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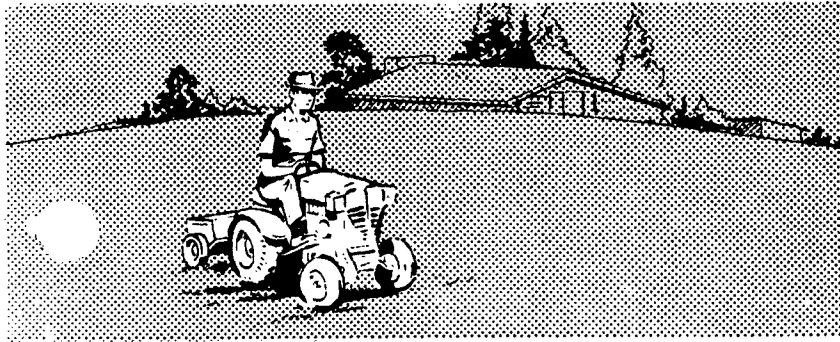
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MAJOR SERVICE MANUAL AND PARTS CATALOG

●
FOR
ONAN
20 HP CCKB ENGINE

PROPERTY
OF
SERVICE PARTS
LIBRARY
DO NOT REMOVE



FOR
**GARDEN TRACTOR
SERVICE**

●
BASIC MODELS

CCKB-MS/2420H

CCKB-MS/2440H

CCKB-MS/2733J

SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

WARNING Onan uses this symbol throughout this manual to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment damage.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

- **Use Extreme Caution Near Gasoline, Gaseous Fuel And Diesel Fuel. A constant potential explosive or fire hazard exists.**

Do not fill fuel tank near unit with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve.

Fuel lines must be of steel piping, adequately secured and free from leaks. Do not use copper piping on flexible lines as copper becomes hardened and brittle. Use black pipe on natural gas or gaseous fuels, not on gasoline or diesel fuels. Piping at the engine should be approved flexible line.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

- **Guard Against Electric Shock**

Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

Always use an appropriately sized, approved double-throw transfer switch with any standby generator set. **DO NOT PLUG PORTABLE OR STANDBY SETS DIRECTLY INTO A HOUSE RECEPTACLE TO PROVIDE EMERGENCY POWER.** It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power.

Use extreme caution when working on electrical components. High voltages cause injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

- **Do Not Smoke While Servicing Batteries**

Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

Be sure the unit is well ventilated.

- **Keep The Unit And Surrounding Area Clean.**

Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Dispose of oily rags. Keep the floor clean and dry.

- **Protect Against Moving Parts.**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

Do not work on this equipment when mentally or physically fatigued.

927-1116
SUPPLEMENTARY PARTS LIST (8/74)

DO NOT REMOVE

These parts apply to the ONAN engines used in Garden Tractor service and will give better service than those previously listed. Use these parts in place of those listed in the main parts catalogs 927-0251 and 927-1103.

Parts are not illustrated as they are similar in appearance to those in the parts catalog.

CYLINDER BLOCK GROUP

<u>REF. NO.</u>	<u>PART NO.</u>	<u>QTY. USED</u>	<u>PART DESCRIPTION</u>
15	BEARING, CRANKSHAFT		
	101-0450	2	*Standard
	101-0450-02	2	.002" Undersize
	101-0450-10	2	.010" Undersize
	101-0450-20	2	.020" Undersize
	101-0450-30	2	.030" Undersize

* - These standard bearings included in replacement cylinder block assembly listed in main parts catalog.

CRANKSHAFT, FLYWHEEL, CAMSHAFT & PISTON GROUP

<u>REF. NO.</u>	<u>PART NO.</u>	<u>QTY. USED</u>	<u>PART DESCRIPTION</u>
11	PISTON AND PIN (Includes Retaining Rings)		
	112-0136	2	Standard
	112-0136-05	2	.005" Oversize
	112-0136-10	2	.010" Oversize
	112-0136-20	2	.020" Oversize
	112-0136-30	2	.030" Oversize
	112-0136-40	2	.040" Oversize

ONAN INDUSTRIAL ENGINES FOR TRACTOR APPLICATION

CCKB SERIES



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WE SUGGEST THAT THIS BOOK BE KEPT HANDY,
EITHER FOR MAKING ADJUSTMENTS OR ORDERING
PARTS.

GENERAL INFORMATION

SERVICE MANUAL

This Onan service manual contains information for proper servicing and overhauling CCKB engines begin Spec H. Onan recommends reading the entire manual to better understand the CCKB engine before performing any work on the unit. The information will enable you to maintain and service the engine which can not only result in better operation, but long unit life as well. Because correct diagnosis is an utmost part of repair, a troubleshooting chart is included.

NOTE: Flywheel end of engine is considered the front. Left and right sides are determined looking at front of engine.

CAUTION This symbol is used to warn of possible equipment damage.

WARNING Onan uses this symbol throughout the text to warn of possible injury or death.

When contacting the factory about the engine always supply the complete model number and serial number as shown on the nameplate (see "MODEL DESIGNATION" following).

MODEL DESIGNATION

Identify your model by referring to the MODEL and SPEC (specification) NO. as shown on the unit nameplate. Always use this number and the engine serial number when making reference to your engine.

How to interpret MODEL and SPEC NO.

CCKB - MS / 2420 J

1	2	3	4

1. Factory code for general identification purposes.
2. Specific Type:
S - MANUAL STARTING
MS - ELECTRIC STARTING
3. Factory code for optional equipment supplied.
4. Specification (Spec Letter) advances with factory production modification.

If your engine needs service or repair, contact an Onan Service Center. Trained mechanics will assure expert repair service on your Onan engine.

WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM ALL SERVICE.

SPECIFICATIONS

Engine Manufacturer	Onan
Engine Design	Opposed two cylinder, four cycle, L head and air cooled
Horsepower	19-1/2 hp @ 3600 rpm 20 hp max. @ 3900 rpm
Displacement	49.8 cu. in.
Bore	3-1/4 inch
Stroke	3 inch
Crankshaft	Horizontal, Ductile Iron
Valves	Mechanical
Bearings (Main and Rod)	Sleeve
Lubrication System	Pressure Feed
Oil Capacity	3-1/2 Quarts
(With Filter)	4 Quarts
Battery Charging System	12 Volt, 15 Amp, Flywheel Alternator or 12 Volt, 20 Amp, Flywheel Alternator

TUNE-UP SPECIFICATIONS

	MINIMUM	MAXIMUM
Valve Tappet Adjustment		
Intake	.006	.008
Exhaust	.015	.017
Breaker Point Gap (Full Separation)		.020
Spark Plug Gap		.025
Ignition Timing Advance (Engine Running)		20° BTC

DIMENSIONS AND CLEARANCES

All clearances given at room temperature of 70°F.
All dimensions in inches unless otherwise specified.

	Minimum	Maximum
Valve Stem in Guide – Intake	0.0010	0.0025
Valve Stem in Guide – Exhaust	0.0025	0.0040
Valve Seat Interference Width	1/32	3/64
Valve Face Angle		44°
Valve Seat Angle		45°
Crankshaft Main Bearing	0.0025	0.0038
Crankshaft End Play	0.006	0.012
Camshaft Bearing	0.0015	0.0030
Camshaft End Play	0.003	
Rod Bearing	0.0005	0.0023
Connecting Rod End Play	0.002	0.016
Timing Gear Backlash	0.002	0.003
Oil Pump Gear Backlash	0.002	0.005
Piston to Cylinder, Conformatic Type (Measured below oil-controlling ring – 90° from pin) Clearance	0.0025	0.0045
Piston Pin in Piston		Thumb Push Fit
Piston Pin in Rod	0.0001	0.0006
Piston Ring Gap in Cylinder	0.010	0.023
Crankshaft Main Bearing Journal – Standard Size	1.9992	2.0000
Crankshaft Rod Bearing Journal – Standard Size	1.6252	1.6260
Cylinder Bore – Standard Size	3.249	3.250

ASSEMBLY TORQUES

ASSEMBLY TORQUES

Assembly torques as given here require the use of a torque wrench. These assembly torques will assure proper tightness without danger of stripping the threads. If a torque wrench is not available, you will have to estimate the degree of tightness necessary for the stud, nut or screw being installed and tighten accordingly. Be careful not to strip the threads. Check all studs, nuts and screws often. Tighten as needed to prevent them from working loose.

TORQUE SPECIFICATIONS

	Ft. - Lb.
Connecting Rod Bolt	27-29
Oil Pump	7- 9
Oil Base Mounting Screws	43-48
Rear Bearing Plate Screws	20-25
Gear Case Cover	10-13
Starter Mounting Bracket to	
Oil Base Screws	43-48
Other 5/16" Cylinder Block Nuts	10-12
Magneto Stator Screws	15-20
Rotor to Flywheel Screws	5
Flywheel Capscrew	35-40
Cylinder Head Bolts	29-31
Spark Plugs	20-25
Valve Cover Capscrews	4- 8
Manifold Screws	15-20
Fuel Pump Mounting Screws	5- 6
Carburetor Mounting Stud Nuts	8-12

ENGINE TROUBLESHOOTING

TROUBLE	Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Valves	Crankshaft Rod Wear	Cylinder Slowly	Engine Stops	Failure to Start	Governor Hunting	High Oil Pressure	Loss of Coolant	Mechanical Knocks	Misfiring	Overheating (Water Cooled)	Overheating (Air Cooled)	Piston Wear	Poor Compression	Ring Wear	Sticking Valves	CAUSE
STARTING SYSTEM																						
																						Loose or Corroded Battery Connection
																						Low or Discharged Battery
																						Faulty Starter
																						Faulty Start Solenoid
IGNITION SYSTEM																						
																						Ignition Timing Wrong
																						Wrong Spark Plug Gap
																						Worn Points or Improper Gap Setting
																						Bad Ignition Coil or Condenser
																						Faulty Spark Plug Wires
FUEL SYSTEM																						
																						Out of Fuel - Check
																						Lean Fuel Mixture - Readjust
																						Rich Fuel Mixture or Choke Stuck
																						Engine Flooded
																						Poor Quality Fuel
																						Dirty Carburetor
																						Dirty Air Cleaner
																						Dirty Fuel Filter
																						Defective Fuel Pump
INTERNAL ENGINE																						
																						Wrong Valve Clearance
																						Broken Valve Spring
																						Valve or Valve Seal Leaking
																						Piston Rings Worn or Broken
																						Wrong Bearing Clearance
COOLING SYSTEM (AIR COOLED)																						
																						Poor Air Circulation
																						Dirty or Oily Cooling Fins
																						Blown Head Gasket
COOLING SYSTEM (WATER COOLED)																						
																						Insufficient Coolant
																						Faulty Thermostat
																						Worn Water Pump or Pump Seal
																						Water Passages Restricted
																						Defective Gaskets
																						Blown Head Gasket
LUBRICATION SYSTEM																						
																						Defective Oil Gauge
																						Relief Valve Stuck
																						Faulty Oil Pump
																						Dirty Oil or Filter
																						Oil Too Light or Diluted
																						Oil Level Low
																						Oil Too Heavy
																						Dirty Crankcase Breather Valve
THROTTLE AND GOVERNOR																						
																						Linkage Out of Adjustment
																						Linkage Worn or Disconnected
																						Governor Spring Sensitivity Too Great
																						Linkage Binding

OIL SYSTEM

WARNING Never remove oil level indicator cap with the engine running, because hot oil will blow out of the tube causing possible injury.

CRANKCASE OIL

Change crankcase oil every 50 operating hours and only when engine is warm. (Exception: Drain initial oil fill at 25 operating hours.)

When changing oil, fill the crankcase to the FULL mark (Figure 1) with a good quality (API) SE oil (gasoline operation only) of the viscosity specified on the nameplate. If SE oil is not available, SD or SD/CC oil may be used.

When adding oil between changes, use oil identical to the oil in the crankcase in API designation, SAE viscosity and brand.

For temperatures above 30°F, use SAE 30 oil; for temperatures below 30°F, use 5W30.

In extremely dusty conditions or in very cold weather, change oil at least every 25 hours of operation.

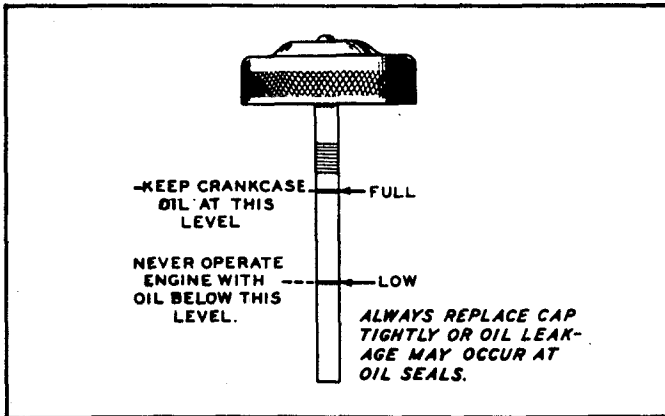


FIGURE 1. OIL LEVEL INDICATOR

OIL FILTER

Change the crankcase oil filter every 100 hours. Remove the filter by turning counterclockwise, using a filter wrench. Coat the rubber gasket on the base of filter lightly with oil. Add the rubber strip provided with the filter to prevent air loss in the area indicated (Figure 2). It is advisable to wipe dry the drip pan located below the filter. Install the filter finger-tight plus 1/4 to 1/2 turn.

CRANKCASE BREATHER

The engine is equipped with an insulated ball check valve for maintaining crankcase vacuum. Inspect every 200 hours. No maintenance is generally required. Should the crankcase become pressurized, as evidenced by oil leaks at the seals or around the cap of the oil level indicator, disassemble and clean as follows:

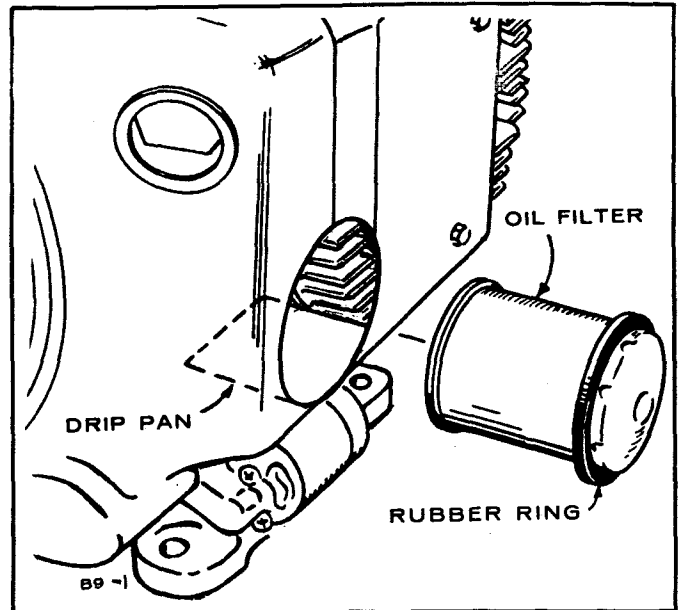


FIGURE 2. ENGINE OIL FILTER

CAUTION Do not overfill crankcase. Do not use service DS oil. Do not mix brands nor grades of motor oil.

Remove hose clamp, breather hose, breather cap clamp and insulator halves to release breather cap and valve assembly. Wash cap and valve assembly and the baffle in a suitable solvent and reinstall. See Figure 3.

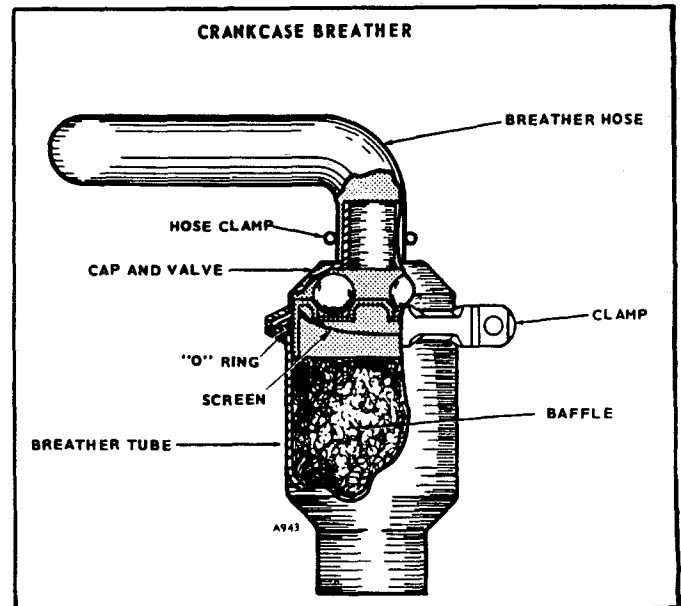


FIGURE 3. CRANKCASE BREATHER

OIL PUMP

To remove the oil pump, it is necessary to detach the intake cup assembly, as illustrated in Figure 4.

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling. Except for gaskets and suction cup, the component parts of the pump are not available individually. Install a new pump assembly if required.

If new oil pump gaskets are installed, they should be the same thickness as those removed. A gasket kit with various thickness gaskets is available.

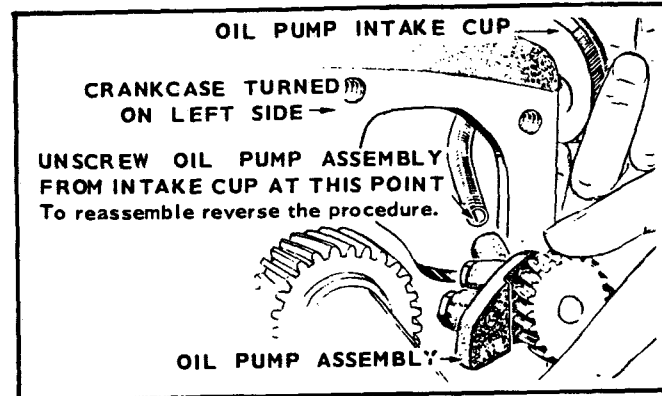


FIGURE 4. OIL PUMP ASSEMBLY

FUEL SYSTEM

CARBURETOR (Figure 5)

The carburetor has an idle fuel adjustment (A), a main fuel adjustment (B), and a low speed stop adjustment (C). The idle fuel adjustment affects engine operation at low speed or idle position. The main fuel adjustment affects operation under load (high speed). Under normal circumstances, factory carburetor adjustments should not be disturbed. If either A or B has been disturbed turn needles (counterclockwise) off their seats 1 to 1-1/2 turns to permit initial starting.

Carburetor Idle Fuel Adjustment:

1. Run the engine at least 10 minutes to warm it up.
2. Move speed control on tractor to slow position so engine is running at approximately 1200rpm.
3. Turn idle needle (A) out (counterclockwise) until engine begins to slow down or run unevenly (rich mixture). Remember this position.
4. Turn idle needle back in (clockwise) past the position where the engine runs smoothly until it begins to slow down or run unevenly (lean mixture).

CAUTION

Do not force the needle against its seat; doing so will damage it.

5. Back the needle out to a position approximately halfway between the two positions. This should provide a smooth running idle.

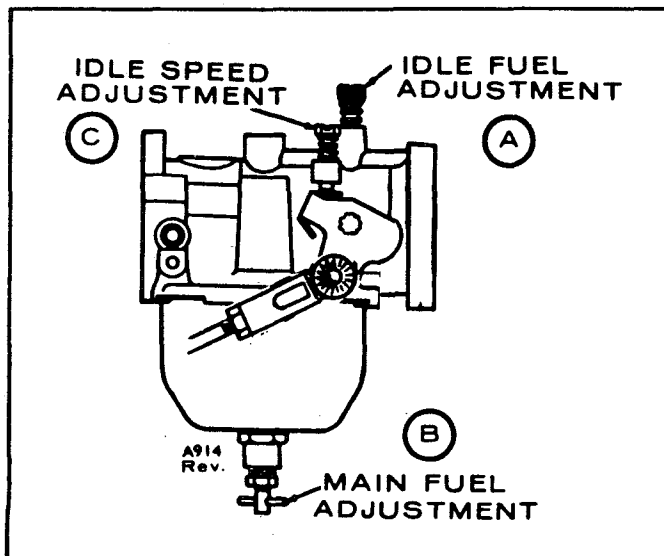


FIGURE 5. CARBURETOR ADJUSTMENTS

Carburetor Main (Load) Fuel Adjustment: If engine runs unevenly with a load applied, the main adjusting needle may need adjustment.

1. Start engine and allow it to warm up.
2. Set idle adjustment so engine runs smoothly. (See Carburetor *Idle Fuel Adjustment*).
3. Push in on governor mechanism to slow engine speed to about 400 to 500rpm.
4. Release governor mechanism to allow engine to accelerate. If engine accelerates evenly without hesitation, main adjustment is correct. If not, turn needle (B) outward about 1/2 turn and again release governor mechanism. Continue this procedure until engine accelerates evenly and without hesitation after releasing the governor.
5. If engine tends to hunt (alternate increase and decrease of speed), open main fuel adjusting needle a little more. Do not open more than 1/2 turn beyond maximum power point.

CARBURETOR DISASSEMBLY

1. Remove the main jet assembly and bowl.
2. Remove the float pin and float. See Figure 6.
3. Lift out the fuel inlet valve and unscrew the valve seat.
4. Remove the no-load adjusting needle.
5. Remove the throttle plate screws and the plate and pull out the throttle shaft.
6. Remove the choke plate screws and plate and pull out the choke shaft.

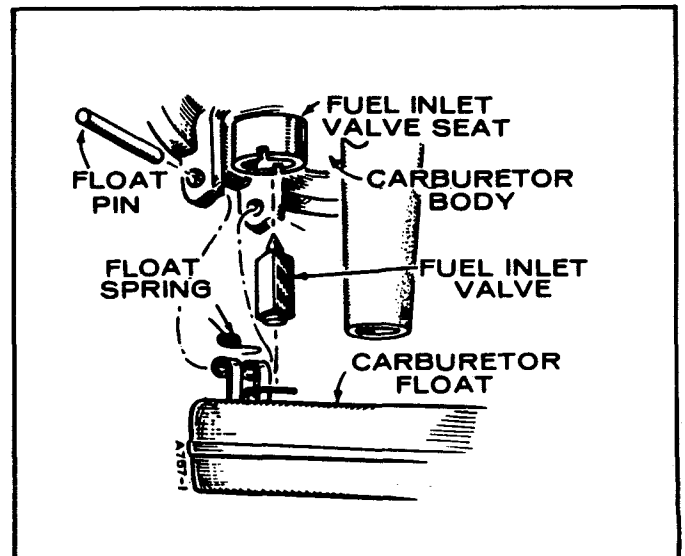


FIGURE 6. FLOAT ASSEMBLY

Cleaning and Repair: To clean the carburetor, soak all components thoroughly in a good carburetor cleaner following the cleaner manufacturer's instructions. Be sure all carbon is cleaned from the carburetor bore, especially in the area of the throttle valve. Blow out the passages with compressed air. If possible, avoid using wire to clean out the passages.

Check the adjusting needles and nozzle for damage. If the float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding. Invert the carburetor body and measure the float level (Figure 7). If necessary, bend the small lip that the intake valve rides on to adjust float level.

Check the choke and throttle shafts for excessive side play and replace if necessary.

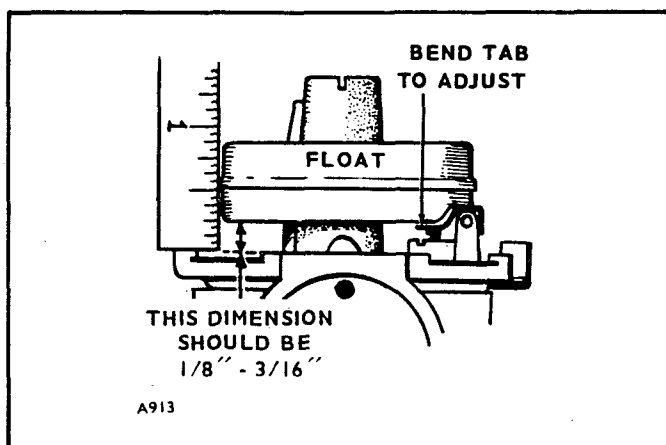


FIGURE 7. FLOAT ADJUSTMENT

CARBURETOR ASSEMBLY

1. Install the throttle shaft and plate, using new screws and lockwashers. Install with bevel mated to the carburetor body. On plates marked with the letter C, install with the mark on the side toward the idle port when viewed from the flange end of the carburetor. To center the plate, back off the top screw, close the throttle lever and seat the plate by tapping it with a small screwdriver. Then tighten the two screws.
2. Install the choke shaft and plate. Center the plate in the same manner as the throttle plate (step 1). Use new screws and lockwashers.
3. Install the fuel inlet valve seat and valve.
4. Install the float, float pin and float spring. Center the pin so the float bowl does not ride against it.
5. Check the float level with the carburetor casting inverted. See Figure 7.
6. Install the bowl ring gasket, bowl and bowl nut. Make sure that the bowl is centered in the gasket the float spring is in place and tighten the main jet assembly securely. Turn in until it seats and back out 1 to 1-1/2 turns.
7. Install the idle adjusting screw finger tight. Then back out 1 to 1-1/2 turns.

FUEL PUMP

The engine uses a diaphragm-type fuel pump. If fuel does not reach the carburetor, check the fuel pump before dismantling it.

1. Disconnect the fuel line at the carburetor.
2. Crank the engine slowly by hand and observe whether fuel comes from the line at the carburetor

WARNING Be sure to direct the fuel flow into a container so gas does not spill on ignition wires.

3. If there is enough fuel in the tank, and the line between the tank and the pump is open but the pump fails, repair or replace it.

Failure of the pump is usually due to a leaking diaphragm, valve or valve gasket, a weak or broken spring or wear in the drive linkage. If the operator chooses to repair the pump rather than install a new one, use complete repair kit. Refer to *Parts Catalog*.

Fuel Pump Reconditioning:

1. Remove fuel lines and mounting screws holding pump to engine.
2. Make an indicating mark with a file across a point at the union of the fuel pump bolt and cover. This mark will assure proper reassembly. Remove assembly screws and remove upper pump body.
3. Turn pump body over and remove valve plate screw and washer. Remove valve retainer, valves, valve springs and valve gasket, *noting their position*. Discard valve springs, valves and valve retainer gasket.
4. Clean pump body thoroughly with solvent and a fine wire brush.
5. Holding the pump cover with the diaphragm surface up, place the new valve gasket into the cavity. Assemble the valve spring and valves in the cavity. Reassemble the valve retainer. Lock in position by inserting and tightening fuel pump valve retainer screw.
6. Place pump body assembly in a clean place and rebuild the lower diaphragm section.
7. Holding mounting bracket, press down on the diaphragm to compress spring under it, then turn bracket 90° to unhook diaphragm so it can be removed.
8. Clean mounting bracket with a solvent and a fine wire brush.
9. Replace the diaphragm fuel pump rod spring, diaphragm gasket, stand new spring in casting, position diaphragm, compress spring and turn 90° to reconnect diaphragm.
10. Hold bracket, then place the pump cover on it (make sure that indicating marks are in line) and insert the four screws. **DO NOT TIGHTEN**. With the hand on the mounting bracket only, push the pump lever to the limit of its travel and hold it in this position while tightening the four screws. This is important to prevent stretching the diaphragm.
11. Mount the fuel pump on engine, using new mounting gaskets. Connect the fuel lines.

