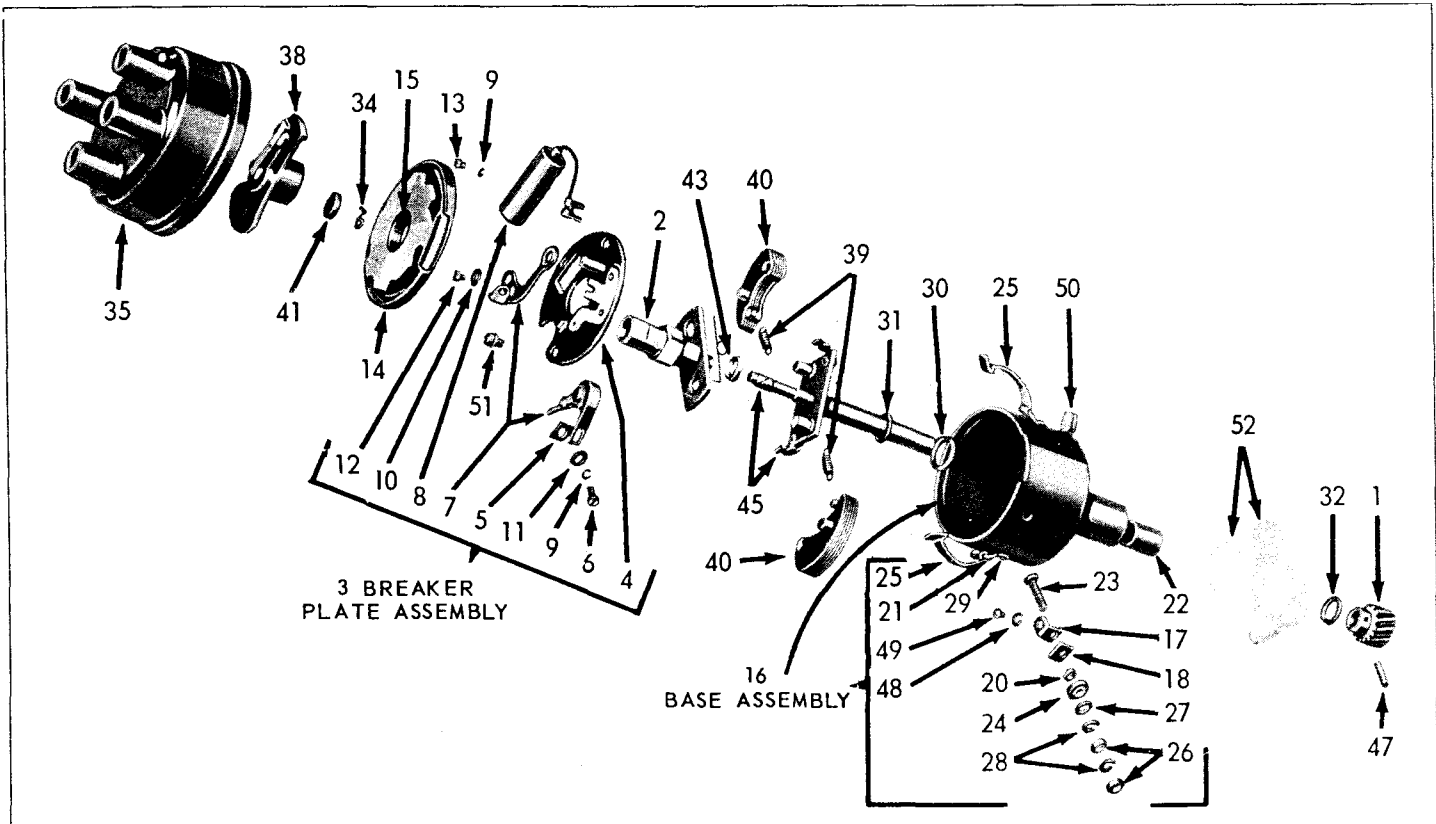
Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.

YF-10C-S1 DISTRIBUTOR - PRESTOLITE No. IAD-6004-2N

YF-10A-S1 (Obsolete) PRESTOLITE No's. IAD-6004-2F

YF-10B-S1 (Less Condenser) IAD-6004-26

NOTE: YF-10C-S1 Replaces YF-10A-S1. All Parts are Identical Except Spring Set for Governor Weights, as Noted.



