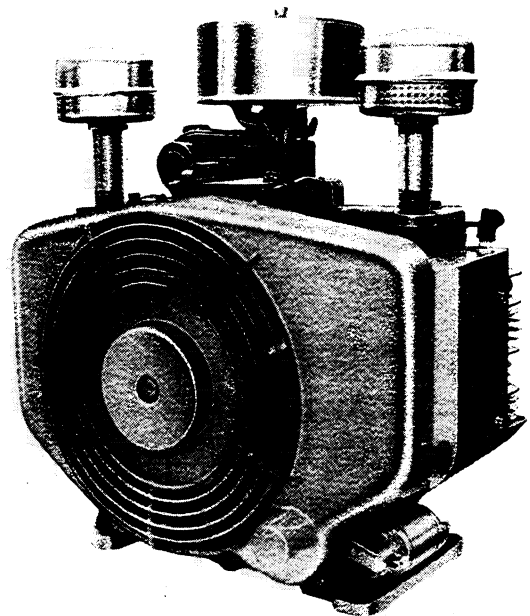




OPERATOR'S SERVICE PARTS MANUAL

CCK- CCKA

Engine



927-1120
5-82 (SPECS G AND J)
REPLACES
7-80 (SPEC G AND J)
Printed in U.S.A.

MILLER ELECTRIC MFG. CO.

SAFETY PRECAUTIONS

The following symbols are used in Onan manuals to alert users to the potentially dangerous conditions relating to maintenance of the equipment and replacement of parts. Please read and observe.



This symbol warns of immediate hazards which will result in severe personal injury or death.



This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.



This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.

MODEL IDENTIFICATION

To avoid errors or delay in filling your parts order, always give the MODEL, SPEC NO., and SERIAL NO. from the Onan nameplate.

For handy reference, insert your nameplate information in the spaces below:

MODEL AND SPEC NO.

SERIAL NO.

PRODUCT SAFETY PRECAUTIONS



Contact with USED ENGINE OILS has been identified by a United States federal agency and some USA state agencies as causing CANCER or REPRODUCTIVE TOXICITY. When checking or changing engine oils take all necessary precautions not to ingest, breathe the fumes or contact the used oil.



Contact with ASBESTOS has been identified by a United States federal agency and some USA state agencies as causing CANCER or REPRODUCTIVE TOXICITY. When handling engine gaskets take all necessary precautions not to ingest, breathe or contact the dust from the gaskets! Use adequate ventilation and wear protective gloves, masks and clothing!



Contact with BENZINE and LEAD, found in gasoline, fuel additives and solvents has been identified by a United States federal agency and some USA agencies as causing CANCER or REPRODUCTIVE TOXICITY. When checking, draining or adding gasoline and fuel additives, or using solvents take all necessary precautions not to ingest, breathe the fumes, or contact the liquids. Use adequate ventilation and wear protective gloves, masks and clothing!

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WARNING

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



WARNING:



The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

SPECIFICATIONS

	CCK	CCKA
Nominal dimensions (inches)		
Height (manual start)	21.0-inches (533.4 mm)	
Height (electric start)	23.0-inches (584.2 mm)	
Width	20.60-inches (533.2 mm)	
Length	15.10-inches (383.5 mm)	
Weight in pounds (approximate)	148 (67.0 kg)	
Engine design: opposed two cylinder, four cycle, L head, air cooled		
Fuel (standard)*	Gasoline	
Number of cylinders	2	
Cylinder bore	3.25-inches (82.55 mm)	
Piston stroke	3-inches (76.2 mm)	
Displacement (cubic inch)	49.8-inches (816.2 cm ³)	
Horsepower	12.9 at 16.0 at	
	(9.62 kW) (12.3 kW)	
	3000 rpm 3600 rpm	
Compression ratio	5.5:1 7:1	
Compression PSI (sea level)	100-200 (690-810 kPa)	
Cooling air volume (CFM) - pressure cooled	730 at 830 at	
	(20.7 m ³) (23.5 m ³)	
	2700 rpm 3600 rpm	
Governor type	Adjustable mechanical flyball	
Fuel pump type	Diaphragm	
Fuel pump lift	4 feet (1.24 m)	
Lubrication system	Full pressure	
Oil pressure gauge	Optional	
Oil capacity		
Manual start models	4-quarts (3.8 litres)	
Electric start models	3.50-quarts (3.3 litres)	
Optional oil filter capacity (U.S. quarts)50-quarts	

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

TUNE-UP SPECIFICATIONS

Breaker point gap (full separation)	0.020-inches (0.508 mm)
Spark plug gap	
Gasoline	0.025-inches (0.635 mm)
Gaseous	0.018-inches (0.4572 mm)
Ignition timing (engine running)	
Manual start	10° BTC 20° BTC
Electric start	20° BTC 20° BTC
Carburetor float clearance (between float bowl top surface and float) Begin Spec 3670J	0.02 ± 0.02 inch (0.5 ± 0.5 mm)
Carburetor float clearance (between float bowl gasket and float) Prior to Spec 3670J312-inches (7.938 mm)
Valve tappet clearances	
Intake006 to .008 (0.152-0.203)
Exhaust015 to .017 (0.381-0.432)