AIR CLEANER

CAUTION NEVER run engine with air cleaner removed. Dirt will enter carburetor and score the cylinders.

To gain access to air cleaner element, loosen thumb screw and pull out air cleaner inlet cover.

Under normal conditions clean filter element every 50 hours by blowing out with low pressure compressed air. Replace element every 200 hours. Check or replace more often if tractor is operating in dusty or dirty conditions.

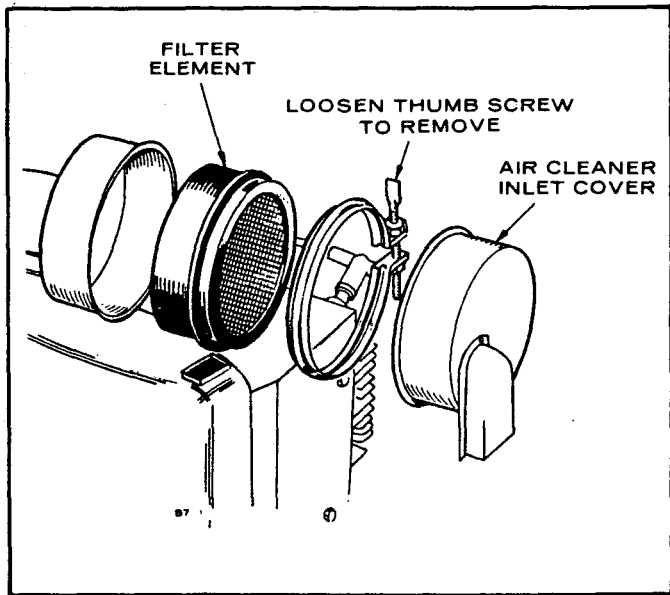


FIGURE 8. AIR CLEANER

GOVERNOR SYSTEM

ADJUSTMENTS (Figure 9)

If governor requires readjustment, observe the following:

Low Speed Adjustment: A tachometer (electric or mechanical) is required to accurately set the governor speed.

1. Use a screwdriver to adjust low speed stop screw (Figure 9) so engine runs at 1200 (± 100)rpm when throttle is held closed.
2. Readjust carburetor idle mixture so engine runs smoothly.
3. Check adjustment made in step 1 and readjust minimum idle speed if necessary.

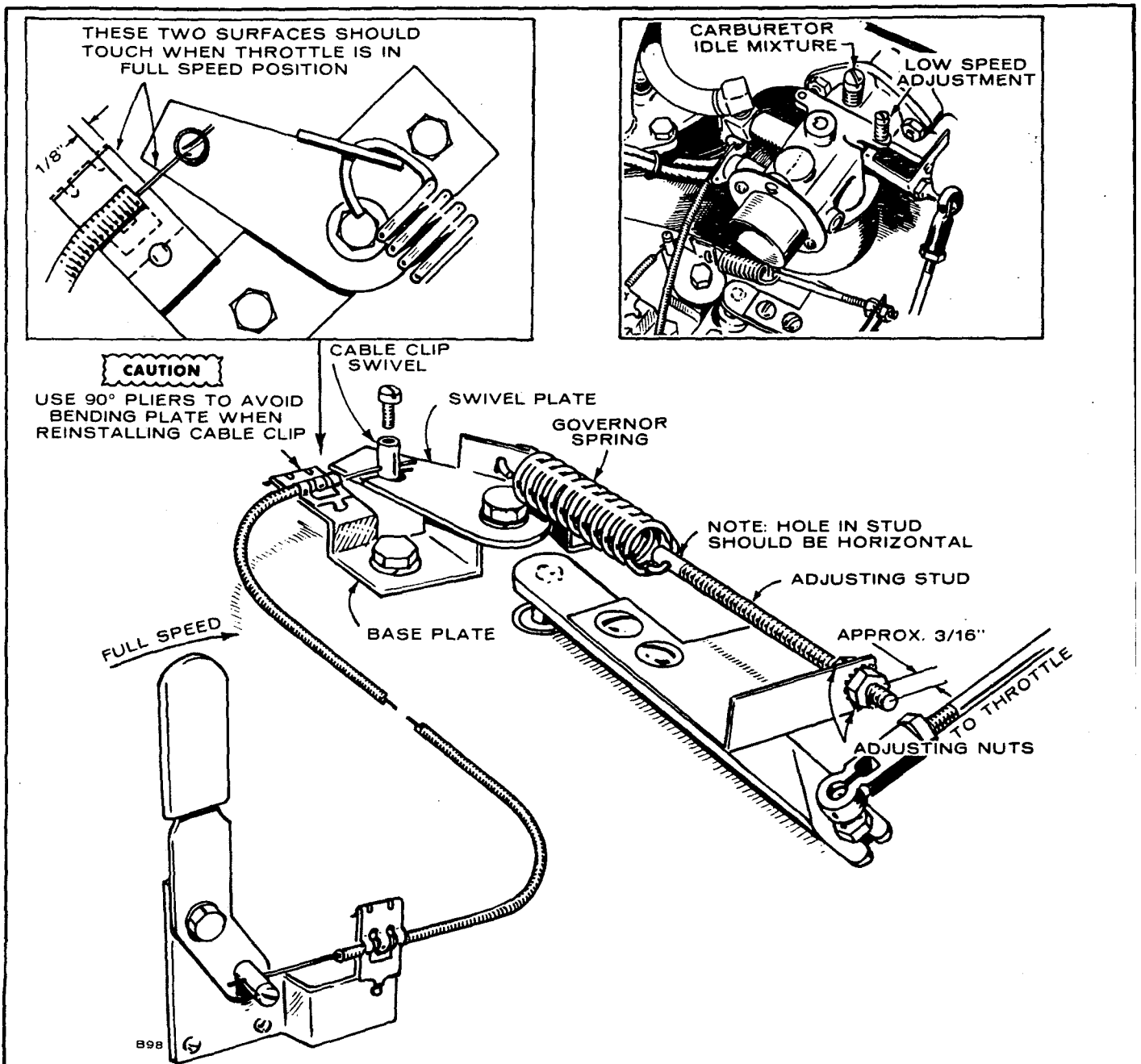


FIGURE 9. GOVERNOR ADJUSTMENTS

High Speed and Cable Adjustment:

1. Move engine speed control on tractor to "fast" position.
2. With speed control in "fast" position, the speed control cable should be holding governor swivel plate against stop on governor base plate (Figure 9).
3. If speed adjustment is necessary, remove cable clip and loosen swivel screw. Hold end of cable housing 1/8 inch from base plate mounting edge and using a 90° pliers reinstall cable clip.
4. Back off from "fast" position on throttle control arm until inner cable moves forward about 1/16 inch.
5. Hold the swivel plate against the stop edge and tighten the swivel screw. Recheck to see if control pulls swivel plate against the base plate.
6. With engine running, loosen stud adjusting nuts and turn toward spring (left) to increase or away from spring (right) to decrease the high speed. Tighten nuts and check speed.
7. Top speed at no load should be 3850 (± 100)rpm.

CAUTION

Bending the base plate will cause misalignment between swivel plate and the edge of base plate.

CLEANING

Inspect the governor linkage, springs, etc. for binding or wear. Clean often in dusty conditions.

IGNITION AND BATTERY CHARGING

BREAKER POINTS

To maintain maximum efficiency from the engine, change the breaker points every 200 hours of operation. Proceed as follows:

1. Remove the two screws and the cover on the breaker box.
2. Remove the two spark plugs so engine can be easily rotated by hand. If plugs have not been changed within the last 100 hours, replace them with new ones after setting the breaker points.
3. Remove the two mounting screws (A) and pull the points out of the box just far enough so screw (B) can be removed. See Figure 10. Replace points with a new set but do not completely tighten mounting screws (A).
4. Remove and replace condenser with a new one.
5. Rotate the engine clockwise (facing flywheel) by hand until points are fully open. Turn screw (C) until point gap measures .020 inch with a flat thickness gauge.
6. Tighten mounting screws and recheck gap.
7. Proceed to *Ignition Timing*.

NOTE: Each time new breaker points are installed, place a drop of oil on the point's pivot point (Figure 10).

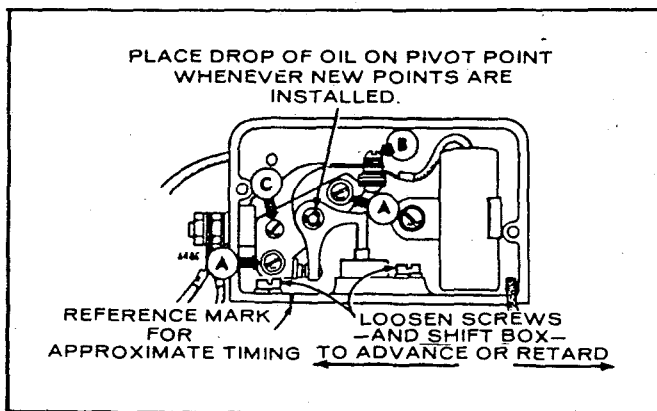


FIGURE 10. BREAKER POINTS & TIMING ADJUSTMENT

IGNITION TIMING

Ignition Timing - Engine Running

Always check timing after replacing ignition points or if noticing poor engine performance. Proceed as follows:

1. To accurately check the ignition timing, use a timing light when engine is running. Connect the timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.

2. Clean off the timing mark on the timing bracket (located on rear bearing plate) and also clean the 20° mark on the front clutch. (For safety turn off front clutch and if possible remove belt from front clutch pulley.)
3. Start engine and check for alignment of these two marks.
4. If misaligned, loosen the mounting screws on breaker box (Figure 10) and move breaker box left to advance, or to the right to retard the timing.
5. Tighten breaker box screws and recheck timing.
6. Replace breaker box cover and any other hardware removed.

Ignition Timing - Engine Not Running

1. Connect a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.
2. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
3. As the points begin to open the light will flicker or go out. At this time the timing marks should be aligned. If not, adjustment is necessary.
4. Align timing marks and loosen breaker box screws (Figure 10). Move breaker box to the left (advance) or to the right (retard) until the light flickers.
5. Tighten the breaker box screws and recheck timing.

SPARK PLUGS

Remove both spark plugs and install new ones every 100 hours. Use Champion H-8 or equivalent. Check to be sure spark plug gap is set at .025''.

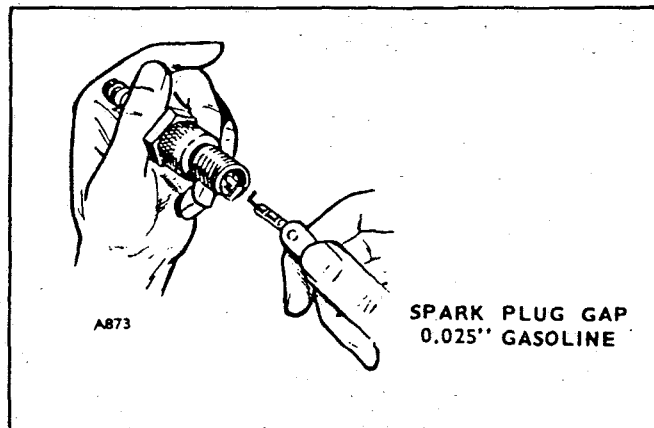


FIGURE 11. SPARK PLUG GAP

IGNITION COIL

To test primary and secondary windings within the ignition coil, proceed as follows:

1. Use a Simpson 260 VOM or equivalent.
2. Place back lead on ground (-) terminal of coil and red lead to positive (+) terminal. Primary resistance should read 3.87 - 4.73-ohms.
3. Change resistance setting on ohmmeter. Place ohmmeter leads inside of spark plug cable holes (Figure 12). Secondary resistance should read 12,600 - 15,400-ohms.
4. If any of the above conditions are not met, replace coil. Refer to *Parts Catalog* for correct part number.

CAUTION This engine uses a 12 volt, negative ground system. Alternator must be connected to battery at all times when engine is running. Do not reverse battery cables. Damage to regulator or ignition coil could result if cables are reversed.

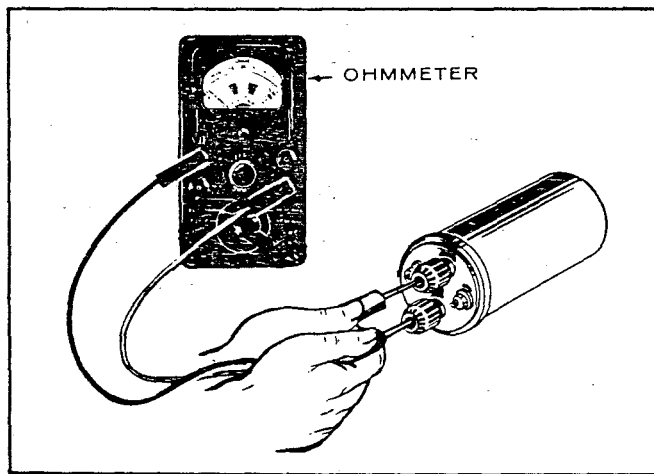


FIGURE 12. IGNITION COIL TESTING

BATTERY INSPECTION

Check battery cells with a hydrometer. The specific gravity reading should be approximately 1.280 at 80°F.

If one or more cells are low on water, add distilled water and recharge.

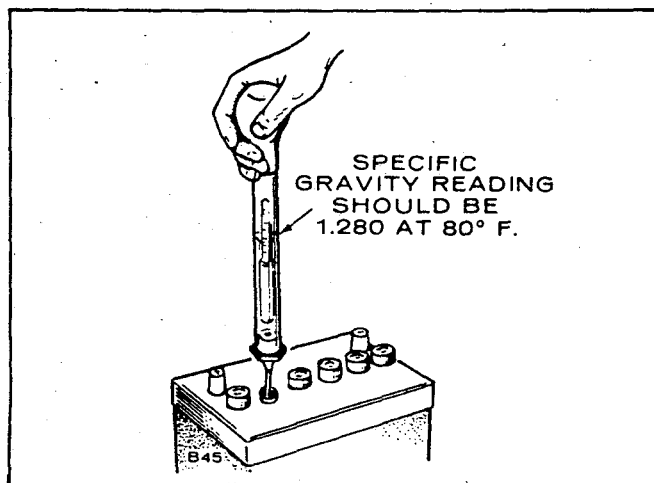


FIGURE 13. SPECIFIC GRAVITY TEST

Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or grease to retard corrosion.

Check battery cells to make sure they are filled to appropriate level adding distilled water as required. Check specific gravity in each cell. Specific gravity should be 1.280 at 80°F; if not, recharge battery to bring it up to this level.

NOTE: Poor contact at the battery cable connections is often a source of trouble. Make sure battery cables are in good condition and that contacting surfaces are clean and tightly connected. Do not reverse battery leads. Use recommended battery tools when disconnecting leads to avoid mechanical battery damage.

FLYWHEEL ALTERNATORS

The alternator is a permanent magnet flywheel alternator with a solid-state voltage regulator-rectifier for controlling output. If ignition spark is weak or if the battery discharges inspect the following:

Inspection:

1. Make sure the alternator stator leads are not shorted together.
2. Check mounting of regulator-rectifier case to unit. It should provide a good electrical ground with clean, bright surfaces.
3. Output control plug or plugs (connector) must be pushed in so it bottoms solidly in the receptacle. Keep it clean and tight.

IMPORTANT: Charging system tests require a fully charged battery.

15AMP FLYWHEEL ALTERNATOR SYSTEM

The 15amp system has two white wires coming from stator and is used on 3600rpm (maximum) engines. See Figure 14.

TESTING PHELON 15 AMP SYSTEM

BASIC TEST	PROCEDURE	TEST VALUES
1. Battery	Battery Voltage - unit not running	12 VDC
2. Regulator	Battery Voltage after unit is running 3 to 5 minutes.	13.6 to 14.7 VDC
3. Alternator Stator and Wiring with Fully Charged Battery.	Ohmmeter reading from stator output - unit not running, check at plug.	.11 to .19-Ohms
4. Alternator and Wiring.	Measure AC open circuit stator voltage with unit running. Measure between two stator leads with plug disconnected and unit running at approximately 3600 rpm.	28 VAC

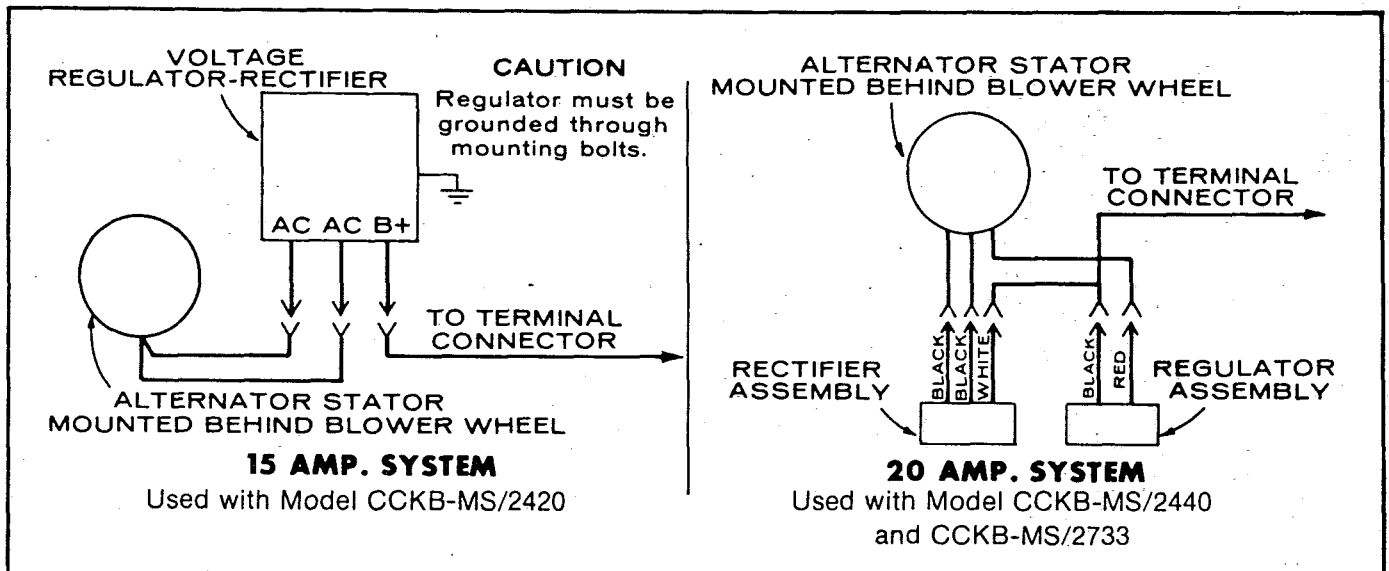


FIGURE 14. FLYWHEEL ALTERNATORS

20 AMP FLYWHEEL ALTERNATOR SYSTEM

System Identification: Syncro flywheel alternator systems use a separate regulator and a separate rectifier. There are two black wires and one red wire coming from the stator assembly. See Figure 14.

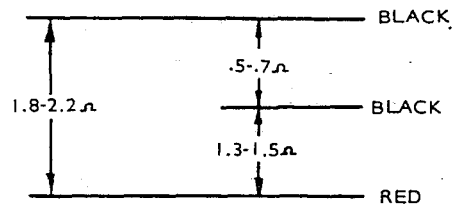
For testing this system, use a voltmeter-ohmmeter such as a *Simpson 270*. Following are various alternator problems with individual test procedures.

TESTING SYNCRO 20 AMP SYSTEM

TEST	VALUE
Battery voltage - unit not running.	12 Volts DC
Battery voltage with unit running at 1800 rpm or more.	14.2 - 14.8 Volt DC *
AC voltage from stator with plug disconnected and unit running at approximately 1800 rpm.	17 Volts AC * Black to Black
Ohmmeter reading at plug when checking two AC stator leads - unit not running.	.5 to .7-Ohms ** Black to Black

* - 60 Volt minimum at greater than 2000 rpm, Red to Ground.

** - Resistance values (Ohms) are as follows between wire pairs.



NO OUTPUT - STATOR ASSEMBLY:

Examine leadwires for loose or broken connections at the regulator and rectifier. Use the Rx1 scale on the ohmmeter for detecting opens in the stator. Disconnect the three wires that come from alternator stator (two black, one red). Connect ohmmeter test leads to red leadwire and ground to check continuity. The ohmmeter reading should be approximately 2.0-ohms.

Next connect meter to black leadwires and ground. Approximately 0.1-ohm should be read from either black lead to ground. If no connection exists between ground and black leads, stator assembly should be replaced.

CHECKING RECTIFIER ASSEMBLY:

Examine each of the two diodes for breakdown by connecting ohmmeter (Rx1 scale) from one black lead to white lead. Meter should read 10-ohms in proper polarity. A shorted diode would read zero resistance and would cause a short circuit through the lead winding when in operation. An open diode would read infinite in both directions indicating that replacement is necessary.

TESTING REGULATOR ASSEMBLY:

To check for proper voltage regulation, attach a DC voltmeter to battery and operate engine at approximately 1800 rpm. Battery voltage will climb to the preset factory setting (14.2 to 14.8 volts).

NOTE: Some installations may vary due to voltage drop in the length of ammeter harnesses. Other variations may stem from a loose connector in the harness or loose or corroded battery leads. Low voltage readings at the battery mean poor battery connections.

To test regulator, remove connector. Using the Rx10,000 scale of your ohmmeter, connect one meter lead to red leadwire and other meter lead to regulator base. No deflection should be noted on the ohmmeter in either polarity. Next connect meter to black leadwire and base of regulator. Meter will deflect fully in one polarity with no deflection in the other.

FULL CHARGE - WILL NOT REGULATE:

Check for broken leads at connection to regulator plates. To be sure regulator winding operates properly, connect red lead to ground and start engine. A maximum of 4 amperes should be noted. This would indicate stator winding is satisfactory. If so, replace regulator.

NO CHARGE:

If alternator does not charge when load is applied to battery, shut off engine and disconnect one red leadwire from regulator terminal. Be sure lead is taped or isolated from conducting engine parts. Once again, start engine. Alternator should charge to full output; if it doesn't, replace stator assembly.

STARTING SYSTEM

ELECTRIC STARTER

Normally the starter will require little or no service other than possible brush replacement. However, if through accident or misuse, the starter requires service or overhaul, the following procedures will provide the information necessary to perform this service.

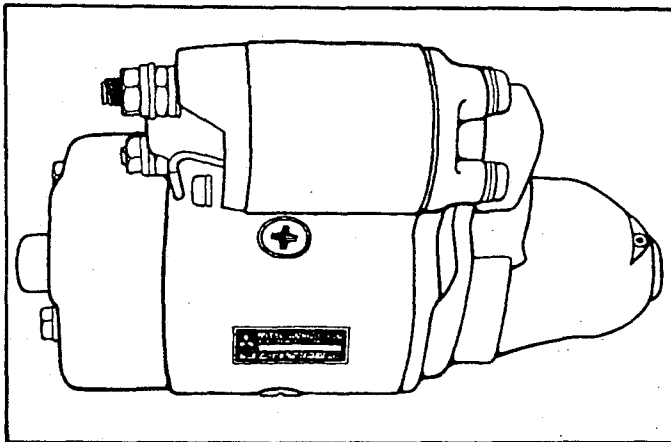


FIGURE 15. STARTER ASSEMBLY

STARTER DISASSEMBLY

1. Loosen the M terminal nut on the magnetic switch and remove the connector. Then unscrew attaching screws and remove the magnetic switch.

NOTE: The packings for the magnetic switch are mounted so that the steel packing is located in the front bracket side.

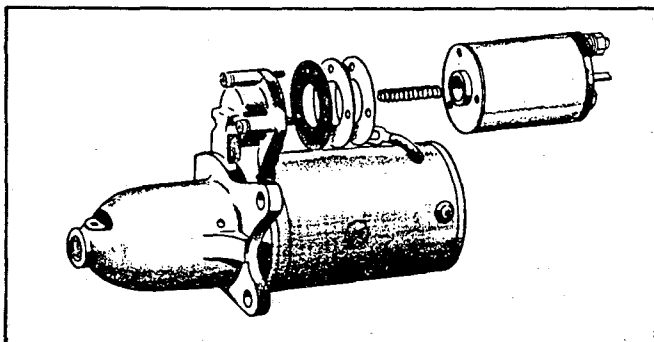


FIGURE 16. MAGNETIC SWITCH REMOVAL

2. After removing the thru bolts, the starting motor can be divided into three parts – the front bracket, housing and rear bracket. The spacing washers

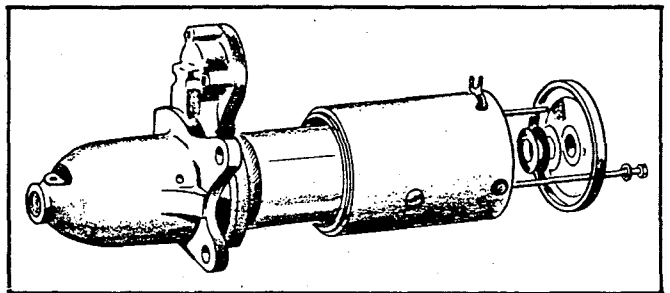


FIGURE 17. REMOVING THROUGH-BOLTS

shown in Figure 17 are used for adjustment of the thrust gap of the armature shaft and are placed between the rear bracket and the commutator.

NOTE: These washers are inserted so the steel washer is located in the commutator side.

3. The armature can easily be removed from the front bracket. Be careful not to miss a small steel washer used in the end of the armature shaft. The shift lever can be removed along with the armature when it is removed. In this case, the spring holder, lever springs and retainer can be taken out before the lever. See Figure 18.