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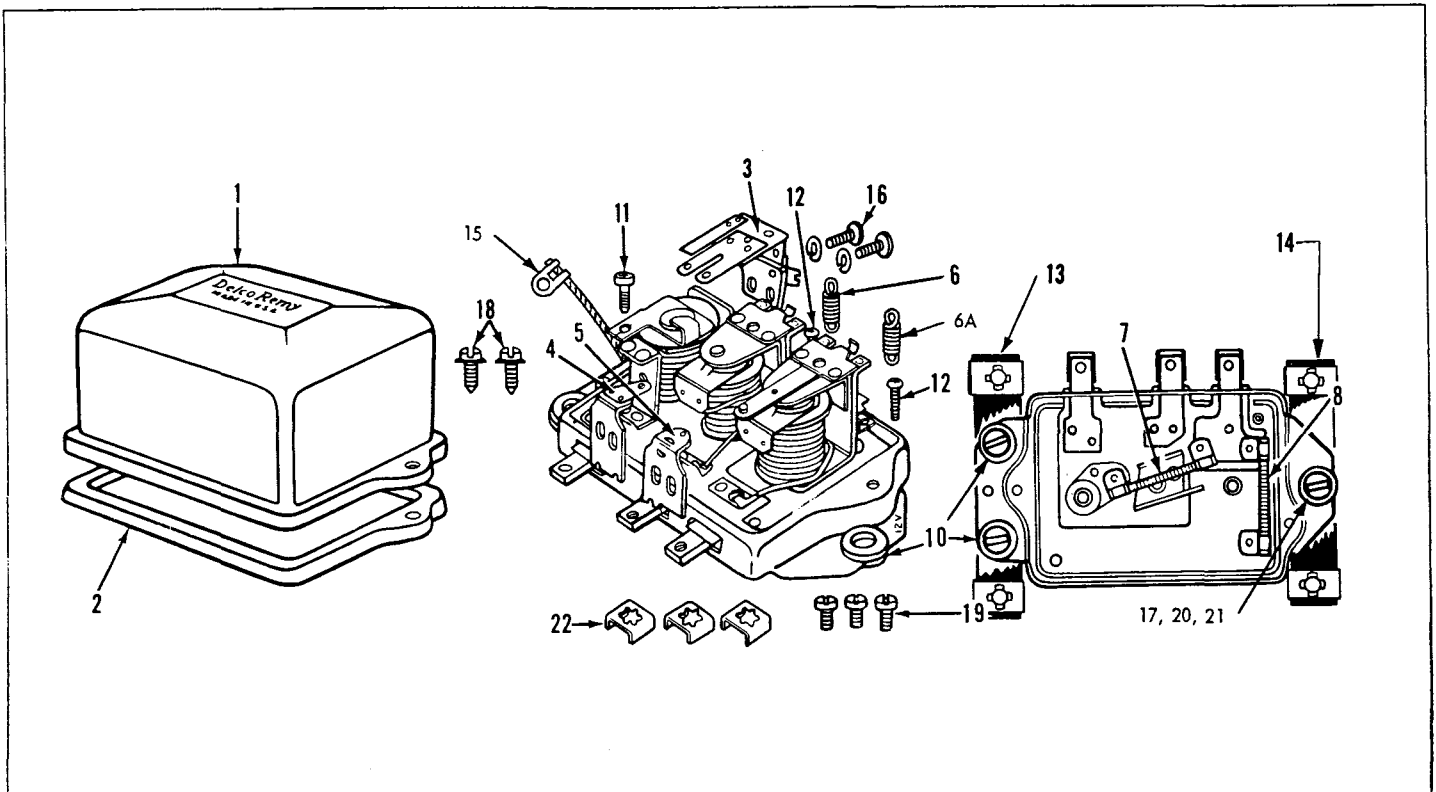
Ref No	Prestolite Part Number	Description	No Req	Ref No	Prestolite Part Number	Description	No Req
1	****	FOLLOWER GEAR	1	30	*	THRUST WASHER (inner) for drive shaft	1
2	IAD-1100LE-1	CAM and STOP PLATE, 4 cyl., L.H.	1	31	*	THRUST WASHER (outer) for drive shaft	1
3	IAD-2004	BREAKER PLATE ASSEMBLY	1	32	*	THRUST WASHER for drive shaft (lower)	1
4		Consisting of:		34		SNAP RING for cam	1
5		BREAKER PLATE	1	35	IG-1324D	DISTRIBUTOR CAP ASSEMBLY includes:...	1
6		SPRING CLIP for contact arm	1			PLUNGER CONTACT and CONTACT SPRING	1
7	IGS-2224L	SCREW for spring clip	1	38	IG-1657R	ROTOR	1
8	IBB-2042SS-1	No. 6-32 thread x 5/16" long, hexagon head	1	39	IGC-203S	SPRING SET for governor weights (YF-10C-S1)	1
9		BREAKER CONTACT SET	1			IGC-200S (for YF-10A-S1, YF-10B-S1)	1
10		CONDENSER (for YF-10C-S1, YF-10A-S1) ..	1	40	IGC-2168LS	GOVERNOR WEIGHT SET	2
11		LOCKWASHER, No. 6	3	41	****	FELT WICK for cam sleeve	1
12		2-for condenser mtg. 1-for spring clip.		42	IGS-32S	CAP PLUG PKG. for vent hole (not illustrated)	1
13		PLAIN WASHER for contact lock screw, No. 8	1	43	*	CAM SPACER	1
14		PLAIN WASHER for spring clip screw, No. 6	1	44	****	FELT WICK (not illustrated)	1
15		LOCKSCREW for breaker contact	1	45	IGS-1180L	DRIVE SHAFT	1
16		No. 8-32 thread x 3/16" long, fillister head.	1	47	*	PIN for gear	1
17		SCREW for condenser mounting	1	48		LOCKWASHER for connector screw, No. 6	1
18		No. 6-32 thread x 5/32" long, fillister head.	1	49		SCREW for connector	1
19		DUST COVER ASSEMBLY, includes:	1			No. 6-32 thread x 3/16" long, round head.	
20		FELT WASHER	1	50	X-1590	OILER	1
21		BASE ASSEMBLY, includes:	1	51		SCREW for breaker plate mounting	2
22	**	CONNECTOR for terminal stud	1			No. 10-32 thread x 5/16" long, fillister head.	
23	**	INSULATOR for terminal stud	1	52	PG-543-A	ADVANCE ARM ASSEMBLY	1
24	***	BRACKET for breaker plate (Not illustrated)	2				
25	**	INSULATING BUSHING for terminal stud	1				
26	***	BRACKET for cap spring	2				
27	*	BRONZE BEARING	2				
28	**	TERMINAL STUD	1				
29	**	INSULATING WASHER for terminal stud	1				
30	***	CLAMP SPRING for cap	2				
31		NUT for terminal stud, No. 10-32 thread	2				
32		PLAIN WASHER for terminal stud, No. 10	1				
33		LOCKWASHER for terminal stud, No. 10	2				
34		RIVET for clamp spring	4				
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NOTE: Parts less part number are not serviced separately.