DIMENSIONS AND CLEARANCES

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

	Minimum	Maximum
Valve Tappet to Cylinder Block Clearance	0.0015 (0.038 mm)	0.0030 (0.08 mm)
Valve Stem in Guide — Intake	0.0010 (0.03 mm)	0.0025 (0.06 mm)
Valve Stem in Guide — Exhaust	0.0025 (0.06 mm)	0.0040 (0.10 mm)
Valve Seat Interference Width	1/32 (.79 mm)	3/64 (1.19 mm)
Valve Face Angle	44°	44°
Valve Seat Angle	45°	45°
Valve Interference Angle	1°	1°
Crankshaft Main Bearing	0.0025 (0.064 mm)	0.0038 (0.97 mm)
Crankshaft End Play	0.006 (0.15 mm)	0.012 (0.30 mm)
Camshaft Bearing	0.0015 (0.04 mm)	0.0030 (0.08 mm)
Camshaft End Play	0.003 (0.08 mm)	—
Rod Bearing (Forged Rod)	0.0005 (0.01 mm)	0.0023 (0.06 mm)
Connecting Rod End Play (Ductile Iron)	0.002 (0.05 mm)	0.016 (0.41 mm)
Timing Gear Backlash	0.002 (0.05 mm)	0.003 (0.08 mm)
Oil Pump Gear Backlash	0.002 (0.05 mm)	0.005 (0.13 mm)
Piston to Cylinder, Strut Type (Measured below Oil — Controlling Ring — 90° from Pin) Clearance0025 (0.06 mm)	0.0045 (0.11 mm)
Piston Pin in Piston	Thumb Push Fit	Thumb Push Fit
Piston Pin in Rod	0.0001 (0.0025 mm)	0.0006 (0.0152 mm)
Piston Ring Gap in Cylinder	0.009 (0.23 mm)	0.020 (0.51 mm)
Crankshaft Main Bearing Journal — Standard Size	1.9992 (50.779 mm)	2.000 (50.8 mm)
Crankshaft Rod Bearing Journal — Standard Size	1.6252 (41.280 mm)	1.6260 (41.300 mm)
Cylinder Bore — Standard Size	3.2490 (82.525 mm)	3.2500 (82.550 mm)

ASSEMBLY TORQUES AND SPECIAL TOOLS

The following special tools are available from Onan.
For further information see *TOOL CATALOG 900-0019*.

Valve Seat Driver
Valve Guide Driver
Oil Guide and Driver
Combination Bearing Remover (Main and Cam)
Combination Bearing Driver (Main and Cam)
Flywheel Puller

BOLT TORQUE	FT.-LB.	N•m
Blower Housing Screws	10-15	(14-20)
Connecting Rod Bolts	27-29	(37-39)
Cylinder Head Screws	29-31	(39-42)
Exhaust Manifold Screws	14-17	(19-23)
Flywheel Mounting Screws	35-40	(48-54)
Fuel Pump Mounting Screws	5-6	(7-8)
Intake Manifold Screws	15-20	(20-27)
Oil Base Screws	43-48	(58-65)
Oil Pump Mounting Screws	7-9	(10-12)
Rear Bearing Plate Capscrews	20-25	(27-34)
Spark Plugs	15-20	(20-27)
Timing Gear Cover Screws	10-13	(14-18)
Valve Cover Nut	4-8	(5-11)
Magneto Stator Screws	15-20	(20-27)
Starter Mounting Bolts	25-35	(34-48)

ENGINE TROUBLESHOOTING

TROUBLE																				GASOLINE ENGINE TROUBLESHOOTING GUIDE									
																				CAUSE									
Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Cylinder Slowly	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

Inspection: Inspect the engine visually before starting. Check for loose or missing parts and any damage that may have occurred in shipment. Be sure the engine is properly filled with oil and fuel.

Crankcase Oil: Be sure the crankcase has been filled with oil to the "FULL" mark on the oil level indicator, Figure 1. Use oil with the API (American Petroleum Institute) designation SE or SE/CC. Do not use an oil with the designation CD unless it is also designated SE and the oil manufacturer certifies it will perform satisfactorily in gasoline engines. Do not mix brands nor grades of motor oil. Recommended oil numbers for expected temperatures are listed in the oil chart.

For gaseous operation, use an ashless or low-ash detergent oil specifically made for gaseous-fueled engines.

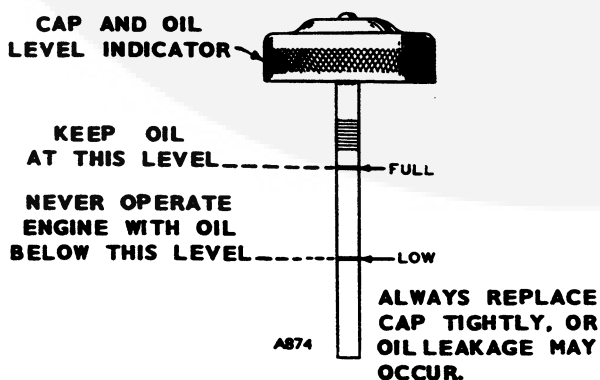
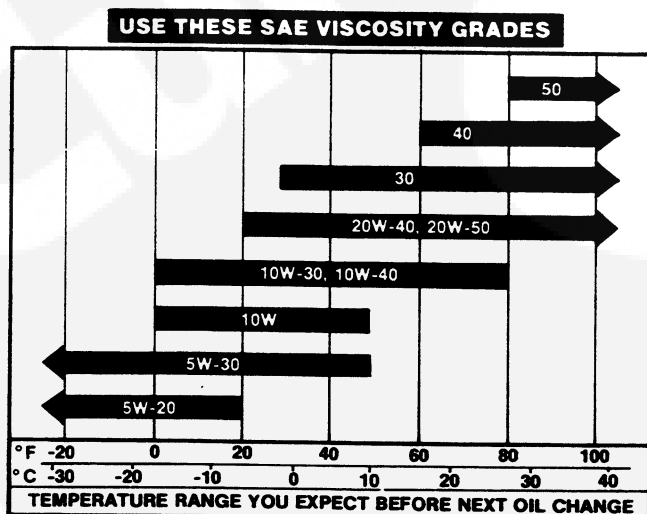


FIGURE 1. OIL LEVEL INDICATOR

CAUTION

Do not overfill crankcase. Overfilling causes the oil to foam and enter the breather system. Do not use service DS oil or damage to the engine could occur.

