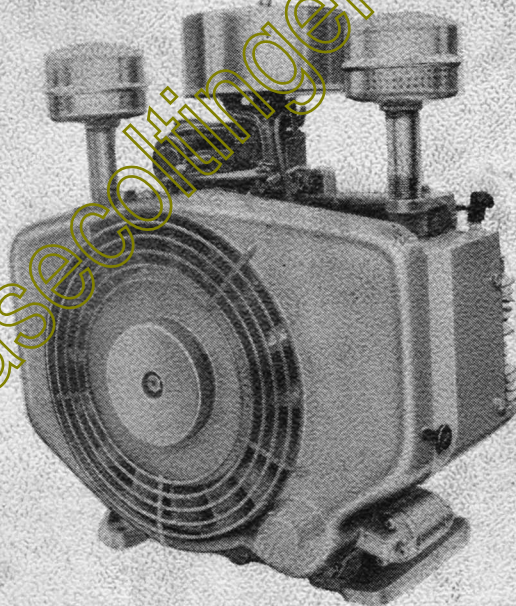


OPERATOR'S/SERVICE MANUAL AND PARTS CATALOG

FOR

SERIES
CCK
CCKA
INDUSTRIAL ENGINES



MANUFACTURED FOR

Miller ELECTRIC MFG. CO.

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(Specs G and J)
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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.

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.

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WARNING

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

SPECIFICATIONS

CCK

CCKA

Nominal dimensions (inches)

Height (manual start)	21"
Height (electric start)	23"
Width	20.60"
Length	15.10"
Weight in pounds (approximate)	148

Engine design: opposed two cylinder, four cycle, L head, air cooled.

Fuel (standard)*	Gasoline
Number of cylinders	2
Cylinder bore	3-1/4"
Piston stroke	3"
Displacement (cubic inch)	49.8
Horsepower	12.9 at 2700 RPM 16.5 at 3600 RPM
Compression ratio	5.5:1 7:1
Compression PSI (sea level)	100 - 120
Cooling air volume (CFM) (pressure cooled)	730 at 2700 RPM 830 at 3600 RPM

Governor type	Adjustable mechanical flyball
Fuel pump type	Diaphragm
Fuel pump lift	4 feet
Lubrication system	Full pressure
Oil pressure gauge	Optional
Oil capacity	
Manual start models	3 Qt.
Electric start models	3-1/2 Qt.
Optional oil filter capacity (U.S. quarts)	
CCK-CCKA	1/2 Qt.

* - Gaseous fuel optional.
Non-leaded or regular grade gasoline. See the Operation section for special instructions.

TUNE-UP SPECIFICATIONS

Breaker point gap (full separation)	0.020
Spark plug gap	
Gasoline	0.025
Gaseous	0.018
Ignition timing (engine running)	
Gasoline and gaseous	
Manual start (CCK)	19° BTC
Electric start (CCK)	20° BTC
Manual and Electric Start (CCKA Without Automatic Spark Advance)	20° BTC
Manual and Electric Start (CCKA With Automatic Spark Advance)	24° BTC

DIMENSIONS AND CLEARANCES

All clearances given at room temperature 70° F (21° C).
All dimensions in inches unless otherwise specified.

	Minimum	Maximum
Valve Tappet to Cylinder Block Clearance	0.0150	0.0030
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°
Valve Interference Angle		1°
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 (Forged Rod)	0.0005	0.0023
Connecting Rod End Play (Ductile Iron)	0.002	0.016
Timing Gear Backlash	0.002	0.003
Oil Pump Gear Backlash	0.002	0.005
Piston to Cylinder, Strut Type (Measured below Oil — Controlling Ring — 90° from Pin) Clearance0025	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	2.000
Crankshaft Rod Bearing Journal — Standard Size	1.6252	1.6260
Cylinder Bore — Standard Size	3.2490	3.2500
Carburetor float clearance (between float bowl gasket and float)		5/16"
Valve tappet clearances		
Intake006 to .008	
Exhaust015 to .017	

ASSEMBLY TORQUES

	LB.-FT.
Blower Housing Screws	8-10
Connecting Rod Bolts	27-29
Cylinder Head Screws	29-31
Exhaust Manifold Screws	15-20
Flywheel Mounting Screws	35-40
Fuel Pump Mounting Screws	5-6
Intake Manifold Screws	15-20
Oil Base Screws	43-48
Oil Pump Mounting Screws	7-9
Rear Bearing Plate Capscrews	20-25
Spark Plugs	25-30
Timing Gear Cover Screws	10-13
Valve Cover Nut	4-8
Magneto Stator Screws	15-20
Starter Mounting Bolts	25-28

SPECIAL TOOLS

Bearing Clearance Guide (Plasti-Gage)		
.002" to .006"	420-0256	
.004" to .009"	420-0257	
Combination Bearing Remover -		
Main and Cam	420-0325	
Combination Bearing Driver		
Main and Cam	420-0324	
Crankshaft Gear Puller	420-0072	
Gear Puller Ring	420-0248	
Flywheel Puller	420-0100	
Carburetor Adjustment Wrench	420-0169	
Continuity Tester	420-0290	
Series Circuit Tester	420-0288	
Torque Wrench - 1/2 Inch Drive		
0 to 100 Ft-Lb	420-0222	
Valve Seat Driver	420-0071	
Valve Guide Driver	420-0300	
Valve Spring Compressor	420-0119	
Valve Lock Replacer	420-0105	
Valve Guide Honing Set	420-0305	
Ridge Reamer	420-0260	
Cylinder Hone	420-0304	
Cylinder Wall Micro-Finishing Brush	420-0320	
Ring Compressor	420-0214	
Ring Spreader	420-0146	
Piston Groove Cleaner	420-0332	
Oil Seal Guide and Driver		
Bearing Plate	420-0181	
Gear Cover	420-0313	
Timing Advance Mechanical		
Cover Driver	420-0296	

ENGINE TROUBLESHOOTING

TROUBLE																				GASOLINE ENGINE TROUBLESHOOTING GUIDE		CAUSE
Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Crankshaft Slowly	Cylinder Wear	Engine Stops	Failure to Start	Governor Hunting	High Oil Pressure	Low Oil Pressure	Loss of Coolant (Water Cooled)	Misfiring	Overheating (Water Cooled)	Overheating (Air Cooled)	Piston Wear	Poor Compression	Ring Wear	Sticking Valves		
																				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		

OPERATION

BEFORE STARTING

Crankcase Oil: Be sure the crankcase has been filled with oil to the "FULL" mark on the oil level indicator. Refer to the *MAINTENANCE* section for the recommended oil changes and complete lubricating oil recommendations.

Recommended Fuel: Use clean, fresh, regular grade, automotive gasoline. Do not use highly-leaded premium types.

For new engines, the most satisfactory results are obtained by using unleaded gasoline. For older engines that have previously used leaded gasoline, heads must be taken off and all lead deposits removed from engine before switching to unleaded gasoline.

CAUTION If lead deposits are not removed from engine before switching from leaded to unleaded gasoline, pre-ignition could occur causing severe damage to the engine.

WARNING Never fill the fuel tank when the engine is running as fumes may cause explosion.

STARTING

Electric Start

1. Move the ignition switch to ON.
2. Push the START button to crank the engine.

Manual Start

1. Engine priming before starting is shown in Figure 1 (manual start only).
2. Pull choke control about 3/4 of the way closed or as necessary according to temperature conditions.
3. Pull start rope with a fast, steady pull to crank engine.
4. As engine warms up, adjust choke gradually to its fully open position.

APPLYING LOAD

Apply load to a new or reconditioned engine gradually in about four steps, not less than 30 minutes running time for each step. Start with 1/4 load, then 1/2, 3/4 and full-load.

STOPPING THE ENGINE

When possible, disconnect all load for one full minute before stopping the engine. Engines equipped with battery ignition are stopped by setting the ignition switch to the *off* position.

Engines equipped with magneto ignition are stopped by pushing the *stop* button (located on the blower housing). Hold in until engine completely stops.

GAS-GASOLINE CONVERSION

Engines having a combination gas-gasoline carburetor can be switched to gasoline operation by the following procedure:

1. Close the manual fuel shutoff valve in supply line for natural gas or propane-butane vapor, wherever located.
2. Open the gasoline fuel shutoff valve, wherever located.
3. Set the spark plug gap as given in the *Dimensions and Clearances* section.
4. See that the choke is free and works easily (be sure to release choke lock on units with electric choke).
5. Start engine. If the engine runs unevenly under half or full load due to faulty carburetor adjustment, the main jet needs adjusting.

To change back to natural or propane-butane operation, reverse the above procedure and reset the spark plug gap.

WORK FUEL PUMP PRIMING ROD BEFORE CRANKING- THEN LEAVE ROD PUSHED ALL THE WAY IN.

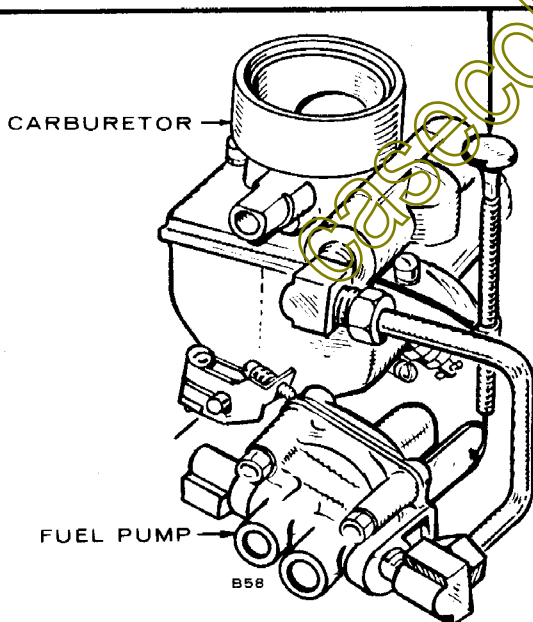


FIGURE 1. ENGINE PRIMING (MANUAL START)

HIGH OPERATING TEMPERATURE CONDITIONS

1. See that nothing obstructs air flow to and from the engine.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.
3. Keep ignition timing properly adjusted.

LOW AMBIENT TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh gasoline. Protect against moisture condensation. Below 0°F, adjust carburetor main jet for a slightly richer fuel mixture.
3. Keep ignition system clean, properly adjusted and batteries in a well charged condition.

EXTREMELY DIRTY OPERATING CONDITIONS

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as required.
3. Change crankcase oil every 50 hours and oil filter, where used, every 100 hours (more frequently if necessary).
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.

OUT-OF-SERVICE PROTECTION

Protect an engine to be out-of-service for more than 30 days as follows:

1. Run unit until thoroughly warm.
2. Turn off fuel supply and run until unit stops.

3. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
4. Remove each spark plug. Pour one ounce (two tablespoons) of rust inhibitor (or SAE 10 oil) into each cylinder. Crank engine slowly (by hand) several times. Install spark plug.
5. Service air cleaner.
6. Clean throttle and governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, bugs, dirt, etc.
8. Clean off dirt and dry entire unit. Coat parts likely to rust with a light film of oil or grease.
9. Disconnect battery and follow standard battery storage procedure. Apply a film of non-conductive grease to battery cable terminal lugs.
10. Fill fuel tank to prevent condensate contamination.
11. Provide a suitable protective cover for the entire unit.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperature.
3. Clean and check battery. Measure specific gravity and charge battery until correct. If battery water level is low add water as necessary. Do NOT overcharge.
4. Connect batteries.
5. Start engine.

WARNING

Do not smoke while servicing batteries. Hydrogen/Oxygen gases emitted from batteries during charging are highly explosive.

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected at once by a competent mechanic.

PERIODIC MAINTENANCE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF OPERATIONAL HOURS					
	8	50	100	200	500	1000
Inspect Engine Generally	x					
Check Fuel Supply	x					
Check Oil Level	x					
Clean Governor Linkage and Oil Ball joints		x				
Service Air Cleaner			x			
Change Crankcase Oil			x			
Check Battery Electrolyte Level			x			
Clean Fuel Filter			x			
Check Reduction Gear Drive (if used)			x			
Change Spark Plugs				x		
Replace Oil Filter (if used)				x		
Clean Crankcase Breather				x		
Inspect Breaker Points				x		
Check Valve Clearance					x	
Remove Carbon and Lead Deposits					x	
Inspect Valves, Grind If Necessary						x

PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The above schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods should be reduced. Frequently check the condition of the crankcase oil, the filters, etc. until the proper service time periods can be established.

When any abnormalities occur in operation — unusual noises from engine or accessories, loss of power, overheating, etc. — contact your Onan dealer.

CRANKCASE OIL

When changing oil, fill the crankcase to the FULL mark (Figure 2) 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. For gaseous operation, use an ashless or low-ash detergent oil specifically made for gaseous-fueled engines.

When adding oil between oil changes, it is preferable to use the same brand as various brands of oil may not be compatible when mixed together.

Oil consumption may be higher with a multigrade oil than with a single grade oil if both oils have comparable viscosities at 210°F. Therefore, single grade oils are generally more desirable, unless anticipating a wide range of temperatures. Use the proper grade oil for the expected conditions.

CAUTION

Do not overfill crankcase. Do not use service DS oil. Do not mix brands or grades of motor oil.

Cooling System: Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

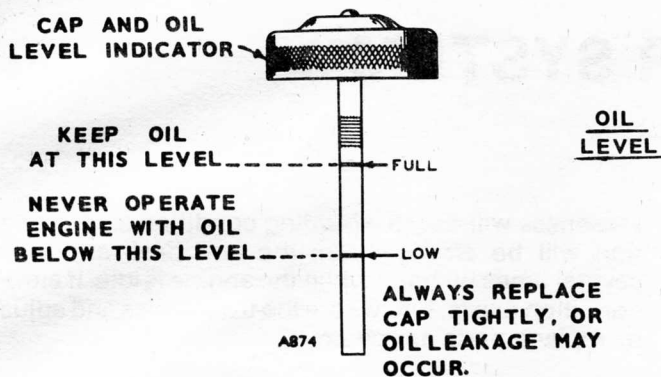
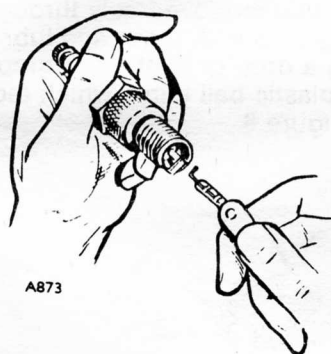


FIGURE 2. OIL LEVEL INDICATOR

SPARK PLUGS

Every 100 hours, remove, check, clean and regap the spark plugs (Figure 3). Be sure to set the correct gap for the fuel used. If a plug is discolored, has fouled or the porcelain is chipped or cracked, replace the plug with a new one.



SPARK PLUG GAP
0.025" GASOLINE
0.018" GAS FUEL

FIGURE 3. GAPPING SPARK PLUG

CRANKCASE BREATHER

This engine uses a crankcase breather valve for maintaining crankcase vacuum. No maintenance is generally required. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, clean baffle and valve in a suitable solvent. See Figure 4.

CARTRIDGE AIR CLEANER

Check and clean air cleaner element every 50 hours. Clean by gently tapping element on a flat surface. Replace element every 200 hours. Clean or replace more frequently in dusty operating conditions (see Figure 5).

OPTIONAL FUEL FILTER

Every 100 operating hours, remove the fuel sediment bowl, empty, clean and dry (Figure 6). Remove the screen and clean any particulate trapped. When replacing sediment bowl, be sure screen and gasket are in place.

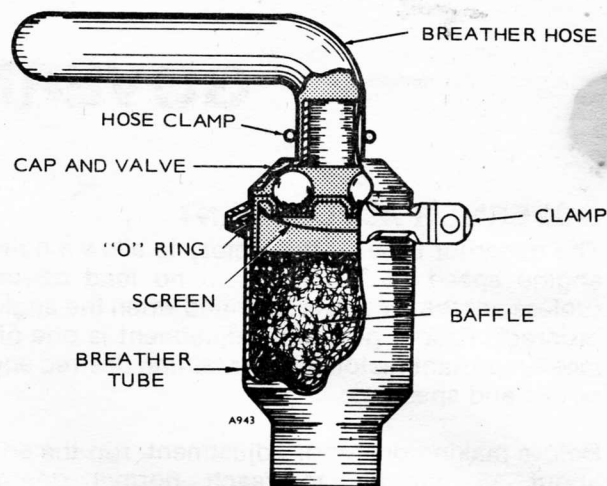


FIGURE 4. CRANKCASE BREATHER

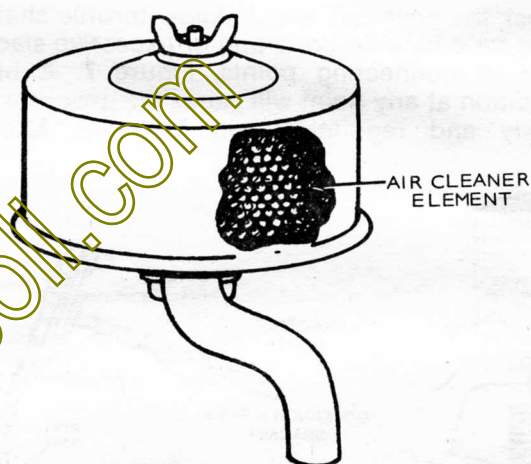


FIGURE 5. AIR CLEANER

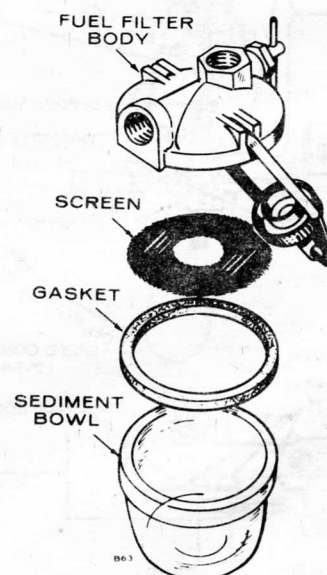


FIGURE 6. OPTIONAL FUEL FILTER

GOVERNOR SYSTEM

GOVERNOR ADJUSTMENT

The governor is set at the factory to allow a nominal engine speed of 2,400 rpm at no load operation (unless another speed is specified when the engine is ordered). Proper governor adjustment is one of the most important factors in maintaining desired engine power and speed.

Before making governor adjustment, run the engine about 15 minutes to reach normal operating temperature. If the engine is being run with the throttle wide open, either the governor is not properly adjusted or the engine is overloaded.

Check the governor arm, linkage, throttle shaft, and lever for a binding condition or excessive slack and wear at connecting points, Figure 7. A binding condition at any point will cause the governor to act slowly and regulation will be poor. Excessive

looseness will cause a hunting condition and regulation will be erratic. Work the arm back and forth several times by hand while the engine is idle. If either condition exists, find where the trouble lies and adjust or replace parts as required.

GOVERNOR LINKAGE

The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft and lever is adjusted at the ball joint. Adjust length so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle shaft just contacts the underside of the carburetor bowl. This setting allows immediate control by the governor after starting. It also synchronizes the travel of the governor arm and the throttle shaft.

The linkage must be able to move freely through its entire travel. Beginning Spec J, clean and lubricate steel ball joints using a drop of light oil or graphite. Earlier models used plastic ball joints which require no lubrication. See Figure 8.

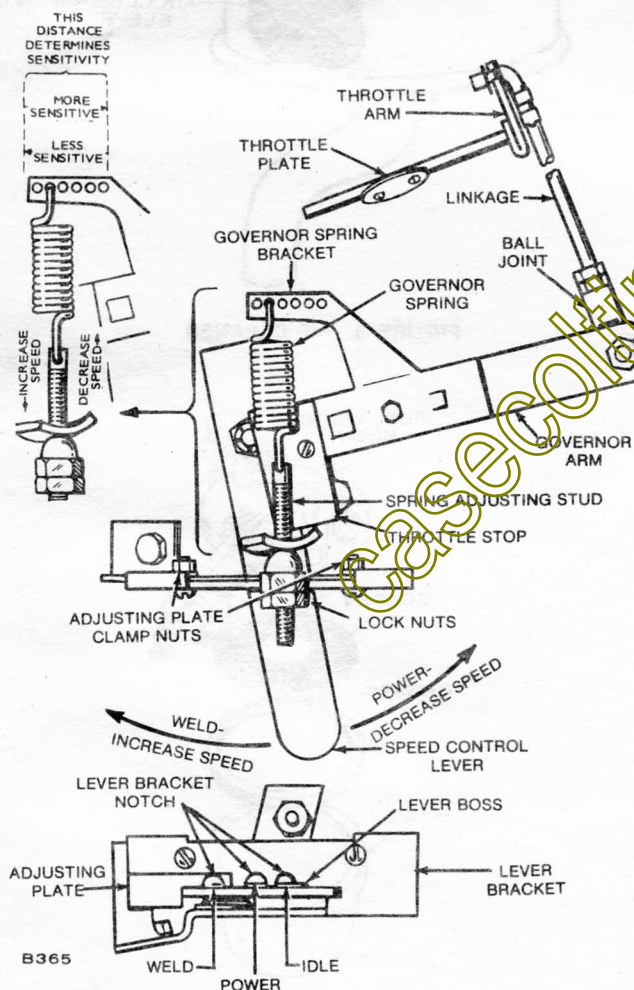


FIGURE 7. GOVERNOR ADJUSTMENTS

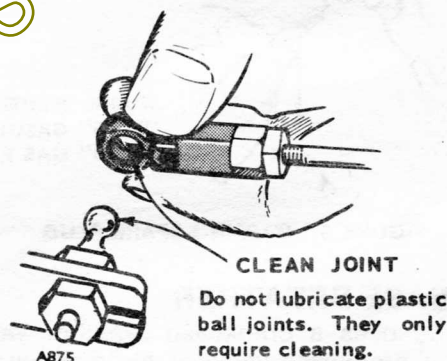


FIGURE 8. GOVERNOR LINKAGE

Speed Adjustment: The speed at which the engine operates is determined by the tension applied to the governor spring. Increasing spring tension increases engine speed. Decreasing spring tension decreases engine speed. The no load speed of the engine should be slightly higher than the speed requirements of the connected load. For example: If the connected load is to turn at 2,310 rpm, set the no load speed of the engine at about 2,400 rpm. Check speed with a tachometer.

With the warmed-up unit operating at no load and with the booster external spring disconnected, adjust the governor spring tension, turn the speed adjusting nut to obtain a voltage and speed reading within the limits shown on the nameplate.

Sensitivity Adjustment: Engine speed drop from no load to full load must be within 100 rpm. Check the engine speed with no load connected and again after connecting a full rated load.

Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition.

Always recheck the speed adjustment after a sensitivity adjustment. Increasing sensitivity will cause a slight decrease in speed and will require a slight increase in the governor spring tension.