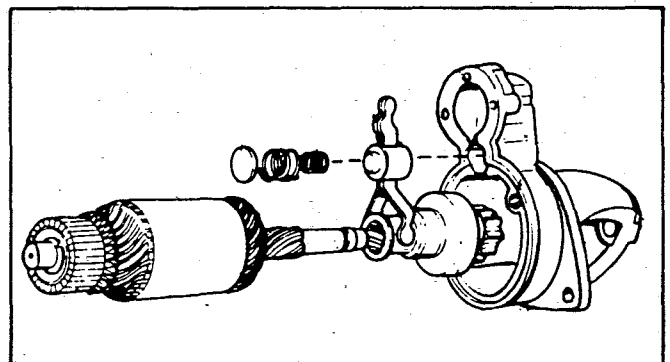


FIGURE 18. REMOVING ARMATURE

4. Remove the ring after driving the pinion stopper toward the pinion gear using a cylindrical tool as shown in Figure 19. The overrunning clutch and the pinion stopper should be removed simultaneously.
5. All four brushes have been soldered to the brushholder in the same way. The brush springs can be removed from the brushholder.
6. The pole shoes may be removed if necessary, by removing the flat head machine screws from the frame.

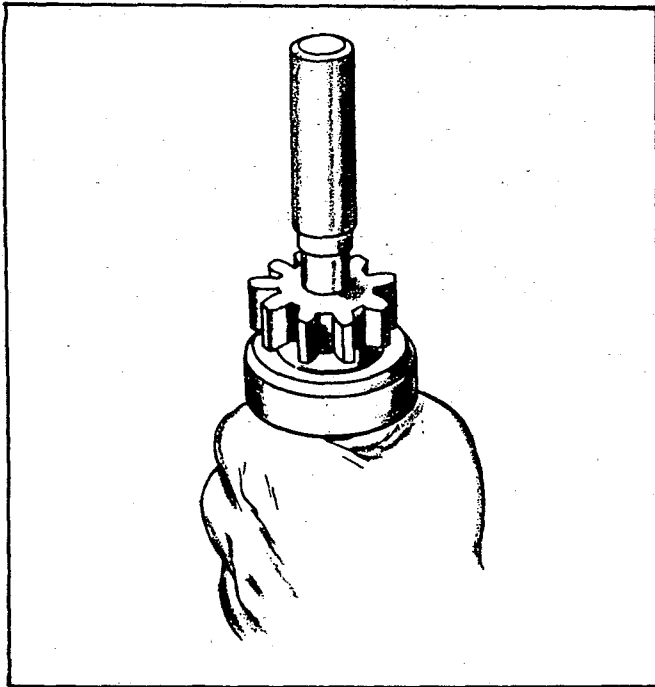


FIGURE 19. REMOVING RING

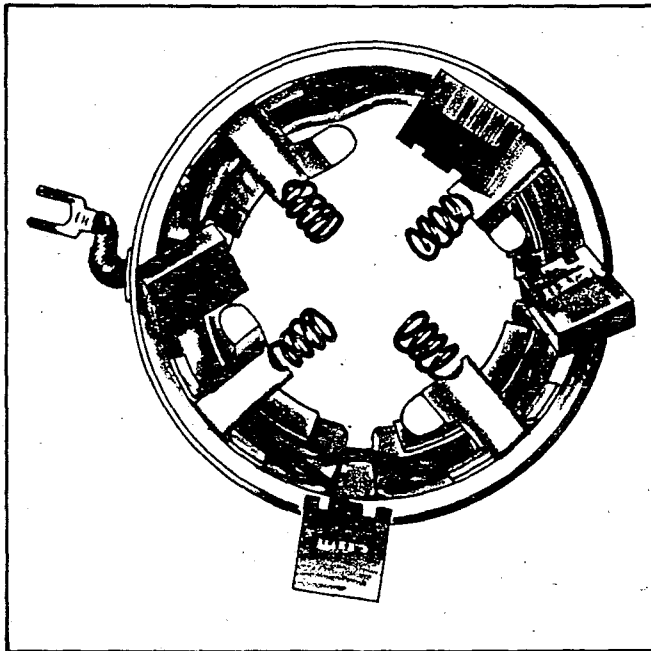


FIGURE 20. BRUSHES

STARTER REASSEMBLY

Inspect the parts carefully in accordance with the procedure described in *Inspection of Parts*. Make any repairs necessary. Reassembly is the reverse of Disassembly. The following precautions should be taken:

1. Clean all of the parts carefully with a dry cloth and compressed air if it is available.

CAUTION

Do not use steam or high pressure water to clean the starter.

NOTE: (A) Bearing equipped parts must not be immersed in cleaning fluid. These parts should be cleaned with a brush dipped in "Varsol" or any other comparable mineral spirits. (B) Do not immerse overrunning clutch in cleaning solvent. (C) Thoroughly dry any parts that have come into contact with the cleaning fluid.

2. Apply SAE 20 oil to the armature shaft and splines. Apply grease (Shell Albania No. 2 or equivalent) sparingly on the shift lever pin, the joint of the shift lever and plunger, the plunger and spacing washers at the end of the shaft.
3. To mount the overrunning clutch; first insert the pinion stopper into the armature shaft, then apply the ring to the groove of the shaft rigidly. For the insertion of the ring, use a tool as shown in Figure 21 and pull the pinion stopper up.
4. Use spacing washers to adjust the armature to give end play of .004" to .020".
5. Tighten the thru bolts to a torque of 35 to 44 in-lbs.

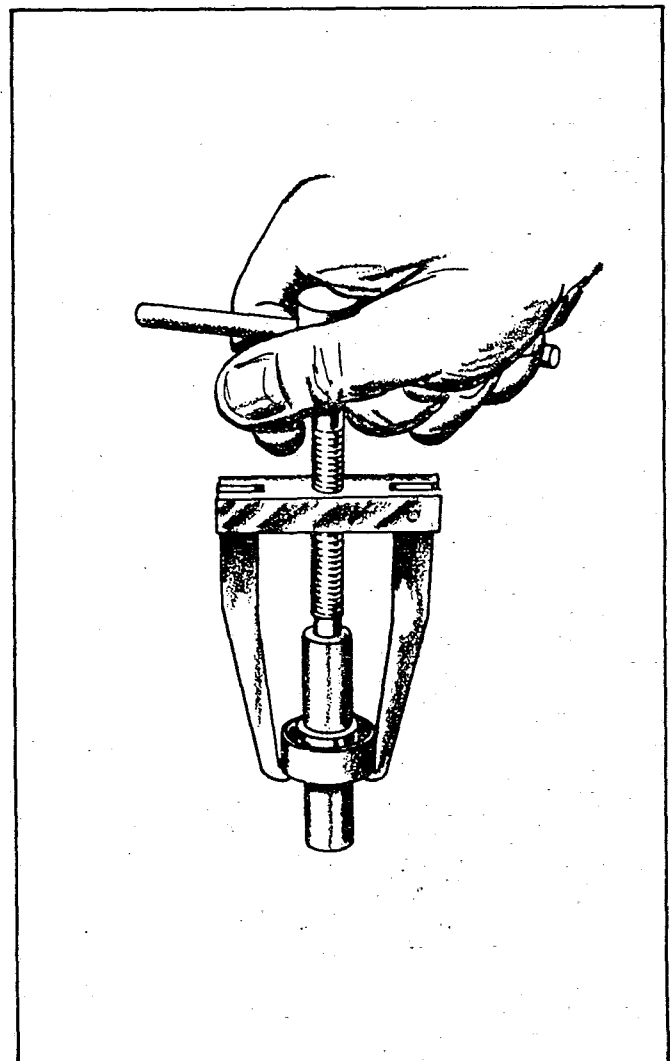


FIGURE 21. MOUNTING OVERRUNNING CLUTCH

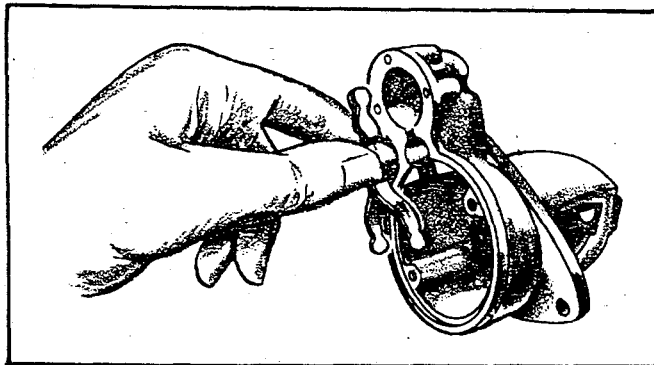


FIGURE 22. INSTALLING SHIFT LEVER

INSPECTION OF PARTS

1. **Testing Armature for Short Circuits:** Place the armature in a growler and hold a thin steel blade parallel to the core and just above it while slowly rotating the armature in the growler. A shorted armature will cause the blade to vibrate and be attracted to the core. Replace shorted armature.

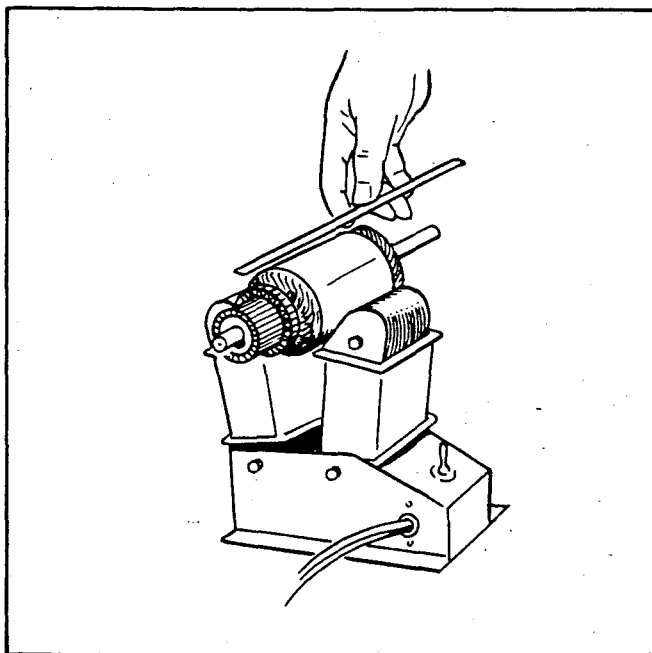


FIGURE 23. TESTING ARMATURE FOR SHORT CIRCUITS

2. **Testing Armature for Grounds:** Touch armature shaft or core and the end of each commutator bar with a pair of ohmmeter leads. If the ohmmeter reading is low, it indicates a grounded armature. Replace grounded armature.
3. **Testing Armature for Open Circuit:** The most likely place for an open to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections.
4. **Testing Commutator Runout:** Place armature in a test bench and check runout with a dial indicator. When commutator runout exceeds .004", commutator should be refaced.

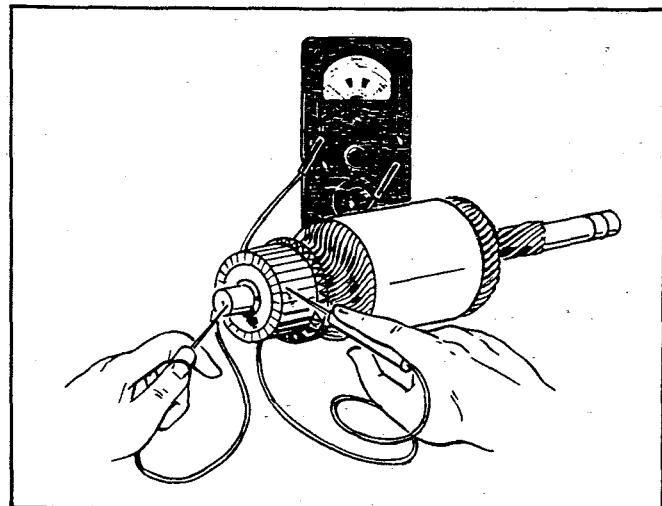


FIGURE 24. TESTING ARMATURE FOR GROUNDS

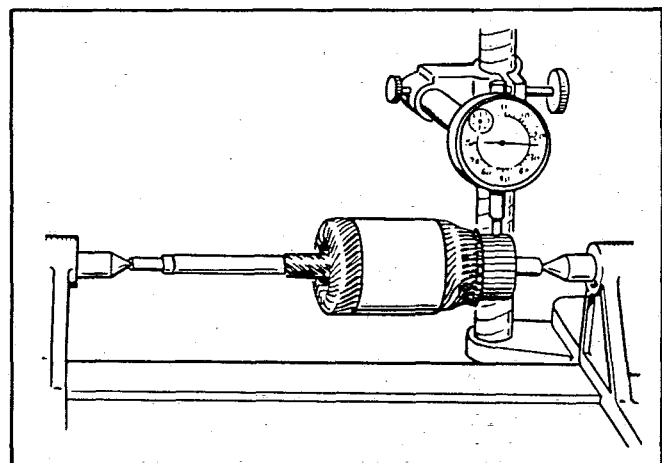


FIGURE 25. TESTING COMMUTATOR RUNOUT

5. **Testing Armature Shaft Runout:** The armature shaft as well as the commutator may be checked. A bent armature often may be straightened, but if the shaft is worn, a new armature is required.

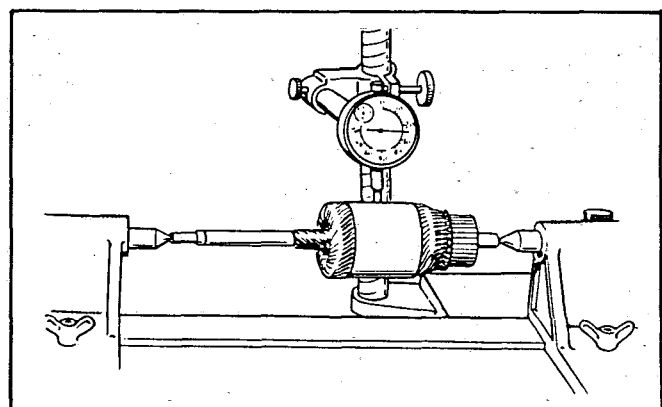


FIGURE 26. TESTING ARMATURE RUNOUT

6. **Testing Field Coils for Grounds:** Place one lead on the connector and the other on a clean spot on the frame after unsoldering shunt field coil wire. If the ohmmeter reading is low, the fields are grounded, either at the connector or in the windings.

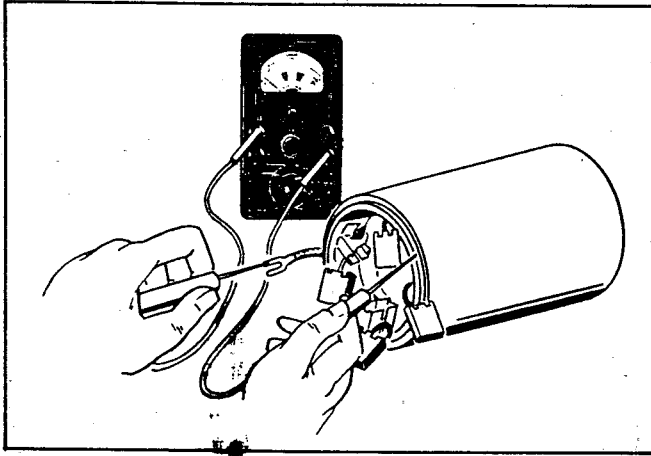


FIGURE 27. TESTING FIELD COILS FOR GROUNDS

7. **Testing Field Coils for Open Circuit:** Place one lead on the connector and the other on a clean spot on the brushholder. If the ohmmeter reading is high, the field coil is open. Check the other three brushholders in the same manner.

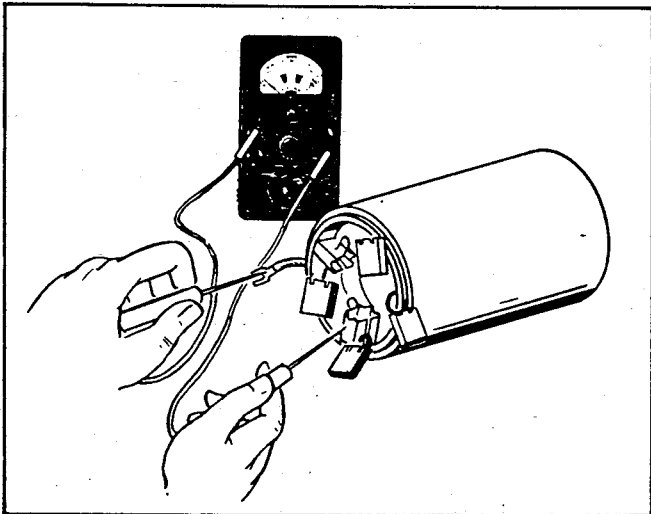


FIGURE 28. TESTING FIELD COILS FOR OPENS

8. **Inspection of Brushes:** When brushes are worn more than .3" they are to be replaced. Figure 29 shows the wear limit. See that the brushes move smoothly in the brushholders.

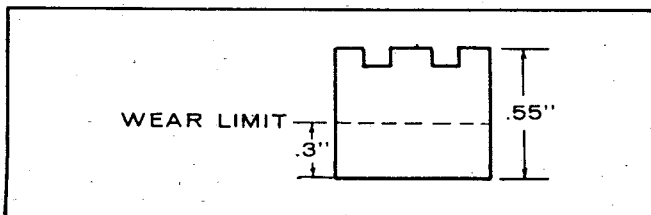


FIGURE 29. BRUSH WEAR LIMIT

9. **Inspection for Brush Spring Tension:** Measure brush spring tension with a tension meter as shown in Figure 30. Push the brush and take a reading just as the brush projects a little from the brushholder. On a new brush the spring tension should be 29 to 38 ounces.

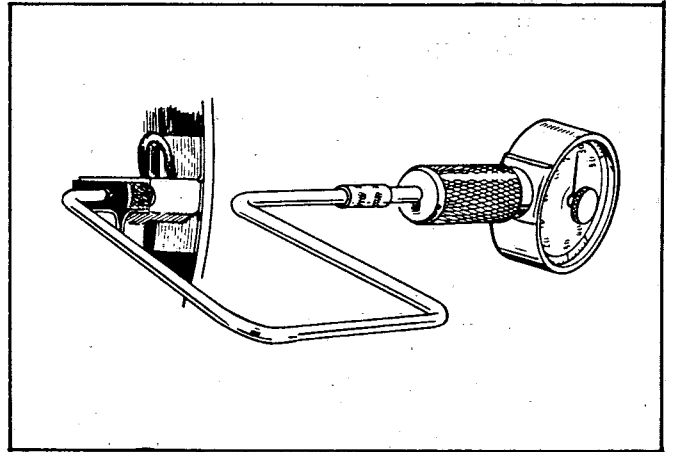


FIGURE 30. TESTING BRUSH SPRING TENSION

INSPECTION AFTER OVERHAUL

1. For no load test, the starting motor is wired as shown in Figure 31 and run. The value of the meter reading at this condition should be as follows:

Voltage	11.5 Volt
RPM	3700
Current Draw	60 A Max.

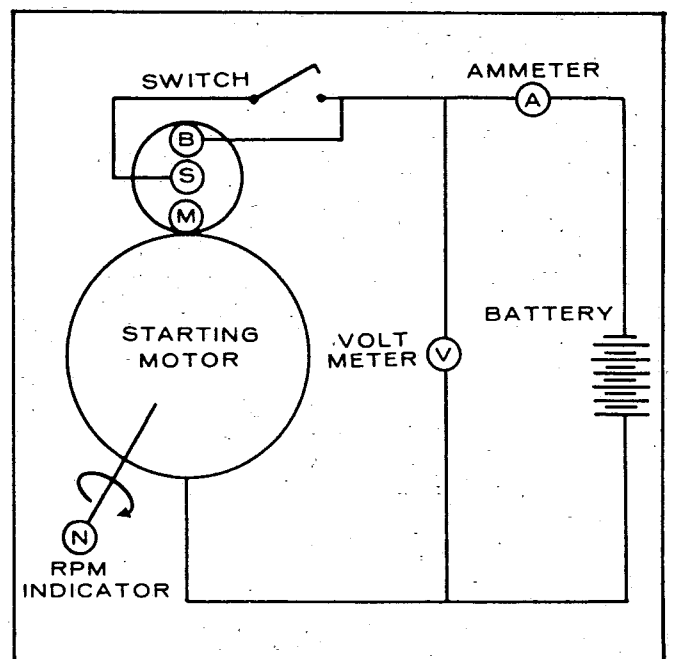


FIGURE 31. STARTER MOTOR WIRING

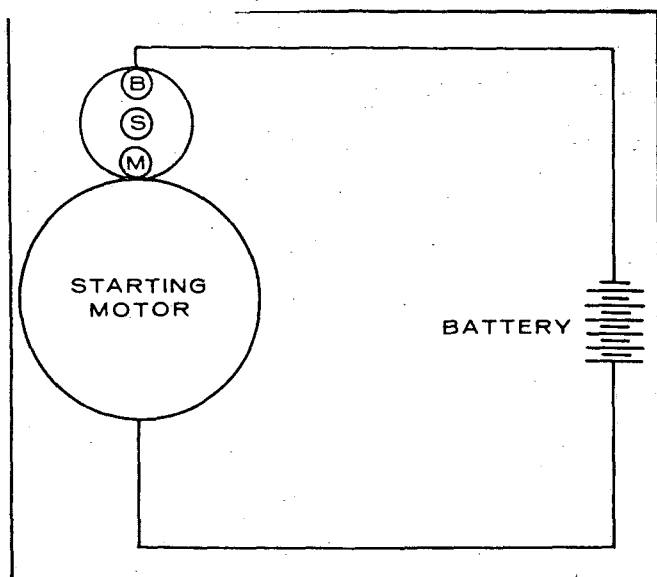


FIGURE 32. BATTERY CONNECTIONS

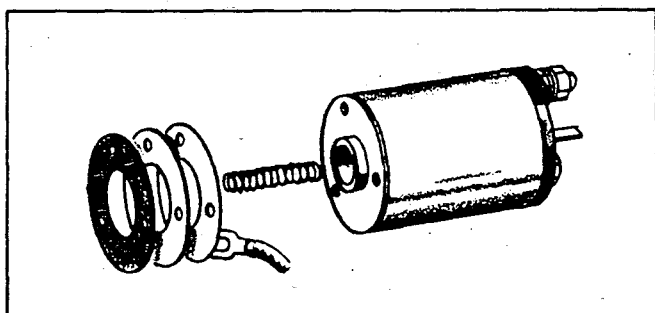


FIGURE 33. ADJUSTING PINION CLEARANCE

NOTE: *The conductor for this test should be large enough and as short as possible. If anything is wrong in the previous test, inspect the following items:*

- Annealed brush springs
 - Improperly seated brushes
 - Insufficient armature endplay
 - Shorted, open or grounded armature
 - Grounded or open field coil
 - Poor electrical connection
 - Dirty commutator
2. To adjust pinion clearance, connect the battery to the starting motor as shown in Figure 32. This will allow the pinion of the starting motor to slide and stop. In this state, measure the clearance between the end of the pinion and pinion stop when the pinion is pushed lightly toward the commutator end. Clearance should be .02 " to .06 ". Adjust for proper clearance by removing the magnetic switch attaching screws and select the proper thickness of the fiber packings shown in Figure 33.

ENGINE DISASSEMBLY

If engine disassembly is necessary, first remove all the complete assemblies (e.g. manifold with carburetor and cartridge air cleaner. Individual assemblies, as the carburetor, can be removed and serviced later, if necessary. Any special assembly instructions for a particular group are included in the applicable section. When reassembling, check each section for these special assembly instructions or procedures.

FLYWHEEL

To remove the flywheel, turn the flywheel mounting screw outward about two turns and use Onan puller 420-0100 to pull the flywheel (Figure 34).

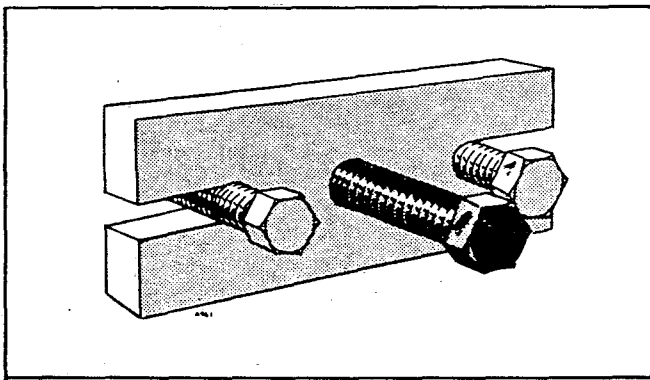


FIGURE 34. ONAN FLYWHEEL PULLER

Do not drop the flywheel. A broken fin will destroy the balance. Always use a steel key for mounting the flywheel.

CAUTION Do not use a screwdriver or similar tool or pry behind the flywheel against the gearcase. The gearcase cover is die-cast material and will break if undue pressure is applied in this manner.

GEAR COVER

After removing the flywheel key and mounting screws, tap the gear cover gently with a soft-faced hammer to loosen it.

CAUTION When installing the gear cover, make sure that the pin in the gear cover engages the governor cup correctly (see below).

Turn the governor cup so that the metal lined hole is at the three o'clock position. The smooth side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal. Adjust the roll (stop) pin to protrude to a point $\frac{3}{4}$ inch from the cover mounting surface. See Figure 36.

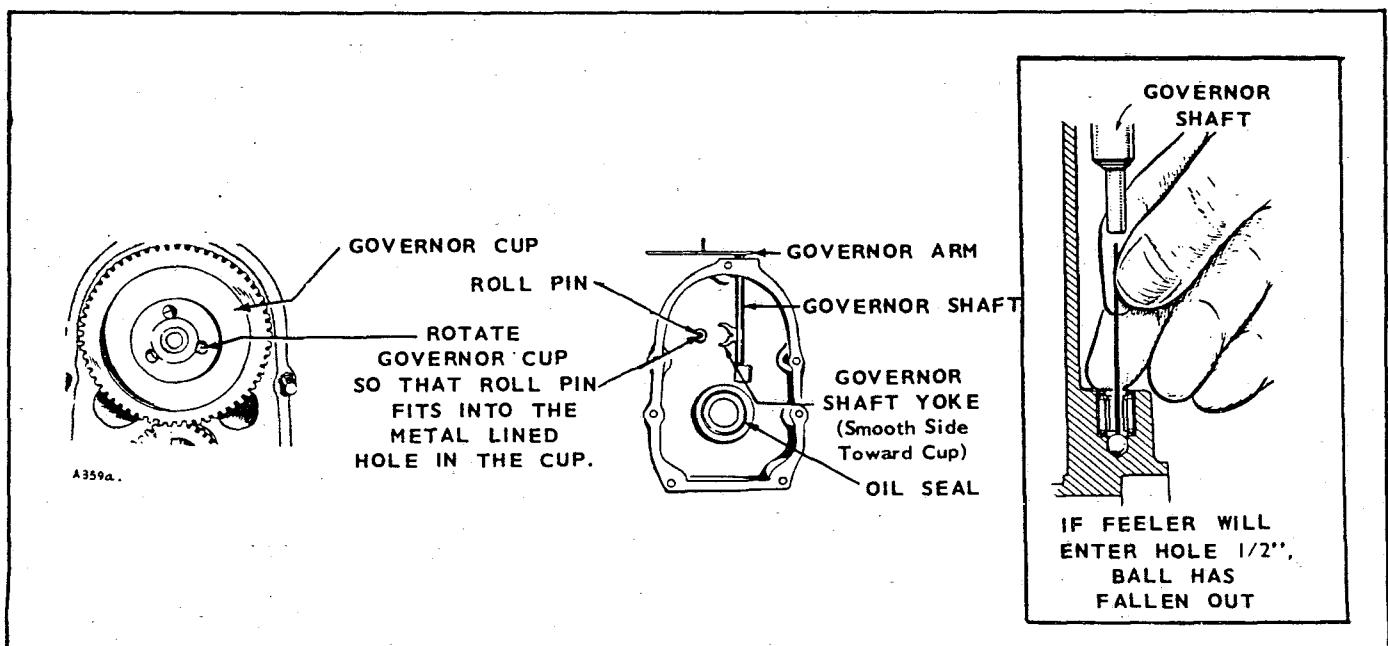


FIGURE 35. GEAR COVER ASSEMBLY

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin. Catch the flyballs while sliding the cup off. See Figure 36.