WARNING

Do not remove the dipstick while the engine is running. Oil may blow out the oil fill tube causing injury.

Recommended Fuel: Use clean, fresh, unleaded or regular grade gasoline. Do not use highly leaded premium fuels. Using unleaded gasoline results in less maintenance.

Use regular gasoline for the first 25 hours to allow the rings to seat well for best performance. Then use unleaded or regular gasoline thereafter.

If regular gasoline is used continually, carbon and lead deposits must be removed from the cylinder to prevent pre-ignition and loss of engine power. Unleaded gasoline may be used safely after lead deposits have been removed.

WARNING

Avoid potential explosions. Never fill the fuel tank when the engine is running.

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 2 (manual start only).
2. Pull choke control about 3/4 of the way closed or as necessary according to temperature conditions.

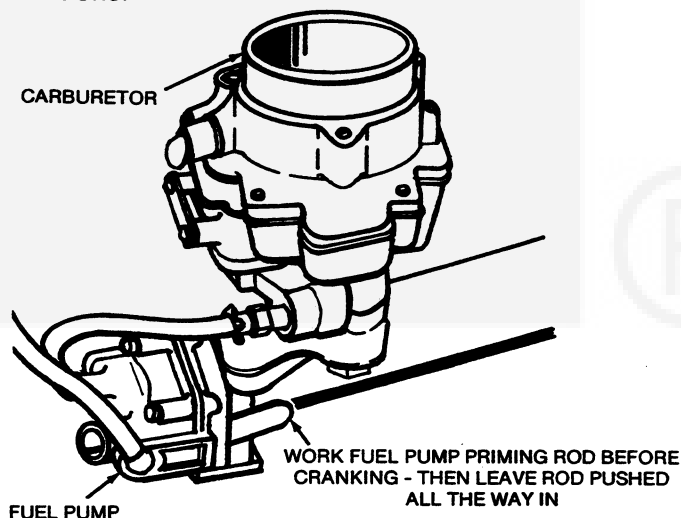


FIGURE 2. ENGINE PRIMING (MANUAL START)

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.

VENTILATION

Good ventilation is needed to cool the engine and to support combustion. Avoid operating the engine in an enclosed area without suitable ventilation.

WARNING

EXHAUST GASES ARE DEADLY POISONOUS!

BREAK-IN PROCEDURE

Controlled break-in is the ideal fitting of all internal moving metal parts. Using the proper oil and applying a conscientious maintenance program during this period helps assure satisfactory service from your Onan engine.

Check the oil level at least every five operating hours. Add oil to keep it at the proper level, but never overfill as overfilling may cause the oil to foam and enter the breather system.

CAUTION

Using the wrong grade and weight of oil and high engine operating temperatures during break-in can cause engine damage.

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 the 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.

HOT WEATHER OPERATION

When operating the engine in temperatures above 75° F (24° C), pay particular attention to the following items to prevent damage:

1. Keep the engine cooling fins clean and free of obstruction.

CAUTION

Plugged or clogged cooling fins can cause overheating and engine damage.

2. See that nothing obstructs air flow to and from the engine.
3. Ensure that you are using the proper grade and weight of oil for ambient temperatures. Check the oil level each time you fill the fuel tank.
4. Check the battery water more frequently than every 50 hours which is recommended under normal conditions. High temperatures cause faster evaporation.

COLD WEATHER OPERATION

When the engine is being used in temperatures below 32° F (-0° C), check the following items closely:

1. Use the correct grade and weight of oil for the temperature conditions. Change the oil only when the engine is warm. If an unexpected temperature drop occurs when the engine is filled with summer oil, before starting the engine, move it to a warm location until the oil will flow freely.
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 that will be out-of-service for more than 30 days as follows:

1. Run the engine until it reaches normal operating temperature.
2. Turn off the fuel supply and run the engine until it stops.
3. Drain oil from oil base while the engine is still warm. Refill with fresh crankcase oil and attach a tag stating viscosity used.
4. Remove spark plugs. Pour 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE #50 oil into the cylinders. Crank the engine over a few times. Reinstall spark plugs.
5. Service air cleaner as outlined in *MAINTENANCE* section.
6. Clean throttle and governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.

10. If battery equipped, disconnect and follow standard battery storage procedure.

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 temperatures.
3. Clean and check battery. Measure specific gravity (1.260 at 77° F [25° C]) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If the level is low, add distilled water and charge until specific gravity is correct. **DO NOT OVERCHARGE.**
4. Check that fuel filter and fuel lines are secure, with no leaks.
5. Check carburetor, adjust if necessary.
6. Connect battery.
7. Start engine.

After engine has started, excessive blue smoke is exhausted until the rust inhibitor has burned away.

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 and Sleepiness
- 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 and repaired at once by a competent mechanic.