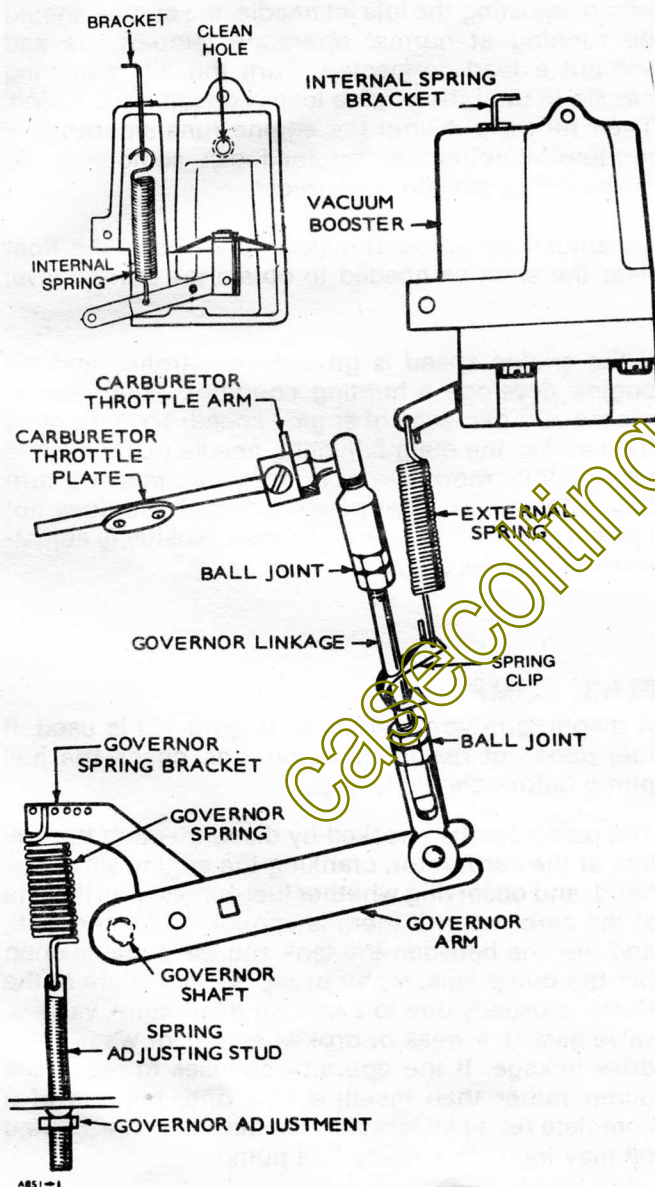


FIGURE 9. VACUUM SPEED BOOSTER

SPEED CONTROL ASSEMBLY

A speed control lever (Figure 9) is used to change the nominal engine speed from 3100 rpm no load as desired for welding, to 2300 rpm, Spec J (1800 rpm, Spec G), at no load as desired for electric power or to 1100 rpm, Spec J (1000 rpm, Spec G), for idle. The governor sensitivity adjustment is set to prevent a greater than 100 rpm speed drop when a full load is connected to the engine.

VACUUM SPEED BOOSTER

The vacuum speed booster (Figure 9) is operated by manifold vacuum. It provides increased engine speed and better regulation when operating the unit in the POWER position (approximately 2300 rpm for Spec J, 1800 rpm for Spec G).

To set the booster, first perform governor speed and sensitivity adjustments with booster disconnected.

Booster Cleaning: Use a fine wire to clean the small hole in the short vacuum tube which fits into the hole in the top of the engine intake manifold (Figure 9). Do not enlarge this hole. If there is tension on the external spring when the unit is operating at no load or light load, it may be due to improper adjustment, restricted hole in the small vacuum tube, or a leak in the booster diaphragm or gasket.

Booster Adjustment: Set external spring clip so that there will be exactly zero spring tension when the engine is running at no load in the POWER position. Apply a full electrical load and pull out the external spring bracket until there is a minimum change in engine speed between no load and full load.

If the regulation is still erratic after properly making all other adjustments, install a new spring.

Throttle Stop Screw: The throttle stop screw should be set at 1/32-inch distance from the manifold when the engine is operating with no load connected, Figure 10.

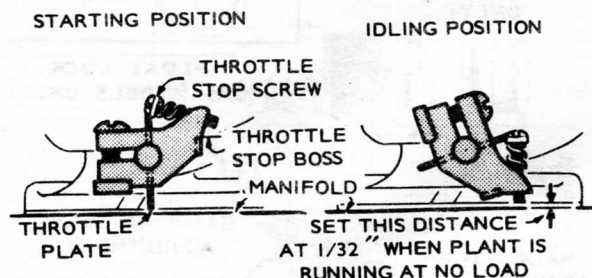


FIGURE 10. THROTTLE STOP SCREW

FUEL SYSTEM

CARBURETOR

Carburetor maintenance should consist of regular cleaning. Some gasolines have a tendency toward formation of gum deposits inside the carburetor which can usually be removed by soaking in alcohol or acetone. A fine soft wire may be used to clean jets.

See that the float is not damaged. If necessary to reset the float level, use a small screwdriver to bend the lip of the float. With the carburetor casting inverted and the float resting lightly against the needle in its seat, there should be 5/16-inch (1/4-inch with Styrofoam plastic float) clearance between the bowl cover gasket and the free end of the float (side opposite needle seat).

GASOLINE

The carburetor (Figure 11) has an adjustable idling jet. It is simple in construction and normally requires little attention other than a periodic cleaning. If the engine runs unevenly at half or full load due to faulty carburetion, the main adjusting needle (early models only) needs adjusting. Make the adjustment while the engine is running at normal operating temperature and with almost a full load connected to the engine.

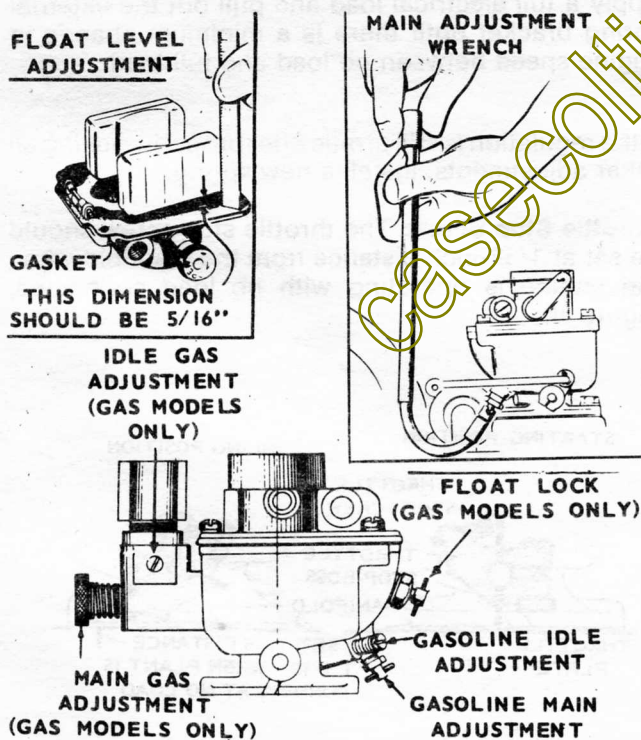


FIGURE 11. CARBURETOR ADJUSTMENT

Turn the main adjusting needle (early models only) out about two full turns. Then turn it slowly in until the engine begins to lose power and speed. Then turn it out very slowly until the engine runs smoothly at full power and speed. Onan carburetor wrench (420-0169) can be purchased from your Onan dealer for easier adjustment of the carburetor engine adjusting needle.

When adjusting the idle jet needle, the engine should be running at normal operating temperature and without a load connected. Turn the idle adjusting needle in until the engine loses considerable speed. Then turn it out until the engine runs smoothly. A hunting condition at no load can sometimes be corrected by an idle adjustment.

To adjust the carburetor float level, bend the float near the shaft as needed to obtain the correct level.

If the engine speed is governor-controlled and the engine develops a hunting condition (alternate increase and decrease of engine speed) try correcting by opening the main adjusting needle (early models only) a little more. Do not open more than 1/2 turn beyond the maximum power point. If this does not correct the condition, the governor sensitivity adjustment should be adjusted.

FUEL PUMP

A diaphragm-type fuel pump (Figure 12) is used. If fuel does not reach the carburetor, check the fuel pump before dismantling it.

The pump can be checked by disconnecting the fuel line at the carburetor, cranking the engine slowly by hand, and observing whether fuel comes from the line at the carburetor. 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, the use of a complete repair kit is recommended. Gasoline diluted oil may indicate a faulty fuel pump.

WARNING

Use care when reassembling pump; all parts must be perfectly aligned, or pump will leak, creating a fire hazard.

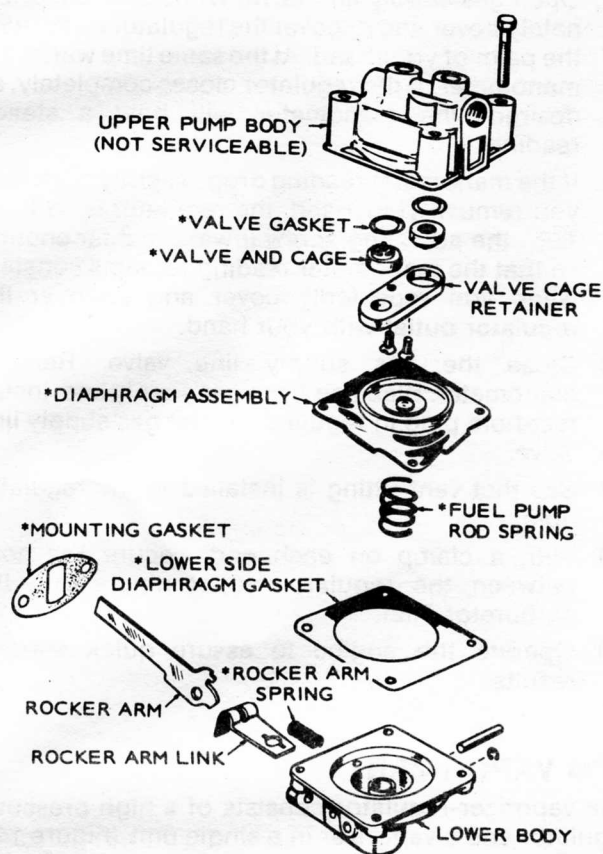


FIGURE 12. FUEL PUMP ASSEMBLY

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 degrees 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 degrees 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 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.

GASEOUS FUEL

Figure 11 shows features contained on a combination carburetor which equips engines to burn either gas (gaseous) or gasoline fuel. Engines so equipped are adjusted at the factory for gas fuel operation using gas rated at approximately 1,000 BTU per cubic foot. If the rating of the fuel to be used is substantially different, a readjustment of the fuel-air mixture is required to attain maximum power and best fuel economy.

Adjust the main gas and the idle gas adjustment in a manner similar to the instructions given for gasoline operation. See also, the instructions for gas operation.

For gas fuel operation, the carburetor float screw (with metal float only) must be turned all the way in to avoid float vibration wear (early models only).

ADJUSTING THE GAS PRESSURE REGULATOR

The maximum allowable inlet pressure is 8 ounces; minimum 2 ounces. If gas line pressure is greater than 8 ounces, install a primary regulator to reduce the pressure. The regulator has an adjustment to control the maximum pressure at which the regulator shuts off when there is no demand. To obtain maximum regulator sensitivity, adjust it to just shut off at your line pressure when there is no demand. Adjust the regulator for shut off when there is no demand to prevent gas leaks. The factory adjusted shutoff is between 2 and 4 ounces. If gas line pressure is between 4 and 8 ounces, readjust the screw, Figure 13.

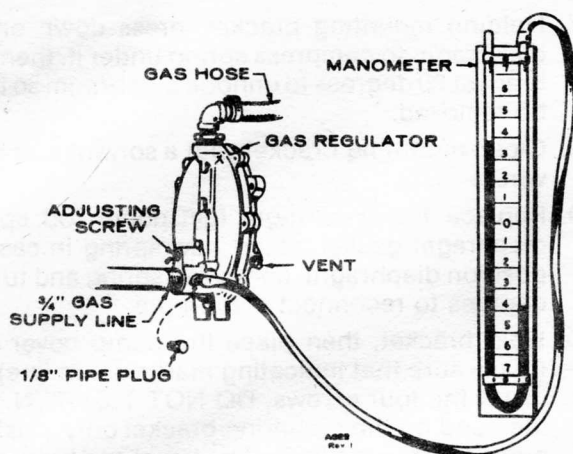


FIGURE 13. TESTING GAS REGULATOR

CAUTION A soap bubble placed over the regulator outlet will not accurately test for regulator closing. The soap bubble's resistance when multiplied by the greater area of the regulator diaphragm is enough to shut off this very sensitive demand type regulator.

1. Use a manometer which reads up to 14 inches water column.
One ounce per square inch equals 1.73 inches water column. Likewise, one inch water column equals 0.58 ounce per square inch.
2. Shut off gas supply. Temporarily remove the 1/8-inch pipe plug at regulator inlet for testing pressure.
3. Connect manometer to read gas supply line pressure.

4. Open gas supply line valve. Without delay, alternately cover and uncover the regulator outlet with the palm of your hand. At the same time watch the manometer. If the regulator closes completely, as desired, the manometer will hold a steady reading.
5. If the manometer reading drops slightly each time you remove your hand, the regulator is leaking. Turn the adjusting screw inward just far enough so that the manometer reading remains constant when you repeatedly cover and uncover the regulator outlet with your hand.
6. Close the gas supply line valve. Remove manometer. Bleed air from gas supply line. Install test-hole plug in regulator. Open gas supply line valve.
7. See that vent fitting is installed in the regulator hole.
8. With a clamp on each end, secure the hose between the regulator outlet nipple and the carburetor inlet.
9. Operate the engine to assure quick starting results.

LPG VAPORIZER

The vaporizer-regulator consists of a high pressure regulator and a vaporizer in a single unit (Figure 14). Regulator portion of the vaporizer-regulator reduces LPG tank pressure to a uniform outlet pressure of 7 psi. The vaporizer section installed in the path of the engine cooling air system furnishes the heat required to offset the cooling effect produced as the LPG fuel is expanded and becomes gas.

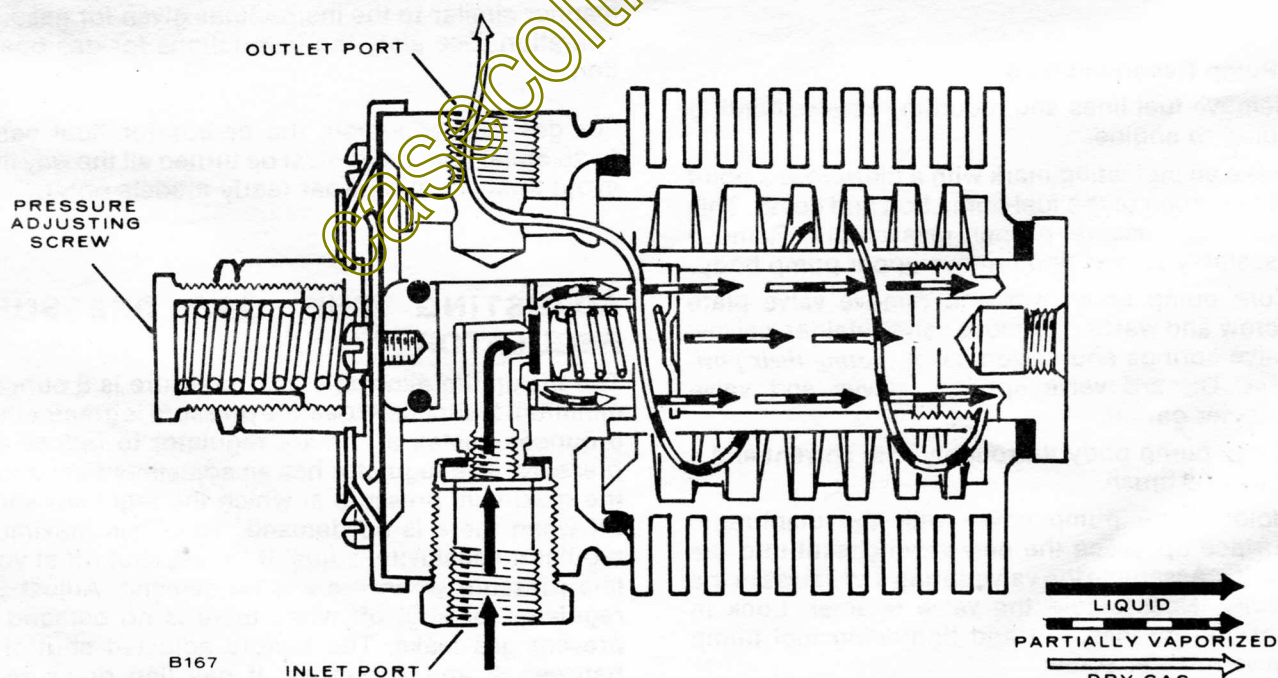


FIGURE 14. LPG VAPORIZER

The vaporizer reduces high pressure liquid fuel to low pressure gaseous fuel. Liquid fuel is admitted into the inlet port and passes through the fuel inlet orifice. With the engine running, the pressure to the right of the valve seat and retainer drops to open the valve, a mixture of partially vaporized fuel enters the center tube (first stage cold chamber) of the vaporizer. The droplets of fuel are sprayed out of the end plug holes into the staggered portions of the cast heat exchanger. The swirling action of the fuel ensures complete vaporization. Dry gas leaves the exchanger through the outlet port of 3 psi.

Vaporizer Adjustments: Adjust the vaporizer to a working pressure of 7 psi whenever the pressure adjusting screw is moved or the unit is overhauled.

1. Place the vaporizer in a vise or other suitable clamp. Attach an air hose from an air supply of approximately 75 psi to the inlet, (Figure 15).
2. Attach a 0 to 30 or 0 to 50 pound pressure gauge to the outlet.
3. Back off the adjusting screw until only one or two threads are engaged. Apply air pressure to the unit.

4. Turn the pressure adjusting screw in slowly until a reading of 7 psi shows on the gauge.

To obtain an accurate gauge reading, it may be necessary to unscrew the gauge partially to bleed off some of the air. Then retighten the gauge and readjust for 7 psi. If the gauge indicator remains steady, the valve is not leaking. If the pressure reading increases slowly, it indicates a leaking valve. Check the components of the vaporizer for correct assembly procedures. Replace defective parts.

5. Tighten the lock nut on the pressure adjusting screw. Turn off the air pressure and remove the gauge and air line.

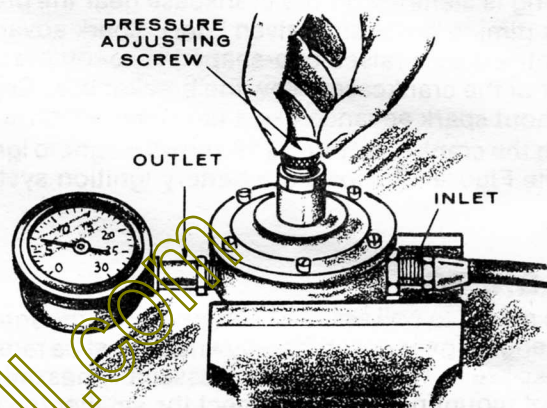


FIGURE 15. VAPORIZER ADJUSTMENT

SAFETY PRECAUTIONS WHEN WORKING WITH LPG

1. Always close the LPG tank shut-off valve when the engine is left unattended between use.
2. Be sure LPG tank shut-off valve is closed before disconnecting tank from system.
3. Ignition switch must be in OFF position prior to disconnecting any electrical wires.
4. Check fuel system regularly for leaks. Use soap to locate leaks and recheck with soap after repairing leaks.
5. Keep a fire extinguisher handy for immediate use. A dry powder or carbon dioxide (CO₂) type is recommended.
6. Never use LPG for cleaning parts.
7. Do not use LPG near open flame. Work in a well ventilated area.

LPG is heavier than air and settles in low places.

IGNITION SYSTEM

Due to the variety of ignition systems used on CCK and CCKA Series engines, complete ignition service information will be given for each in separate sections. Use only the section which applies to the engine which is being serviced. Correct ignition timing is stamped on the crankcase near the breaker box (timing procedure given later). Spark advance is identified by a raised cup-shaped cover on the upper rear of the crankcase below the breaker box. Engines without spark advance use a flat cover which is flush with the crankcase. Figure 16 shows magneto ignition while Figure 17 shows the battery ignition system.

MAGNETO

The magneto coil assembly (Figure 18) is mounted on the engine gear cover. The flywheel must be removed to expose it. The magneto coil assembly has only one set of mounting holes. Connect the smaller (ground) coil lead to the magneto coil assembly mounting screw, (Figure 16). Connect the larger magneto coil assembly lead to the breaker box insulated terminal.

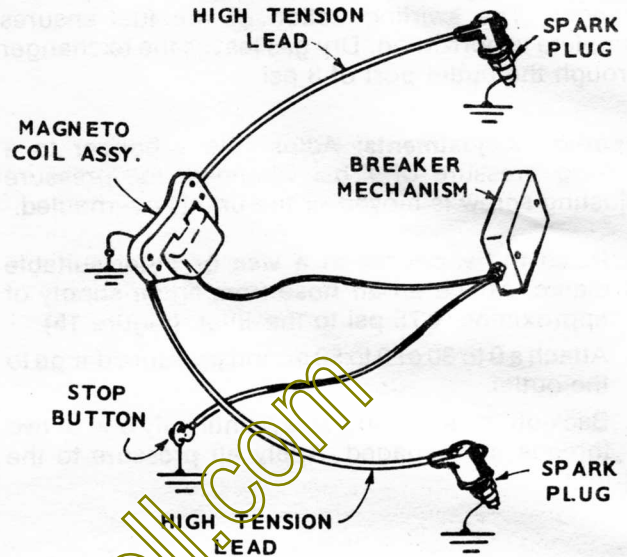


FIGURE 16. MAGNETO IGNITION SYSTEM

**WARNING - USE ONLY
A 6-VOLT COIL TESTER**

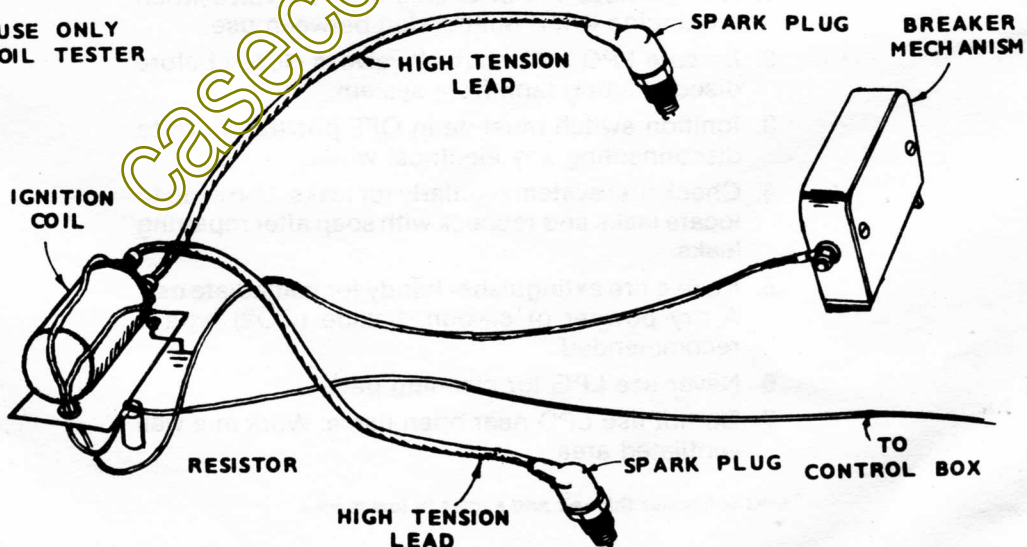
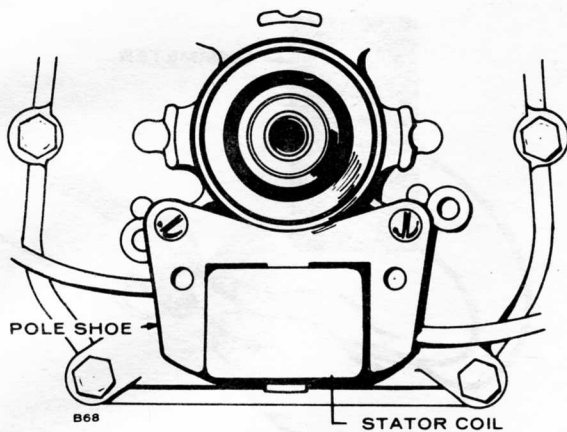


FIGURE 17. BATTERY IGNITION SYSTEM



IF FLYWHEEL RUBS ON POLE SHOE, LOOSEN POLE SHOE MOUNTING SCREWS, TAP POLE SHOE, AND RETIGHTEN MOUNTING SCREWS.