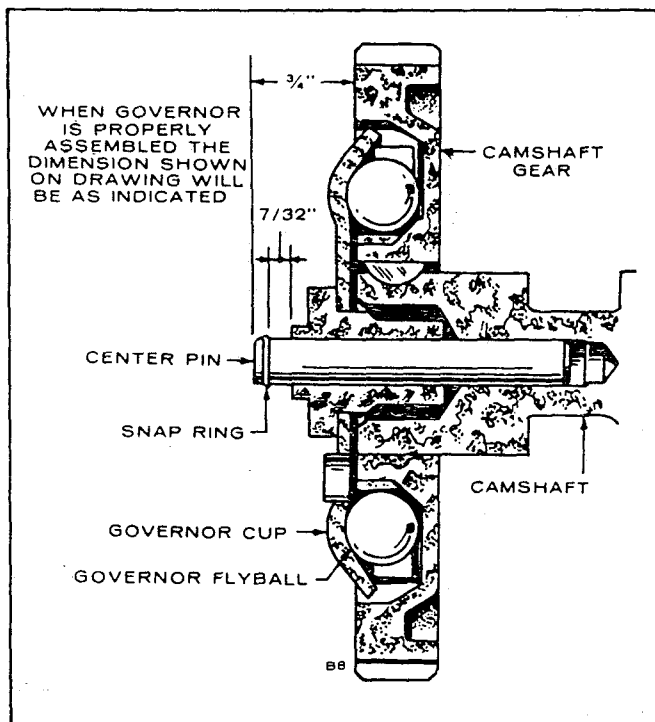


FIGURE 36. GOVERNOR CUP

Replace any flyball that is grooved or has a flat spot. If the arms of the ball spacer are worn or otherwise damaged, replace the entire timing gear set. The governor cup must spin freely on the camshaft center pin without excessive looseness or wobble. If the race surface of the cup is grooved or rough, replace it with a new one.

When installing the governor cup, tilt the engine so the gear is up, put the flyballs in place and install the cup and snap ring on the center pin (Figure 36).

The camshaft center pin extends out $3/4$ inch from the end of the camshaft. This distance provides an in-and-out travel distance of $7/32$ inch for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine may race, especially at no load), remove the center pin and press a new pin in only the required amount. Otherwise, grind off the hub of the cup as required. The camshaft center pin cannot be pulled outward nor removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

TIMING GEARS

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, install both gears new, never one only. Use a gear pulling ring (Onan No. 420-0248) to remove the crankshaft gear. Be sure to remove the snap ring first.

The camshaft gear is pressed on and keyed to the camshaft. The camshaft and gear must be removed as an assembly after first removing the crankshaft gear lock ring and washer. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Remove the operating plunger for the breaker points. Remove the fuel pump and tappets.

The camshaft may be pressed out of the gear by use of a hollow tool or pipe which will fit over the camshaft center pin. Do not press on the center pin or damage it in any way. The governor ball spacer is a press fit to the camshaft gear.

When pressing a camshaft gear onto the camshaft, be sure the gear is started straight and that the key is properly in place. When replacing the cam gear on units having automatic spark advance mechanisms, remove the spark advance mechanism and put blocks beside the pins to avoid damage when pressing on cam gear. Install the governor cup assembly before installing the camshaft and gear in the engine.

Each timing gear is stamped with an O mark near the edge. The gear teeth must mesh so that these marks coincide exactly when the gears are installed in the engine (Figure 37). Be sure, when installing the camshaft gear and shaft assembly, that the thrust washer is properly in place behind the camshaft gear. Replace the camshaft retaining washer and lock ring to the crankshaft.

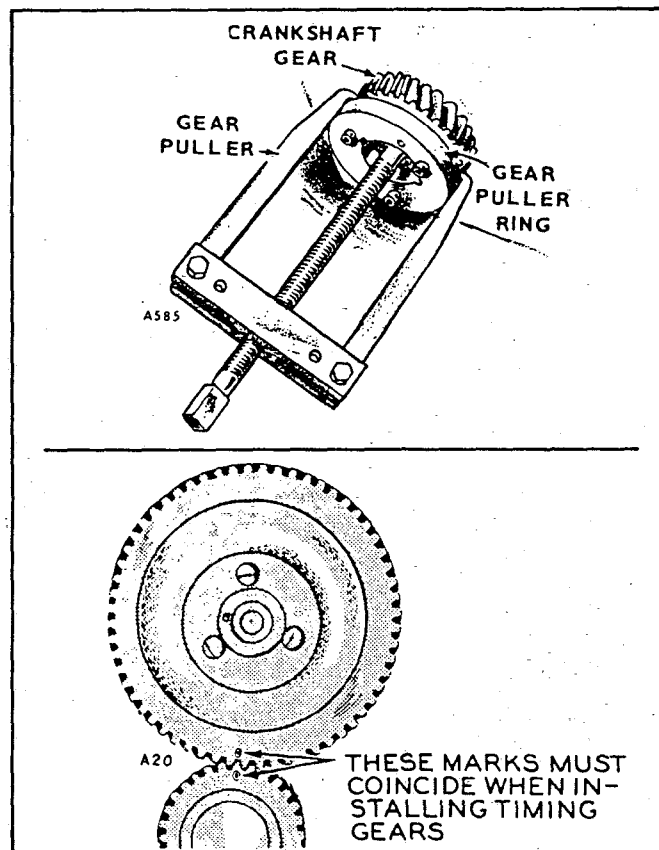


FIGURE 37. TIMING GEAR REMOVAL AND INSTALLATION

CYLINDER HEADS

The cylinder heads should be tightened in the order designated per Figure 38 to a torque of 5 foot-pounds, then 10 foot-pounds, etc. until all are torqued to 29 to 31 foot-pounds.

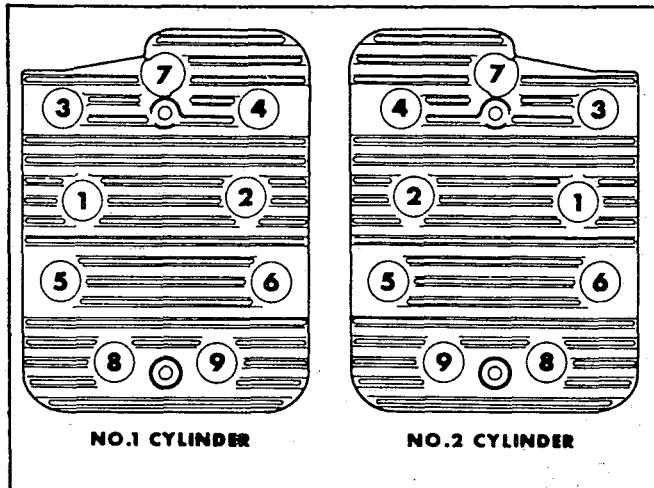


FIGURE 38. HEAD BOLT TIGHTENING SEQUENCE

VALVES

Properly seated valves are essential to good engine performance. The cylinder head is removable for valve servicing. Do not use a pry to loosen the cylinder head. Rap sharply on the edge with a soft-faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder head, piston top, valves, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve.

Worn valve stem guides may be replaced from inside the valve chamber. See Figure 39. A seal is provided behind the intake valve guides only. The smaller diameter of the tapered valve guides must face toward the valve head.

Tappets are also replaceable from the valve chamber, after first removing the valve assemblies.

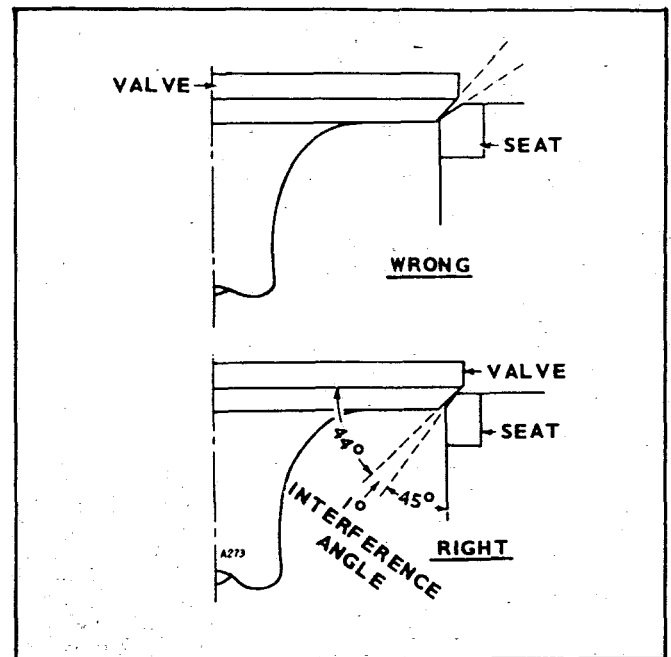


FIGURE 40. VALVE FACE AND SEAT ANGLES

The valve face angle is 44° . The valve seat angle is 45° . This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life (Figure 40).

The valves should not be hand lapped, if at all avoidable, since the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44° . Valve seats should be ground with a 45° stone and the width of the seat band should be $1/32$ to $3/64$ of an inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat, using an air pressure type testing tool. If such a tool is not available, make pencil

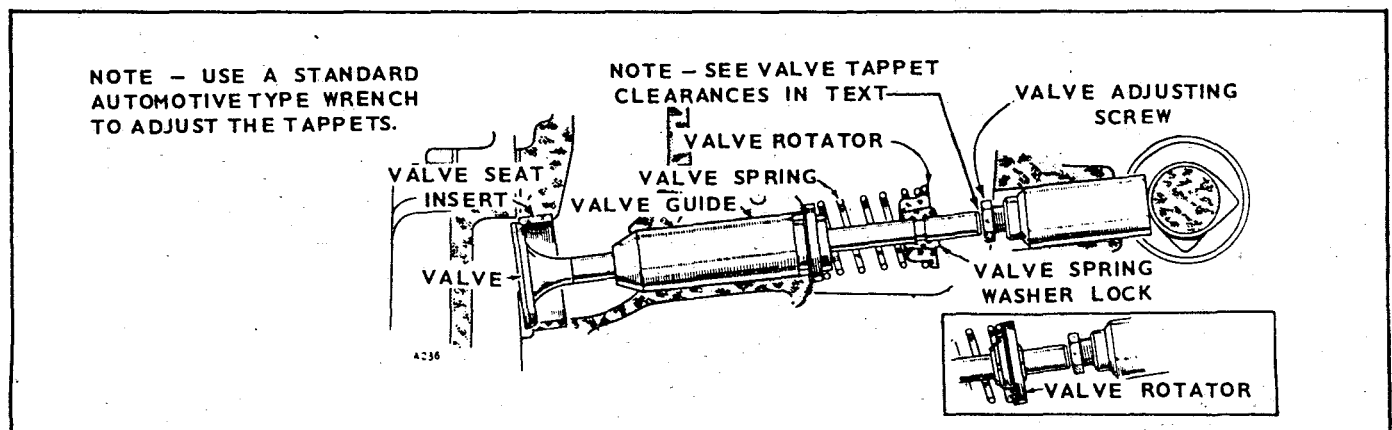


FIGURE 39. CCKB VALVE SYSTEM

marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

Lightly oil the valve stems and reassemble all parts removed. Adjust the valve clearance (see *Tappet Adjustment*).

The positive type valve rotocoils serve to prolong valve life and decrease valve repairs. Check the rotocoils periodically by removing the cylinder heads and cranking the engine. When functioning properly, the valve is rotated a fraction of a turn each time it opens. If rotocoils are faulty, install new ones.

TAPPET ADJUSTMENT

The engine is equipped with adjustable tappets. To make a valve adjustment, remove the valve covers. Crank the engine over slowly by hand until the left hand intake valve, when facing the flywheel, opens and closes. Continue about 1/4 turn until the correct timing marks align. This should place the left hand piston at the top of its compression stroke, the position it must be in to get proper valve adjustment for the left hand cylinder. Clearances are shown in *Dimensions and Clearances* section. For each valve, the gauge should just pass between the valve stem and valve tappet (Figure 41).

To correct the valve clearance, turn the adjusting screw as needed to obtain the right clearance. The screw is self-locking.

To adjust the valves on the right hand cylinder, crank the engine over one complete revolution and again line up the correct timing marks. Then follow the adjustment given for the valves of the left hand cylinder.

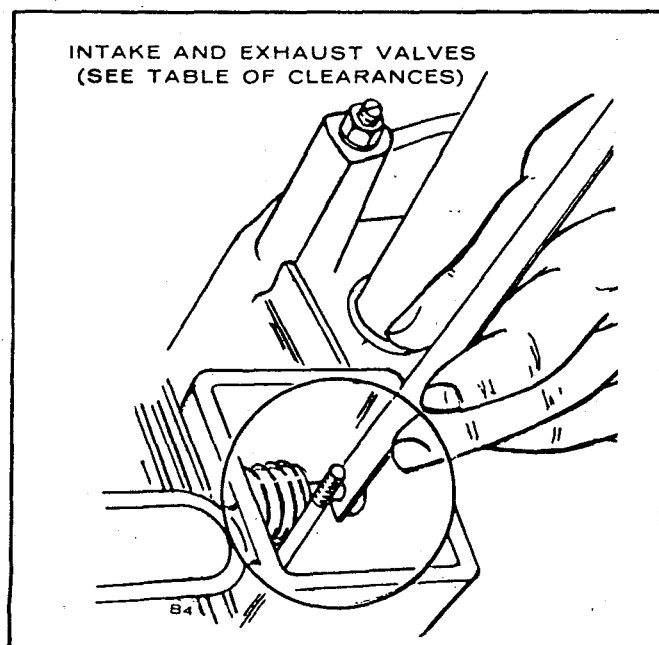


FIGURE 41. ADJUSTING TAPPETS

PISTONS AND RINGS

Whenever there is a noticeable wear ridge at the top of each cylinder, remove the ridge with a ridge reamer before removing the pistons. If ridge is not removed, the rings can catch the ridge when pushing out the pistons and cause a ring land fracture (Figure 42).

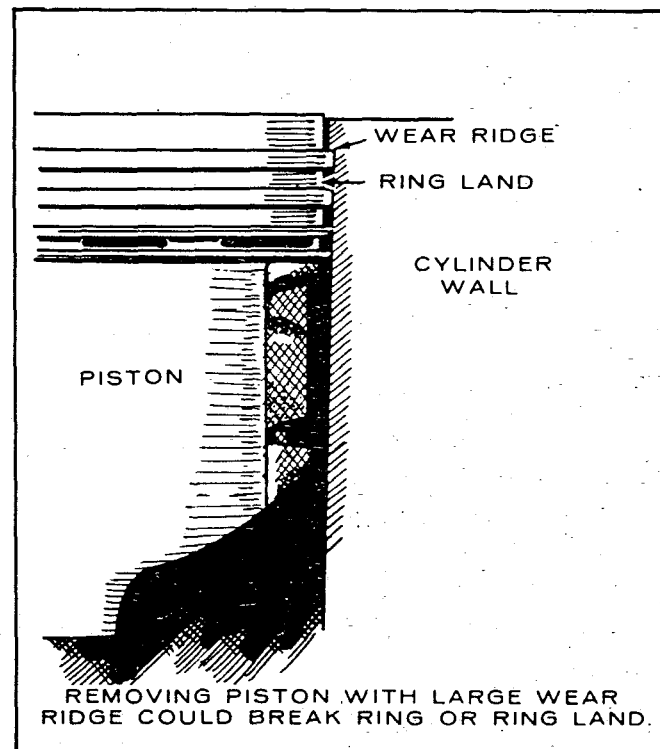


FIGURE 42. WEAR RIDGE ON CYLINDER WALL

To remove the piston and connecting rod assemblies, turn the crankshaft until a piston is at the bottom of the stroke. Remove the nuts from the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. Be careful not to scratch the crankpin or the cylinder wall when removing these parts.

NOTE: Keep the connecting rod bearing caps and bearings with their respective rods.

The pistons are fitted with two compression rings and one oil control ring with an expander. Remove these rings from the piston using a piston ring spreader.

Clean the piston ring grooves with a groove cleaner or the end of a broken ring filed to a sharp point (see Figure 43). All passages should be cleaned with a non-caustic solvent. Clean the rod bore and the back of the connecting rod bearings thoroughly.

Mark each piston to make sure the rod will be assembled on the piston from which it was removed. Remove the piston pin retainer from each side and push the pin out.

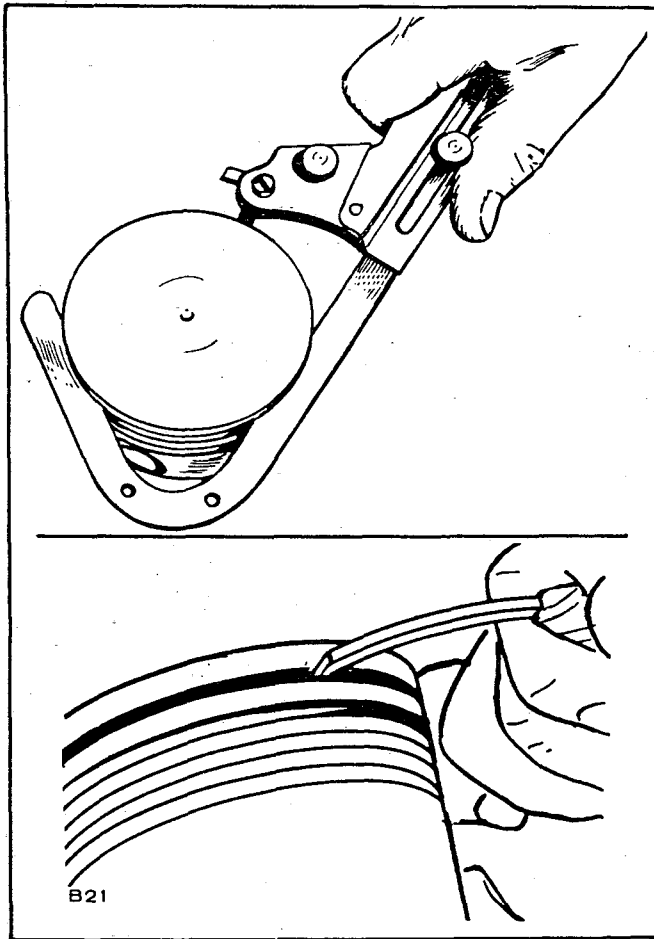


FIGURE 43. CLEANING RING GROOVES

Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring land using new rings and a feeler gauge as shown in Figure 44. See *Dimensions and Clearances* section for proper side clearance measurement and ring groove widths.

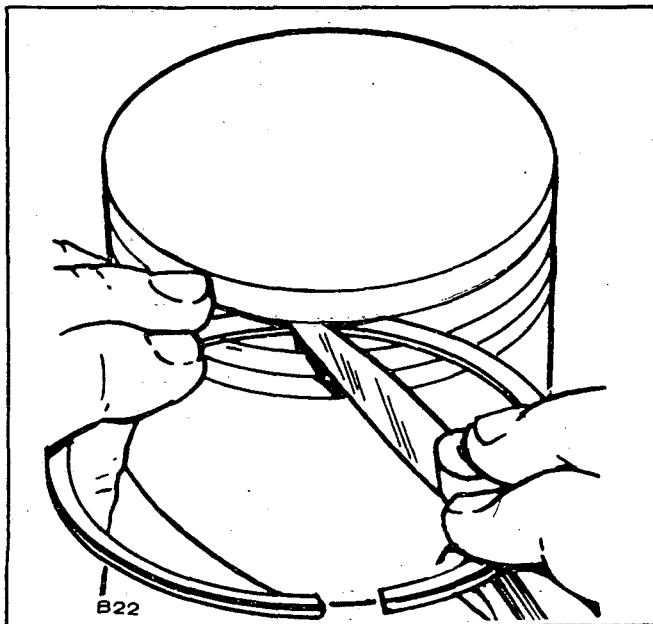


FIGURE 44. INSPECTING RING LANDS

Improper width rings or excessive ring side clearance can result in ring breakage. New rings in worn ring grooves don't have good cylinder wall contact (Figure 45).

Replace pistons showing signs of bad scoring or burring, excessive skirt clearance, wavy or worn ring lands, fractures or damage from detonation. Replace piston pins showing fractures, scored bores or bores out of round more than 0.002 inch.

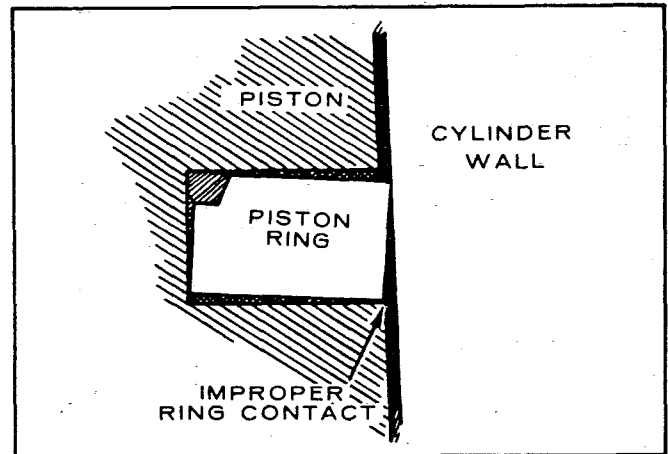


FIGURE 45. NEW RING IN WORN PISTON RING GROOVE

Use a new piston pin to check the pin bushing in the connecting rod for wear. The clearance should be as shown in *Dimensions and Clearances* section.

Before installing new rings on the piston, check the ring gap by placing each ring squarely in its cylinder at a position corresponding to the bottom of its travel (see Figure 46). The gap between the ends of the ring is given in *Dimensions and Clearances* section. Rings which are slightly oversize may be filed as necessary to obtain the correct gap, but do not use rings which require too much filing. Standard size rings may be used on .005 inch oversize pistons. Other oversize rings must be used with corresponding oversize pistons.

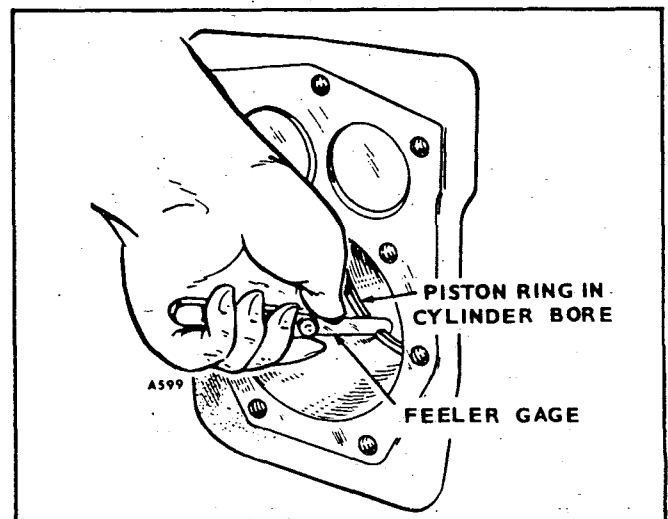


FIGURE 46. FITTING PISTON RINGS

Rings of the tapered type are usually marked *top* on one side, or identified in some other manner and the ring must be installed with this mark toward the closed end of the piston.

Space each ring gap one third of the way around the piston from the preceding one, with no gap directly in line with the piston pin. The bottom piston ring groove should be fitted with an expander and an oil control ring and the two upper grooves fitted with compression rings. If a chrome faced ring is used, it will be in the top groove. The oil control ring is selected for best performance in regard to the correct unit pressure characteristics.

The piston is fitted with a full-floating type piston pin. The pin is kept in place by two lock rings in the piston, one at each side. Be sure these lock rings are properly in place before installing the piston and connecting rod in the engine. Refer to *Dimensions and Clearances* section for the correct piston-to-cylinder clearance.

CONNECTING RODS

The connecting rods should be serviced at the same time the pistons or rods are serviced. Rods must be removed with the piston. Replaceable bushings and bearings are used. See *Parts Catalog* section for available undersize and standard size bearings.

Proper clearance is obtained by replacing the pin bushing and the bearings. The rod bearings are precision size and require no reaming.

Install the connecting rods and caps with raised lines (witness marks) aligned and with the caps facing toward the oil base. The rod and cap numbered 2 fits on the crankshaft journal nearest the bearing plate. Coat the crankshaft journal bearing surfaced with oil before installing the rods. Crank the engine by hand to see that the rods are free. If necessary, rap the connecting rod cap screws sharply with a soft-faced hammer to set the rod square on the journal.

Checking Bearing Clearance with Plastigage: Make certain that all parts are marked or identified so that they are reinstalled in their original positions.

Place a piece of correct size Plastigage in the bearing cap the full width of the bearing insert about 1/4 inch off center (Figure 47).

Rotate the crank about 30° from bottom dead center and reinstall the bearing cap. Tighten the bolts to the torque specified in the *Assembly Torques and Special Tools* section. Do not turn the crankshaft.

Remove the bearing cap. Leave the flattened Plastigage on the part to which it has adhered and compare the widest point with the graduations on the Plastigage envelope to determine bearing clearance.