PERIODIC MAINTENANCE

OIL LEVEL

Check oil level at least every eight hours of operation. Check more frequently on a new or overhauled engine as oil consumption is higher until piston rings seat properly.

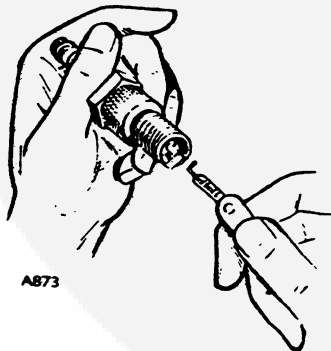
OIL CHANGE

Change crankcase oil after the first 25 hours of operation; change every 100 hours after that. If operating in extremely dusty conditions, change oil more frequently.

To drain the crankcase oil, remove the 1/2 inch pipe plug from the front of the oil base. Replace the pipe plug after draining and refill the crankcase with fresh detergent oil. Oil must meet or exceed the API (American Petroleum Institute) designation SE or SE/CC. Refer to *OPERATION* section for correct oil viscosity grade.

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

EXHAUST SYSTEM

Make regular inspections of the exhaust system throughout the entire life of the engine. Locate leaks in muffler and piping while the engine is operating. Repair all leaks immediately after they are detected for personal safety.

WARNING

Leaky exhaust systems emit noxious carbon monoxide fumes which are a potential safety hazard in enclosed areas.

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.

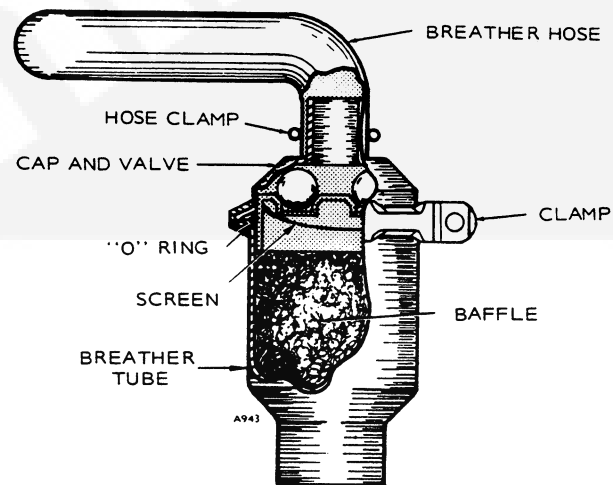


FIGURE 4. CRANKCASE BREATHER

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).

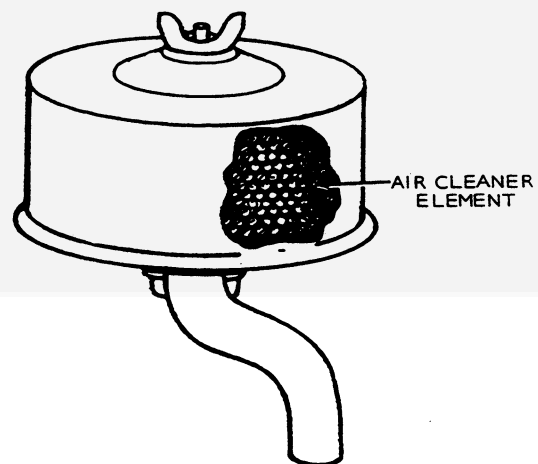


FIGURE 5. AIR CLEANER

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.

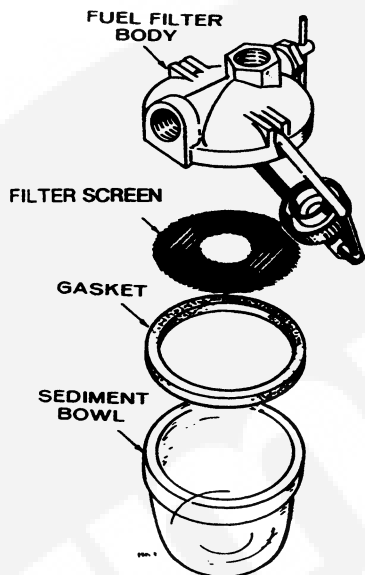


FIGURE 6. OPTIONAL FUEL FILTER

COOLING SYSTEM

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

BREAKER POINTS

Check breaker points every 100 hours. Replace points every 200 operating hours. Replace points sooner if they are pitted or burned.

Regularly scheduled maintenance lowers operating costs and lengthens the service life of the unit. Use the following schedule 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 may have to be reduced. Check the condition of the crankcase oil, the filters, etc., frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from the engine or accessories, loss of power, overheating, etc., contact your nearest Onan Service Center.

PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	25	50	100	200
Inspect Engine Generally	x ¹				
Check Oil Level	x				
Service Air Cleaner		x ²			
Change Crankcase Oil				x ²	
Check Battery Electrolyte Level			x		
Clean Cooling Fins			x		
Replace Oil Filter (if used)					x
Replace Spark Plugs				x	
Check Breaker Points				x	
Clean Breather Valve					x ²
Replace Air Cleaner Element					x ²
Check Valve Clearance			x ³		x ⁴
Compression Check					x

x¹ - With engine running, visually and audibly check exhaust system for leaks.

x² - Perform more often in extremely dusty conditions.

x³ - Initial break-in check only.

x⁴ - For detailed maintenance, contact an Onan Service Center.