FIGURE 18. MAGNETO STATOR ASSEMBLY

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 19. Replace points with a new set but do not completely tighten mounting screws (A).
4. Rotate flywheel clockwise (facing flywheel) by hand until points are fully open. Turn screw (C) until point gap measures .020 inch with a flat thickness gauge.
5. Tighten mounting screws and recheck gap.
6. Proceed to *Ignition Timing*.

Each time new breaker points are installed, place a drop of oil on the point's pivot point, (Figure 19).

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

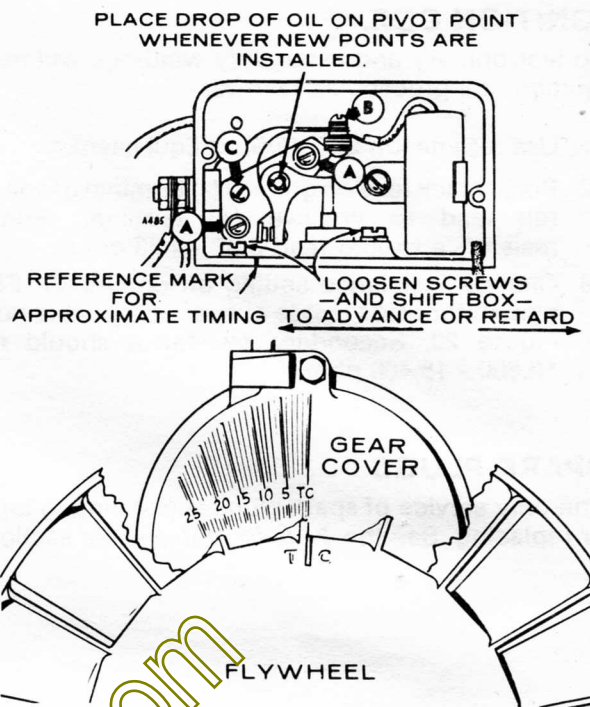


FIGURE 19. IGNITION TIMING

timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.

2. Place a white chalk or paint mark on the timing mark.
3. Start the engine and check the timing.
4. If timing needs adjustment, loosen the mounting screws on breaker box and move it left to advance or right to retard the timing.
5. Tighten the screws on the breaker box and recheck timing.
6. Replace breaker box cover and any other hardware removed.

Ignition Timing — Engine Not Running

1. Connect a continuity tester 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. The buzzer should sound just as points break.
4. If timing needs adjustment, loosen the mounting screws on breaker box and move it left to advance or right to retard the timing.

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 black 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 20. Secondary resistance should read 12,600 - 15,400 ohms.

SPARK PLUGS

The only service of spark plugs is cleaning, gapping or replacing. See the *Periodic Maintenance* section.

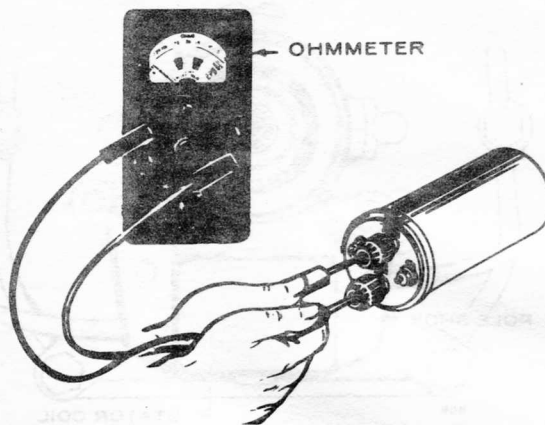


FIGURE 20. TESTING IGNITION COIL

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STARTING SYSTEM

ELECTRIC STARTING

The standard starting motor on older models with electric start engines is the gear-drive starter shown in Figure 21. The gear-drive starting system is mounted on a shaft which extends from the starter motor. When not running, the gear is retracted so it clears the flywheel ring gear. When starting a spiral spring, a screw sleeve, and increasing speed forces the drive pinion to engage the flywheel ring gear. The pinion and ring rear teeth are beveled on the ends to ensure their engaging properly.

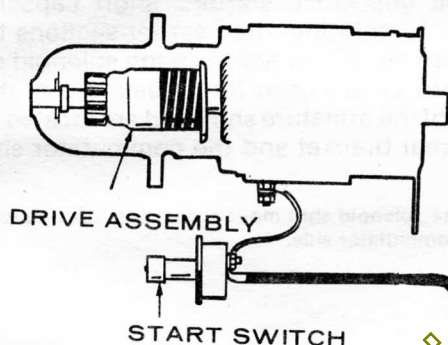


FIGURE 21. GEAR-DRIVE STARTER

The solenoid-shift starter (standard on engines beginning Spec J) is shown in Figure 22. After the starter button is pushed, battery current energizes the start solenoid. The solenoid causes an arm to push the starter pinion into the flywheel ring gear. Simultaneously, the start solenoid contacts close and allow the starter motor to start turning. The starter remains engaged until the start button is released. An overrunning clutch protects the starter from damage before it can be disengaged from the flywheel.

CAUTION

Starter motors are not designed for continuous operation. Do not operate more than 30 seconds per "ON" cycle. Do not operate starter more than 10 seconds in a stall condition if engine will not rotate. Serious damage could result if these time limits are exceeded.

Maintenance: For proper cranking motor operation with a minimum of trouble, a periodic maintenance procedure should be followed. Periodic lubrication,

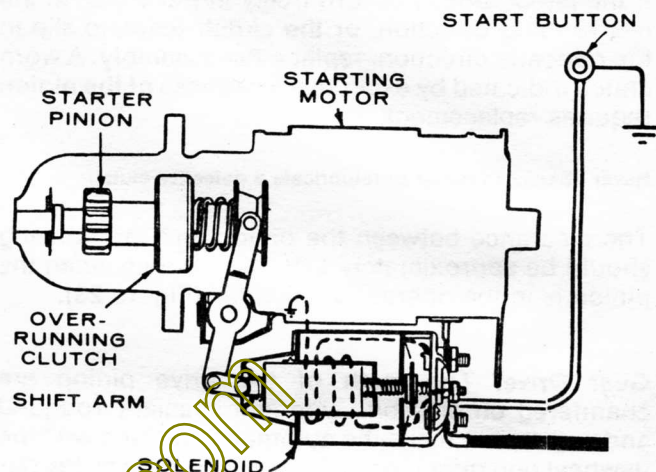


FIGURE 22. SOLENOID-SHIFT STARTER

Inspection of the brushes and commutator as described in this section will ensure long cranking motor life. Periodic disassembly (see *Disassembly*) of the cranking motor for a thorough overhaul is recommended as a safeguard against accumulations of dust, grease and parts wear.

Lubricate all oil-type bearings with 8 to 10 drops of light engine oil (SAE 20). All oil-less type bearings and bushings should be given a few drops of light oil. Lubricate the cranking motor drives with a few drops of light engine oil.

Never oil the commutator. Oil on the commutator reduces the cranking ability of the motor.

The commutator can be cleaned by using number 00 sandpaper. Never use emery cloth. If the commutator is out of round or has high mica, remove it from the cranking motor. Turn the commutator down on a lathe being careful to remove only enough material to true up the commutator and remove high mica.

It is not necessary to undercut mica on starter motor commutators.

Replace worn brushes. If brushes wear rapidly, check for excessive brush spring tension and roughness or high mica on the commutator.

Solenoid Shift: Periodically inspect solenoid and shift lever to make sure they are operating properly. Keep the solenoid shift lever free of dirt and excess grease.

The overrunning clutch is packed in a special high melting point grease and after its initial assembly, needs no further lubrication. This clutch prevents the engine from turning the starter motor at too high a speed once it is started. Do not subject the overrunning clutch to grease dissolving or high temperature cleaning methods. This may cause the clutch to lose some or all of its grease.

If the pinion does not turn freely in the clutch in the overrunning direction, or the clutch tends to slip in the opposite direction, replace the assembly. A worn clutch indicated by excessive looseness of the pinion requires replacement.

Never attempt to repair or relubricate a defective clutch.

The clearance between the pinion and the housing should be approximately 1/16- to 1/8-inch when the pinion is in the operating position (Figure 23).

Gear Drive: The teeth of the drive pinion are chamfered on only one side and specially rounded and polished to make the automatic meshing with the flywheel ring gear more efficient. The drive is designed so if the ends of the pinion teeth meet end to end with the ring gear teeth (keeping in mind that the threaded screw shaft is freely mounted on the drive shaft), the drive assembly can move back slightly against the pressure of the driving spring. The longitudinal movement of the screw shaft permits the pinion to turn slightly farther and enter the flywheel ring gear.

It is important the correct length of drive spring be used when making replacements. The length of the drive spring controls the longitudinal movement of the pinion (meshing and unmeshing of the pinion and flywheel ring gear).

Keep the drive shaft free of rust, burrs or bends so the screw shaft can move freely along it. A damaged pinion necessitates the replacement of the assembly.

Onan recommends replacement of faulty gear-drive assemblies and provides no further service information concerning their repair. For further repair information, contact the manufacturer of your starter motor.

Disassembly:

1. Remove all wires to the starting unit. Tag each wire so it can be reconnected as originally.
2. Remove the solenoid (where applicable).

The solenoid spacers are mounted with the steel spacer toward the bracket (Figure 35).

3. Remove the starter motor thru-bolts and separate the starter into three main assemblies — the front bracket, the housing and the rear bracket. On some gear-drive starters, short capscrews are used to hold the three starter sections together, Figure 24. The spacers on the solenoid starter in Figure 24 are used for adjustment of the thrust gap of the armature shaft and are located between the rear bracket and the commutator shaft.

On the solenoid shift models, the steel spacing washer is on the commutator side.

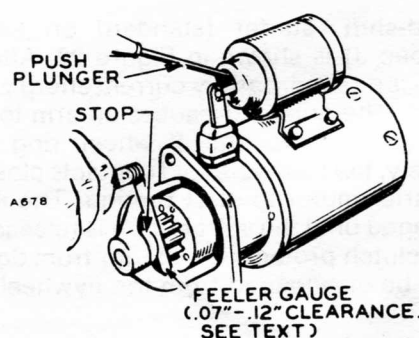
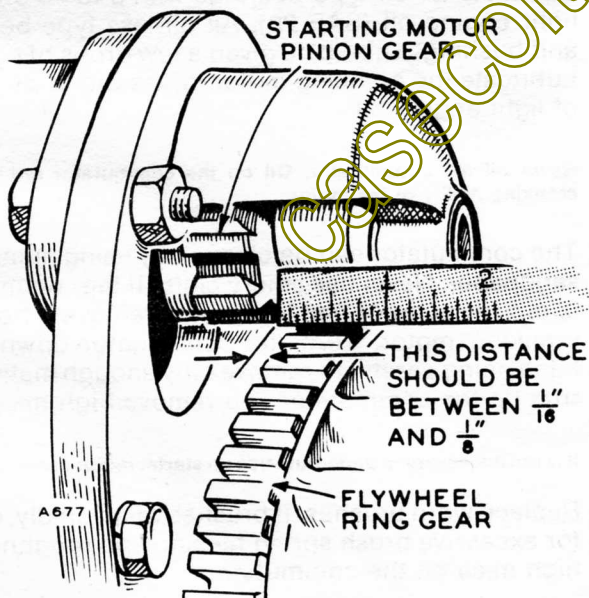


FIGURE 23. PINION CLEARANCES

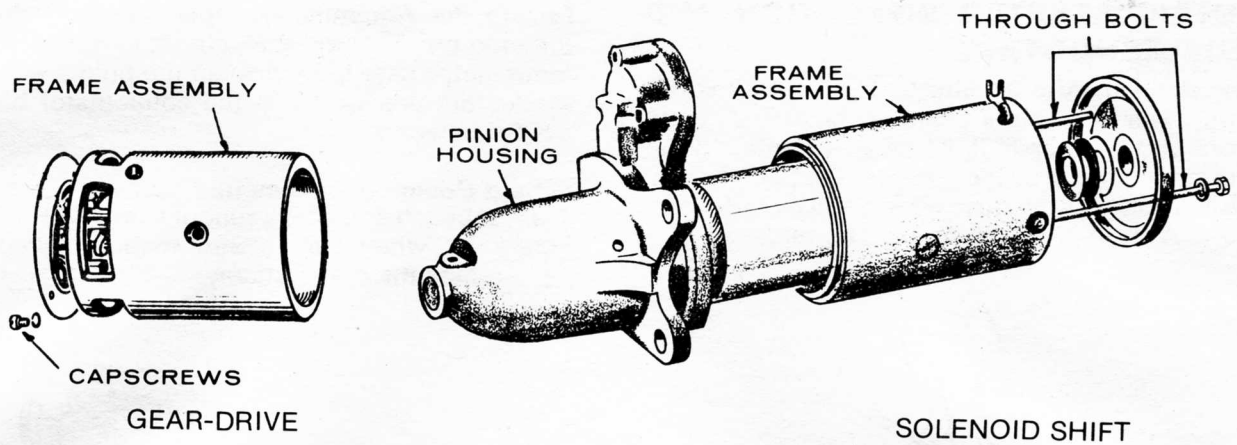


FIGURE 24. STARTER DISASSEMBLY

4. **Solenoid Starter Only:** The armature can now be removed from the front bracket. Be careful not to miss the small steel washer used in the end of the armature shaft. Remove the shift lever at the same time the armature is removed. The spring holder, lever springs and retainer can be removed prior to the lever, Figure 25.

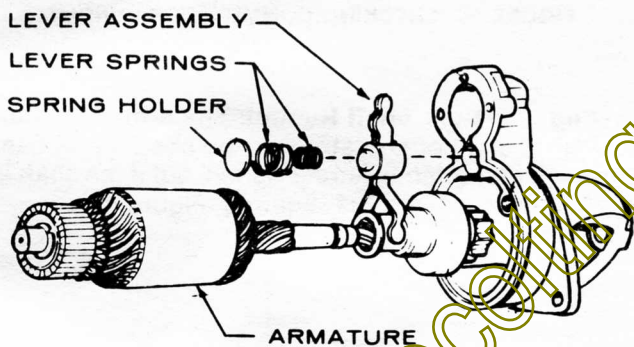


FIGURE 25. REMOVING ARMATURE FROM SOLENOID SHIFT STARTER

5. **Solenoid Starter Only:** Remove the ring after driving the pinion stopper toward the pinion gear using a cylindrical tool Figure 26. Remove the overrunning clutch and the pinion stopper at the same time.
6. **Gear Drive Starter Only:** The entire assembly is mounted on the armature shaft. When disassembling the starter, pay particular attention to the various parts and their positioning in the starter assembly, Figure 27. If the gears of the pinion are damaged, replace the entire pinion. Inspect the screw shaft for rust and burrs.
7. Remove the brushes from the brushholder and inspect them (inspection of brushes and brush springs discussed later).
8. Remove the pole shoes if necessary by removing the flathead machine screws which anchor them to the frame.

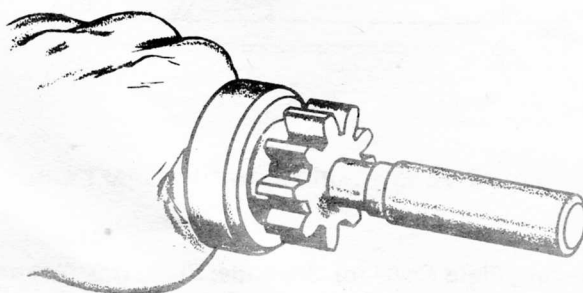


FIGURE 26. TOOL FOR DRIVING PINION STOPPER

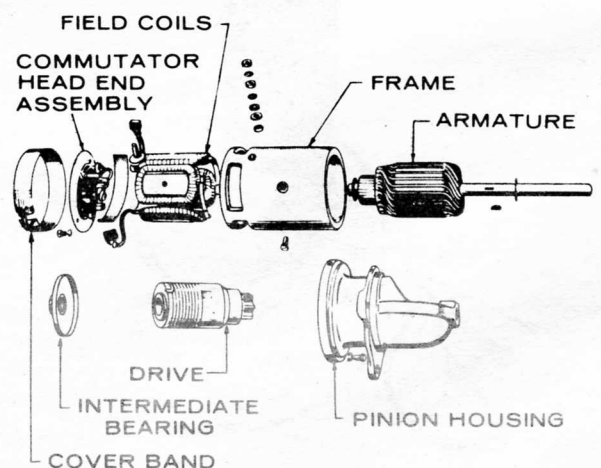


FIGURE 27. GEAR DRIVE STARTER

ELECTRIC STARTER INSPECTION AND TROUBLESHOOTING

Testing the Armature for Shorts: Place the armature in the growler and hold a thin steel blade parallel to the core and just above it, while slowly rotating the armature in the growler. Figure 28. A shorted armature causes the blade to vibrate and move toward the core. A shorted armature must be replaced.

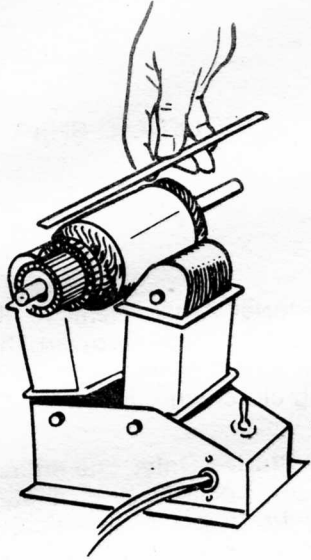


FIGURE 28. TEST FOR SHORTED ARMATURE

Testing Armature for Grounds: Touch armature shaft or core and the end of each commutator bar with a pair of ohmmeter leads, Figure 29. If the ohmmeter reading is low, it indicates a grounded armature. Replace grounded armature.

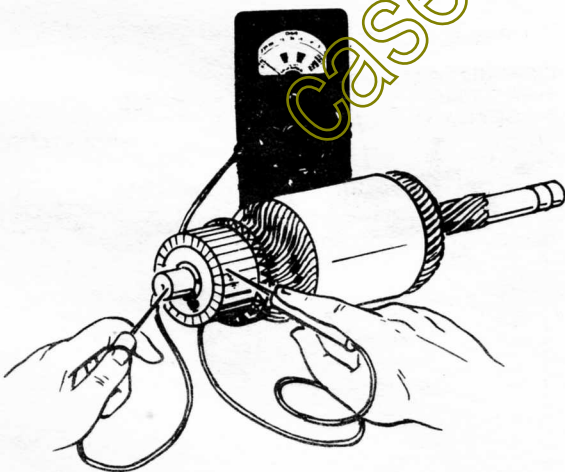


FIGURE 29. TEST FOR GROUNDED ARMATURE

Testing the Armature for Open Circuit: The most common place for an open circuit to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections.

Testing Commutator Runout: Place the commutator in a test bench and check runout with a dial indicator, Figure 30. When commutator runout exceeds .004 inch, reface the commutator.

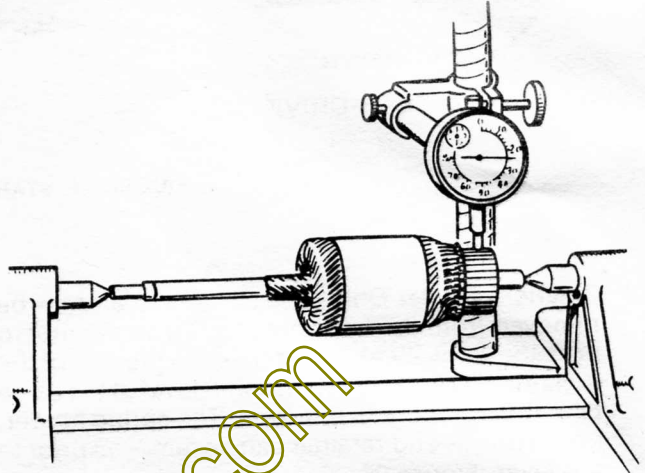


FIGURE 30. CHECKING COMMUTATOR RUNOUT

Testing Armature Shaft Runout: The armature shaft as well as the commutator may be checked. A bent armature can often be straightened, but if the shaft is worn, a new armature is required, Figure 31.