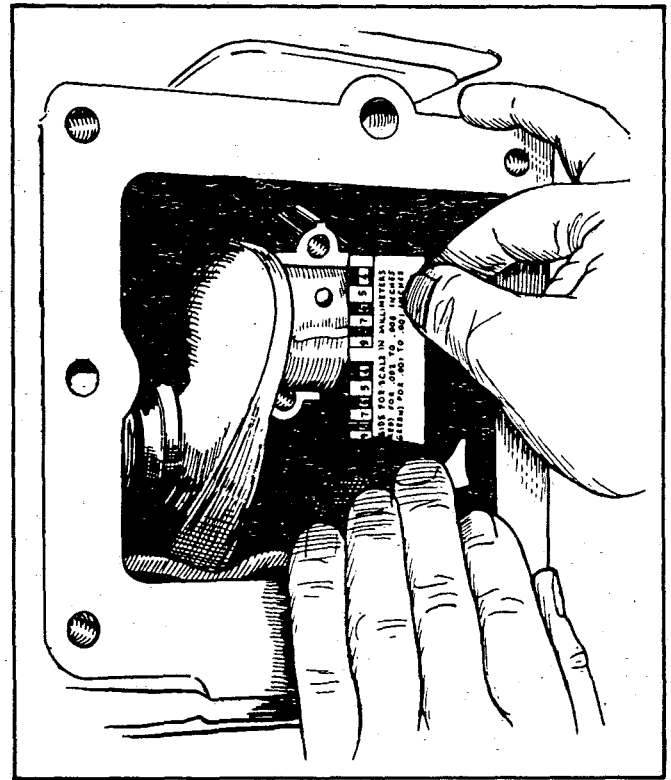


FIGURE 47. MEASURING BEARING CLEARANCE WITH PLASTIGAGE

CYLINDER BLOCK

Inspection:

1. Make a thorough check for cracks. Minute cracks may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide (white lead) dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.
2. Inspect the cylinder bore for scoring. Check the Welsh plugs for a tight, even fit and the fins for breakage.
3. Check the cylinder bore for taper, out of round and wear with a cylinder bore gauge, telescope gauge or inside micrometer (Figure 48). These measurements should be taken at four places – the top and bottom of piston ring travel.
4. Record measurements taken lengthwise at the top and bottom of the piston travel as follows:
 - a. Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where the greatest ring wear occurs.
 - b. Also, lengthwise of the block, measure and record as "B" the cylinder diameter at the piston skirt travel.
 - c. Crosswise of the block, measure and record as "C" the diameter of the top of the cylinder at the greatest point of wear.

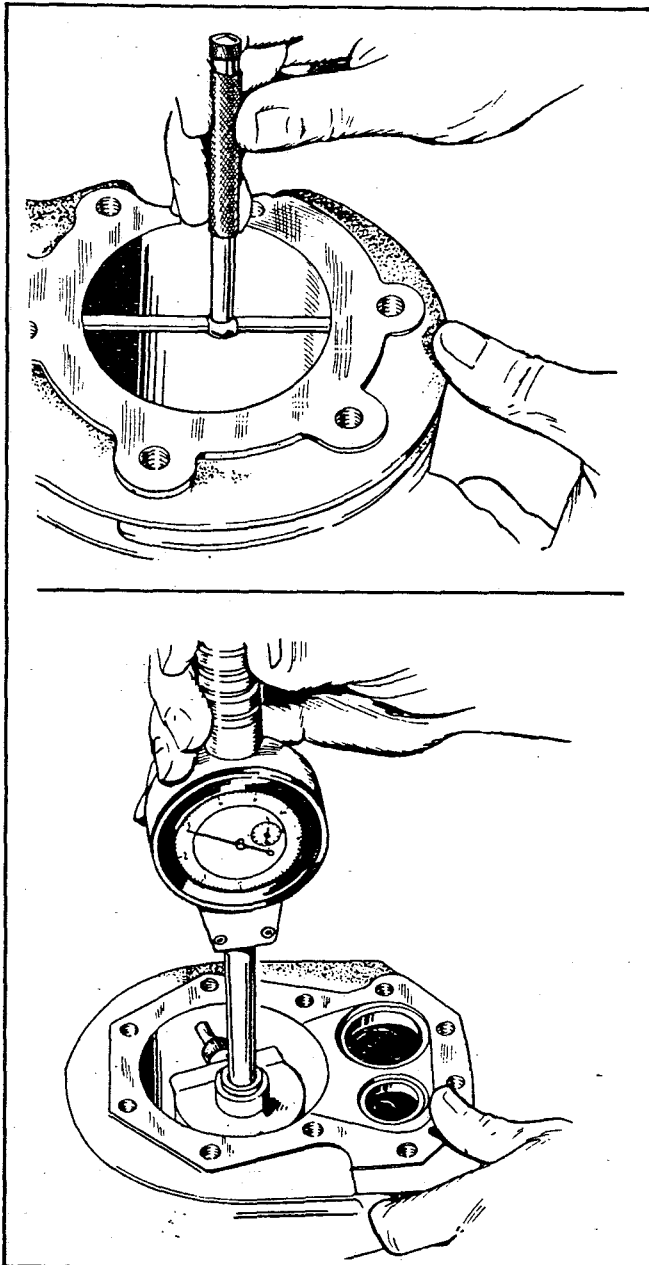


FIGURE 48. METHODS OF CYLINDER BORE INSPECTION

- d. Measure and record as "D" the diameter at the bottom of the cylinder bore and crosswise of the block.
- e. Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper.
- f. If cylinder taper exceeds 0.005 inch, rebores and hone to accommodate the next oversize piston. Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.002 inch, the cylinders must be rebores and honed for the next oversize piston. A rebores machine is used when going to oversize pistons. The following repair data covers honing to oversize by use of a hone.

Repair:

1. A hone can be used to rebores a cylinder (Figure 49). Remove stock to 0.002 inch undersize of finish bore with coarse hone (100 grit), then complete honing with finish hones (300 grit).
2. Anchor the block solidly for either vertical or horizontal honing. Use either a drill press or heavy-duty drill which operates at approximately 250 to 450 rpm.
3. Lower the hone into the cylinder until it protrudes 1/2 to 3/4 inch past the end of the cylinder. Rotate the adjusting nut until the stones come in contact with the cylinder wall at the narrowest point.
4. Turn the hone by hand. Loosen the adjusting nut until the hone can be turned.
5. Connect drill to hone and start drill. Move the hone up and down in the cylinder approximately 40 cycles per minute. Usually the bottom of the cylinder must be worked out first because it is smaller. Then when the cylinder takes a uniform diameter, move the hone up and down all the way through the bore. Follow the hone manufacturer's recommendations for wet or dry honing and oiling the hone.
6. Check the diameter of the cylinder regularly during honing. A dial bore gauge is the easiest method but a telescoping gauge can be used. Check the size at six places in the bore; measure twice at the top, middle and bottom at 90° angles.
7. When the cylinder is approximately 0.002 inch within the desired bore, change to fine stones and finish the bore. The finish should not be smooth but as shown in Figure 50. The crosshatch formed by the scratching of the stones should form an angle of 23°. This can be achieved by moving the hone up and down in the cylinder about 40 cycles per minute.
8. Clean the cylinder block thoroughly with soap, water and clean rags. A clean white rag should not be soiled on the wall after cleaning is complete. Do not use a solvent or gasoline since they wash the oil from the walls but leave the metal particles.
9. Dry the crankcase and coat it with oil.

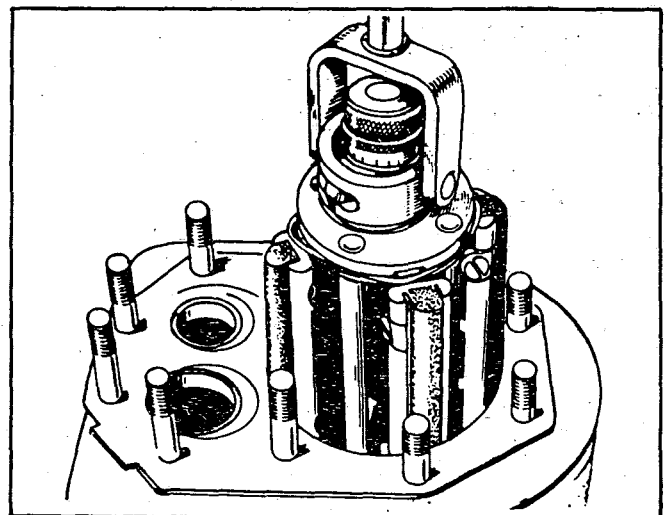


FIGURE 49. HONING CYLINDER

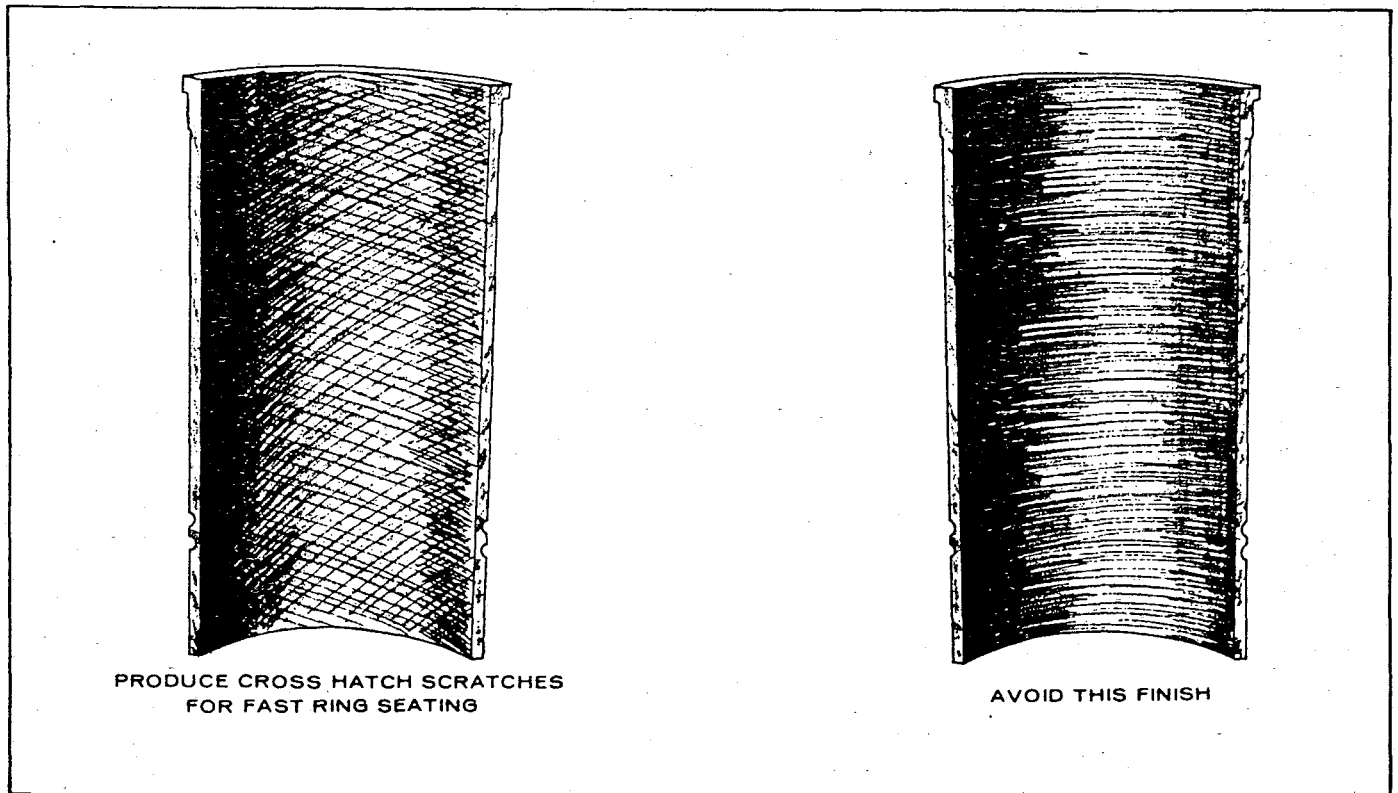


FIGURE 50. CORRECT HONE FINISH

CRANKSHAFT

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, the bearing journals should be refinished to use nearest available undersize bearings or a new crankshaft should be installed. If a worn main bearing journal cannot be fitted with an available precision type undersize bearing, then refinish it to the next undersize. If a worn rod journal cannot be fitted by installing new bearing inserts (forged rod), then refinish it to take the corresponding undersize bearing insert available.

Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

BEARINGS

Removal of the camshaft or crankshaft bearings requires complete disassembly of the engine. Use a press or a suitable drive plug to remove the bearings. Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation. Use oil on the bearings to reduce friction when installing and again lubricate with oil after installing (see Figure 51). Use combination bearing driver 420-0324 to install the camshaft bearings.

Camshaft

Replacement camshaft bearings are precision type which do not require line reaming or line boring after installation. Coat the bearing with lubricating oil to

reduce friction. Place the bearing on the crankcase over the bearing bore with the lubricating hole (front only) in proper position. Be sure to start the bearing straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in until past the ignition plunger hole.

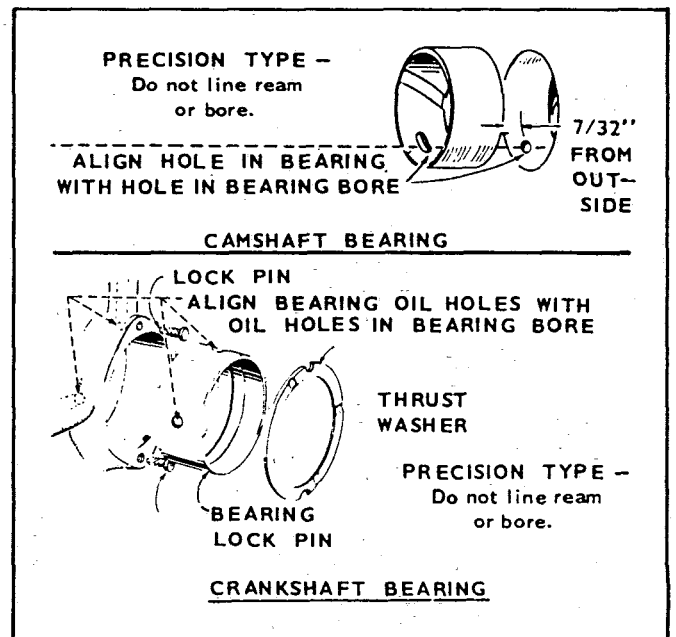


FIGURE 51. INSTALLATION OF CAM AND CRANKSHAFT BEARINGS

Crankshaft

New crankshaft main bearings are precision type which *do not* require line reaming or line boring after installation. See *Parts Catalog* section for standard size and undersizes available.

Before putting in the main bearings, expand the bearing bore by placing the casting in hot water or in an oven heated to 200°F. If practical, cool the precision bearing to shrink it.

For putting in either the front or rear main bearing, using instructions following, always align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open. The cold oiled precision bearing should require only light taps to position it. Install the bearing flush with the inside end of the bore. If the head of a lock pin is damaged, use side cutters or "Easy-Out" tool to remove pin. Then install a new lock pin. Apply oil to the thrust washers to hold in place when the crankshaft is installed. The oil grooves in the thrust washer bearings must face the crankshaft. Be sure two notches fit over lock pins.

OIL SEALS

The bearing plate must be removed to replace its oil seal. Drive the oil seal out from the inside using

bearing plate driver 420-0181 and gear cover driver 420-0313.

Before installing the seals, fill the space between seals with a fibrous grease or stiff cup grease. This will improve sealing (see Figure 52).

When installing the gear cover oil seal, tap the seal inward until rear (spring side) of casing is 1 inch from the mounting face of the cover. Install new style, thin open face seal, 1-7/64 inches from mounting face of cover.

When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander, or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

Engines equipped with some types of reduction gear assemblies, do not use the rear oil seal. The reduction gear assembly is oiled directly from the engine crankcase. Refer to the instructions screened on the case of the reduction gear assembly.

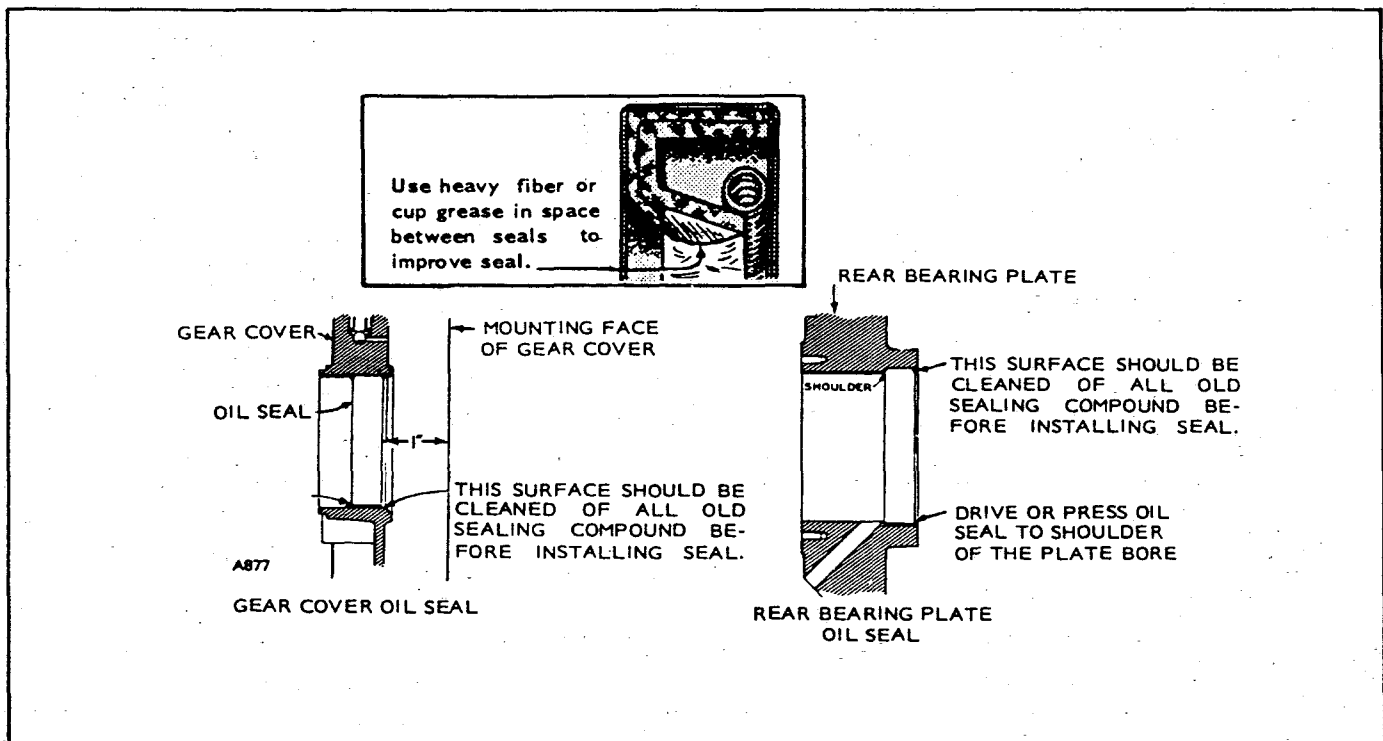


FIGURE 52. GEAR COVER AND REAR BEARING PLATE OIL SEALS

CRANKSHAFT ENDPLAY

After the rear bearing end plate has been tightened using the torque recommended in *Assembly Torques and Special Tools* section, check the crankshaft endplay as shown in Figure 53. If there is too much endplay (see *Dimensions and Clearances* section for minimum and maximum endplay), remove the rear bearing end plate and replace the gasket with a thinner gasket from the gasket kit. For too little endplay, remove the rear bearing end plate and replace the gasket with a thicker one. Reinstall the end plate making sure the thrust washer notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

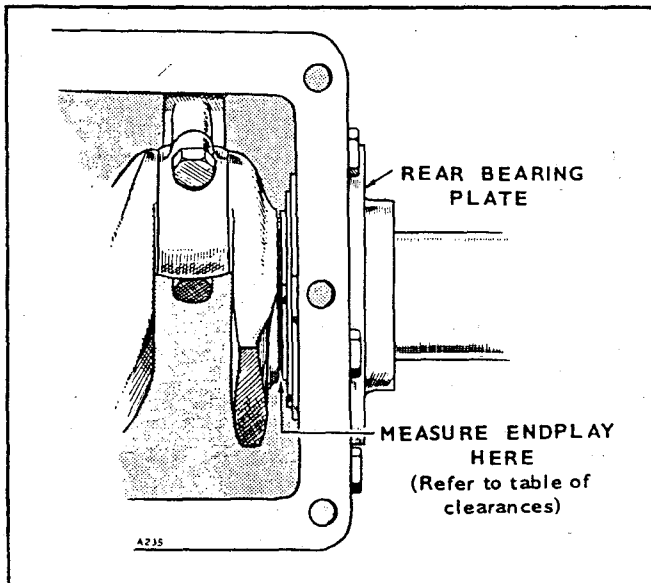


FIGURE 53. MEASURING CRANKSHAFT ENDPLAY

OIL PUMP

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling (Figure 54). Except for gaskets, the component parts of the pump are not available individually. The suction cup is available separately. Install a new pump assembly, if required.

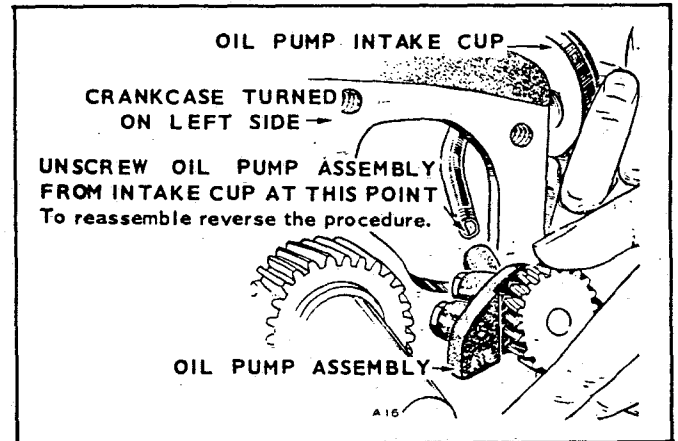


FIGURE 54. OIL PUMP

PARTS CATALOG

This catalog applies to tractor application CCKB Engines. Parts are arranged in groups of related items and are identified by a reference. Part illustrations are typical. Using the Model and Spec No. from the engine nameplate, select the Parts Key No. that applies to your engine. This Parts Key No. represents parts that differ between models. Right and left engine sides are determined by facing the blower end (front) of the engine.

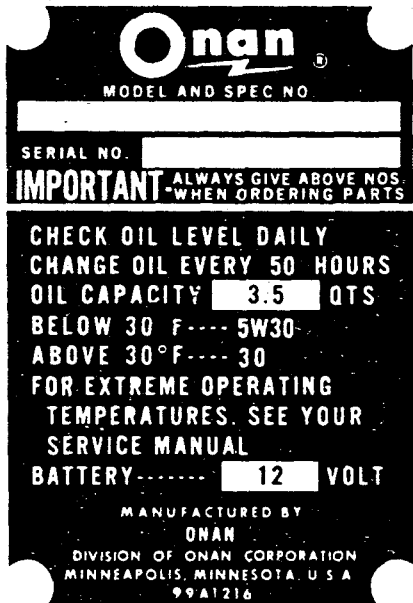
INSTRUCTIONS FOR ORDERING REPAIR PARTS

For parts or service, contact the dealer from whom you purchased this equipment or refer to your Nearest Authorized Onan Parts and Service Center.

To avoid errors or delay in filling your parts order, please furnish all information requested.

Always refer to the nameplate on your unit:

1. Always give the MODEL and SPEC NO. and SERIAL NO.



PARTS KEY TABLE

MODEL AND SPEC NO.	PARTS KEY NO.
CCKB-MS/2420 H	1
CCKB-MS/2440 H	2
CCKB-MS/2733 J	3

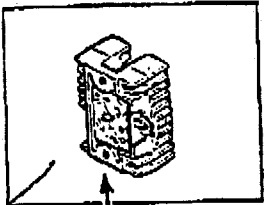
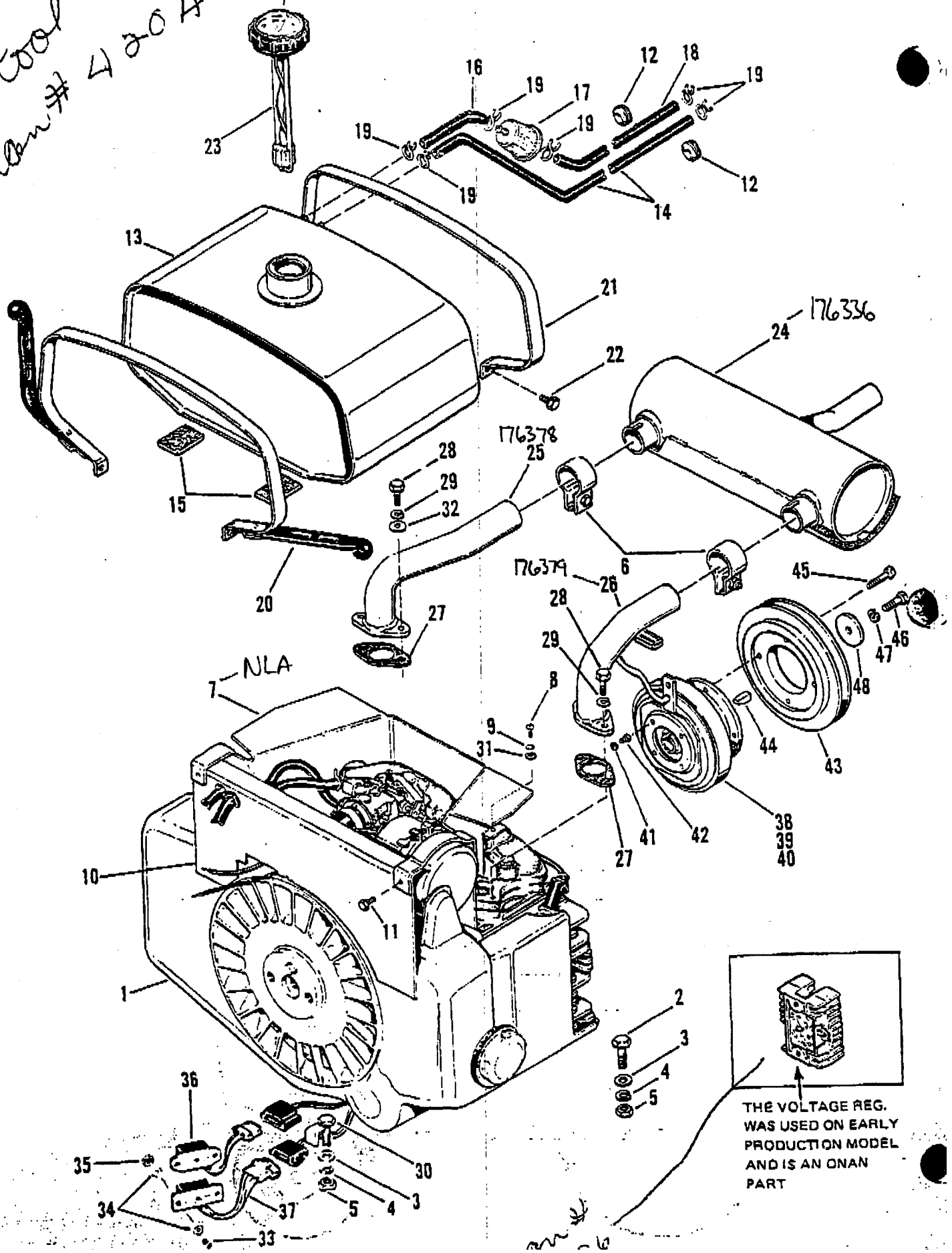
For handy reference, insert YOUR engine nameplate information in the spaces above.