GOVERNOR SYSTEM

Information in this governor section is applicable to engines with the following Model and Specification Numbers: CCKA-MS/3670J, 3718J, 3848J; CCKA-S/3671J, 3871J.

GOVERNOR OPERATION

These CCKA welder engines use a 10-ball governor with a two-speed control. The weld solenoid and its linkage is supplied and installed by Miller Electric.

Low speed is set at 1850 rpm with no welding load for generating single phase power (weld solenoid de-energized). High speed is set at 3000 rpm for welding with weld solenoid energized.

A reliable instrument for checking engine speed is required for accurate governor adjustment. Engine speed can be checked with a tachometer.

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

The engine starts at wide open throttle. As the engine comes up to speed the governor takes over control to maintain an idle (no load) speed of about 1850 rpm.

Governor Linkage Adjustments

The tension of the governor spring controls engine speed. The governor spring is factory set in the hole of the governor arm nearest the pivot point or shaft. To decrease sensitivity move spring to hole farthest from pivot.

When an AC power load is applied, the throttle opens proportionally under governor control to provide more engine power.

When the weld (high) speed solenoid is energized for welding, the tension of the spring controls the speed at about 3000 rpm. Sensitivity control is determined by the position of the solenoid spring in the governor arm hole. The throttle opening will vary depending on the load current demands of the welding operation.

The governor linkage rod connects the governor arm (Figure 7) to the throttle shaft lever so they function properly when the engine starts and runs. The linkage rod is adjusted with the engine stopped and the throttle plate at wide open position. The engine will

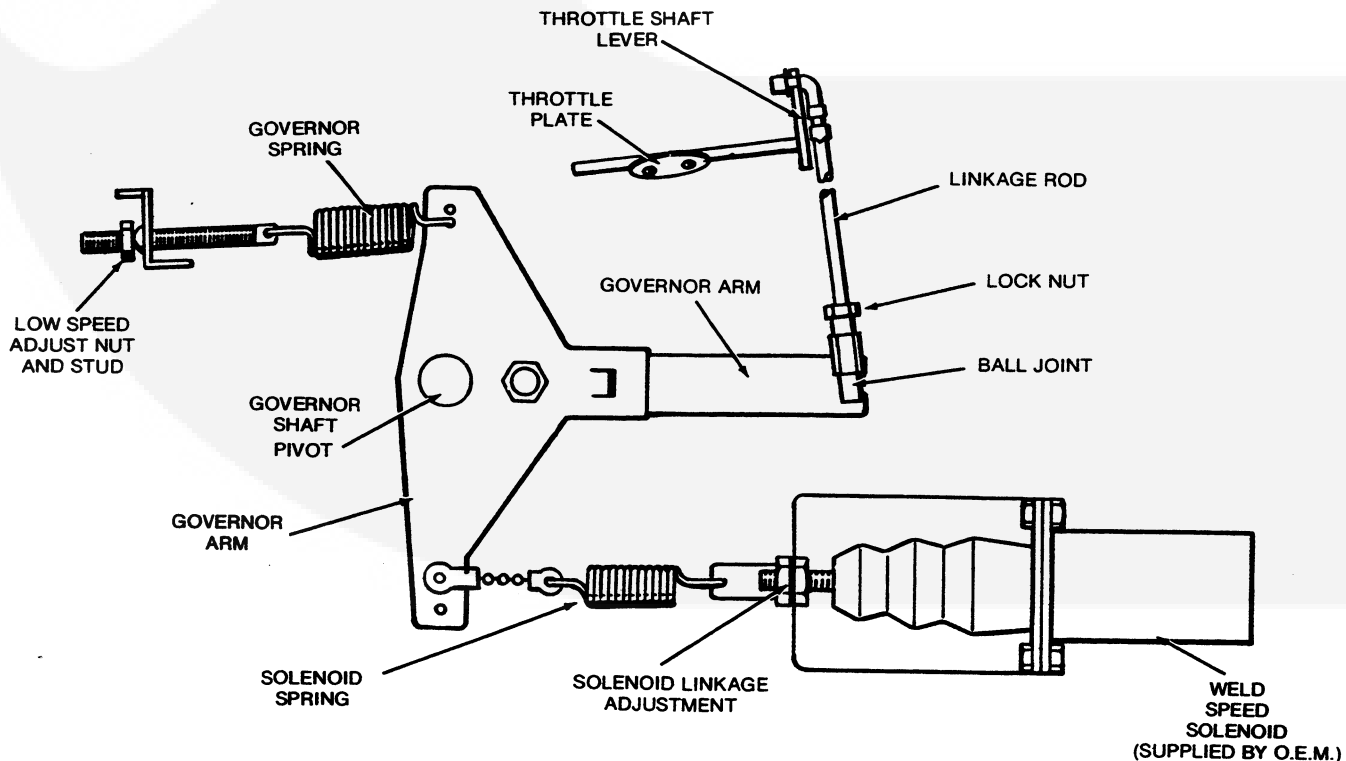


FIGURE 7. TWO SPEED GOVERNOR MECHANISM

also crank and start in this condition. Adjust the linkage rod as follows.

1. Loosen lock nut on linkage rod and disconnect linkage at ball joint engine stopped, Figure 8.
2. Place speed control in the weld position.
3. Move governor arm toward carburetor as far as it will go, then hold it there.
4. Move linkage rod in the same direction as far as it will go and hold it there.
5. With governor arm and linkage rod held in position, rotate ball so that socket centerline is one turn short of the ball centerline.
6. Move ball joint over the ball and snap in place.
7. Tighten lock nut against ball joint.
8. The throttle plate should now almost touch the throttle stop.