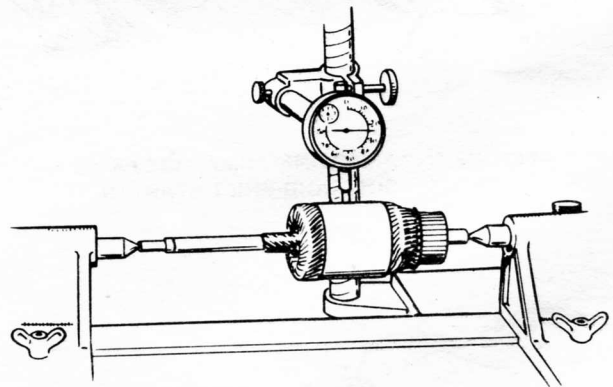
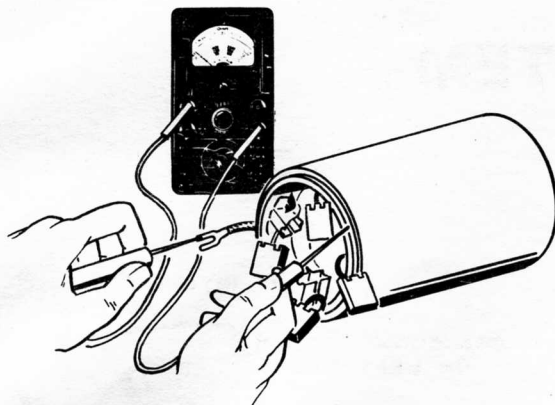


FIGURE 31. CHECKING ARMATURE SHAFT RUNOUT

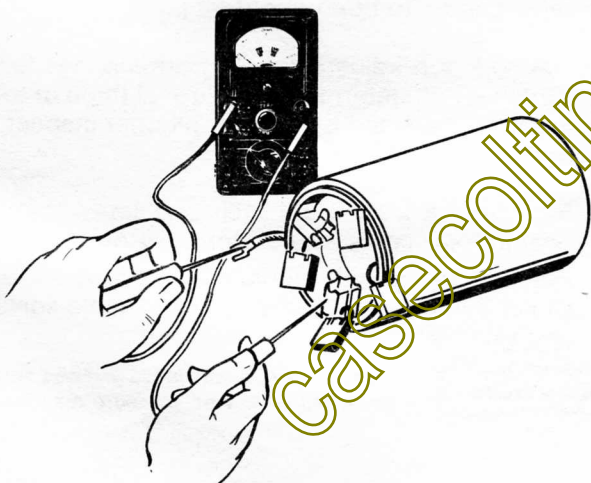
Testing Field Coils for Grounds: Place one test probe on the connector and the other on a clean spot on the frame after unsoldering the shunt field coil wire. If the ohmmeter reading is low, the fields are grounded either at the connector or in the windings, Figure 32.



ONE PROD ON FIELD COIL LEAD,
ONE PROD ON FRAME.
- SHOULD NOT LIGHT.

FIGURE 32. FIELD COIL GROUND TEST

Testing Field Coils for Open Circuit: Place one test probe on the connector and the other on a clean spot on the brushholder, Figure 33. If the ohmmeter reading is high, the field coil is open. Check all brushholders in the same manner.



ONE PROD ON FIELD COIL LEAD,
ONE PROD ON BRUSH HOLDER.
- SHOULD LIGHT.

FIGURE 33. TEST FOR OPEN FIELD COIL

Inspection of Brushes: When brushes are worn more than 0.3 inch, replace them. Figure 34 shows the wear limit. See that the brushes move smoothly in the brushholders.

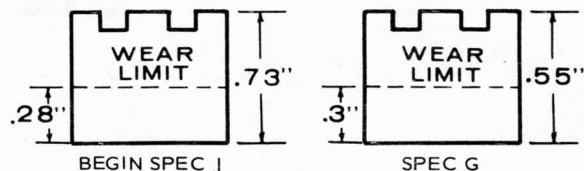


FIGURE 34. BRUSH WEAR LIMITS

Inspection for Brush Spring Tension: Measure brush spring tension with a tension meter, Figure 35. Push the brush into its holder and take the reading just as the brush slightly projects from the brushholder. On a new brush the spring tension should be 49 to 59 ounces for CCK, CCKA engines begin Spec J, and 29 to 38 ounces for Spec G engines.

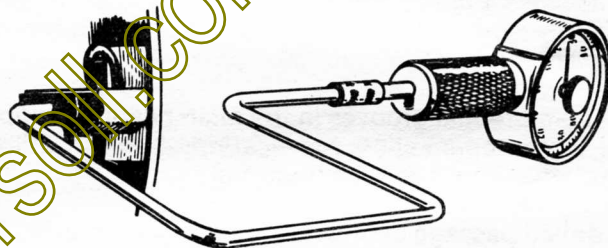


FIGURE 35. MEASURING BRUSH SPRING TENSION

Assembly: Reassembly is much the reverse of disassembly procedure. Follow a few precautions and procedures:

1. Clean all parts carefully with a dry cloth and compressed air if available.

CAUTION Do not immerse bearing equipped parts in cleaning fluid. Clean with a brush dipped in mineral spirits. Do not immerse the overrunning clutch in cleaning solvent. The solvent may break down the lubricant and shorten the bearing life.

2. Apply 20 weight oil to armature shaft and splines. Use grease sparingly for solenoid starter's shift lever pin, joint of shift lever and plunger, plunger and spacing washers at end of the shaft.
3. Use spacing washers to adjust armature end play of .004 to .020 inch.
4. When assembling starter to engine oil base, do not draw the mounting bolts up tight. The gears should have .004- to .007-inch backlash. Tap the starter in or out from the oil base to adjust. Then tighten bolts securely.

OIL SYSTEM

The CCK Series engines have pressure lubrication to all working parts. The oil system includes:

- Oil intake cup
- Gear type oil pump
- Oil pressure gauge (optional)
- Oil passages to deliver oil throughout engine
- Oil filter (if used)

The oil pump is located on the front surface of the crankcase and is driven by the crank gear. The inlet pipe and screen assembly is attached directly to the pump body. A discharge passage in the cover of the pump registers with a drilled passage in the crankcase. Parallel passages distribute oil to the front main bearing, rear main bearing and pressure control bypass valve. See Figure 36.

Circumferential grooves in the main bearings supply oil to the connecting rod bearings through drilled passages from each main journal.

A drilled passage connects the front main bearing oil supply to the front camshaft bearing. The flyball governor is lubricated by a drilled passage in the front camshaft journal.

The oil overflow from the bypass valve furnishes lubrication to the camshaft drive gears.

Normal oil pressure should be 30 psi or higher when the engine is at operating temperature. If pressure drops below 30 psi at governed speed, inspect the oil system for faulty components.

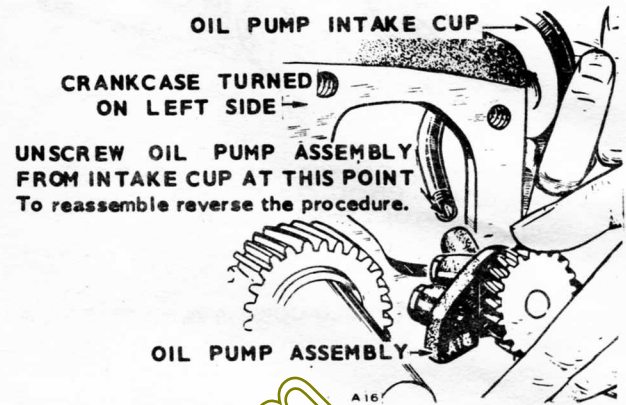


FIGURE 36. OIL PUMP ASSEMBLY

OIL BY-PASS VALVE

The by-pass valve (located to the right and behind gear cover), controls oil pressure by allowing excess oil to flow directly back to the crankcase. Normally the valve begins to open about 30 psi.

The valve is non-adjustable and normally needs no maintenance. To determine if abnormal (high or low) oil pressure is caused by a sticky plunger inspect as follows:

1. Remove 3/8 x 24 x 3/4-inch cap screw located behind gear cover and under governor arm.
2. Remove spring and plunger with a magnet tool. Clean plunger and spring with a suitable solvent and reinstall.

CAUTION

Be sure plunger is reinstalled in the same way it came out or low oil pressure may result.

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.

Keep all parts in their respective order . . . valve assemblies, rod caps for respective rod and piston assemblies, etc.. Analyze reasons for parts failures. Use new gaskets for assembly.

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 37.

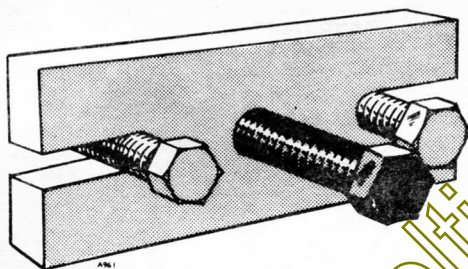


FIGURE 37. ONAN FLYWHEEL PULLER

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.

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

A magneto flywheel which has lost its magnetism can be remagnetized. The spark should jump a 3/16-inch gap with ease, as tested by holding the spark plug wire away from a clean metal part of the engine while cranking.

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 roll pin prevents cup rotation, but allows for the proper expanding action of the governor cup against the yoke. See Figure 38.

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 3/4 inch from the cover mounting surface.

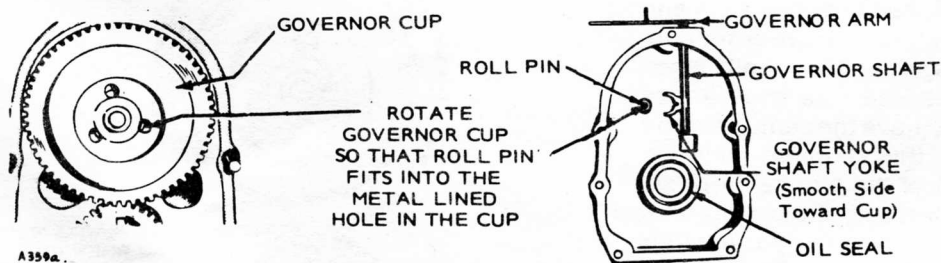


FIGURE 38. GEAR COVER ASSEMBLY

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 (Figure 39).

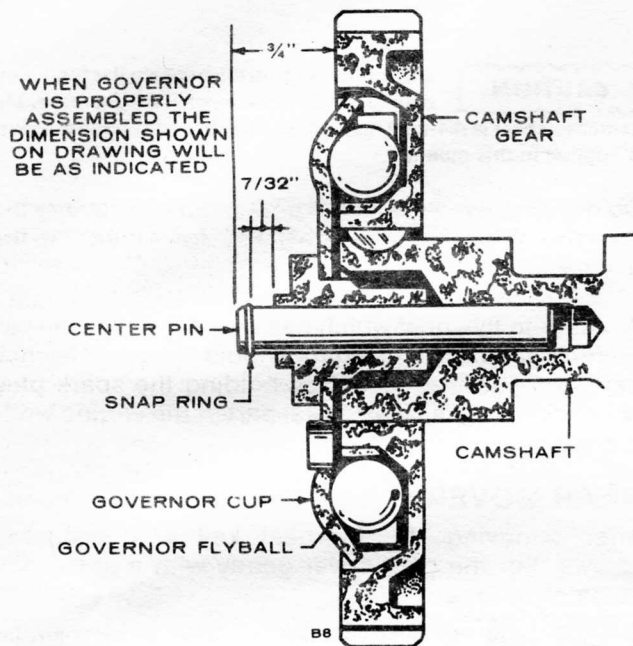


FIGURE 39. GOVERNOR CUP

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.

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 or 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, either gear can be

replaced if the other mating gear is still usable. Use a gear pulling ring (number 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.

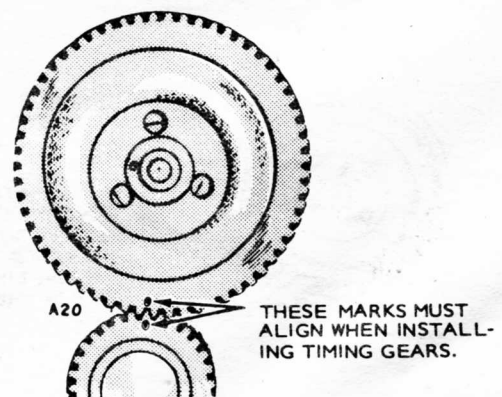
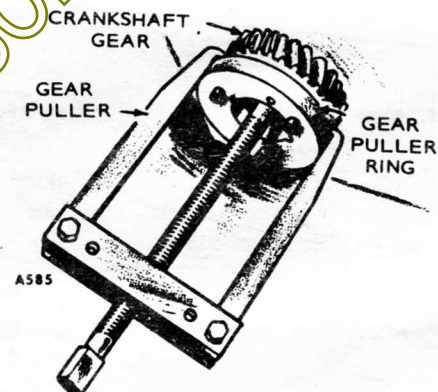


FIGURE 40. TIMING GEAR REMOVAL AND INSTALLATION

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 40. 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.

CYLINDER HEADS

The cylinder head should be tightened in the order designated per Figure 41 to a torque of 5 foot-pounds, then 10 foot-pounds, etc. until all are torqued to 29 to 31 foot-pounds.

CAUTION

Do not remove heads when they are hot. Warpage may occur.

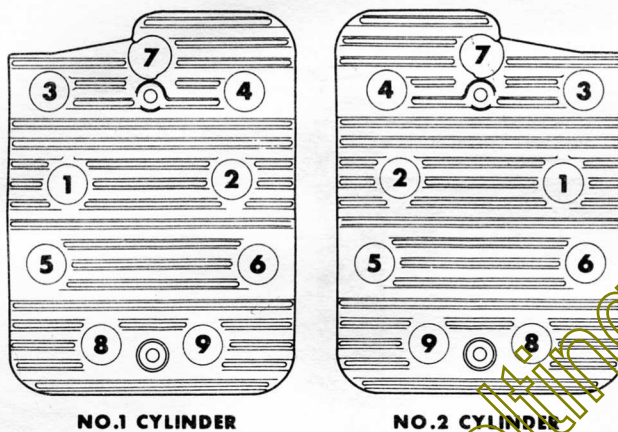


FIGURE 41. HEAD BOLT TIGHTENING SEQUENCE

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 42. 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.

The valve *face* angle is 44 degrees. The valve *seat* angle is 45 degrees. This 1-degree 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 43.

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 degrees. Valve seats should be ground with a 45 degree 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

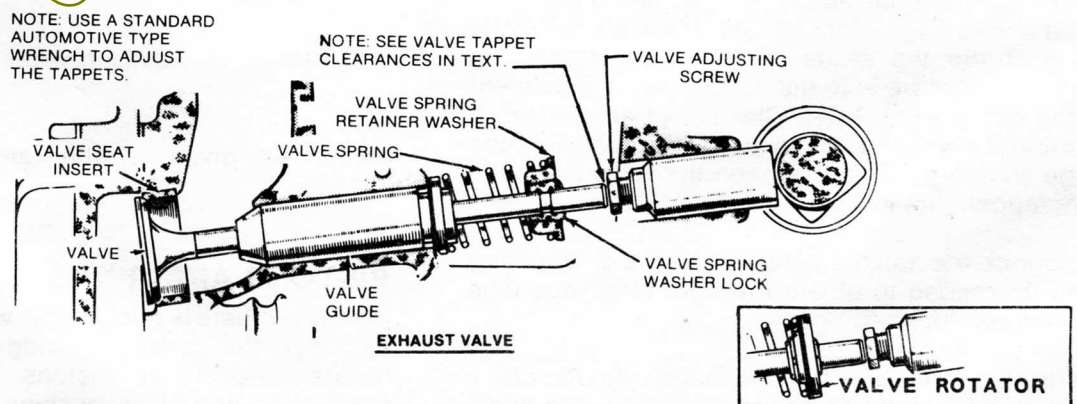


FIGURE 42. CCK AND CCKA VALVE SYSTEM

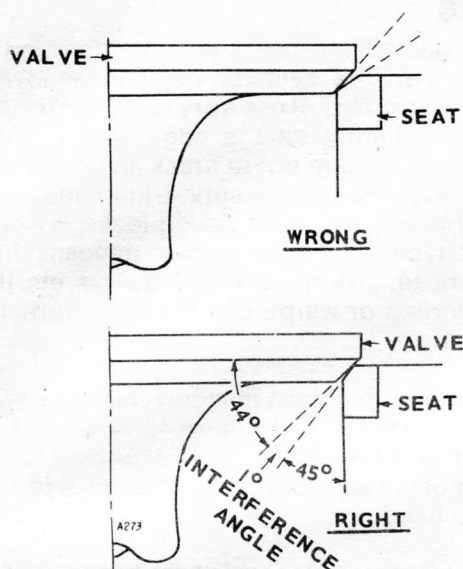


FIGURE 43. VALVE FACE AND SEAT ANGLES

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 *Tapped 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 44.

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

INTAKE AND EXHAUST VALVES
(SEE TABLE OF CLEARANCES)

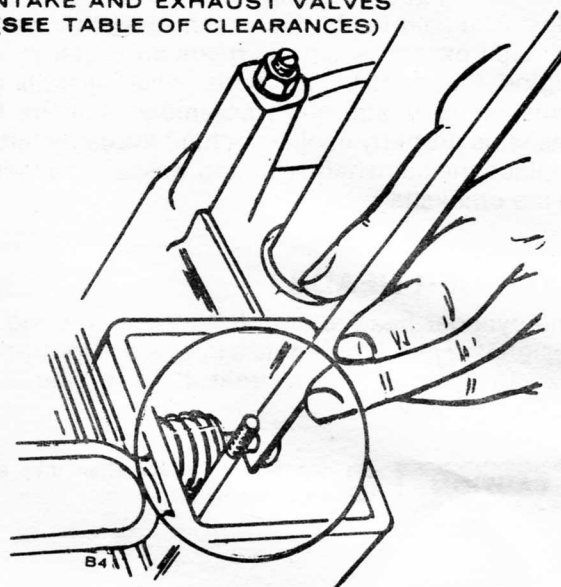
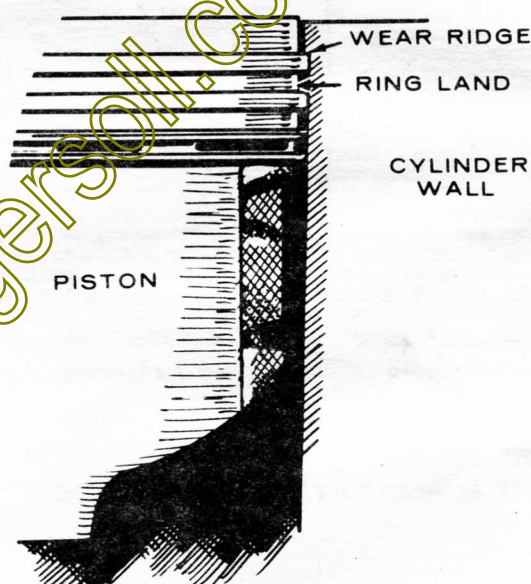


FIGURE 44. ADJUSTING TAPPETS



REMOVING PISTON WITH LARGE WEAR RIDGE COULD BREAK RING OR RING LAND.

FIGURE 45. WEAR RIDGE ON CYLINDER WALL

adjustment given for the valves of the left hand cylinder.

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 not, the rings can catch the ridge when pushing out the pistons and cause a ring land fracture, Figure 45.

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.

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 46). All passages should be cleaned with a non-caustic solvent. Clean the rod bore and the back of the connecting rod bearings thoroughly.

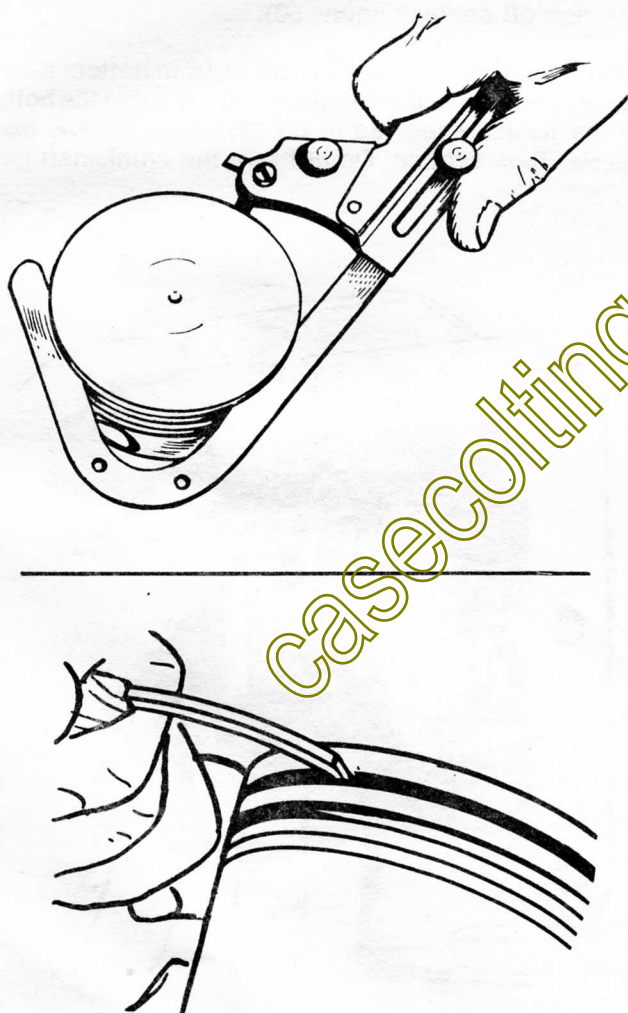


FIGURE 46. CLEANING RING GROOVES

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.

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 47. See *DIMENSIONS AND CLEARANCES* section for proper side clearance measurement.

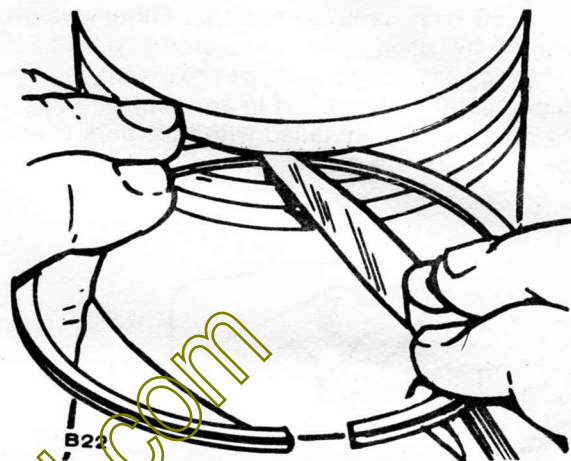


FIGURE 47. INSPECTING RING LANDS

Improper width rings or excessive ring side clearance can result in ring breakage. New rings in worn ring grooves do not have good cylinder wall contact, Figure 48.

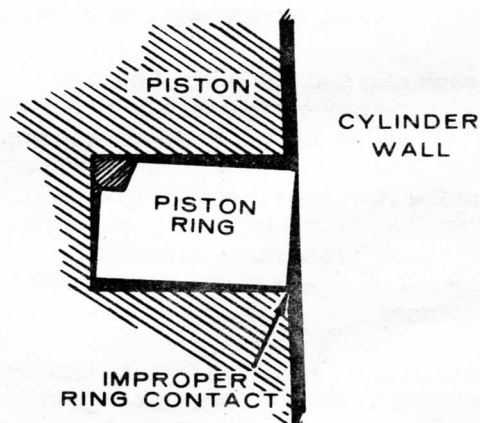


FIGURE 48. NEW RING IN WORN PISTON RING GROOVE

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.

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 49. 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. 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.