2. Do not order by reference number or group number; always use part number and description.
3. Give the part number, description and quantity needed of each item. If an older part cannot be identified, return the part prepaid to your dealer or nearest AUTHORIZED SERVICE STATION. Print your name and address plainly on the package. Write a letter to the same address stating the reason for returning the part.
4. State definite shipping instructions. Any claim for loss or damage to your unit in transit should be filed promptly against the transportation company making the delivery. Shipments are complete unless the packing list indicates items are back ordered.

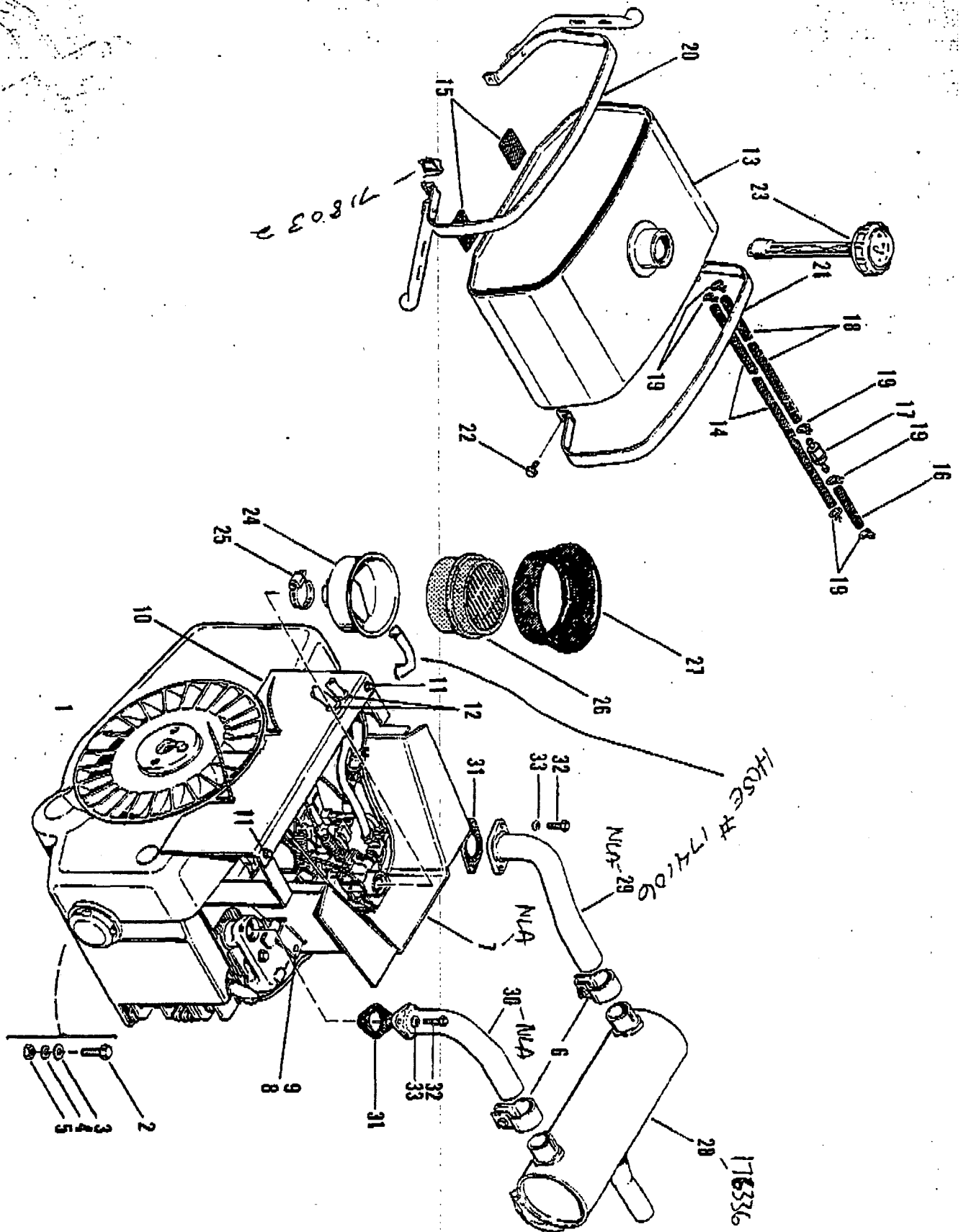
Prices are purposely omitted from this Parts Catalog due to the confusion resulting from fluctuating costs, import duties, sales taxes, exchange rates, etc.

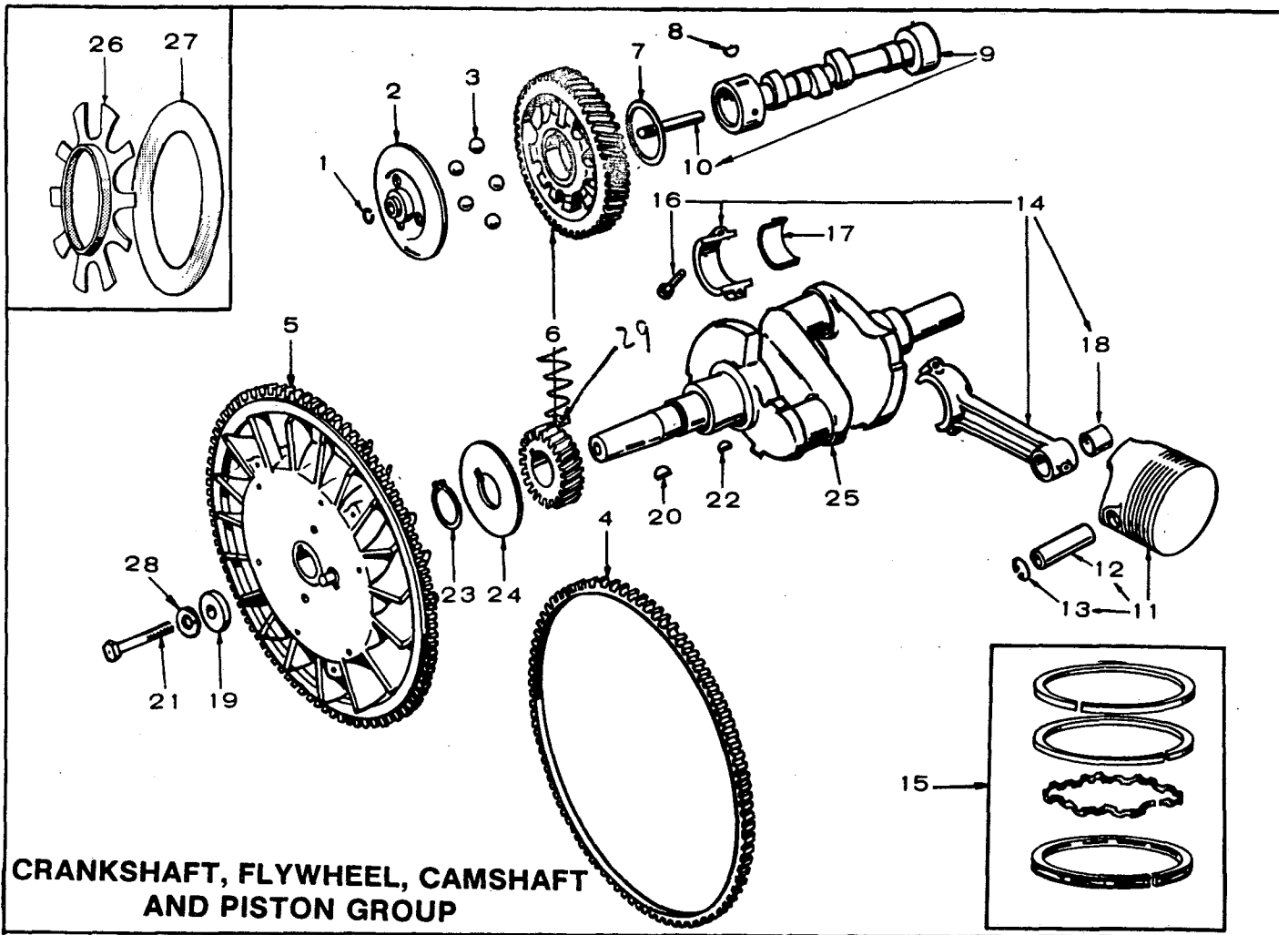
For current parts prices, consult your Onan Dealer, Distributor or Parts and Service Center.

Work tool
on # 420A 294



THE VOLTAGE REG.
 WAS USED ON EARLY
 PRODUCTION MODEL
 AND IS AN ONAN
 PART





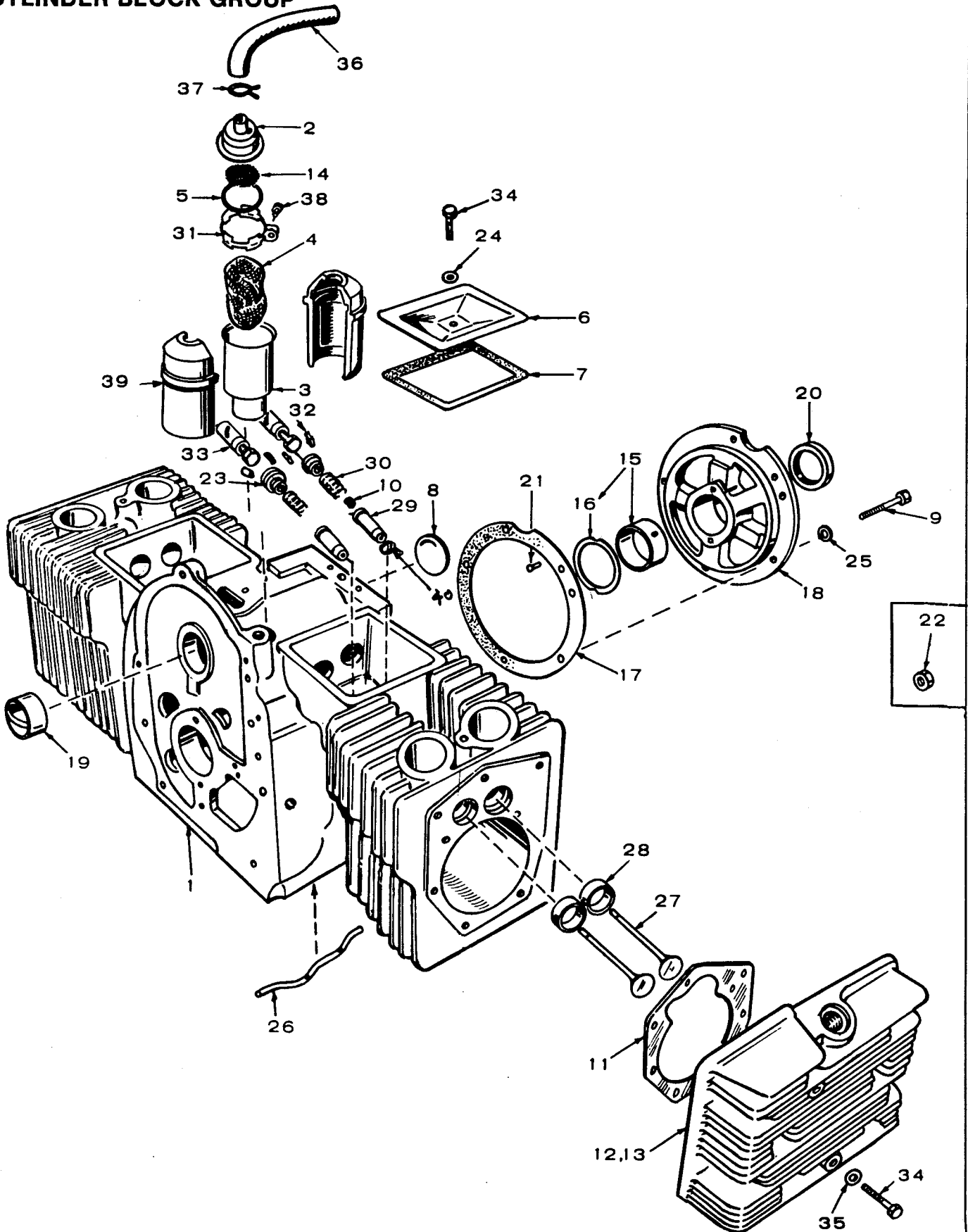
CRANKSHAFT, FLYWHEEL, CAMSHAFT AND PISTON GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	
1	150-0078	1	Ring, Camshaft Center Pin		113-0153-10	2	.010" Oversize	
2	150-0612	1	Cup, Governor		113-0153-20	2	.020" Oversize	
3	510-0015	5	Ball, Fly - Governor		113-0153-30	2	.030" Oversize	
4	134-0673	1	Gear, Ring - Flywheel		113-0153-40	2	.040" Oversize	
5	FLYWHEEL (Includes Ring Gear and Rotor)			16	805-0010	4	Bolt, Place - Connecting Rods (Special)	
	134-2621	1	Key 1 (15 Amp. Alternator)	17	BEARING, CONNECTING ROD			
	134-2642	1	Key 2 & 3 (20 Amp. Alternator)	114-0188	4	Standard		
6	105-0000-0332	1	Gear Set , Timing (Includes Camshaft and Crankshaft Gears) <i>Parts Manual +</i>	114-0188-02	4	.002" Undersize		
7	105-0004	1	Washer, Camshaft Gear Thrust	114-0188-10	4	.010" Undersize		
8	515-0001	1	Key, Camshaft Gear Mounting	114-0188-20	4	.020" Undersize		
9	105-0238	1	Camshaft (Includes Center Pin)	114-0188-30	4	.030" Undersize		
10	150-0075	1	Pin, Camshaft Center	18	114-0036	2	Bushing, Piston Pin - Connecting Rod	
11	PISTON AND PIN (Includes Retaining Rings)			19	526-0128	1	Washer, Flywheel Mounting	
	112-0136-179	2	Standard	20	KEY, FLYWHEEL MOUNTING			
	112-0136-05	2	.005" Oversize	515-0098	1	* Key 3		
	112-0136-10	2	.010" Oversize	515-0002	1	Key 1 & 2		
	112-0136-20	2	.020" Oversize	21	104-0170	1	Screw, Flywheel Mounting (Special)	
	112-0136-30	2	.030" Oversize	22	515-0001	1	* Key, Crankshaft Gear Mounting	
	112-0136-40	2	.040" Oversize	23	518-0014	1	Lock, Crankshaft Gear Washer	
12	112-0069	2	Pin, Piston	24	104-0043	1	Washer, Crankshaft Gear Retaining	
13	112-0003	4	Ring, Piston Pin Retaining	25	104-0000-132-1	1	Crankshaft (Replaces all Specs. Use with 515-0098 Key Only.)	
14	114-0203	2	Rod Assembly, Connecting (Forged) - Includes Bushing and Place Bolts	26	150-1257	1	+ Spacer, Governor Fly Ball	
15	RING SET, PISTON			27	150-0077	1	+ Plate, Governor Fly Ball	
	113-0153	2	Standard	28	850-0055	1	Washer, Lock - Flywheel Mounting	
	113-0153-05	2	.005" Oversize		29	104-0032	1	Gear, Crankshaft

ERLYSW

33 * Parts included with crankshaft.

CYLINDER BLOCK GROUP



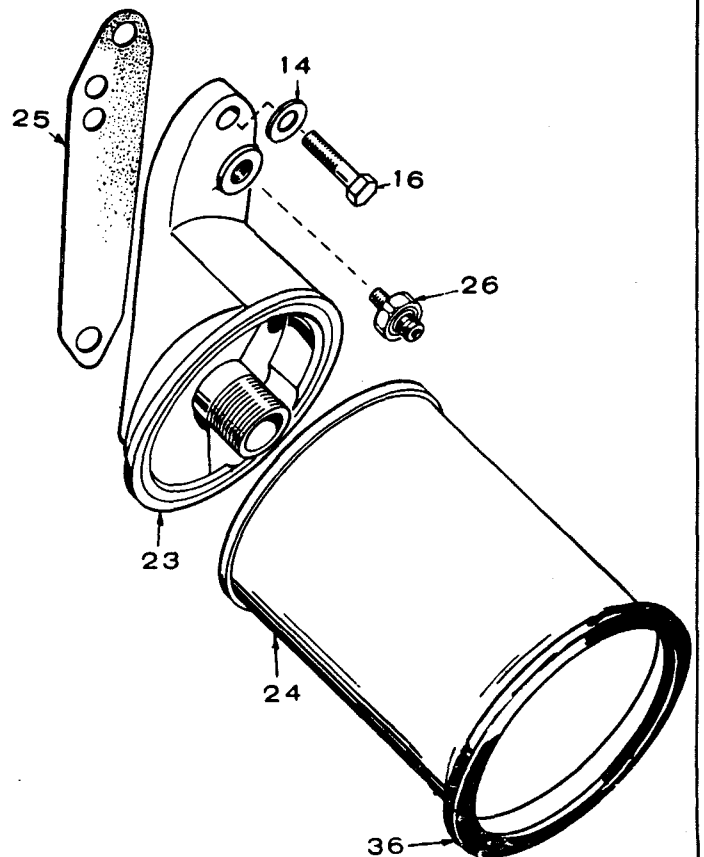
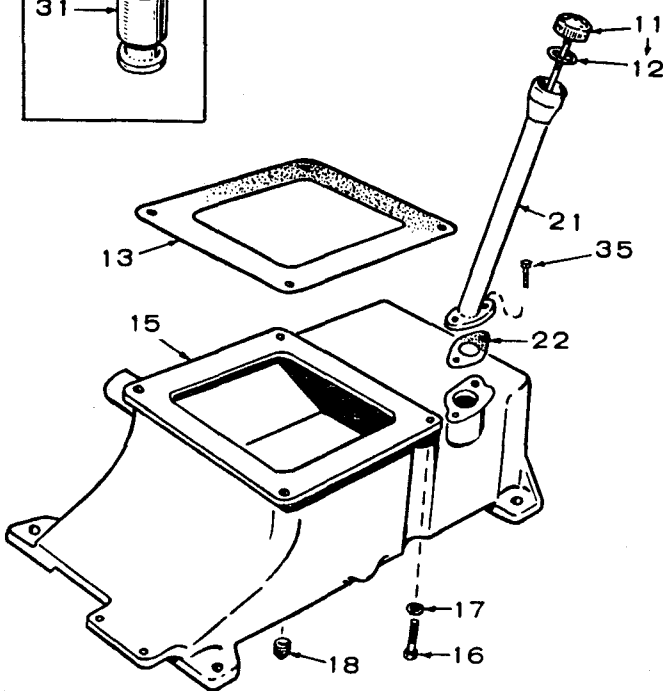
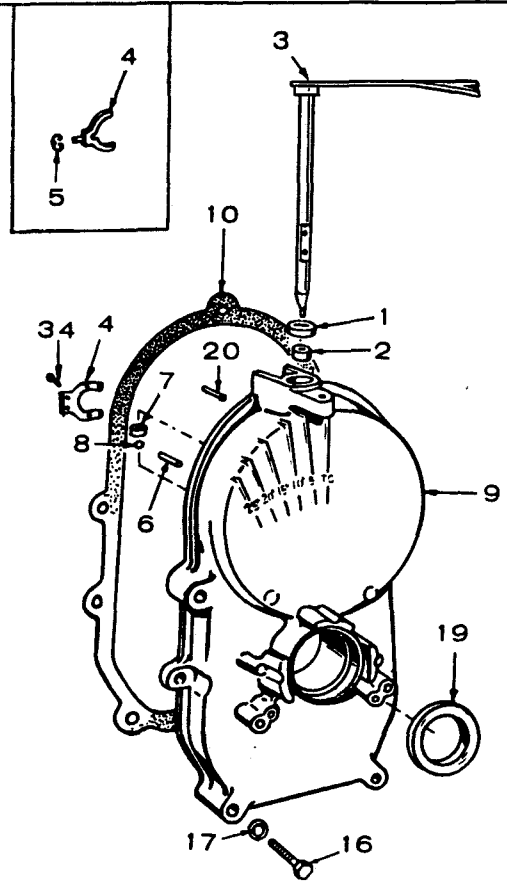
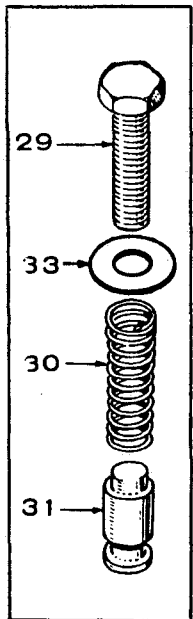
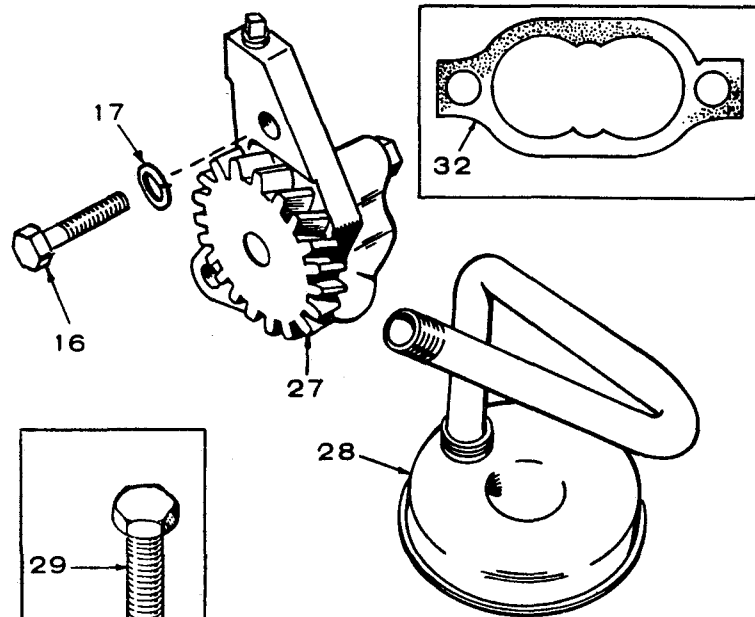
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	110-1885	1	Block Assembly, Cylinder (Includes Parts Marked *)
2	123-0954	1	Cap, Breather Tube
3	123-0953	1	Tube, Breather
4	123-0965	1	Baffle, Breather Tube
5	509-0117	1	Seal, "O" Ring - Breather Tube
6	110-0666	2	Cover, Valve Compartment
7	110-0667	2	Gasket, Valve Cover
8	517-0048	1	*Plug, Camshaft Expansion
9	800-0512	5	*Screw, Bearing Plate Mounting (5/16-18 x 1") - Replaces Stud and Nut used on early models
10	509-0090	2	Seal, Intake Valve Stem
11	110-0892	2	Gasket, Cylinder Head
12	110-0884	1	Head, Cylinder - Right (#2 Cylinder)
13	110-0883	1	Head, Cylinder - Left (#1 Cylinder)
14	123-0958	1	Screen, Breather Tube
15	BEARING, CRANKSHAFT		
	101-0450	2	*Standard
	101-0450-02	2	.002" Undersize
	101-0450-10	2	.010" Undersize
	101-0450-20	2	.020" Undersize
	101-0450-30	2	.030" Undersize
16	104-0575	2	*Washer, Crankshaft Bearing Thrust
17	101-0115	1	*Gasket Kit, Bearing Plate
18	101-0422	1	*Plate, Bearing (Excludes Bearing)
19	101-0367	2	*Bearing, Camshaft Front or Rear (Precision)
20	509-0041	1	*Seal, Bearing Plate
21	516-0072	4	*Pin, Main Bearing Stop
22	110-0445	5	Nut, Bearing Plate Stud (5/16-18) - Used on Early Models
23	110-0904	4	Rotocap, Valve
24	526-0063	2	Washer, Copper - Valve Compartment Cover

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
25	850-0045	5	*Washer, Lock - Rear Bearing Plate
26	120-0386	1	*Tube, Crankcase Oil
27	VALVE		
	110-1037	2	Intake - Chrome Cobalt Alloy
	110-0880	2	Exhaust - Chrome Cobalt Alloy
28	INSERT, VALVE SEAT - Chrome Cobalt Alloy		
	110-0872	2	*Exhaust, Standard
	110-0872-02	2	.002" Oversize
	110-0872-05	2	.005" Oversize
	110-0872-10	2	.010" Oversize
	110-0872-25	2	.025" Oversize
	110-1000	2	*Intake, Standard
	110-1000-02	2	.002" Oversize
	110-1000-05	2	.005" Oversize
	110-1000-10	2	.010" Oversize
	110-1000-25	2	.025" Oversize
29	*GUIDE, VALVE		
	110-0902	2	Exhaust
	110-1827	2	Intake
30	110-0539	4	Spring, Valve
31	123-0951	1	Clamp, Breather Cap
32	110-0639	8	Lock, Valve and Spring Retaining
33	TAPPET, VALVE		
	115-0006	4	Standard
	115-0006-05	4	.005" Oversize
34	SCREW, HEX HEAD CAP		
	110-0879	8	Cylinder Head (5/16-18 x 1-1/4")
	114-0022	10	Cylinder Head (5/16-18 x 1-3/4")
	800-0012	2	Valve Compartment Cover (1/4-20 x 2-1/4")
35	526-0122	18	Washer, Flat - Cylinder Head Screws
36	503-0582	1	Hose, Breather
37	503-0170	2	Clamp, Breather Hose
38	809-0035	1	Screw, Breather Clamp
39	123-0998	2	Insulator Half, Breather Tube

* - Included in Cylinder Block Assembly.