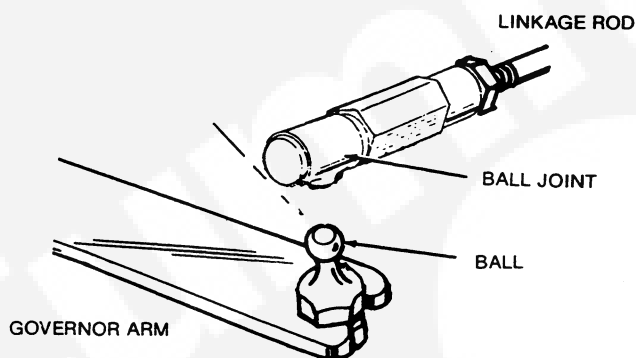
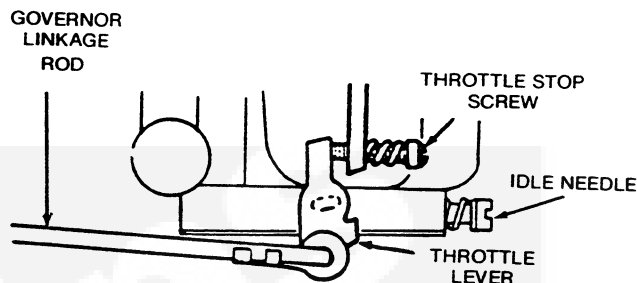


FIGURE 8. BALL JOINT

Carburetor Adjustments for AC Power Speed

1. Turn idle mixture screw in until lightly seated, then back out 1-1/8 turns.
2. Position POWER/WELD switch to POWER.
3. Run engine at least 10 minutes to warm up before making adjustments for no load.
4. With engine running and no generator load, pull governor arm toward front of engine so the throttle stop screw is against its stop (Figure 9). Continue to hold the governor arm in this position while completing the adjustments described in steps 5 through 7.
5. Adjust throttle stop screw for about 1800 rpm (AC power speed).
6. Turn the IDLE adjustment screw IN until engine speed drops and then OUT until engine speed drops again. Over a narrow range between these two settings, engine speed will be at its maximum. Set the idle adjustment screw about 1/8 turn outward from the midpoint of this range (Figure 9).
7. Re-adjust the THROTTLE stop screw to obtain 1700 rpm with no load.
8. Release governor arm.



CLOSED POSITION

FIGURE 9. THROTTLE STOP SCREW SETTING

9. Adjust low speed nut (Figure 7) on governor spring for a stable no load engine speed of 1850 rpm.

Increasing spring tension increases speed, decreasing spring tension reduces speed.

Sensitivity Adjustment

To set governor sensitivity for the best speed drop between no load and full load, proceed as follows:

1. Make sure governor linkage and speed adjustments are correct and governor spring is in hole nearest to governor shaft pivot. See Figure 7.
2. Check engine speed with no load.
3. Check engine speed with full load.
4. Connect governor spring in hole in governor arm that provides the least speed and voltage drop between no load and full power load operation and gives best no load stability.
5. Re-check speed adjustment after sensitivity adjustment is made because an increase in sensitivity may cause a slight increase in speed.

Weld Solenoid Linkage Adjustment

To adjust the solenoid for a stable 3000 rpm weld speed, proceed as follows:

1. Make sure governor linkage, sensitivity and speed are correctly set at 1850 no load and engine is warmed up. Place solenoid spring in hole nearest governor shaft pivot.
2. Set welder for maximum output.
3. Position POWER/WELD switch to WELD.
4. Position AUTOMATIC IDLE switch to OFF.
5. Adjust solenoid linkage (Figure 7) so that a full stroke of the energized solenoid operates the engine at about 3000 rpm.
6. Connect solenoid spring in hole in governor arm that provides the least speed drop between no load and full weld load operation and best stability.



If the high speed solenoid is not properly adjusted, it is possible to burn out the solenoid.

GOVERNOR SYSTEM

Information in this governor section is applicable to engines with the following Model and Specification Numbers: CCK-MS/1196G; CCK-S/1195G; CCKA-MS/2052G, 2237G, 2677G, 2748J, 2778J; CCKA-S/2103G, 2769J.

GOVERNOR OPERATION

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.

With the engine stopped, work the governor arm back and forth several times by hand. If the linkage is binding or extremely loose, find where the trouble lies and adjust or replace parts as required, Figure 10. A binding condition at any point will cause the governor to act slowly and regulation will be poor. Exces-

sive looseness will cause a hunting condition and regulation will be erratic.

A reliable instrument for checking engine speed is required for accurate governor adjustment. Engine speed can be checked with a tachometer.

The engine starts at wide open throttle. As the engine comes up to speed the governor takes over control to maintain an idle (no load) speed of 1100 rpm.

SPEED CONTROL ASSEMBLY

A speed control lever (Figure 10) is used to change the nominal engine speed from 3100 rpm no load as desired for welding, to 1900 rpm, at no load as desired for electric power or to 1100 rpm, Spec J (1000 rpm, Spec G), for idle.

GOVERNOR ADJUSTMENTS

Linkage: The governor linkage rod connects the governor arm (Figure 10) to the throttle shaft lever so they function properly when the engine starts and runs. The linkage rod is adjusted with the engine stopped and the throttle plate at wide open position. The engine will also crank and start in this condition. Adjust the linkage as follows.