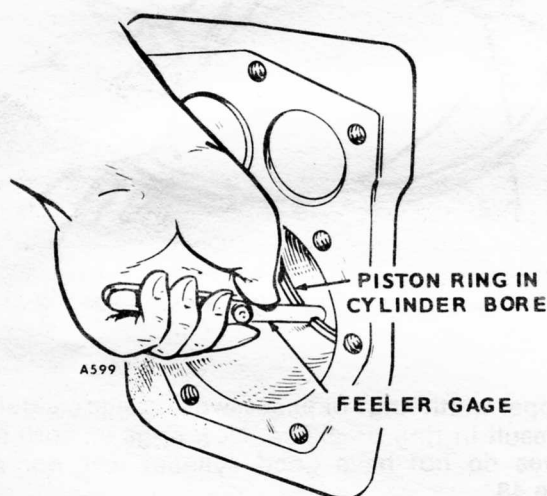


FIGURE 49. FITTING PISTON RINGS TO CYLINDER

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 List* 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 surfaces 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 Plastigauge: Make certain that all parts are marked or identified so that they are reinstalled in their original positions.

Place a piece of correct size Plastigauge in the bearing cap the full width of the bearing insert about 1/4 inch off center (Figure 50).

Rotate the crank about 30 degrees 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.

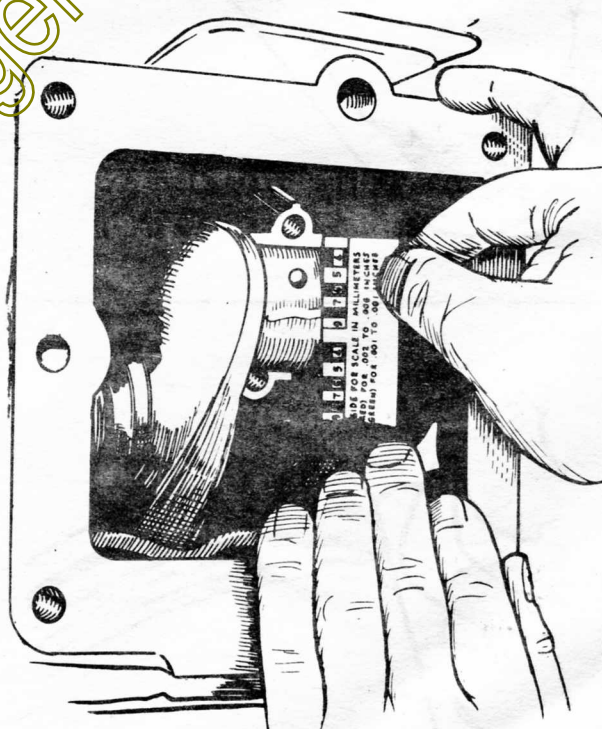


FIGURE 50. MEASURING BEARING CLEARANCE WITH PLASTIGAUGE

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

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 percent kerosene and 75 percent 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.

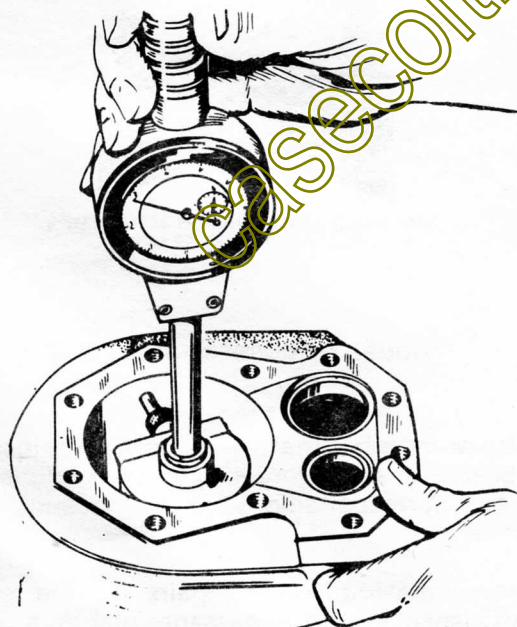
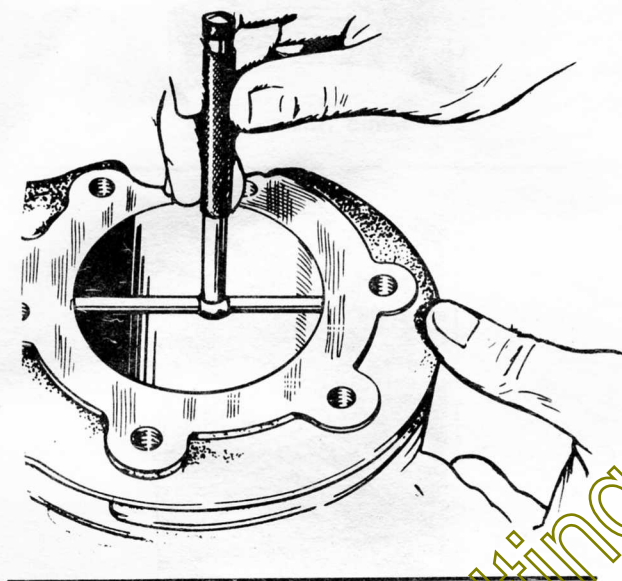


FIGURE 51. METHODS OF CYLINDER BORE INSPECTION

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 51. These measurements should be taken at four places — two at the top and two at the 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.
 - 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, rebore 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 rebored and honed for the next oversize piston. A reboring 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 rebore a cylinder, Figure 52. 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

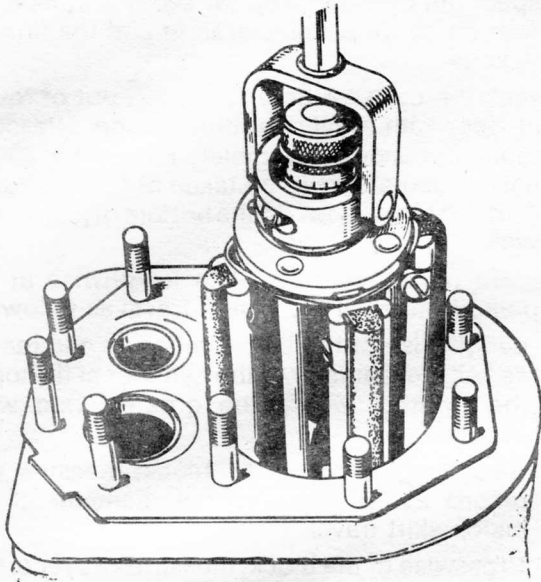
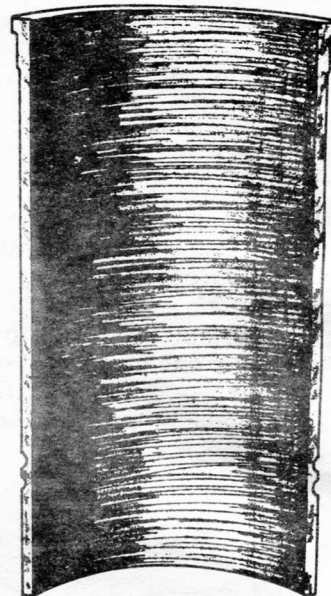
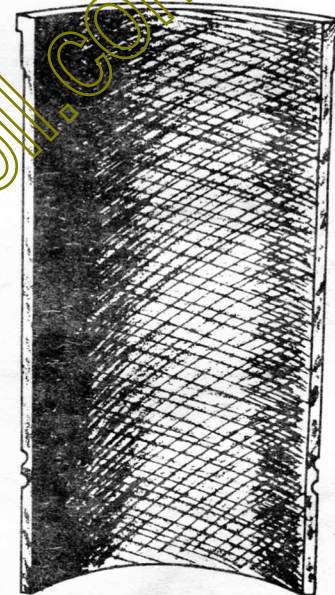


FIGURE 52. HONING CYLINDER



AVOID THIS FINISH



PRODUCE CROSS HATCH SCRATCHES
FOR FAST RING SEATING

FIGURE 53. CORRECT HONE FINISH

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 degree 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 53. The crosshatch formed by the scratching of the stones should form an angle of 23 degrees. 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.

CRANKSHAFT

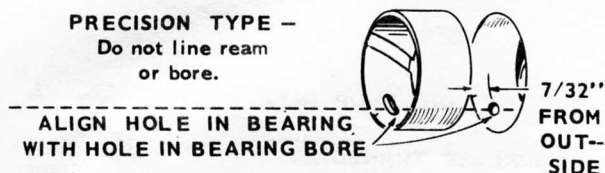
Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, the bearing journals should be refinished to use nearest available undersize bearings or a new crankshaft should be installed. If a worn main bearing journal cannot be fitted with an available precision type undersize bearing, then refinish it to the next under-

size. 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.

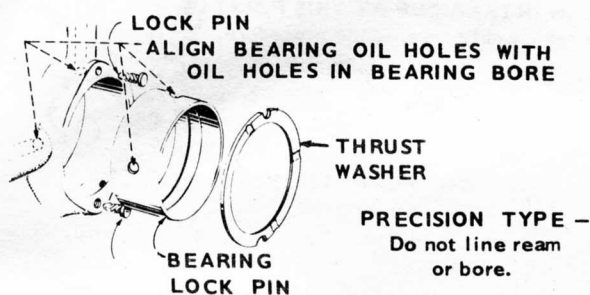
Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

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 54. Use combination bearing driver 420-0324 to install the camshaft bearings.



CAMSHAFT BEARING



CRANKSHAFT BEARING

FIGURE 54. INSTALLATION OF CAM AND CRANKSHAFT 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.

Crankshaft: New crankshaft main bearings are precision type which *do not* require line reaming or line boring after installation. See *Parts List* 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.

CAUTION

If a torch is used, to prevent warpage, apply only a little heat.

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.

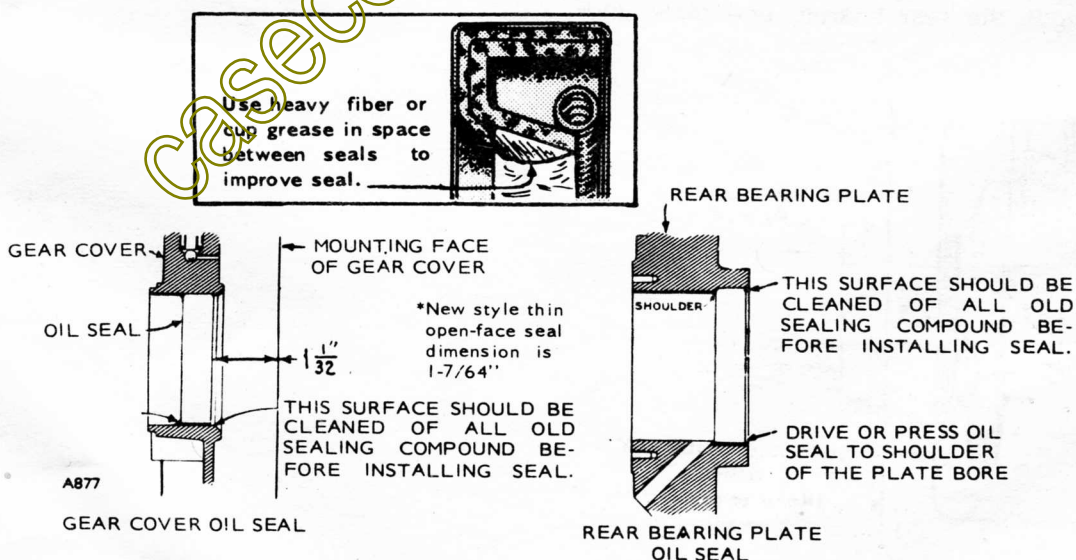


FIGURE 55. GEAR COVER AND REAR BEARING PLATE OIL SEALS

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 55.

When installing the gear cover oil seal, press the seal inward until rear (spring side) of casing is 1-1/32-inch from the mounting face of the gear cover. Install new style, thin open face seal, 1-7/64 inches from mounting face of cover.

When installing the bearing plate oil seal, press 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.

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 56. 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

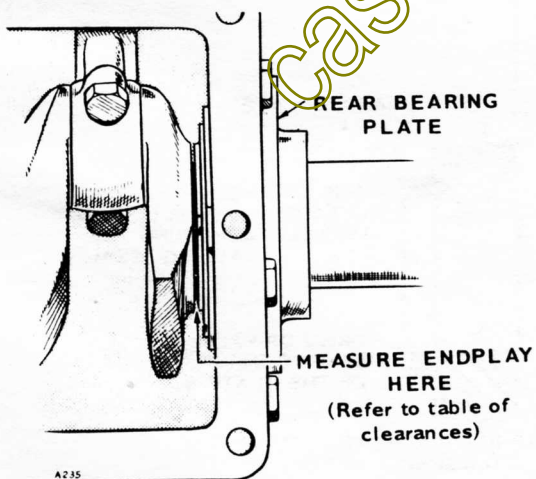


FIGURE 56. MEASURING CRANKSHAFT ENDPLAY

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.

OIL PUMP

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling, Figure 57. 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.

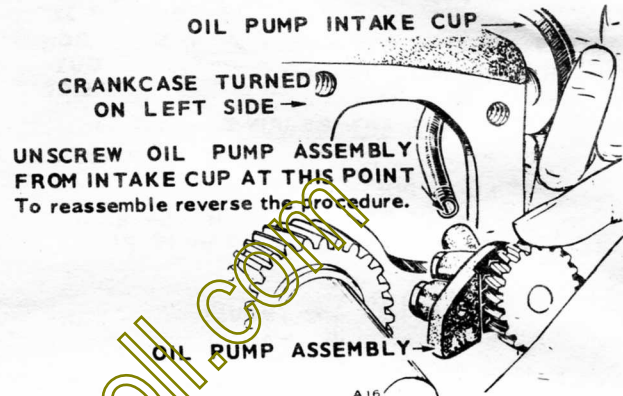


FIGURE 57. OIL PUMP

PARTS CATALOG

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.

The image shows a rectangular nameplate with a black background and white text. At the top is the Onan logo. Below it are fields for 'MODEL AND SPEC NO.' and 'SERIAL NO.'. A bold 'IMPORTANT' section follows, with the instruction 'ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS'. Below this are maintenance instructions: 'CHECK OIL LEVEL DAILY', 'CHANGE OIL EVERY 100 HOURS', 'OIL CAPACITY [] QTS', 'BELOW 30°F --- SAE 10W', 'ABOVE 30°F --- SAE 30', 'FOR EXTREME OPERATING TEMPERATURES SEE YOUR SERVICE MANUAL', and 'BATTERY --- [] VOLT'. At the bottom, it says 'MANUFACTURED BY ONAN' and 'DIVISION OF ONAN CORPORATION MINNEAPOLIS, MINNESOTA, U.S.A.'.

For handy reference, insert "YOUR" 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.

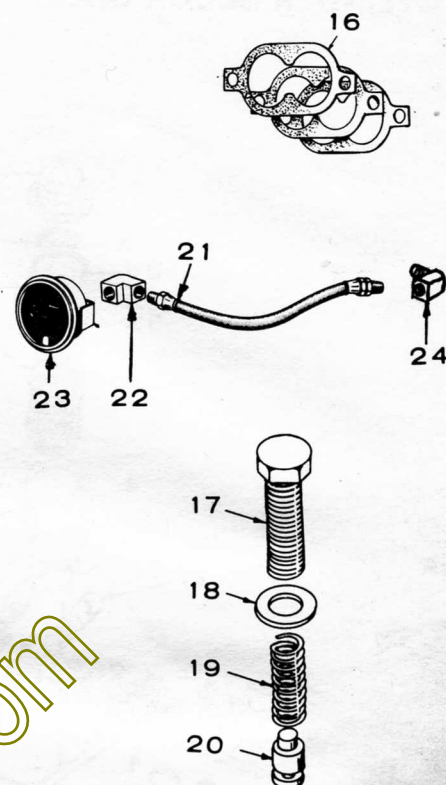
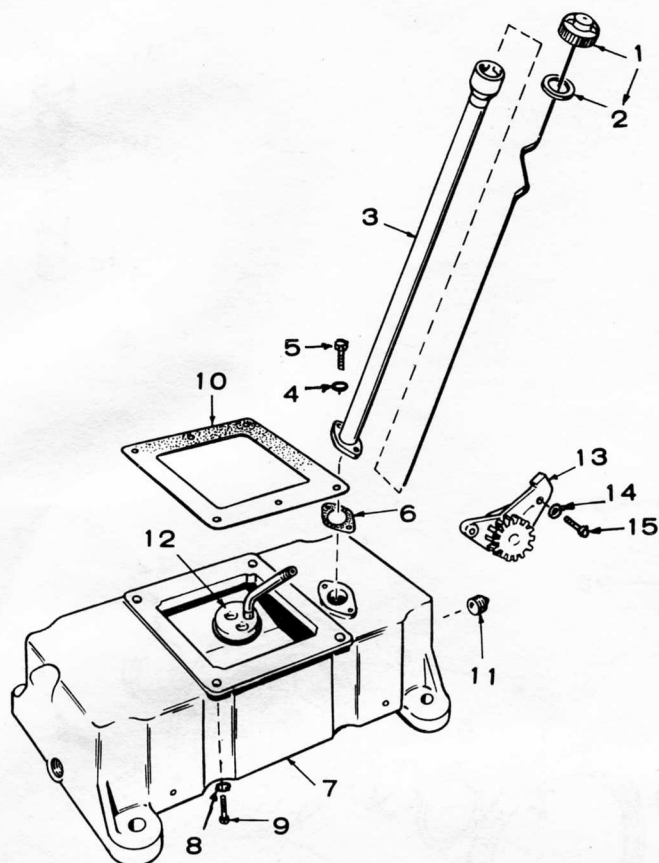
"En esta lista de partes los precios se omiten de proposito, ya que bastante confusion resulto de fluctuaciones de los precios, derechos aduanales, impuestos de venta, cambios extranjeros, etc."

Consiga los precios vigentes de su distribuidor de productos "ONAN".

This catalog applies to the CCK and CCKA Engines listed below. Parts are arranged in groups of related items. Each part is identified by a reference number corresponding to the same reference number in the illustration. Parts illustrations are typical. Using the *MODEL* and *SPEC NO.* from the engine nameplate, select the Parts Key No. (1, 2, etc., in the last column) that applies to your Engine. This Parts Key No. represents parts that differ between models. Unless otherwise mentioned in the description, parts are interchangeable between models. Right and left engine sides are determined by *facing* the blower end (front) of the engine.

ENGINE DATA TABLE

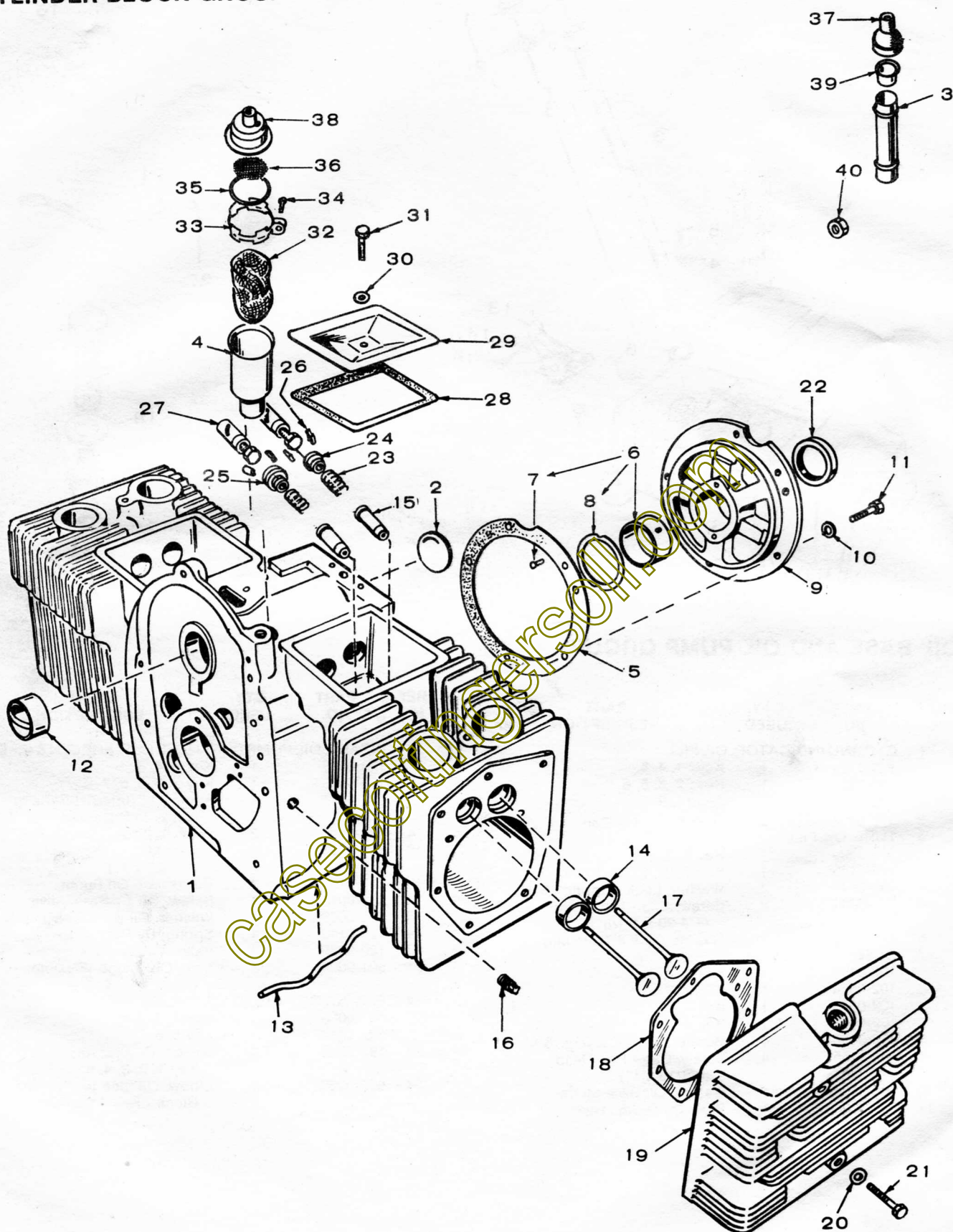
MODEL AND SPECIFICATION NUMBER	PARTS KEY NUMBER
CCK-S/1195G	1
CCK-MS/1196G	2
CCKA-MS/2052G	3
CCKA-S/2103G	4
CCKA-MS/2237G	5
CCKA-MS/2677G	6
CCKA-MS/2748J	7
CCKA-S/2769J	8
CCKA-MS/2778J	9