40 110-3136

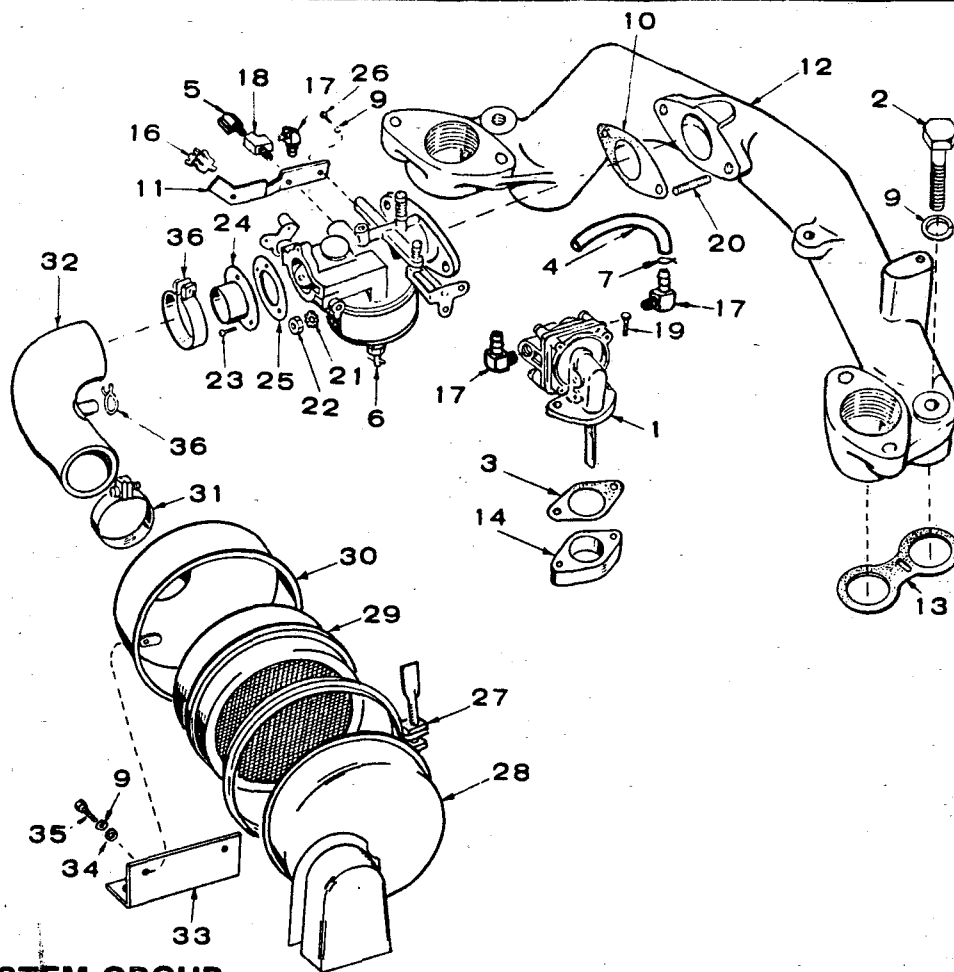
**GEAR COVER, OIL BASE
AND OIL PUMP GROUP**



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	509-0008	1	*Seal, Oil - Governor Shaft
2	510-0013	1	*Bearing, Governor Shaft - Upper
3	ARM AND SHAFT ASSEMBLY, GOVERNOR		
	150-1422	1	*Key 3
	150-1008	1	Key 1 & 2
4	YOKE, GOVERNOR SHAFT		
	150-1187	1	*Key 3
	150-0620	1	Key 1 & 2
5	518-0129	1	Ring, Yoke Retaining - Key 1 & 2
6	516-0130	1	*Pin, Governor - Cup Stop
7	BEARING, GOVERNOR SHAFT - LOWER		
	510-0013	1	*Key 3
	510-0008	1	Key 1 & 2
8	510-0014	1	*Ball, Bearing - Governor Shaft
9	COVER ASSEMBLY, GEAR		
	103-0333	1	Key 1 & 2
	103-0480	1	Key 3 - Complete Assembly Replaces All Specs (Includes Parts Marked *)
10	103-0011	1	Gasket, Gear Cover
11	123-0694	1	Cap and Indicator, Oil Fill
12	123-0191	1	Gasket, Oil Fill Cap
13	102-0158	1	Gasket, Oil Base Mounting
14	526-0065	2	Washer, Copper - Oil Filter Adapter Mounting
15	BASE, OIL		
	102-0770	1	Key 3
	102-0740	1	Key 1 & 2
16	SCREW, HEX CAP		
	102-0455	4	Oil Base to Block (3/8-16 x 1-1/4")
	800-0028	2	Oil Filter Adapter Mounting (5/16-18 x 1")
	114-0022	4	Gear Cover Mounting (5/16-18 x 1-3/4")
	800-0034	1	Gear Cover Mounting (5/16-18 x 2-1/4")
	800-0007	2	Oil Pump Mounting (1/4-20 x 1")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
17	WASHER, LOCK		
	850-0050	4	Oil Base Mounting (3/8")
	850-0045	5	Gear Cover Mounting (5/16")
	850-0040	2	Oil Pump Mounting (1/4")
18	505-0110	1	Plug (3/8"), Oil Drain
19	509-0040	1	*Seal, Gear Cover
20	516-0141	2	Pin (5/16 x 1-1/8") - Gear Cover
21	123-1149	1	Tube, Oil Fill
22	141-0078	1	Gasket, Oil Fill Tube Mounting
23	122-0320	1	Adapter, Oil Fill
24	122-0323	1	Filter, Oil (Spin-on)
25	122-0321	1	Gasket, Oil Filter Adapter
26	309-0237	1	Switch, Oil Light
27	120-0491	1	Pump, Oil Complete (NOTE: Internal parts not sold separately)
28	120-0648	1	Intake, Oil Pump (Includes Cup, Screen and Pipe)
29	801-0048	1	Screw (3/8-24 x 3/4") - Oil By-Pass
30	120-0140	1	Spring, Oil By-Pass Valve
31	120-0398	1	Valve, Oil By-Pass
32	120-0161	1	Gasket Kit, Oil Pump
33	526-0066	1	Washer, Oil Pressure Relief Valve
34	815-0046	2	*Screw (8-32 x 3/8"), Pan Head
35	821-0018	2	Screw (1/4-20 x 5/8"), Self Locking - Oil Fill Tube Mounting
36	122-0347	1	Gasket, Oil Filter

* - Included in Gear Cover Assembly.



FUEL SYSTEM GROUP

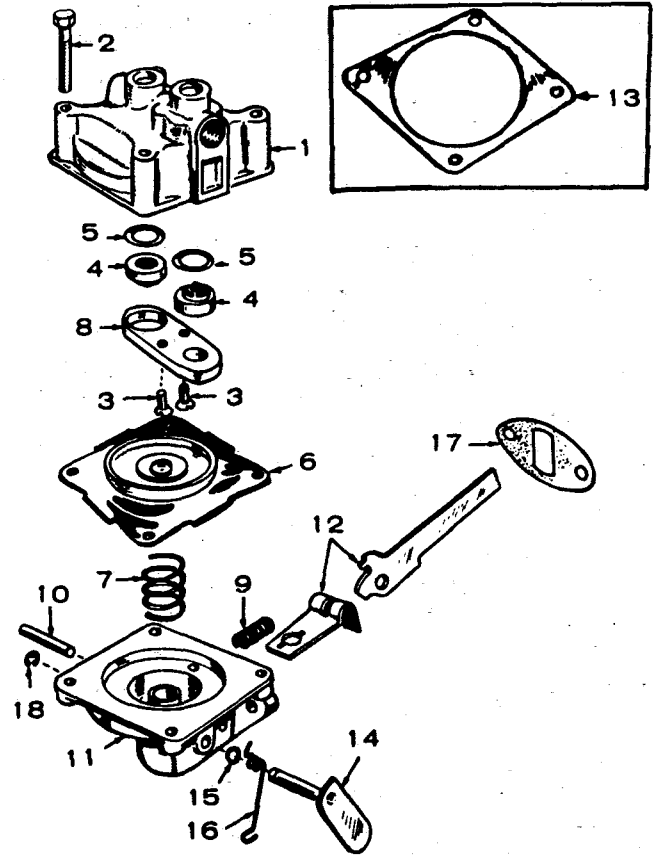
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	149-1318	1	* Pump, Fuel	20	520-0526	2	Stud, Carburetor Mounting
2	800-0054	2	Screw (3/8-16 x 2") - Intake Manifold Mounting	21	854-0017	2	Washer (5/16"), Shakeproof I.T. - Carburetor Mounting
3	149-0003	2	Gasket, Fuel Pump Mounting	22	868-0002	2	Nut (5/16-24), Jam - Carburetor Mounting
4	503-0669	1	Line, Fuel Pump to Carburetor	23	815-0199	3	Screw (10-32 x 5/16"), Fillister Head - Air Inlet Mounting
5	502-0388	1	Elbow, Carburetor Inlet (Restricted)	24	145-0398	1	Adapter, Air Inlet
6	141-0689	1	* Carburetor	25	140-0921	1	Gasket, Air Inlet
7	503-0301	2	Clamp, Rubber Hose	26	813-0097	2	Screw (10-32 x 5/16") - Choke Bracket Mounting
9	WASHER, LOCK			27	140-1073	1	Clamp Assembly - Air Cleaner
	850-0030	3	Air Inlet Mounting (#10)	28	140-1094	1	Cover, Air Cleaner Inlet
	850-0050	2	Intake Manifold Mounting (3/8")	29	140-1071	1	Element, Air Cleaner
	850-0030	2	Air Cleaner Bracket Mounting (#10)	30	140-1135	1	Cover, Air Cleaner Outlet
10	141-0281	1	Gasket, Carburetor Mounting	31	503-0311	1	Clamp (2"), Air Inlet
11	153-0453	1	Bracket, Choke	32	140-1075	1	Inlet, Air
12	154-0951	1	Manifold, Intake	33	140-1133	1	Bracket, Air Cleaner
13	154-0013	2	Gasket, Intake Manifold	34	526-0234	2	Washer, Flat - Air Cleaner Bracket Mounting
14	149-0045	1	Spacer, Fuel Pump Mounting	35	815-0178	2	Screw (10-32 x 5/8") - Air Cleaner Bracket Mounting
16	518-0176	2	Clip, Throttle Cable	36	503-0004	1	Clamp (1-7/8"), Air Inlet Hose
17	502-0313	3	Elbow, Street (2) Fuel Pump (1) Carburetor				
18	502-0058	1	Tee, Carburetor Inlet				
19	806-0009	2	Screw (1/4-20 x 1-1/4") - Fuel Pump Mounting				

* - For Components, see separate group.

FUEL PUMP PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149-1318	1	Pump, Fuel (Complete)
	149-0526	1	Repair Kit (Includes Parts Marked *)
1		1	Body (Not Sold Separately)
2	815-0148	4	Screw (#8-32 x 7/8"), Machine
3	815-0147	2	Screw (#6-32 x 5/8"), Phillips - Retainer
4	149-0096	2	*Valve and Cage
5	149-0095	2	*Gasket, Valve
6	149-0582	1	*Diaphragm Assembly
7	149-0672	1	*Spring
8	140-0539	1	Retainer, Valve Cage
9	149-0675	1	*Spring
10	516-0113	1	Pin, Rocker Arm
11		1	Body (Not Sold Separately)
12	149-0710	1	Link and Arm, Rocker (Sold only as a set)
13	149-0858	1	*Gasket, Diaphragm - Lower Side
14	149-1042	1	ΔLever, Primer
15	509-0065	2	ΔSeal, "O" Ring
16	149-1044	1	ΔSpring, Primer Lever
17	149-0003	1	*Gasket, Pump Mounting
18	518-0129	1	ΔRing, Retainer - Primer Lever

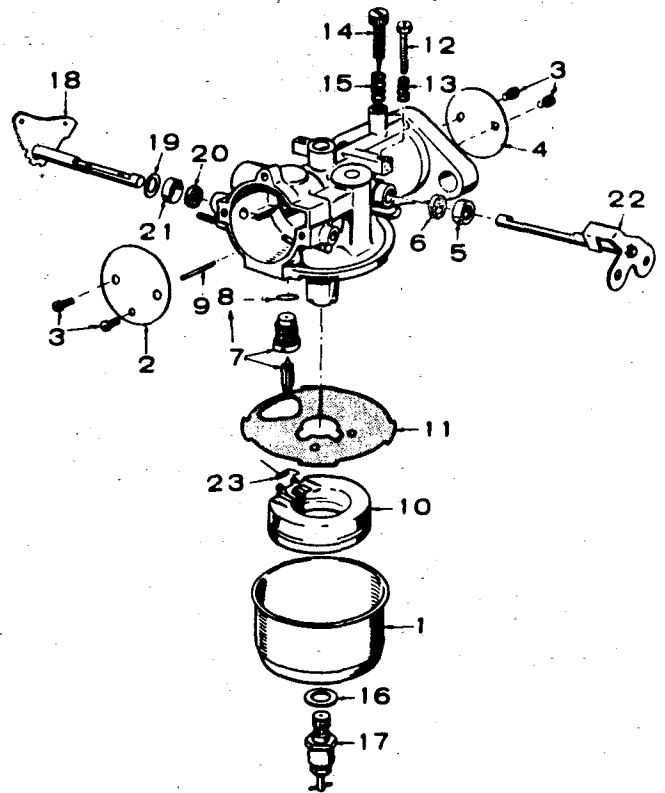
* - Parts Included in Repair Kit.
 Δ - Not used Key 3.



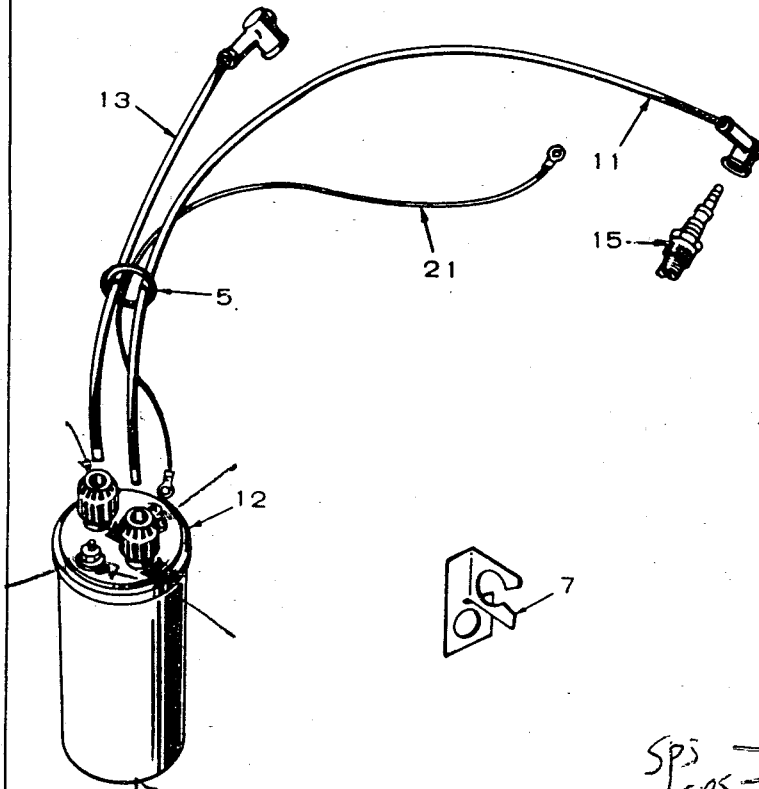
CARBURETOR PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	141-0689	1	Carburetor, Gasoline
	141-0747	1	Repair Kit (Includes Parts Marked *)
	141-0748	1	Gasket Kit (Includes Parts Marked £)
	141-0281	1	£*Gasket, Carburetor Flange
1	141-0708	1	Bowl, Fuel
2	141-0741	1	Plate, Choke
3	141-0698	4	Screw and Washer - Choke and Throttle Plate Mounting
4	141-0706	1	Plate, Throttle
5	141-0705	1	*Retainer, Seal
6	141-0661	1	£*Seal, Rubber
7	141-0830	1	*Valve Seat Assembly, Fuel
8	141-0696	1	Washer, Fuel Valve Seat
9	141-0703	1	*Shaft, Float
10	141-0702	1	Float Assembly
11	141-0701	1	£*Gasket, Bowl to Body
12	141-0700	1	Screw, Throttle Stop
13	141-0711	1	Spring, Throttle Stop
14	141-0713	1	Needle, Idle Adjusting
15	141-0710	1	Spring, Idle Needle
16	141-0077	1	£*Washer, Main Jet Assembly
17	141-0712	1	Jet Assembly, Main
18	141-0742	1	Shaft and Lever, Choke
19	141-0699	1	Washer
20	141-0697	1	£*Seal, Felt
21	141-0203	1	*Retainer, Felt Seal
22	141-0709	1	Shaft and Lever, Throttle
23	141-0799	1	*Spring, Float

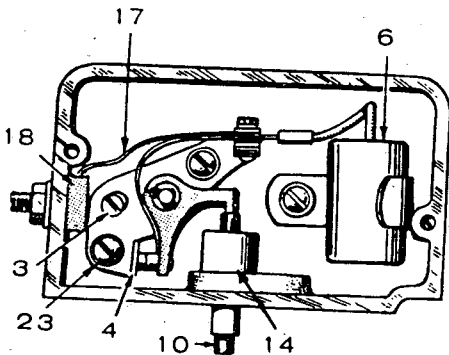
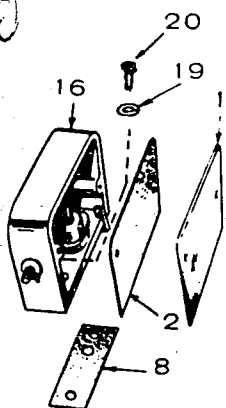
* - Parts contained in Repair Kit.
 £ - Parts contained in Gasket Kit.



IGNITION GROUP



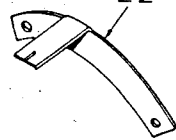
REVISE DRAWING



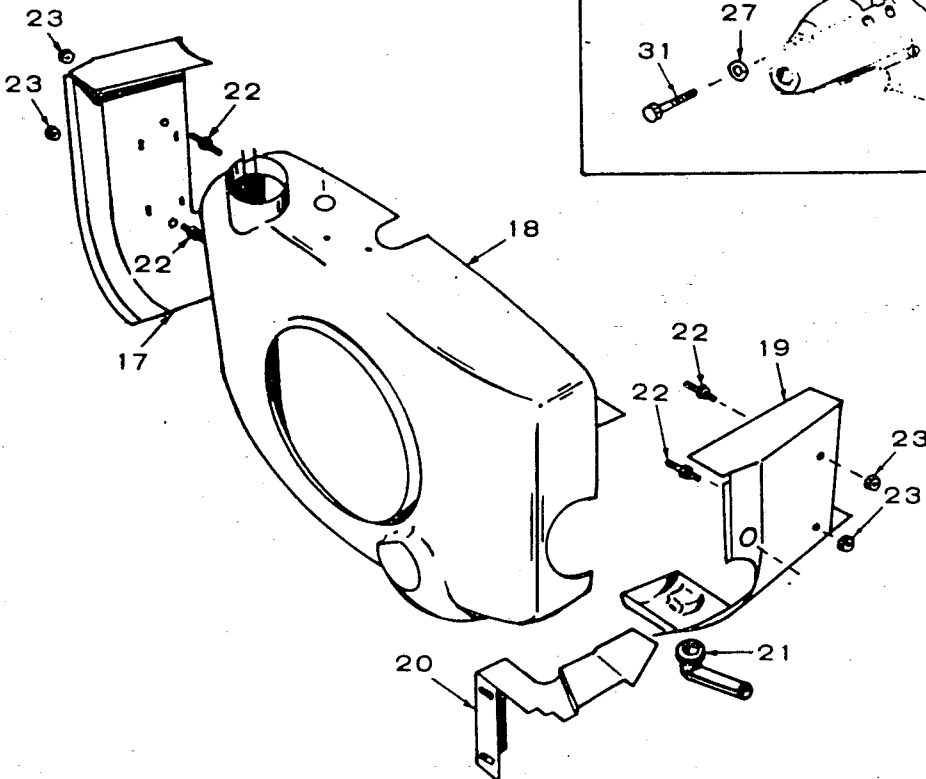
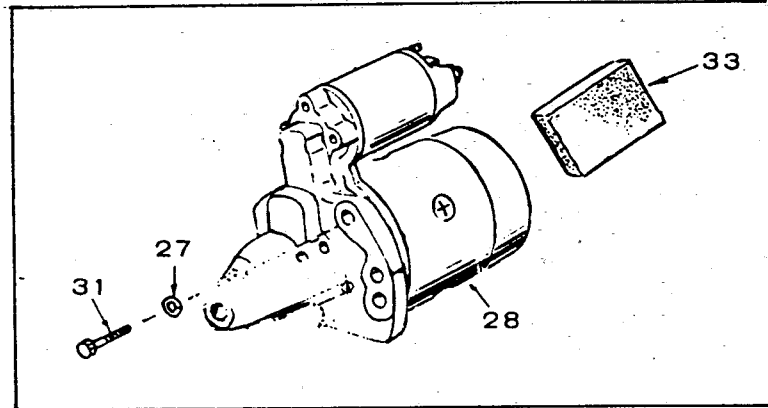
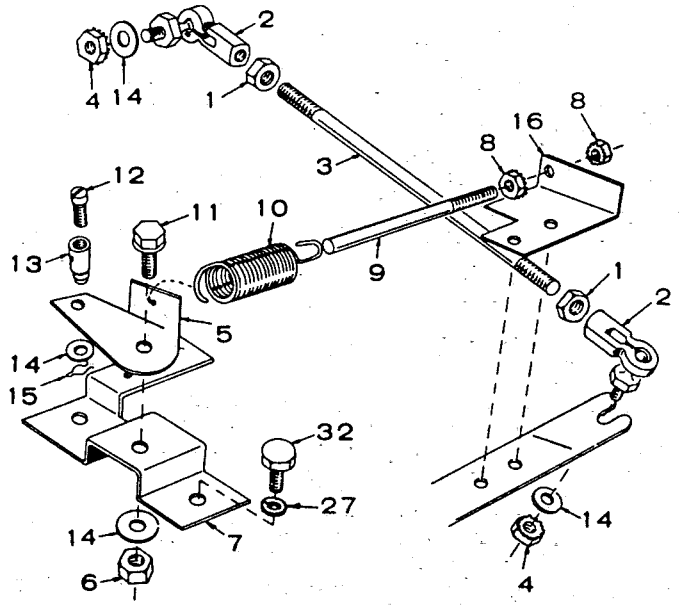
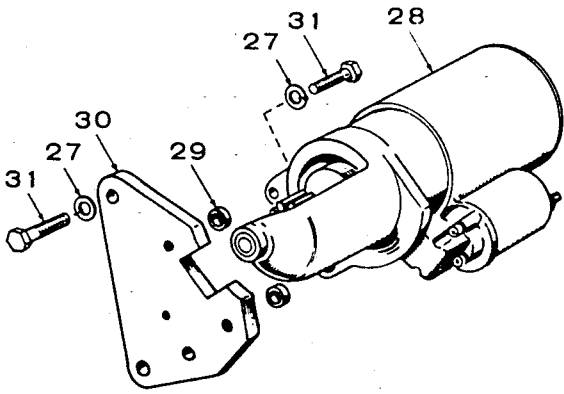
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	160-0930	1	*Cover, Breaker Box
2	160-0150	1	*Gasket, Breaker Box Cover
3	160-0075	1	*Cam, Point Gap Adjusting
4	160-0002	1 #	*Point Set, Breaker
5	509-0035	1	*"O" Ring - Spark Plug Cables
6	312-0069	1 #	*Condenser, Breaker Points
7	167-0188	1	Clip, Spark Plug Cables
8	160-0043	1	Gasket, Breaker Box Mounting
10	160-0265	1	*Plunger

11	167-1464	1	Cable (23-1/2"), Spark Plug - Right Side
SPS → 12	166-0595	1	Coil, Ignition (Include YMT)
SPS → 13	167-1483	1	Cable (19"), Spark Plug - Left Side
14	160-0264	1	*Guide, Plunger
15	167-0241	2	Plug, Spark
16	160-0257	1	Box Assembly, Breaker (Includes Parts Marked *)
17	160-0428	1	*Strap, Point Set to Terminal Block
18	160-0349	1	*Block and Terminal Assembly
19	850-0040	2	*Washer (1/4"), Lock
20	802-0034	2	*Screw (1/4-20 x 3/4") - Breaker Box Mounting
21	334-0028	1	Wire, Lead
22	160-1165	1	Bracket, Timing
23	518-0049	3	*Screw (8-32 x 1/4") - Breaker Box
24	166-0554	2	+ MNT
* - Parts included in 160-0257 Breaker Box Assembly.			
25	850-0005	2	+ WASHER, Lock
26	166-0604	2	CAP
27	166-0614	2	+ Bushing
28	160-0836	1	Kit, Ignition (Include YMT) (Include parts marked #)

+ - PARTS Included with Coil.
- PARTS " IS KIT.