1. Loosen lock nut on linkage rod and disconnect linkage at ball joint engine stopped, Figure 11.

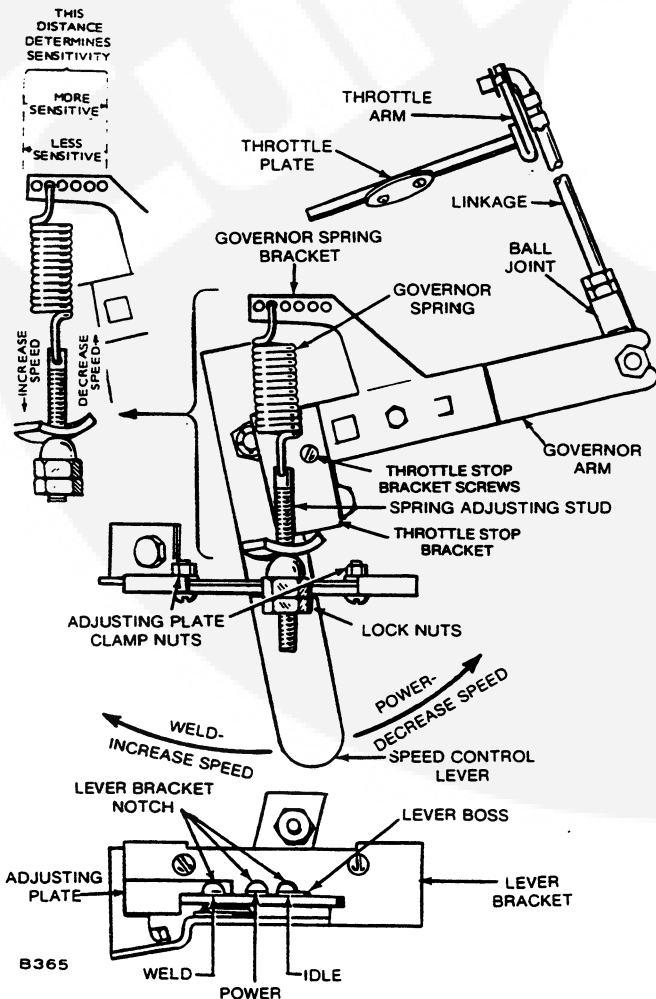


FIGURE 10. GOVERNOR ADJUSTMENTS

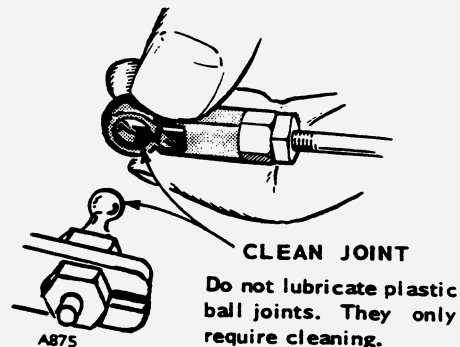


FIGURE 11. GOVERNOR LINKAGE

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 11.

2. Place speed control in the weld position.
3. Move governor arm toward the carburetor as far as it will go, then hold it there.
4. Move linkage rod in the same direction as far as it will go and hold it there.

5. With governor arm and linkage held in position, rotate ball joint so that socket centerline is one turn short of the ball centerline.
6. Move the ball joint over the ball and snap in place.
7. Tighten lock nut against ball joint.
8. The throttle plate should now almost touch the throttle stop.

Idle Speed Setting: This is controlled by the throttle stop bracket (Figure 10) and by the throttle stop screw (Figure 12) on the carburetor.

1. Place the speed control in the idle position.
2. Run the engine at least 10 minutes to warm up before making adjustments.
3. With engine running and no generator load, pull governor arm forward so the throttle stop screw (Figure 12) touches the stop. Set throttle stop screw for a stable idle of 1100 rpm.

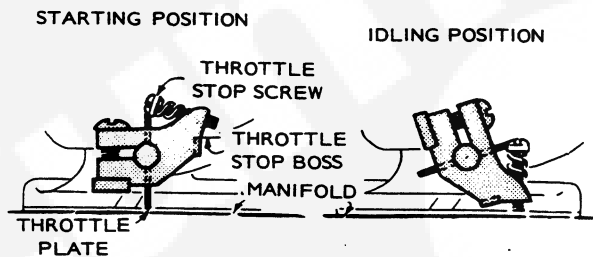


FIGURE 12. THROTTLE STOP SCREW

4. With the speed control in the idle position, the throttle stop bracket should be tight against the speed control lever pushing the governor arm and linkage all the way forward. To adjust, loosen the two bracket mounting screws, reposition and tighten.

The throttle stop bracket does not adjust speed, it only locks the governor in the idle position.

AC Power Speed Setting (No Load): This is controlled by the governor adjustment nut on the governor spring adjusting stud, Figure 13.

1. Place the speed control in the power position and disconnect the vacuum booster spring (external spring).
2. Loosen the lock nut and adjust no load speed to 1900 rpm by turning acorn nut (Figure 13).
3. Tighten lock nut and reconnect vacuum booster spring.