12 Volt-17 Amp CURRENT-VOLTAGE REGULATOR

YJ-41-D (Negative Ground)
YJ-41 (Positive Ground)

Delco-Remy No. 1119257
Delco-Remy No. 1119152-D



NOTE: Parts are identical for both regulators, except for **contact** and **support** as noted, and polarity.

Ref No	Delco-Remy Part No.	Description	No Req	Ref No	Delco-Remy Part No.	Description	No Req
1	1931886	COVER	1	15	1933941	GROUND LEAD ASSEMBLY	1
2	1931887	GASKET, cover	1	16	1924764	SCREW and LOCKWASHER, relay armature attaching	2
3	1939646	RELAY ARMATURE	1	17	1874495	LOCKWASHER, Shock mount attach. screw	3
4,5	1945732 1948328	CONTACT and SUPPORT (combined unit) .. For YJ-41-D (1119257) For YJ-41 (1119152-D)	1	18	1943385	SCREW, cover	2
6	1912176	SPRING, current regulator armature	1	19	1878502	TERMINAL SCREW	3
6A	1949142	SPRING, voltage regulator armature	1	20	124818	NUT, Shock mount attaching	3
7	1910174	RESISTOR, 'F' terminal to ground	1	21	273484	SCREW, Shock mount attaching	3
8	1910174	RESISTOR, 'F' terminal to relay	1	22	1878503	TERMINAL CLAMP	3
10	1879663	GROMMET (rubber) in base	3				
11	1912159	ADJUSTING SCREW, relay armature	1				
12	1944590	SCREW, regulator armature adjusting	2				
13	1911034	RUBBER SHOCK MOUNT, long (4 hole)	1				
14	1911028	RUBBER SHOCK MOUNT, short (3 hole)	1				

Order parts from nearest **SERVICE STATION** shown in directory following parts list.
IMPORTANT: Always give Model, Specification and Serial Numbers as shown on name plate.