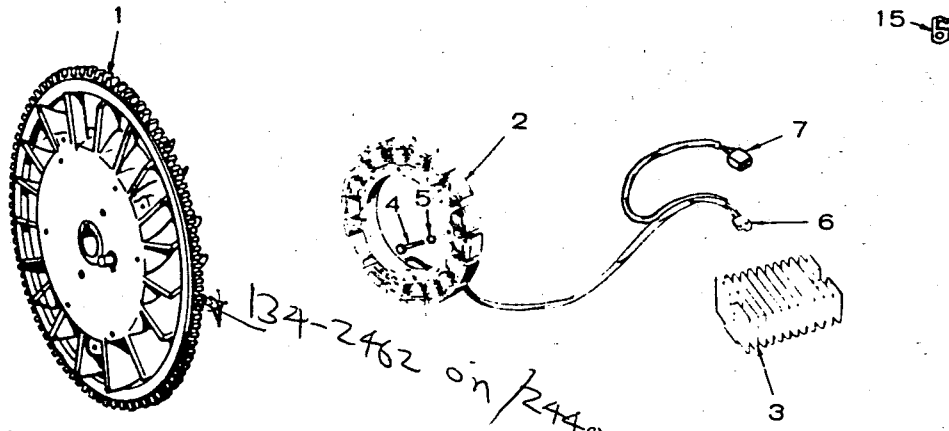
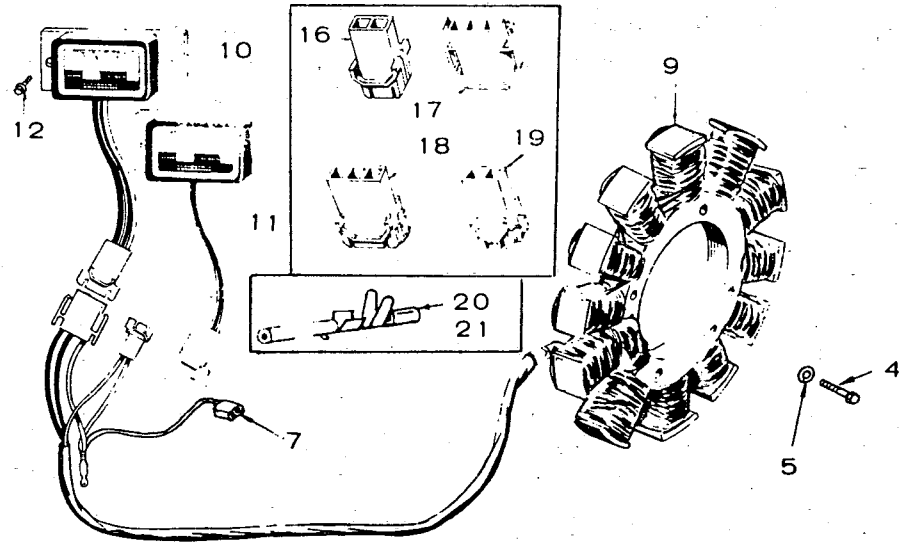


GOVERNOR, STARTER AND BLOWER HOUSING GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	870-0053	2	Nut (10-32), Lock - Governor Rod
2	JOINT, BALL 150-0639 150-0939	2 2	Key 3 Key 1 & 2
3	LINK, GOVERNOR 520-0187 520-0623	1 1	Key 3 Key 1 & 2
4	870-0131	2	Nut (10-32), Keps - Governor Ball Joint
5	150-1386	1	Arm, Governor Pivot
6	870-0065	1	Nut (5/16-18), Lock - Governor Arm Pivot
7	150-1385	1	Bracket, Throttle Control
8	870-0131	2	Nut (10-32) - Governor Control
9	150-0147	1	Stud, Governor High Speed
10	150-0098	1	Spring, Governor High Speed
11	821-0009	1	Screw (1/4-20 x 3/8"), Self Locking - Governor Control Arm
12	815-0104	1	Screw (8-32 x 5/16"), Fillester Head - Governor Control Swivel
13	152-0197	1	Swivel, Governor Control
14	WASHER, FLAT 526-0006 526-0196 526-0018	1 2 1	Governor Control Swivel (#12) Governor Linkage (#10) Governor Arm Pivot (1/4")
15	516-0059	1	Key, Hair Pin - Governor Control Swivel
16	150-1384	1	Bracket, Governor Control
17	134-0589	1	Housing, Cylinder Air - Left
18	HOUSING, BLOWER 134-2871 134-2622	1 1	Key 3 Key 1 & 2

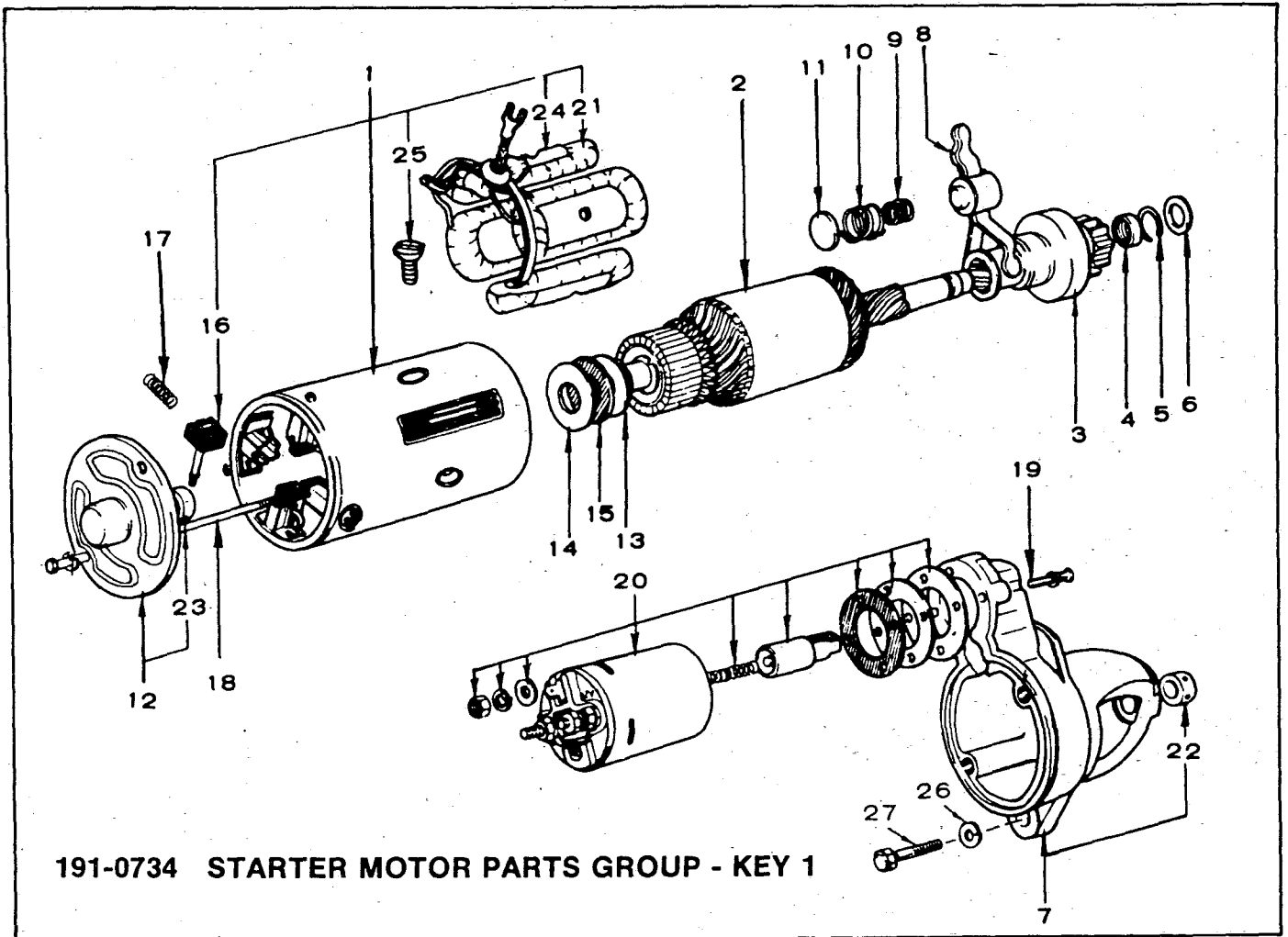
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
19	HOUSING, CYLINDER AIR - RIGHT 134-2760 134-2500 134-2094	1 1 1	Key 3 Key 2 Key 1
20	134-2131	1	Baffle, Air - Key 1 & 2
21	122-0345	1	Tube, Oil Filter Drain
22	520-0751	4	Stud, Cylinder Air Housing Mounting
23	870-0232	4	Nut (1/4-20) - Cylinder Air Housing Mounting
27	WASHER, LOCK 850-0040 850-0050	2 3	Control Bracket Mounting (1/4") Starter Motor Mounting (3/8") - Key 3
	850-0050	5	Starter Motor Mounting (3/8") - Key 1 & 2
28	MOTOR, STARTING (For Components, See Separate Groups 191-1052 191-0922 191-0734	1 1 1	Key 3 Key 2 Key 1
29	191-0864	2	Spacer, Starter Motor Mounting - Key 1 & 2
30	191-0854	1	Bracket, Starter Motor Mounting - Key 1 & 2
31	SCREW, HEX CAP 800-0051 800-0051 102-0455	3 2 3	Starter Motor Mounting (3/8-16 x 1-1/4") - Key 3 Starter Motor to Bracket (3/8-16 x 1-1/4") - Key 1 & 2 Starter Bracket Mounting (3/8-16 x 1-1/4") - Key 1 & 2
32	821-0009	2	Screw (1/4-20 x 3/8"), Self Locking - Governor Control to Blower Housing
33	191-1076	1	Seal, Starter Air - Key 3



CHARGING ALTERNATOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1		1	Flywheel and Ring Gear	11	191-0939	1	Regulator Assembly - Key 2 & 3
2	191-0932	1	Stator & Harness Assembly (15 Amp Alternator) - Key 1	12	815-0181	4	Screw (10-32 x 1/2") - Regulator and Rectifier Mounting
3	191-0886	1	Regulator - Rectifier Assembly - Key 1	15	167-0188	1	Clip, Stator Lead
4	813-0108	3	Screw (10-32 x 1-1/2"), Round Head - Stator Mounting	16	323-0879	1	Connector, Stator Leads (2 Pins) - Key 2 & 3
5	850-0030	3	Washer (#10), Lock - Stator Mounting	17	323-0882	1	Connector, Stator Leads (3 Sockets) - Key 2 & 3
6	323-0853	1	Connector	18	323-0881	1	Connector, Rectifier Leads (3 Pins) - Key 2 & 3
7	323-0851	1	Connector	19	323-0880	1	Connector, Regulator Leads (2 Sockets) - Key 2 & 3
9	191-1016	1	Stator & Harness Assembly (20 Amp Alternator) - Key 2 & 3	20	323-0496	5	Pin, Connector - Key 2 & 3
10	191-0938	1	Rectifier Assembly - Key 2 & 3	21	323-0488	5	Socket, Connector - Key 2 & 3

* - See Crankshaft and Flywheel Group for part number.

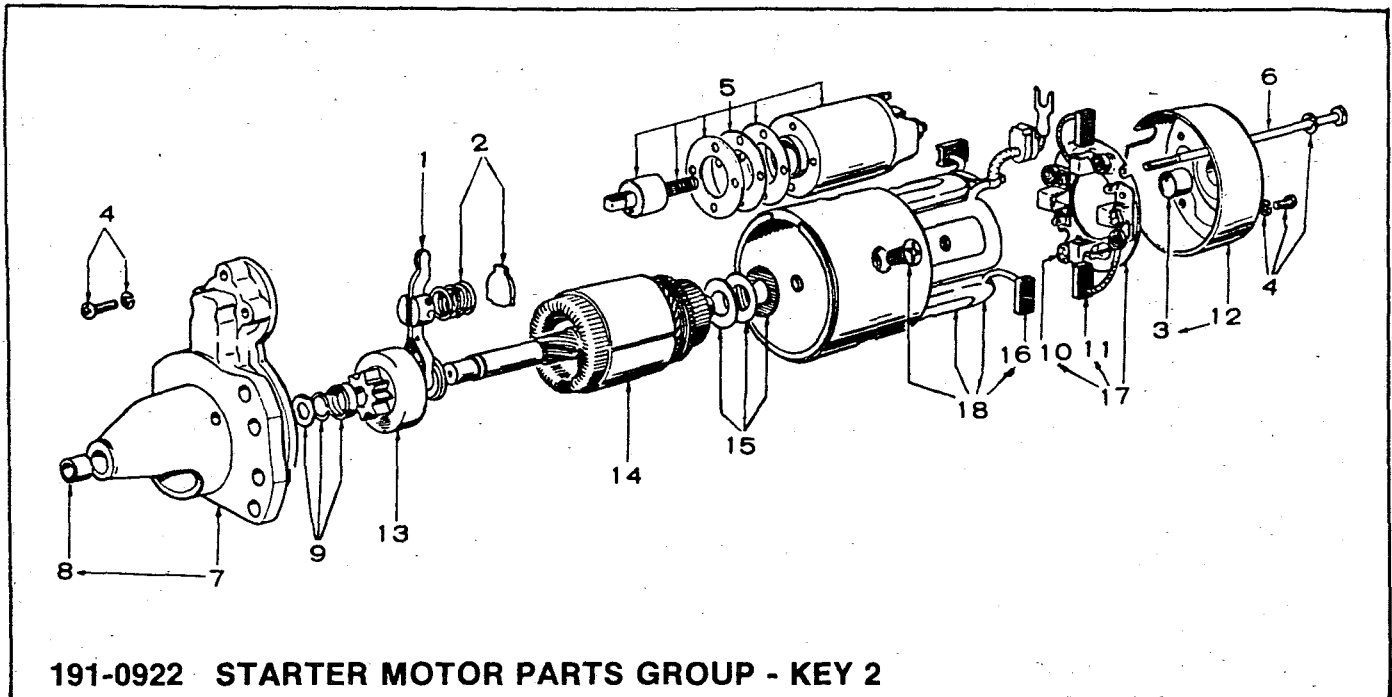


191-0734 STARTER MOTOR PARTS GROUP - KEY 1

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0734	1	Motor Assembly, Starting
1	191-0742	1	Yoke Assembly (Frame) - Includes Parts Marked *
2	191-0743	1	Armature
3	191-0744	1	Clutch, Starter
4	191-0745	1	Stop, Pinion
5	191-0746	1	Ring
6	191-0747	1	Washer, Plain
7	191-0748	1	Bracket Assembly, Front
8	191-0749	1	Lever Assembly
9	191-0750	1	Spring, Lever (A)
10	191-0751	1	Spring, Lever (B)
11	191-0752	1	Holder, Spring
12	191-0753	1	Bracket Assembly, Rear
13	191-0754	1	Washer, Plain
14	191-0755	1	Washer, Plain
15	191-0756	1	Washer, Insulator

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
16	191-0757	4	*Brush
17	191-0758	4	Spring, Brush
18	191-0759	2	Bolt, Through
19	191-0760	3	Screw, Machine P.H.
20	191-0761	1	Switch Assembly, Solenoid
21	191-0762	1	*Coil Assembly, Field
22	191-0763	1	Bearing, Front
23	191-0764	1	Bearing, Rear
24	191-0765	4	*Pole Shoe
25	191-0766	4	*Screw, Pan Head
26	850-0050	2	Washer, Lock - Starter Motor Mounting
27	800-0051	2	Screw, Hex Cap - Starter Motor Mounting

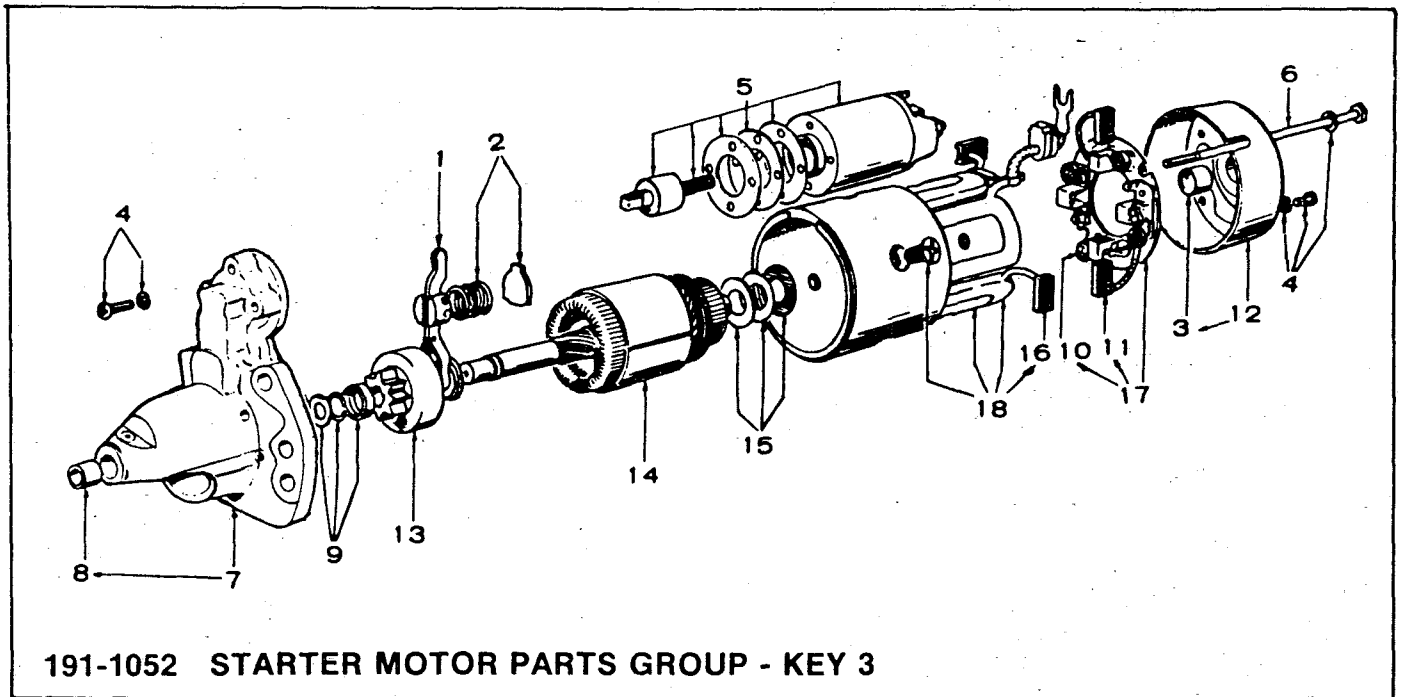
* - Included in Yoke Assembly.



191-0922 STARTER MOTOR PARTS GROUP - KEY 2

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0922	1	Motor, Starting - Complete
1	191-0983	1	Lever Assembly
2	191-0984	1	Spring Set
3	191-1010	1	Bearing, Rear Bracket Assembly
4	191-1011	1	Screw Set
5	191-0987	1	Switch Assembly
6	191-0988	2	Bolt, Through
7	191-0989	1	Bracket Assembly, Front (Includes Bearing)
8	191-0990	1	Bearing, Front Bracket
9	191-0991	1	Stopper Set, Pinion
10	191-1007	4	£Spring, Brush
11	191-1008	2	£Brush, Negative
12	191-1009	1	Bracket Assembly, Rear (Includes Bearing)
13	191-0995	1	Clutch Assembly
14	191-0996	1	Armature
15	191-0997	1	Washer Set
16	191-1005	2	Brush, Positive
17	191-1006	1	Holder Assembly, Brush (Includes Parts Marked £)
18	191-1001	1	Field Coil Set (Includes Positive Brush)

£ - Parts included in 191-1006 Brush Holder Assembly.



191-1052 STARTER MOTOR PARTS GROUP - KEY 3

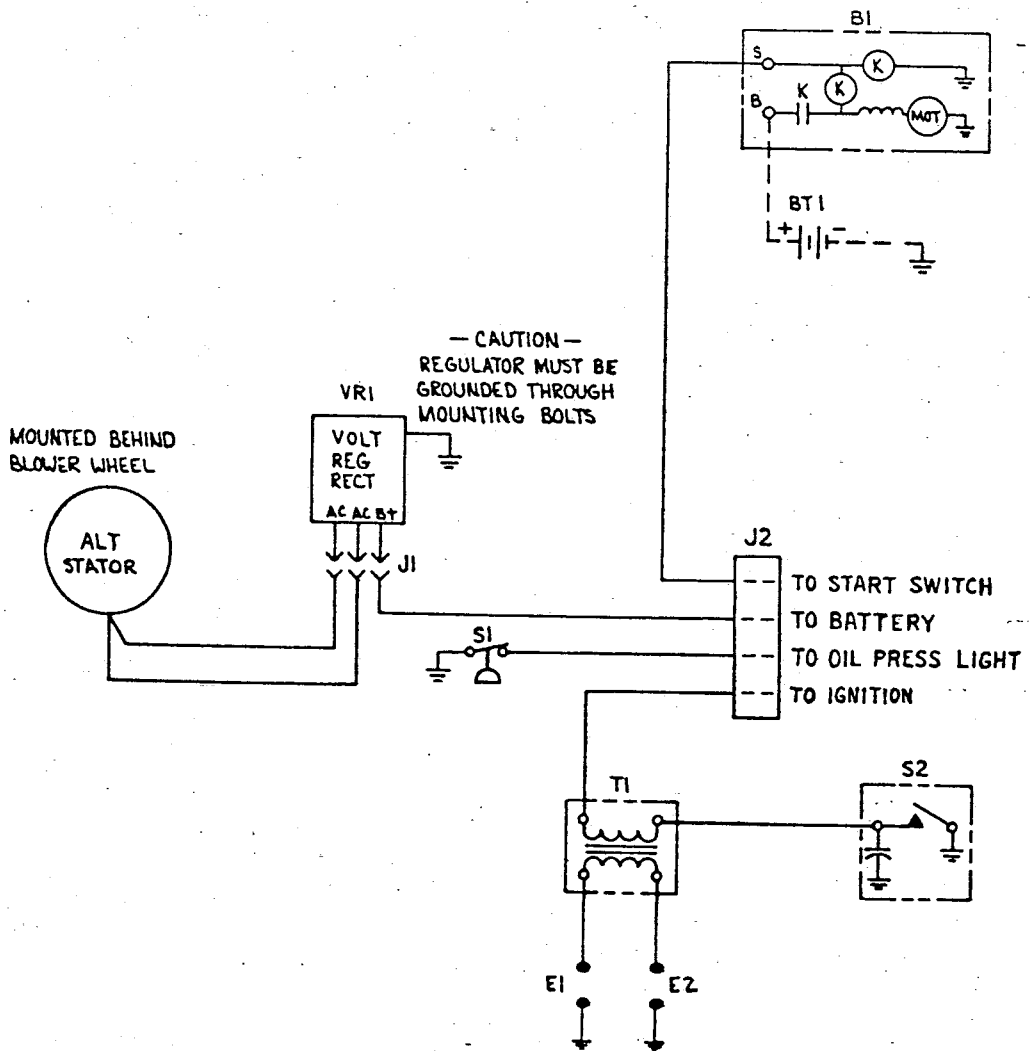
<u>REF. NO.</u>	<u>PART NO.</u>	<u>QTY. USED</u>	<u>PART DESCRIPTION</u>
	191-1052	1	Motor, Starting - Complete
1	191-0983	1	Lever Assembly
2	191-0984	1	Spring Set
3	191-1010	1	Bearing, Rear Bracket Assembly
4	191-1011	1	Screw Set
5	191-0987	1	Switch Assembly
6	191-0988	2	Bolt, Through
7	191-1086	1	Bracket Assembly, Front (Includes Bearing)
8	191-0971	1	Bearing, Front Bracket
9	191-0991	1	Stopper Set, Pinion
10	191-1007	4	Spring, Brush
11	191-1008	2	Brush, Negative
12	191-1009	1	Bracket Assembly, Rear (Includes Bearing)
13	191-1087	1	Clutch Assembly
14	191-1088	1	Armature
15	191-0997	1	Washer Set
16	191-1005	2	Brush, Positive
17	191-1006	1	Holder Assembly, Brush (Includes Parts Marked *)
18	191-1089	1	Field Coil Set (Includes Positive Brushes)

* - Parts Included in 191-1006 Brush Holder Assembly.

SERVICE KITS AND MISCELLANEOUS

NOTE: For other kits, refer to the group for the part in question.

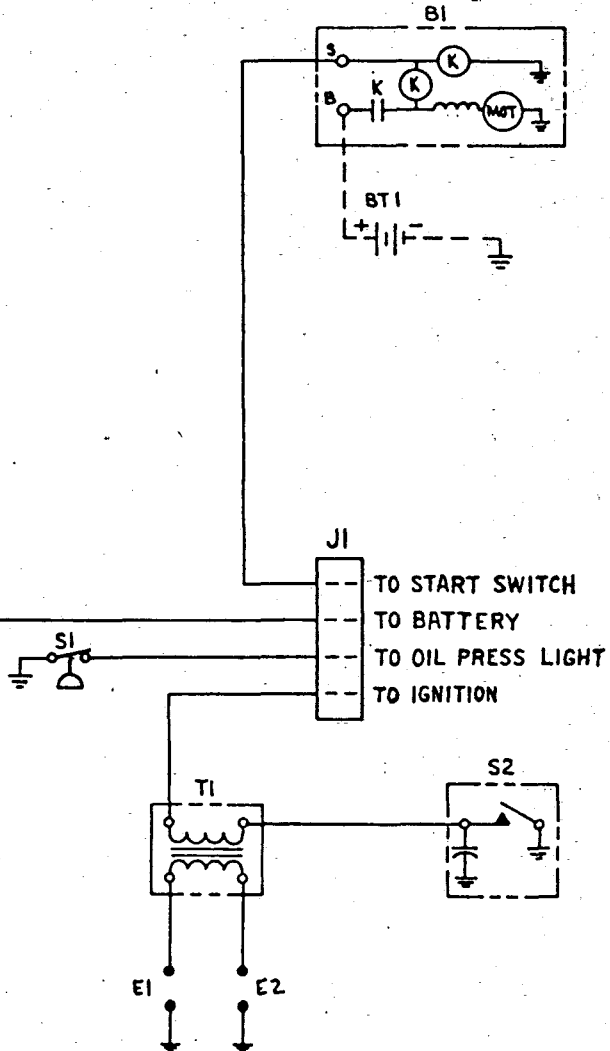
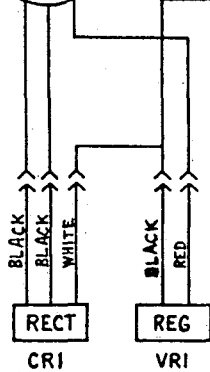
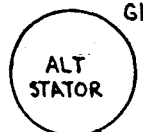
<u>REF. NO.</u>	<u>PART NO.</u>	<u>QTY. USED</u>	<u>PART DESCRIPTION</u>
	168-0103	1	Gasket Kit, Complete Engine
	160-0836	1	Ignition Tune-Up Kit
	168-0095	1	Carbon Removal Gasket Kit
	522-0267	1	Kit, Overhaul



PARTS LIST REF			
REF DES	PART NO.	QTY	DESCRIPTION
B1		1	STARTER & SOLENOID-ENGINE
BT1		1	BATTERY, 12 V
E1 & 2		2	SPARK PLUG
G1		1	ALTERNATOR-FLYWHEEL 15 AMP
J1		1	CONNECTOR
J2		1	CONNECTOR
S1		1	SWITCH-LOW OIL PRESS
S2		1	BREAKER & CAP ASSEMBLY
T1		1	IGNITION COIL-(ONAN)
VR1		1	REGULATOR-RECTIFIER-VOLTAGE

ENGINE WIRING DIAGRAM - MODEL CCKB-MS/2420

MOUNTED BEHIND
BLOWER WHEEL



PARTS LIST REF			
REF DES	PART NO.	QTY	DESCRIPTION
B1		1	STARTER & SOLENOID-ENGINE
BT1		1	BATTERY, 12 V
CRI		1	RECTIFIER ASSY
E1 & 2		2	SPARK PLUG
G1		1	ALTERNATOR-FLYWHEEL 20 AMP
J1		1	CONNECTOR
S1		1	SWITCH-LOW OIL PRESS
S2		1	BREAKER & CAP ASSEMBLY
T1		1	IGNITION COIL-(ONAN)
VRI		1	REGULATOR-VOLTAGE

ENGINE WIRING DIAGRAM - MODEL CCKB-MS/2440H AND CCKB-MS/2733J