OIL BASE AND OIL PUMP GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	CAP AND INDICATOR, OIL FILL			12	INTAKE, OIL PUMP (INCLUDES CUP, SCREEN & PIPE)		
	123-0489	1	Keys 1, 4, 8		120-0400	1	Key 1, 4, 8
	123-0527	1	Keys 2, 3, 5, 6		120-0648	1	Key 2, 3, 5, 6, 7, 9
	123-0694	1	Keys 7, 9	13	120-0491	1	Pump, Oil (Internal Parts Not Sold Separately)
2	123-0191	1	Gasket, Oil Fill Cap	14	850-0040	2	Washer, Lock - Spring (1/4")
3	TUBE, OIL FILL			15	800-0007	2	Screw, Cap - Hex Head (1/4-20 x 1-1/8")
	123-0508	1	Key 2, 3, 5, 6	16	120-0161	1	Gasket Kit, Oil Pump
	123-1149	1	Key 7, 9	17	801-0048	1	Screw, Oil By-Pass Valve
4	850-0040	2	Washer, Lock - Spring (1/4")	18	526-0066	1	Washer, Oil By-Pass Valve
5	800-0004	2	Screw, Cap - Hex Head (1/4-20 x 1-1/8")	19	120-0140	1	Spring, By-Pass Valve
6	141-0078	1	Gasket, Oil Fill Tube Mtg.	20	120-0398	1	Valve, Oil By-Pass
7	BASE, OIL			21	501-0004	1	Line, Oil Gauge (Flexible) - Key 1, 2, 3, 4, 5, 6
	102-0402	1	Key 1, 4, 8	22	ELBOW, OIL LINE TO OIL GAUGE		
	102-0564	1	Key 2, 3, 5		502-0005	1	Key 1, 2, 3, 4
	102-0773	1	Key 7, 9		502-0017	1	Key 5, 6
	102-0766	1	Key 6	23	193-0068	1	Gauge, Oil Pressure - Key 1, 2, 3, 4, 5, 6
8	850-0050	4	Washer, Lock - Spring (3/8")	24	502-0020	1	Elbow, Oil Line to Cylinder Block - Key 1,2,3,4,5,6
9	102-0455	4	Screw, Cap - Hex Head (3/8-16 x 1")				
10	102-0158	1	Gasket, Oil Base Mounting				
11	505-0056	1	Plug, Oil Drain (1/2")				

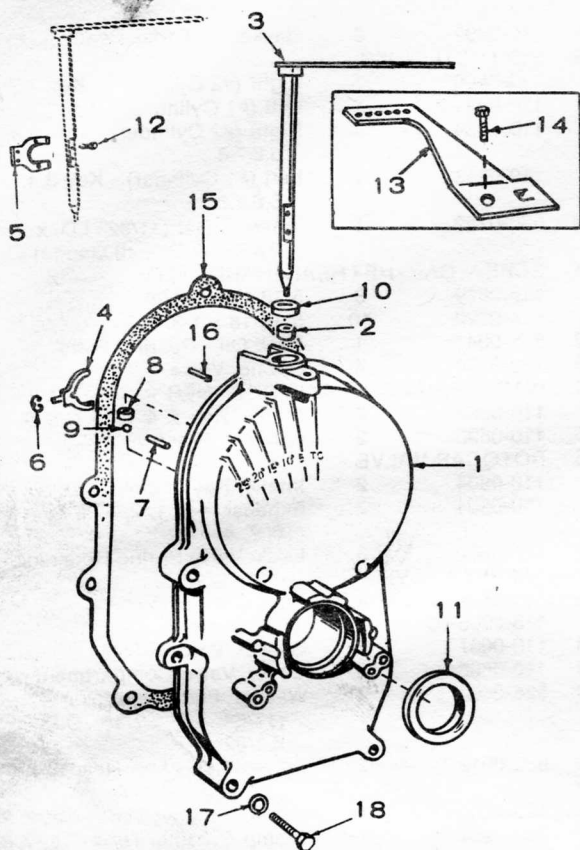
CYLINDER BLOCK GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	BLOCK ASSEMBLY, CYLINDER (Includes Parts Marked *)			18	110-0892	2	Gasket, Cylinder Head
	110-1516	1	Key 1, 2, 3, 4, 5, 6	19	HEAD, CYLINDER		
	110-2358	1	Key 7, 8, 9		110-0890	1	Right (#2 Cylinder) - Key 1,2
2	517-0048	1	Plug, Camshaft - Expansion		110-0891	1	Left (#1 Cylinder) - Key 1,2
	*TUBE, BREATHER				110-0884	1	Right (#2 Cylinder) - Key 3,4, 5,6,7,8
3	123-0129		Key 1, 2, 3, 4, 5, 6		110-0883	1	Left (#1 Cylinder) - Key 3,4, 5,6,7,8
4	123-0953	1	Key 7, 8, 9	20	526-0122	1	Washer, Flat (11/32" I.D. x 23/32" O.D. x 10 Gauge)
5	101-0115	1	*Gasket Kit, Bearing Plate	21	SCREW, CAP - HEX HEAD (HARDENED)		
6	BEARING, CRANKSHAFT (Includes Pins and Thrust Washer)				110-0879	8	5/16-18 x 1-1/4"
	101-0450	2	*Standard		114-0022	10	5/16-18 x 1-3/4"
	101-0450-02	2	.002" Undersize	22	509-0041	1	Seal, Oil - Bearing Plate
	101-0450-10	2	.010" Undersize	23	110-0539	4	Spring, Valve
	101-0450-20	2	.020" Undersize	24	WASHER, VALVE SPRING RETAINER		
	101-0450-30	2	.030" Undersize		110-0893	2	Intake, Key 3, 4, 5, 6, 7, 8, 9
7	516-0072	4	*Pin, Main Bearing Stop		110-0893	2	Exhaust, Key 9
8	104-0575	2	*Washer, Crankshaft Bearing	25	ROTOCAP, VALVE		
9	101-0316	1	*Plate, Bearing (Excludes Bearing)		110-0904	2	Intake, Key 1, 2
10	850-0045	5	*Washer, Lock - Spring (5/16")		110-0904	2	Exhaust, Key 1, 2, 3, 4, 5, 6, 7, 8
11	800-0512	5	*Screw, Cap - Hex Head (5/16-18 x 1")	26	110-0639	8	Lock, Valve Spring Retaining
12	101-0367	2	*Bearing, Camshaft (Precision)	27	TAPPET, VALVE		
13	120-0386	1	*Tube, Oil		115-0006	4	Standard
14	INSERT, VALVE SEAT				115-0006-05	4	.005" Oversize
			Exhaust	28	110-0667	2	Gasket, Valve Cover
	110-0872	2	*Standard	29	110-0666	2	Cover, Valve Compartment
	110-0872-02	2	.002" Oversize	30	526-0063	2	Washer, Flat - Copper (17/64" I.D. x 7/16" O.D. x 1/32")
	110-0872-05	2	.005" Oversize	31	800-0012	2	Screw, Cap - Hex Head (1/4-20 x 2-1/4")
	110-0872-10	2	.010" Oversize	32	123-0865	1	Baffle, Breather Tube - Key 7, 8, 9
	110-0872-25	2	.025" Oversize	33	123-0951	1	Clamp, Breather Tube - Key 7, 8, 9
			Intake	34	809-0035	1	Screw, Tapping - Round Head (#8 x 3/4") - Key 7, 8, 9
	110-1000	2	*Standard	35	509-0117	1	Seal, "O" Ring - Breather Tube - Key 7, 8, 9
	110-1000-02	2	.002" Oversize	36	123-0958	1	Screen, Breather Tube - Key 7,8,9
	110-1000-05	2	.005" Oversize		CAP, BREATHER TUBE		
	110-1000-10	2	.010" Oversize	37	123-0073	1	Key 1, 2, 3, 4, 5, 6
	110-1000-25	2	.025" Oversize	38	123-0954	1	Key 7, 8, 9
15	110-0902	4	*Guide, Valve	39	123-0104	1	Valve, Breather Tube - Key 1, 2, 3, 4, 5, 6
16	505-0057	1	Plug, Pipe - Wet Hole	40	110-0445	5	Nut, Bearing Plate Mounting - Key 1, 2, 3, 4, 5, 6
17	VALVE						
	110-1037	2	Intake, Stellite - Key 1, 2				
	110-0881	2	Intake, Steel - Key 3, 4, 5, 6, 7, 8, 9				
	110-0880	2	Exhaust, Stellite				

* - Included in Cylinder Block Assembly.

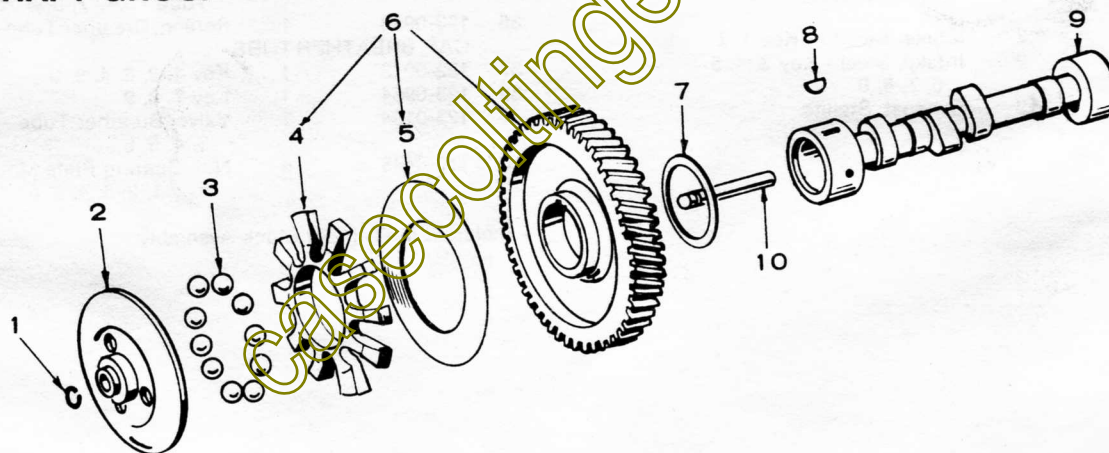
GEAR COVER GROUP



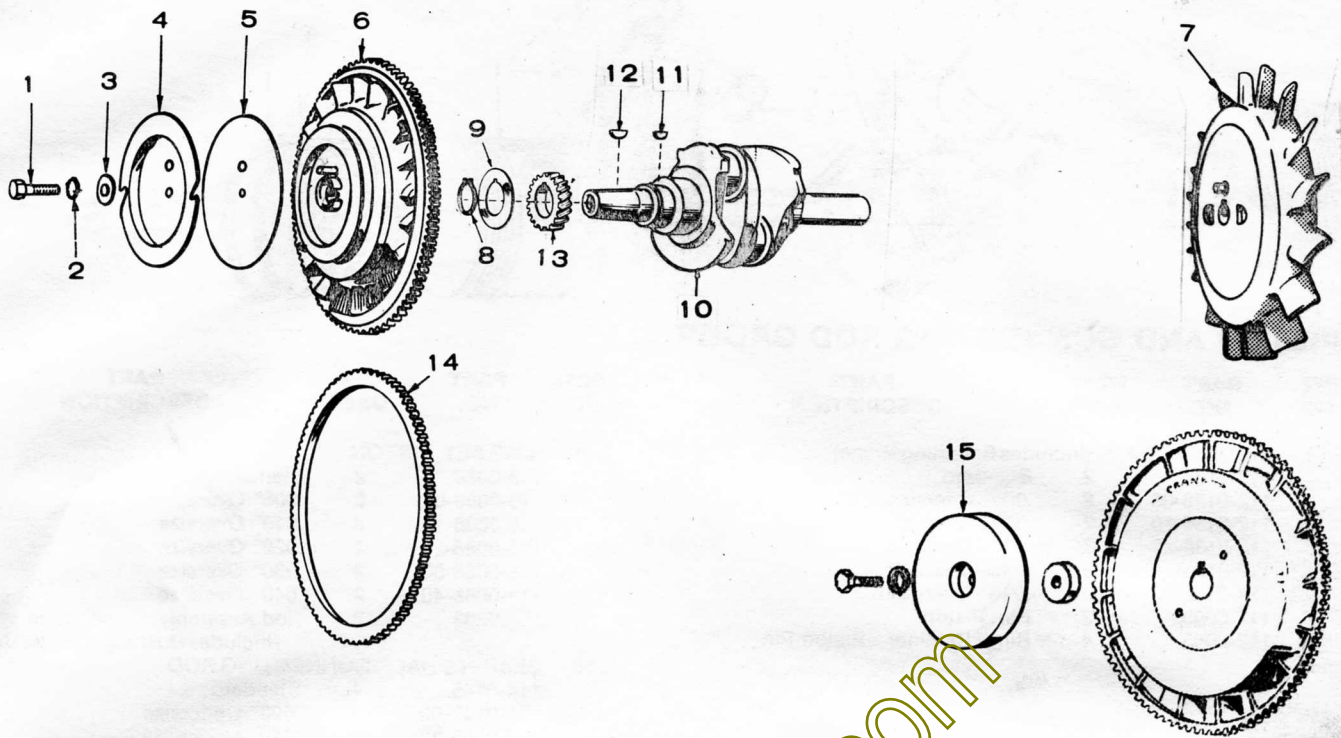
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	COVER ASSEMBLY, GEAR (Includes Parts Marked *)		
	103-0207	1	Key 1, 2, 3, 4, 5, 6
	103-0428	1	Key 7, 8, 9
2	510-0013	1	*Bearing, Governor Shaft - Upper
3	*SHAFT AND ARM, GOVERNOR		
	150-0377	1	Key 1, 2, 3, 4, 5, 6
	150-1421	1	Key 7, 8, 9
	*YOKE, GOVERNOR SHAFT		
4	150-0620	1	Key 1, 2, 3, 4, 5, 6
5	150-1187	1	Key 7, 8, 9
6	518-0129	1	*Ring, Yoke Retainer - Key 1, 2, 3, 4, 5, 6
7	516-0130	1	*Pin, Governor Cup Stop
8	*BEARING, GOVERNOR SHAFT (LOWER)		
	510-0008	1	Key 1, 2, 3, 4, 5, 6
	510-0013	1	Key 7, 8, 9
9	510-0014	1	*Ball, Bearing - Governor Shaft
10	509-0008	1	*Seal, Oil - Governor Shaft
11	509-0040	1	*Seal, Oil - Gear Cover
12	815-0046	2	*Screw, Pan Head Machine (#8-32 x 3/8") - Key 7, 8, 9
13	150-0988	1	Extension, Governor Arm
14	815-0181	1	Screw, Tapping - Hex Head w/ET (#10-32 x 1/8")
15	103-0011	1	Gasket, Gear Cover
16	516-0141	2	Pin, Gear Cover Locating
17	850-0045	5	Washer, Lock - Spring (5/16")
18	SCREW, CAP - HEX HEAD		
	800-0032	4	5/16-18 x 1-3/4"
	800-0034	1	5/16-18 x 2-1/4"

* - Included in Gear Cover Assembly.

CAMSHAFT GROUP

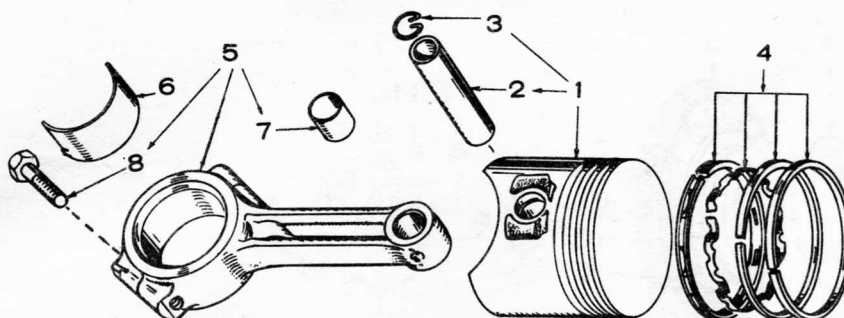


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150-0078	1	Ring, Camshaft Center Pin
2	150-1116	1	Cup, Governor
3	510-0015	10	Ball, Fly - Governor
4	150-1257	1	Spacer, Governor Flyball
5	150-0077	1	Plate, Governor Flywheel
6	105-0332	1	Gear, Camshaft - Timing
7	105-0004	1	Washer, Camshaft Gear Thrust
8	515-0001	1	Key, Camshaft Gear Mounting
9	105-0238	1	Camshaft (Includes Center Pin)
10	150-0075	1	Pin, Camshaft Center



CRANKSHAFT AND FLYWHEEL GROUP

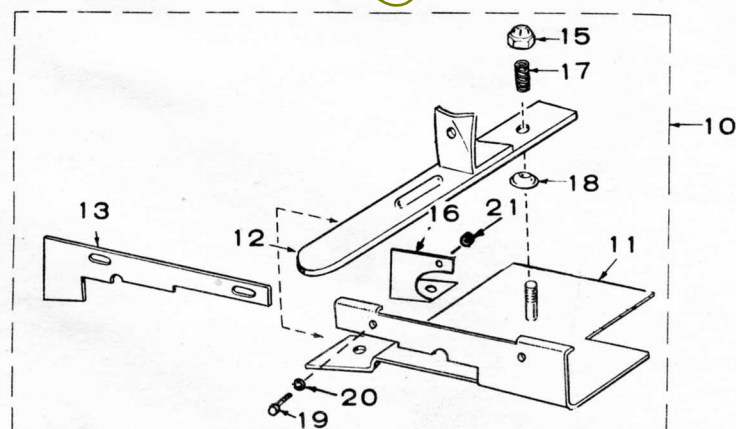
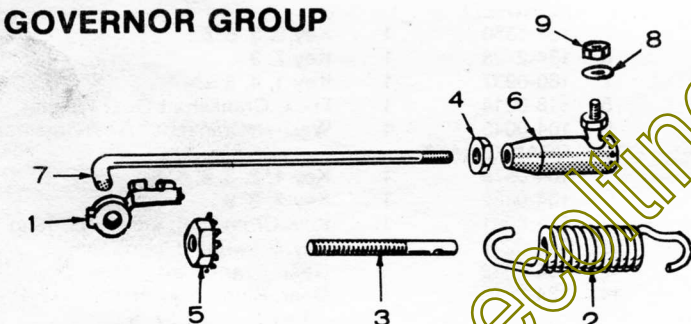
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	104-0170	1	SCREW, CAP - HEX HEAD (Flywheel Mounting)	6	134-1550	1	FLYWHEEL
	104-0369	1	7/16-14 x 4-1/8" - Key 1, 4, 7, 8, 9	6	134-2728	1	Key 2, 3, 5, 6
2	850-0055	1	7/16-14 x 5" - Key 2, 3, 5, 6	7	160-0937	1	Key 7, 9
3	526-0017	1	Washer, Lock - Spring (7/16")	8	518-0014	1	Key 1, 4, 8
	526-0128	1	WASHER, FLAT (Flywheel Mounting)	9	104-0043	1	Lock, Crankshaft Gear Washer
			15/32" I.D. x 1-1/4" O.D. x 1/4" - Key 1, 4, 8	10	104-0578	1	Washer, Crankshaft Gear Retainer
4	192-0308	1	15/32" I.D. x 1-1/2" O.D. x 1/4" - Key 2, 3, 5, 6, 7, 9	10	104-0882	1	CRANKSHAFT
5	192-0296	1	Sheave, Rope - Key 1, 2, 3, 4, 5, 6, 8	11	515-0001	1	104-0578
			Backplate, Rope Sheave - Key 2, 3, 5, 6	12	515-0227	1	104-0882
				13	104-0032	1	Key, Crankshaft Gear Mounting
				14	134-0673	1	Key, Flywheel Mounting
				15	134-2824	1	Gear, Crankshaft - Timing
							104-0032
							134-0673
							134-2824
							Key 2, 3, 5, 6, 7, 9
							Guard, Flywheel Capscrew - Key 7, 8, 9



PISTON AND CONNECTING ROD GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PISTON AND PIN (Includes Retaining Rings)			4	RING SET, PISTON		
112-0136	2	Standard		113-0088	2	Standard	
112-0136-05	2	.005" Oversize		113-0088-05	2	.005" Oversize	
112-0136-10	2	.010" Oversize		113-0088-10	2	.010" Oversize	
112-0136-20	2	.020" Oversize		113-0088-20	2	.020" Oversize	
112-0136-30	2	.030" Oversize		113-0088-30	2	.030" Oversize	
112-0136-40	2	.040" Oversize		113-0088-40	2	.040" Oversize	
2	112-0069	2	Pin, Piston	5	114-0203	2	Rod Assembly, Connecting (Includes Bushing & Place Bolts)
3	112-0003	4	Ring, Retainer - Piston Pin	6	BEARING HALF, CONNECTING ROD		
				114-0145	4	Standard	
				114-0145-02	4	.002" Undersize	
				114-0145-10	4	.010" Undersize	
				114-0145-20	4	.020" Undersize	
				114-0145-30	4	.030" Undersize	
				7	114-0036	2	Bushing, Piston Pin - Connecting Rod
				8	805-0010	4	Bolt, Place (5/16-24 x 1-1/4")

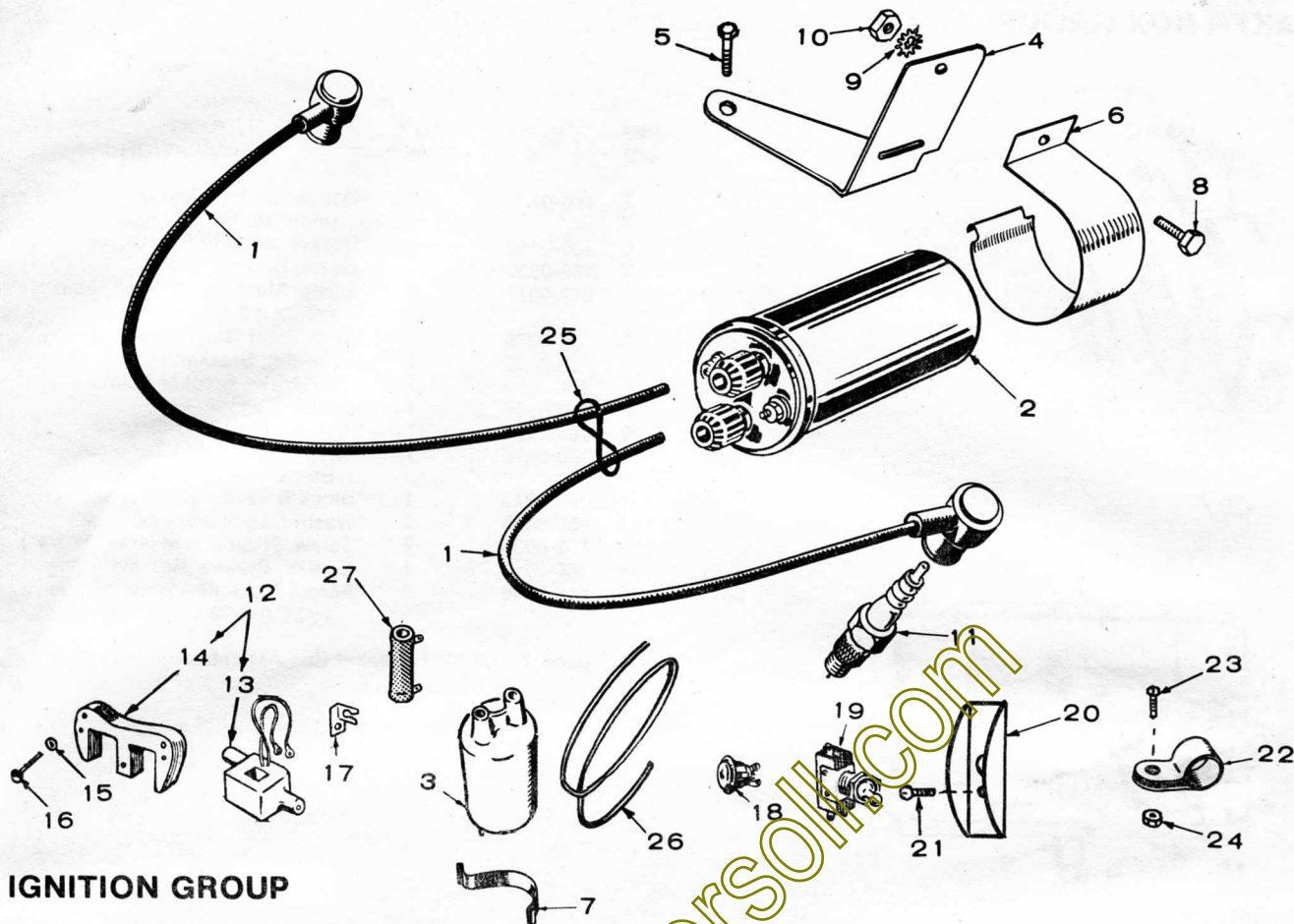
GOVERNOR GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	518-0006	1	Clip, Governor Link End
2	150-0098	1	Spring, Governor
3	150-1009	1	Stud, Speed Adjusting
4	870-0053	1	Nut, Machine - Hex (#10-32)
5	870-0200	1	Nut, Machine - Hex (#10-32) w/ET
6	150-0639	1	Joint, Ball
7	150-0629	1	Link, Governor
8	526-0196	1	Washer, Flat (7/32 I.D. x 7/16 O.D. x 1/8" Thick)
9	870-0131	1	Nut, Machine - Hex with ET (#10-32)
10	ARM ASSEMBLY, VARIABLE SPEED CONTROL		
	152-0212	1	Key 7, 8, 9 (Includes Parts Marked *)
	152-0147	1	Key 1, 2, 3, 4, 5, 6 (Includes Parts Marked †)
11	152-0146	1	*†Bracket, Variable Speed Lever
12	LEVER, SPEED CONTROL		
	152-0211	1	*Key 7, 8, 9
	152-0145	1	†Key 1, 2, 3, 4, 5, 6
13	PLATE, ADJUSTING		
	152-0213	1	*Key 7, 8, 9
	152-0152	1	*Key 1, 2, 3, 4, 5, 6
14	152-0144	1	Adapter, Throttle Stop
15	870-0065	1	*†Nut, Locking (1/4-20)
16	152-0153	1	*†Stiffener, Speed Control Bracket
17	150-1012	1	*†Spring, Throttle Lever
18	152-0041	1	*†Washer, Tension - Adjusting Lever
19	812-0077	2	*†Screw, Machine - Round Head (#8-32 x 3/8")
20	853-0005	2	*†Washer, Lock - ET (#8)
21	860-0008	2	*†Nut, Machine - Hex (#8-32)

* - Included in 152-0212 Variable Speed Control Assembly.

† - Included in 152-0147 Variable Speed Control Assembly.



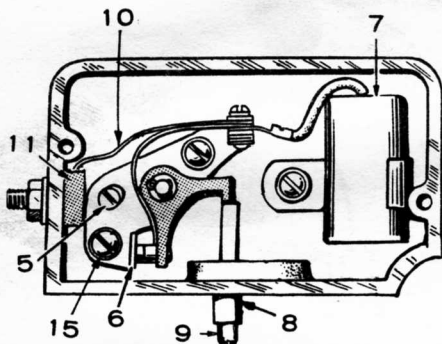
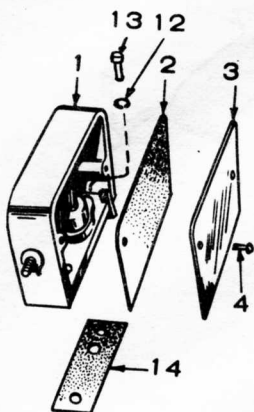
IGNITION GROUP

Note: See separate group for breaker box and associated parts.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	CABLE, SPARK PLUG			13	160-0750	1	*Coil, Magneto Stator - Key 1, 4, 8
	167-1463	1	Right Side	14	160-0749	1	*Shoe, Pole - Magneto Stator - Key 1, 4, 8
	167-1465	1	19" - Key 1, 4, 8				
	167-1464	1	8-3/4" - Key 2	15	WASHER, FLAT (Magneto Stator Assembly Mounting)		
	167-1556	1	24" - Key 3		- KEY 1, 4, 8		
	167-1494	1	11-1/2" - Key 5, 6		526-0015	2	9/32" I.D. x 9/16" O.D. x 1/16" Thick
			10" - Key 7, 9		526-0184	2	17/64" I.D. x 5/8" O.D. x 10 Gauge Thick
			Left Side	16	815-0259	2	Screw, Cap - Hex Head - Tapping (1/4-20 x 1-1/4") - Key 1, 4, 8
	167-1462	1	16-3/4" - Key 1, 4, 7, 8, 9	17	167-0188	4	Clip, Spark Plug Cables - Key 1, 4, 8
	167-1466	1	22-3/4" - Key 2	18	313-0018	1	Switch, Stop - Key 1, 4, 8
	167-1463	1	19" - Key 3	19	308-0140	1	Switch, Toggle - Start-Stop - Key 5, 6, 7, 9
	167-1464	1	24" - Key 5, 6	20	308-0356	1	Guard, Start Stop Switch - Key 7, 9
	COIL, IGNITION			21	808-0022	1	Screw, Tapping - Round Head (#8 x 3/8") - Key 7, 9
2	166-0535	1	Key 3, 5, 6, 7, 9	22	332-0051	1	Clip, Wire Support - Key 7, 9
3	160-0792	1	Key 2	23	813-0098	1	Screw, Machine - Round Head (#10-32 x 3/8") - Key 7, 9
4	166-0628	1	Bracket, Coil Mounting - Key 7, 9	24	870-0131	1	Nut, Machine - Hex (#10-32) - Key 7, 9
5	821-0004	1	Screw, Cap - Hex Washer Head (#10-32 x 5/16") - Key 7, 9	25	509-0035	1	Ring "O" - Spark Plug Cables - Key 3
	CLAMP, COIL MOUNTING			26	334-0028	1	Lead (4 foot piece of wire)
6	166-0588	1	Key 7, 9	27	304-0060	1	Resistor, Ignition (1.72-Ohm, 25 Watt)
7	160-0488	1	Key 2				
8	800-0004	1	Screw, Cap - Hex Head (1/4-20 x 5/8") - Key 7, 9				
9	856-0006	1	Washer, Lock - EIT (1/4") - Key 7, 9				
10	862-0001	1	Nut, Machine - Hex (1/4-20) - Key 7, 9				
11	167-0241	2	Plug, Spark				
12	160-0752	1	Magneto Stator Assembly (Includes Parts Marked *) - Key 1, 4, 8				

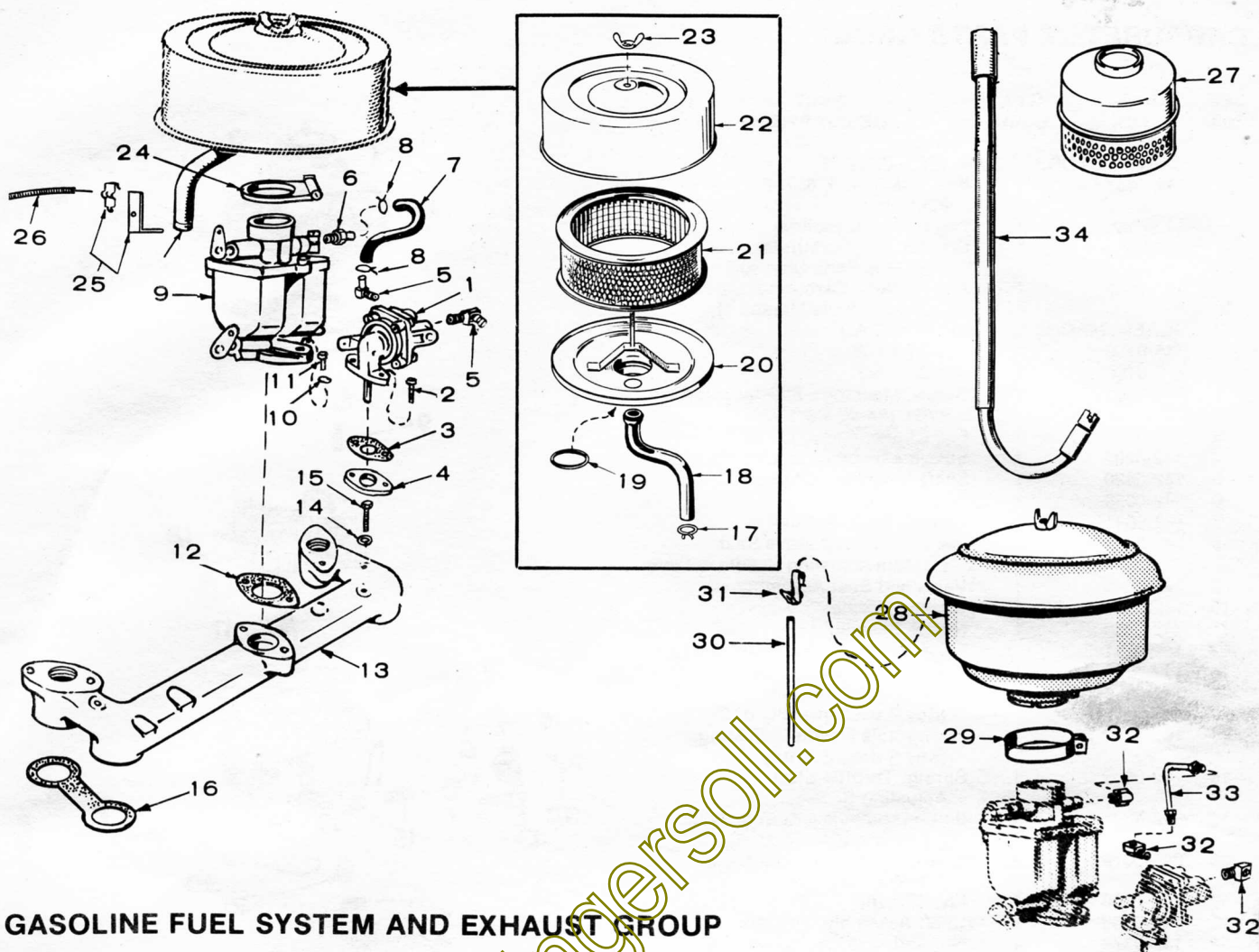
* - Included in 160-0752 Magneto Stator Assembly.

BREAKER BOX GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	160-0257	1	Box Assembly, Breaker (Includes Parts Marked *)
2	160-0150	1	*Gasket, Breaker Box Cover
3	160-0930	1	*Cover, Breaker Box
4	812-0077	2	*Screw, Machine - Round Head (#8-32 x 3/8")
5	160-0075	1	*Cam, Point Gap Adjusting
6	160-0002	1	*Point Set, Breaker
7	312-0069	1	*Condenser, Breaker Points
8	160-0264	1	*Guide, Plunger
9	160-0265	1	*Plunger, Breaker Points
10	160-0428	1	*Strap, Point Set to Terminal Block
11	160-0349	1	*Block & Terminal Assembly
12	850-0040	2	*Washer, Lock - Spring (1/4")
13	802-0034	2	*Screw, Socket Head (1/4-20 x 3/4")
14	160-0043	1	Gasket, Breaker Box Mounting
15	518-0049	3	*Screw, Machine - Round Head w/ET (#8-32 x 1/4")

* - Included in 160-0257 Breaker Box Assembly.



GASOLINE FUEL SYSTEM AND EXHAUST GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	149-0693	1	Pump, Fuel (See separate group for components)	17	503-0171	1	Clamp, Breather Tube - Key 7, 8, 9
2	806-0009	1	Screw, Cap - Counter Bore (1/4-20 x 1 1/2")	18	123-1199	1	Tube, Breather - Key 7, 8, 9
3	149-0003	2	Gasket, Fuel Pump Mounting	19	509-0124	1	Ring, "O" - Seal - Key 7, 8, 9
4	149-0045	1	Spacer, Fuel Pump Mounting	20	140-1294	1	Base, Air Cleaner - Key 7, 8, 9
5	ELBOW, ADAPTER TO HOSE			21	140-1216	1	Element, Air Cleaner - Key 7, 8, 9
	502-0313	1	Fuel Pump Inlet - Key 7, 8, 9	22	140-1295	1	Cover, Air Cleaner - Key 7, 8, 9
	502-0313	1	Fuel Pump Outlet - Key 8	23	865-0020	1	Nut, Wing (1/4-20) - Key 7, 8, 9
6	CONNECTOR, FUEL HOSE			24	140-1058	1	Clamp, Air Cleaner Mounting - Key 7, 8, 9
	502-0395	1	Fuel Pump Outlet - Key 7, 9	25	153-0263	1	Bracket and Clamp, Manual Choke
	502-0395	1	Carburetor Inlet - Key 7, 8, 9	26	CABLE, CHOKE		
7	HOSE, FUEL				153-0097	1	Key 7, 8, 9
	503-0694	1	Key 7, 9 (7")		153-0351	1	Key 1, 2, 3, 4, 5, 6
	503-0744	1	Key 8 (4-1/8")	27	155-0484	2	Muffler, Exhaust
8	503-0301	2	Clamp, Hose - Key 7, 8, 9	28	140-0283	1	Cleaner, Air - Key 1, 2, 3, 4, 5, 6
9	CARBURETOR (See separate group for components)			29	503-0019	1	Clamp, Air Cleaner Mounting - Key 1, 2, 3, 4, 5, 6
	142-0416	1	Key 1, 2, 3, 4, 5, 6, 7, 8 (Gasoline)	30	140-0471	1	Pipe, Breather - Key 1, 2, 3, 4, 5, 6
	142-0436	1	Key 9 (Gas-Gasoline)	31	140-0459	1	Bracket, Breather Pipe - Key 1, 2, 3, 4, 5, 6
10	850-0040	2	Washer, Lock - Spring (1/4")	32	ELBOW, STREET (90°)		
11	800-0009	2	Screw, Cap - Hex Head (1/4-20 x 1-1/2")		502-0002	1	Fuel Pump Outlet - Key 1, 2, 3, 4, 5, 6
12	141-0078	1	Gasket, Carburetor Mounting		502-0002	1	Carburetor Inlet - Key 1, 2, 3, 4, 5, 6
13	MANIFOLD, INTAKE				502-0020	1	Fuel Pump Inlet - Key 1, 2, 3, 4, 5, 6
	154-0688	1	Key 1, 2, 3, 4, 5, 6, 7, 8	33	149-0611	1	Line, Fuel Pump to Carburetor - Key 1, 2, 3, 4, 5, 6
	154-1639	1	Key 9	34	420-0169	1	Wrench, Carburetor Adjusting
14	850-0050	2	Washer, Lock - Spring (3/8")				
15	800-0054	2	Screw, Cap - Hex Head (3/8-16 x 2")				
16	154-0013	2	Gasket, Intake Manifold to Cylinder Block				

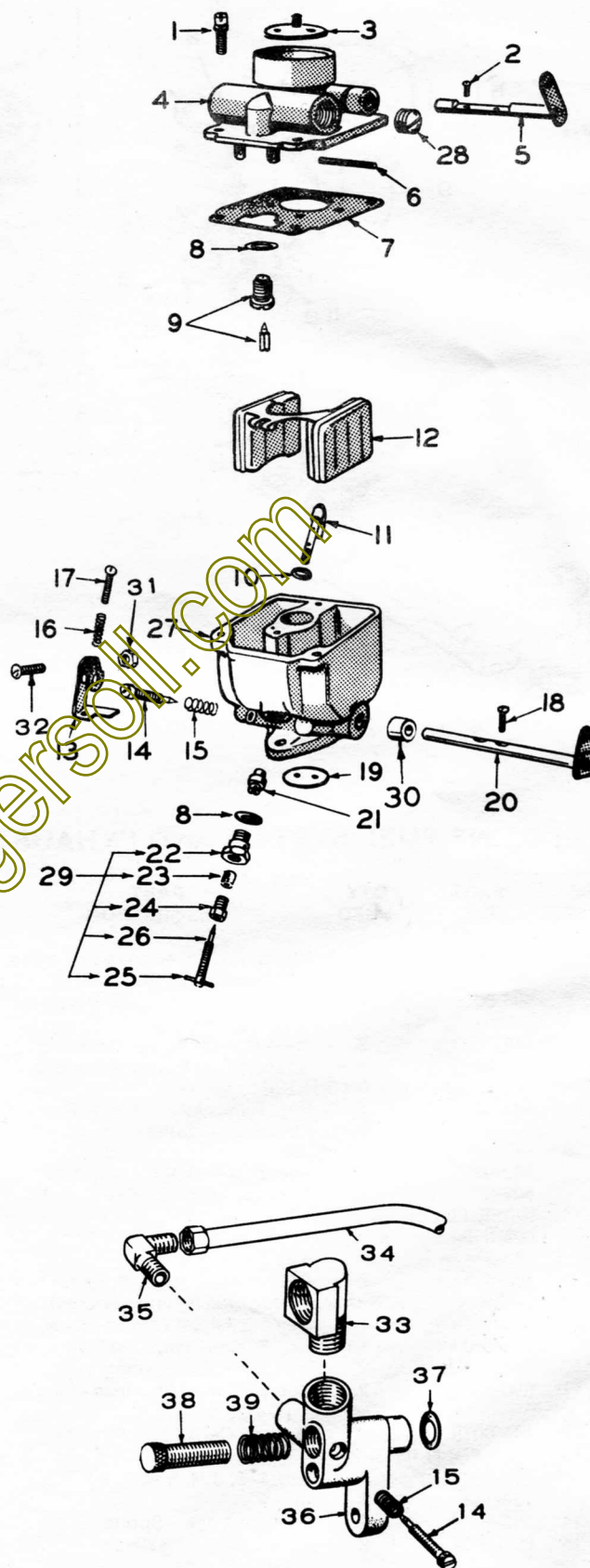
CARBURETOR PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	CARBURETOR ASSEMBLY, COMPLETE		
	142-0461	1	Key 1, 2, 3, 4, 5, 6, 7, 8 (Gasoline)
	142-0436	1	Key 9 (Gas-Gasoline)
	142-0371	1	Kit, Repair - Carburetor (Includes Parts Marked †)
	142-0033	1	Kit, Gasket - Carburetor (Includes Parts Marked *)
1	SCREW, MACHINE - FILLISTER HEAD		
	815-0103	1	#10-24 x 1/2"
	815-0109	2	#10-24 x 5/8"
2	815-0091	1	†Screw, Machine - Fillister Head w/ET (#4-40 x 3/16")
3	142-0055	1	Fly, Choke
4	142-0205	1	Sleeve Assembly, Choke (Cover)
5	142-0420	1	Shaft Assembly, Choke
6	142-0039	1	†Shaft, Float
7	142-0031	1	*†Gasket, Body to Bowl
8	148-0017	2	*†Gasket (1) Float Valve Seat (1) Main Adjusting Needle Retainer
9	142-0049	1	†Valve and Seat Assembly
10	142-0032	1	*†Gasket, Nozzle
11	142-0285	1	Nozzle Assembly
12	142-0361	1	Float and Lever Assembly
13	145-0008	1	Lever, Idle Stop
14	142-0040	1	†Needle, Idle Adjusting (Key 9 uses quantity of 2)
15	142-0282	1	Spring, Idle Needle Adjusting (Key 9 uses quantity of 2)
16	142-0035	1	Spring, Throttle Stop Adjusting Screw
17	812-0063	1	Screw, Machine - Round Head (#6-32 x 1/2")
18	815-0072	2	†Screw, Machine - Oval Head (#4-40 x 1/4")
19	142-0369	1	Fly, Throttle
20	142-0368	1	†Shaft Assembly, Throttle
21	142-0370	1	Nut and Jet Nozzle
22	142-0046	1	£Retainer, Main Adjusting Needle
23	142-0206	1	†£Packing, Main Adjusting Needle
24	142-0045	1	£Retainer, Main Adjusting Needle Packing
25	516-0027	1	£Pin, Main Adjusting Needle
26	142-0041	1	†£Needle
27		1	Body Assembly (Not Sold Separately)
28	505-0053	1	Plug, Carburetor Inlet
29	142-0042	1	Needle Assembly (Includes Parts Marked £)
30	142-0343	2	Bushing, Throttle Shaft
31	870-0053	1	Nut, Hex (#10-32)
32	813-0102	1	Screw, Machine - Round Head (#10-32 x 5/8")
33	502-0074	1	Elbow, Adapter - Key 9
34	149-0030	1	Line, Idle - Fuel - Key 9
35	502-0034	1	Elbow, Idle Line to Adapter - Key 9
36	148-0126	1	Adapter, Carburetor - Key 9
37	509-0091	1	Gasket, Adapter Mounting - Key 9
38	148-0131	1	Screw, Adapter Adjusting - Key 9
39	148-0010	1	Spring, Adapter Adjusting Screw - Key 9

† - Included in 142-0371 Repair Kit.

* - Included in 142-0033 Gasket Kit.

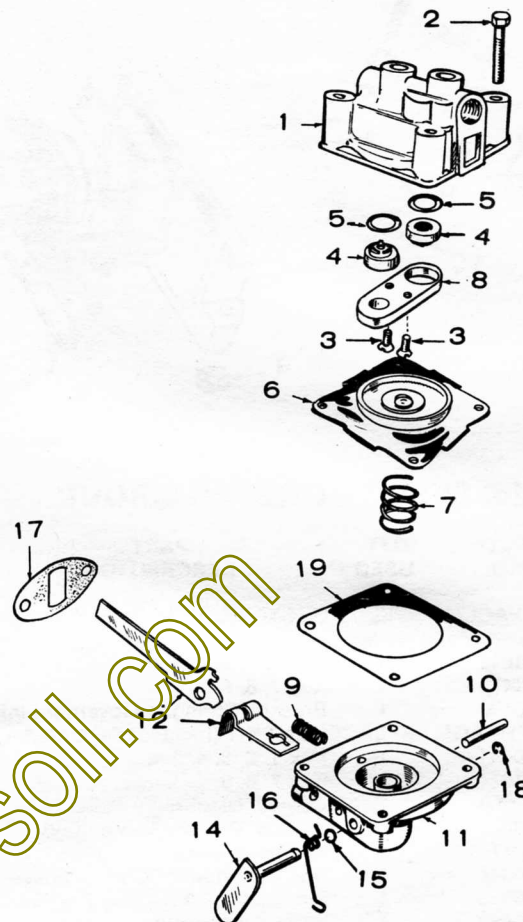
£ - Included in 142-0042 Needle Assembly.

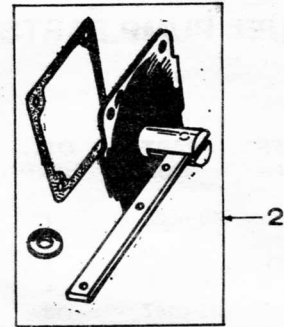
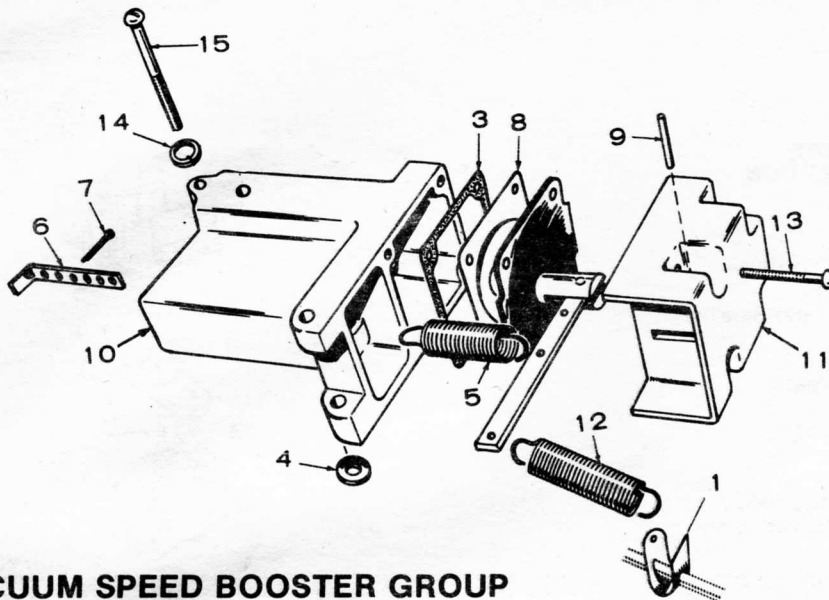


FUEL PUMP PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149-0526	1	Repair Parts Kit, Includes Parts Marked *
1		1	Body, Not Sold Separately
2	815-0148	4	Screw, Hex Head
3	815-0147	2	Screw, Phillips, Valve 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	149-0539	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, (Only as a Set)
14	149-0551	1	Lever, Primer
15	509-0065	2	Seal, "O" Ring
16	149-0404	1	Spring, Primer Lever
17	149-0003	1	*Gasket, Pump Mounting
18	518-0129	1	Ring, Retainer, Primer Lever
19	149-0858	1	†*Gasket, Diaphragm - Lower Side
	149-0693	1	Pump, Fuel - Complete

* - Parts Contained in Repair Kit.



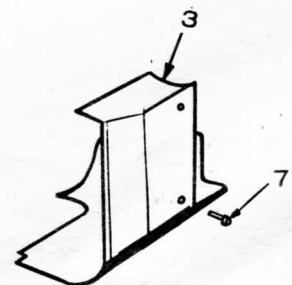
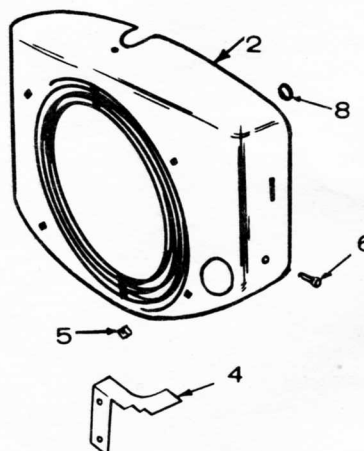
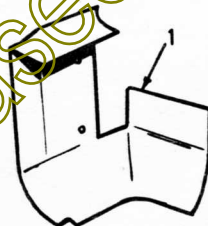


VACUUM SPEED BOOSTER GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
KIT, VACUUM SPEED BOOSTER REPLACEMENT (Includes Parts Marked *)				9	516-0085	1	*Pin, Diaphragm Lever Pivot
150-1013	1		Key 1, 2, 3, 4, 5, 6	10		1	Housing, Vacuum Booster (Not Sold Separately)
150-1475	1		Key 7, 8, 9	11		1	*Cover, Vacuum Booster (Not Sold Separately)
1 150-0430	1		Bracket, Spring to Governor Link	12	150-0475	1	*Spring, External
2 *DIAPHRAGM REPLACEMENT KIT (Includes Parts Marked †)				13	815-0148	4	*Screw, Slotted Hex Head (#8-32 x 7/8")
150-0434	1		Key 1, 2, 3, 4, 5, 6	14	853-0008	2	Washer, Lock - ET (#10)
150-1474	1		Key 7, 8, 9	15	813-0111	2	Screw, Machine - Round Head (#10-32 x 2-1/4")
3 150-0668	1		†Gasket, Diaphragm Plate	*Included in Vacuum Speed Booster Replacement Kit.			
4 150-0425	1		†Gasket, Booster to Manifold	*Included in Diaphragm Replacement Kit.			
5 150-0475	1		*Spring, Internal				
6 150-0376	1		*Bracket, Internal Spring Adjusting				
7 516-0039	1		*Pin, Cotter - Adjusting Bracket				
8 150-0666	1		*Plate, Diaphragm				

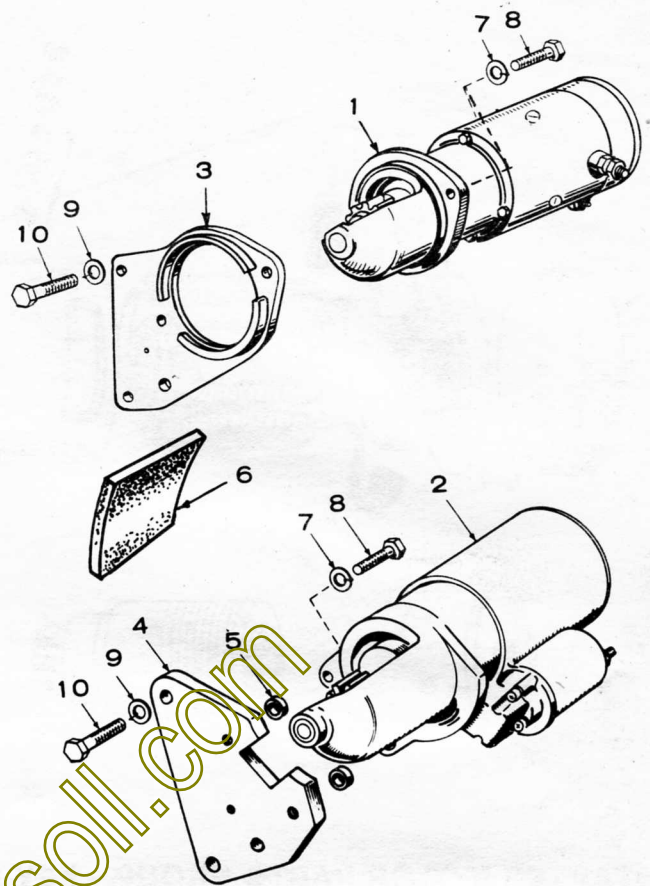
BLOWER HOUSING GROUP

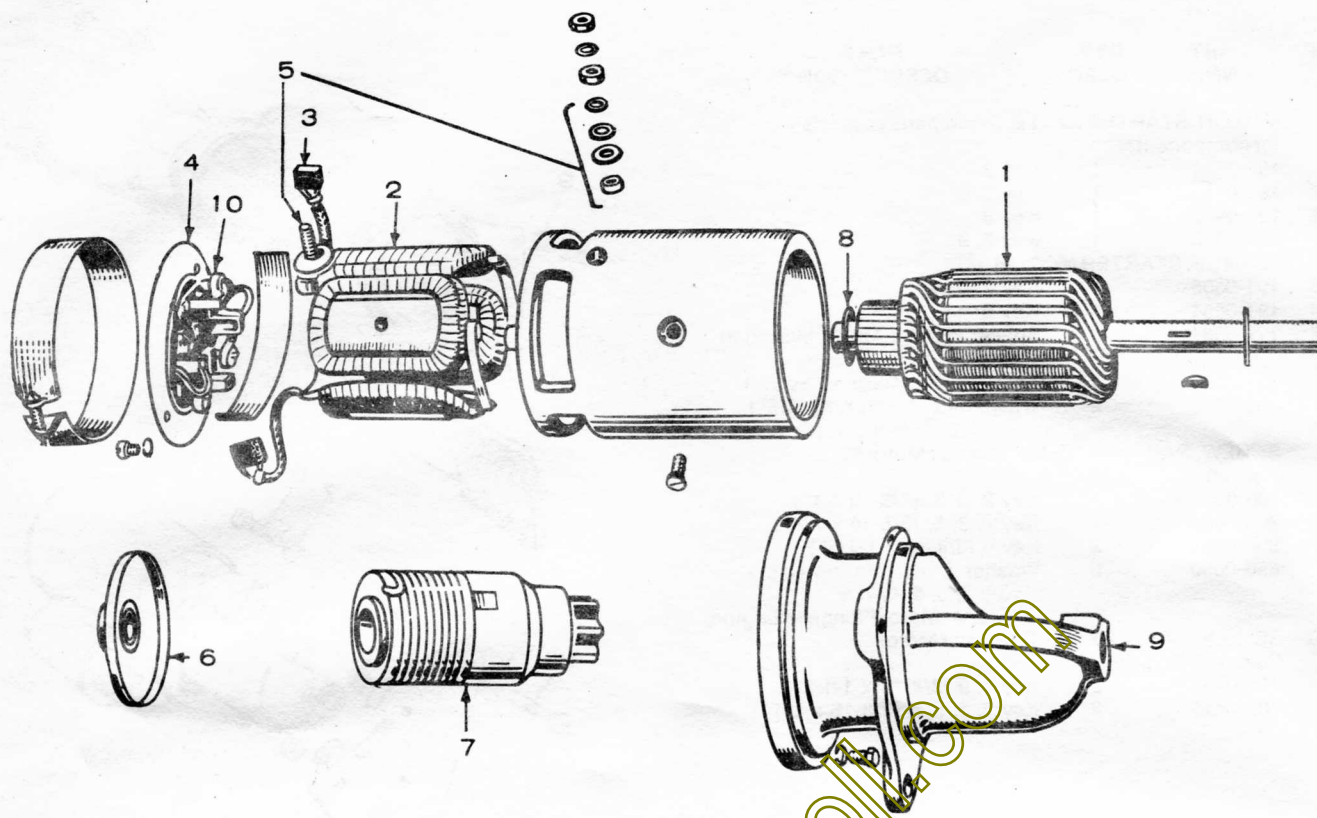
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	134-0589	1	Housing, Cylinder Air (Left)
2	HOUSING, BLOWER		
	134-1579	1	Key 1, 4
	134-0705	1	Key 2
	134-2209	1	Key 3
	134-2390	1	Key 5
	134-2946	1	Key 8
	134-2935	1	Key 7, 9
	134-2845	1	Key 6
3	HOUSING, CYLINDER AIR (RIGHT)		
	134-0588	1	Key 1, 4, 8
	134-0674	1	Key 2
	134-2134	1	Key 3, 5, 6
	134-2791	1	Key 7, 9
4	BAFFLE, AIR		
	134-0670	1	Key 2
	134-0798	1	Key 1, 4, 8
	134-2131	1	Key 3, 5, 6
5	870-0110	4	Nut, Retaining - Key 8
6	SCREW, CAP, HEX WASHER HEAD		
	821-0010	2	1/4-20 x 1/2"
	815-0261	2	1/4-20 x 7/16"
7	815-0261	4	Screw, Cap - Hex Washer Head (1/4-20 x 7/16")
8	508-0095	2	Grommet, Blower Housing - Key 1, 4, 8



STARTER MOTOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	MOTOR, STARTER (NOTE: See separate groups for components)		
1	191-0511	1	Key 2
2	191-0790	1	Key 3, 5
2	191-0922	1	Key 6
2	191-1052	1	Key 7, 9
	FLANGE, STARTER MOTOR		
3	191-0508	1	Key 2, 3, 5
4	191-0854	1	Key 6
5	191-0864	2	Spacer, Starter Motor Mounting - Key 6
6	191-1076	1	Seal, Starter Motor - Key 7, 9
7	850-0050	2	Washer, Lock - Spring (3/8") - Key 2, 3, 5, 6
8	SCREW, CAP - HEX HEAD (Starting Motor to Flange)		
	800-0050	1	Key 2, 3, 5, (3/8-16 x 1")
	800-0049	1	Key 2, 3, 5, (3/8-16 x 7/8")
	800-0051	2	Key 6 (3/8-16 x 1-1/2")
9	850-0050	2	Washer, Lock - Spring (3/8") - Key 2, 3, 5, 6, 7, 9 (Starter Motor Flange to Engine)
10	SCREW, CAP - HEX HEAD (Starter Motor Flange to Engine)		
	800-0051	2	Key 7, 9 (3/8-16 x 1-1/2")
	102-0455	2	Key 2, 3, 5, 6 (3/8-16 x 1")

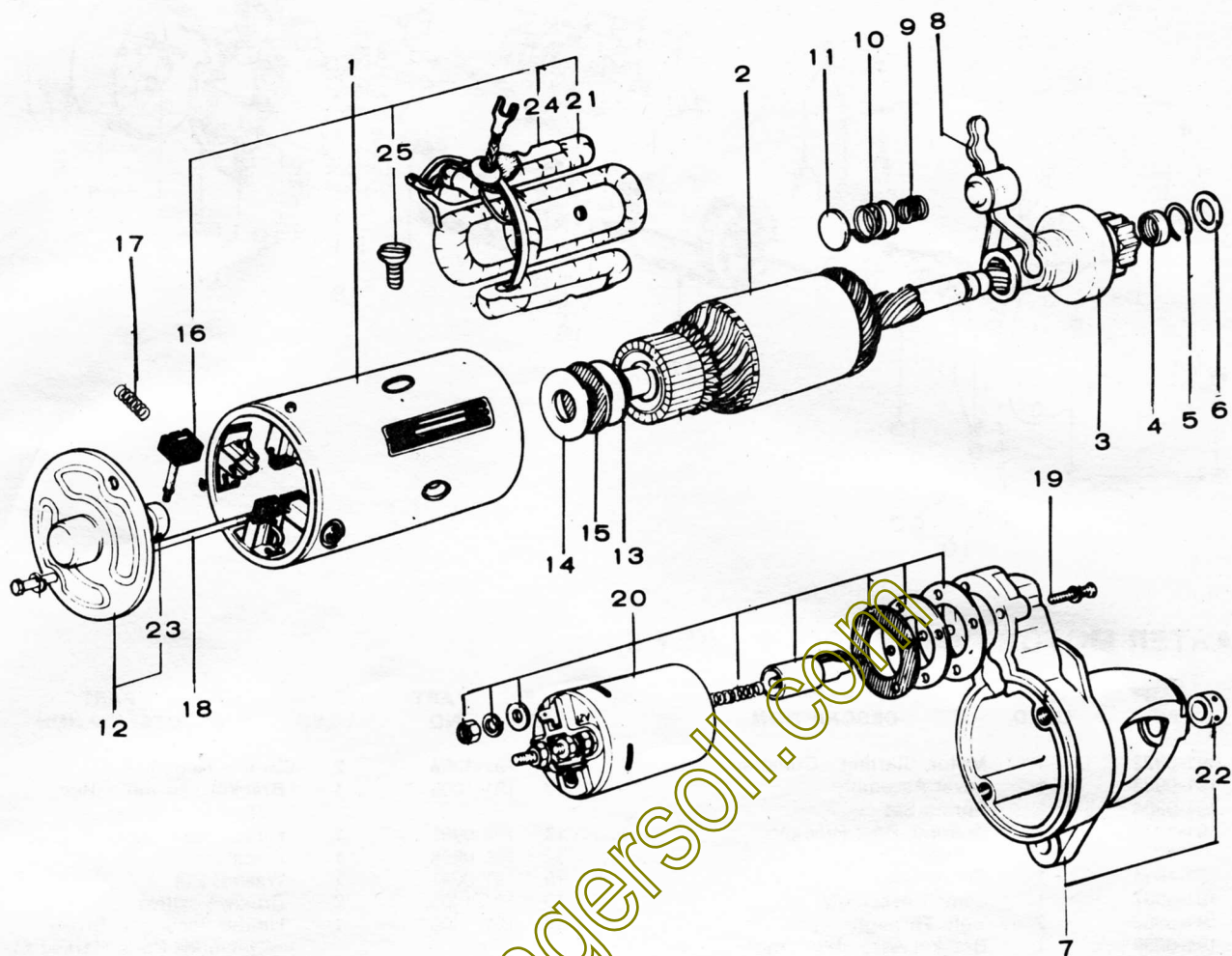




STARTER MOTOR PARTS GROUP - KEY 2

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0511	1	Motor Assembly, Starter (Complete)	7	191-0271	1	Drive Assembly
1	191-0517	1	Armature	8	191-1021	1	Washer, Armature Thrust (Package)
2	191-1017	1	Coil Assembly, Package - Field	9	191-0735	1	Bearing, Drive End
3	191-0513	1	Brush Set, Service	10	191-1020	1	Spring, Brush (Set of 4)
4	191-1018	1	Head Assembly, Commutator End				
5	191-1022	1	Stud, Terminal (Package)				
6	191-1019	1	Bearing Assembly, Intermediate				

NOTE: Parts shown on the illustration without a reference number are not sold separately.

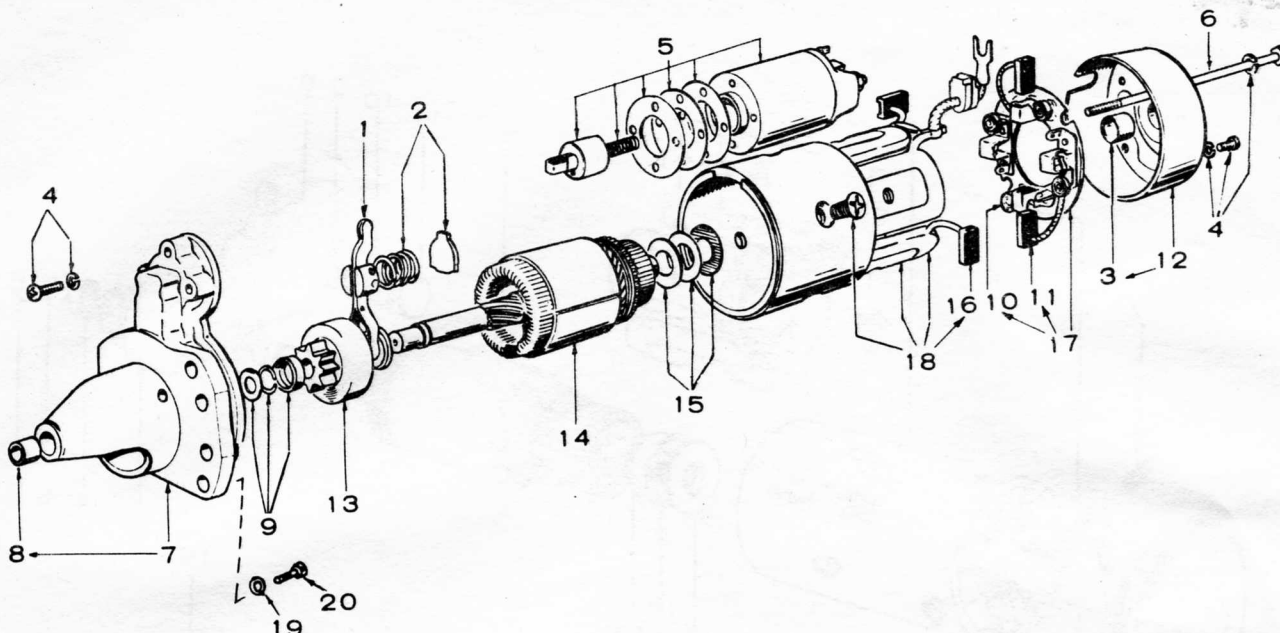


STARTER MOTOR PARTS GROUP - KEY 3, 5

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0790	1	Motor Assembly, Starting - Complete
1	191-0806	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	191-0807	1	Washer, Plain
7	191-0808	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	191-0809	1	Bracket Assembly, Rear

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
13	191-0754	1	Washer, Plain
14	191-0755	1	Washer, Plain
15	191-0756	1	Washer, Insulator
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, Plus Head

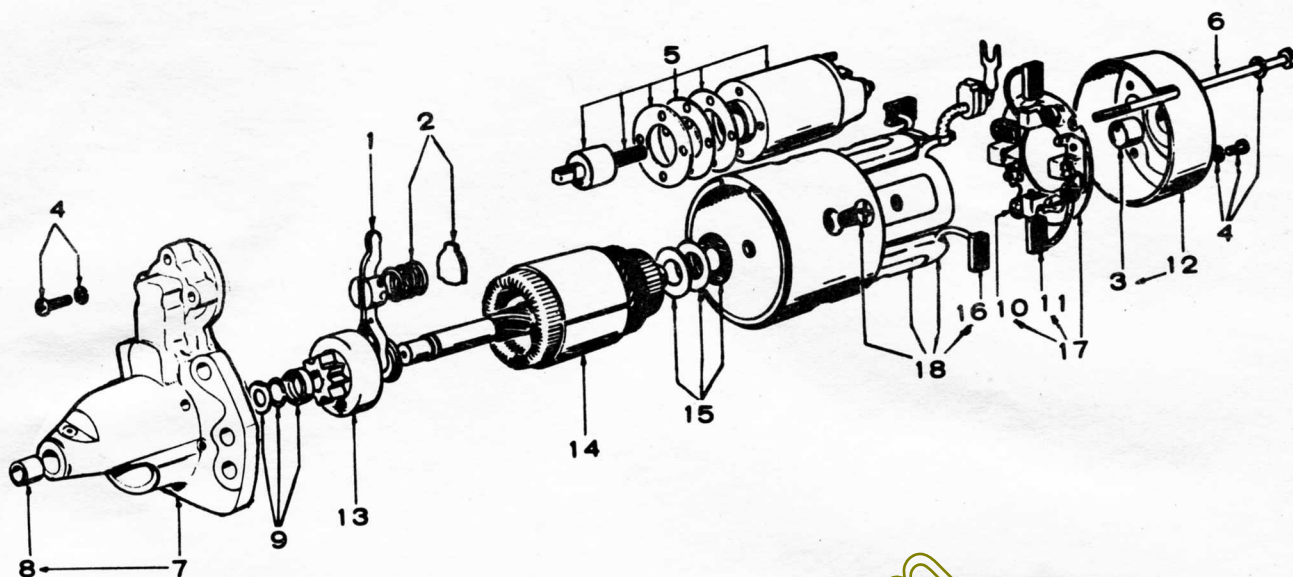
* - Included in Yoke Assembly.



STARTER MOTOR PARTS GROUP - KEY 6

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

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



STARTER MOTOR PARTS GROUP - KEY 7, 9

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	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

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	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.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	98-1100	1	Decal Kit
	168-0103	1	Gasket Kit, Complete Engine
	160-0836	1	Ignition Tune-up Kit
	168-0095	1	Carbon Removal Gasket Kit
	522-0164	1	Kit, Overhaul

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