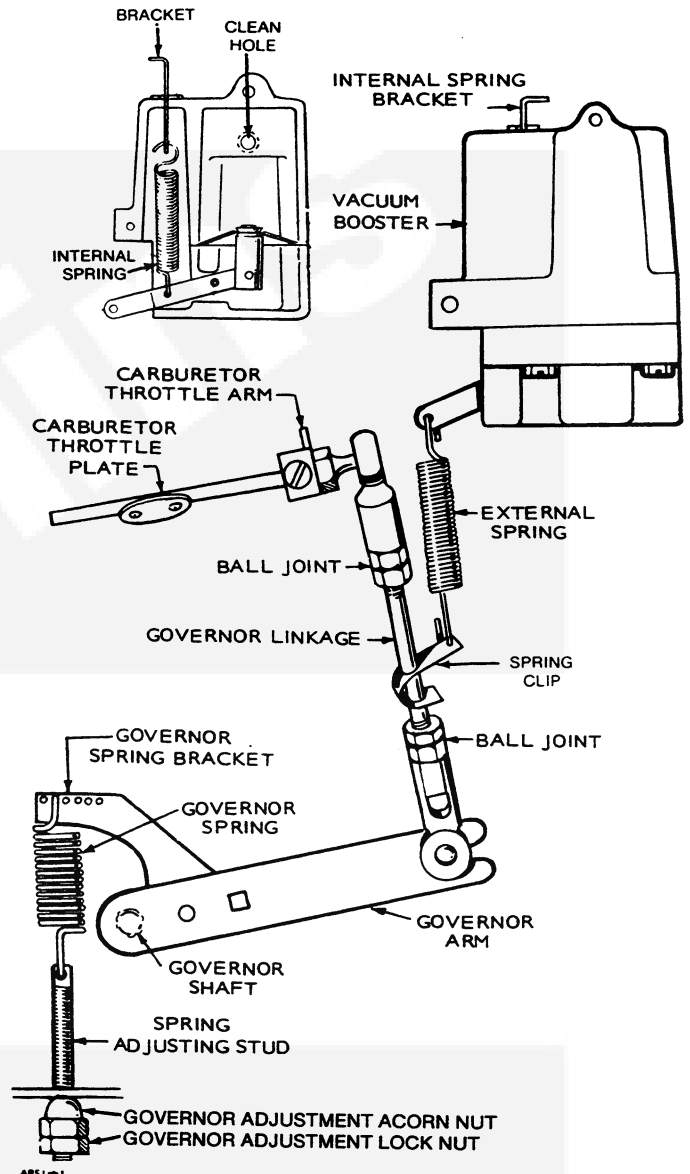


FIGURE 13. VACUUM SPEED BOOSTER

Before making weld speed setting adjustment, make sensitivity and vacuum speed booster adjustments.

Weld Speed Setting (No Load): Place speed control in the weld position and adjust as follows.

1. Loosen adjusting plate clamp screws (Figure 10).
2. Sliding plate to the left increases speed and moving plate to the right decreases speed.
3. Adjust speed for a stable 3100 rpm no load.
4. Tighten adjusting plate clamp screws.

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

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 13). 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.

Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition, by moving governor spring in governor spring bracket, Figure 10.

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.

VACUUM SPEED BOOSTER

The vacuum speed booster (Figure 13) is operated by manifold vacuum. It provides increased engine speed and better regulation when operating the unit in the POWER position only.

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

FUEL SYSTEM

Due to the variety of carburetors used on CCK and CCKA Series Engines, adjustment information will be given for each in separate sections. Use only the section or sections that apply to the engine being serviced. Carburetor and Fuel Pump overhaul sections are applicable to all CCK and CCKA series engines.

The carburetor idle screw and the float level were set for maximum efficiency at the factory and will seldom require readjustment. If adjustment seems necessary, first be sure the ignition system is working properly and is not the source of the problem.

CARBURETOR (Begin Spec 3670J)

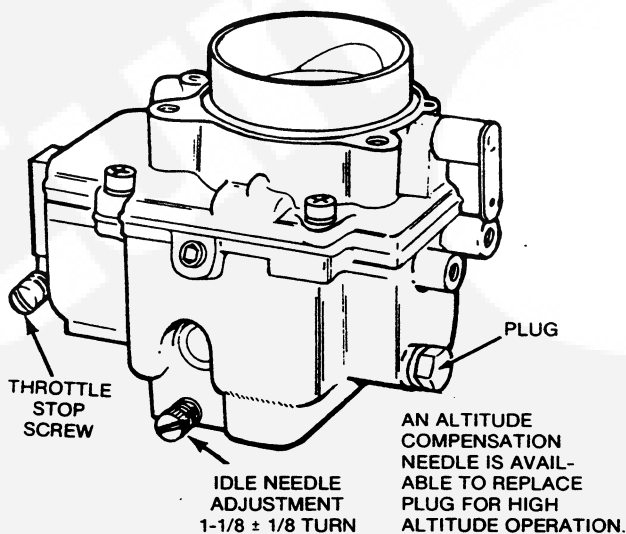


FIGURE 14. CARBURETOR ADJUSTMENTS

CAUTION

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

Carburetor Adjustment

The governor linkage adjustment must precede the carburetor idle adjustment. See *GOVERNOR* section for linkage and idle speed adjustment.

Float Adjustment

An exceedingly high float setting will usually result in an engine that is hard to start when warm. If the setting is too low, the engine may not receive enough fuel under sudden acceleration or load change. Adjust setting as follows:

1. Disconnect throttle control, choke, breather hose, and fuel line from carburetor.
2. Remove the two bolts that hold the intake manifold spacer in place and remove the complete carburetor and spacer assembly as a unit.
3. Separate the upper body of the carburetor from the fuel bowl section.
4. Invert the upper body of the carburetor so that the float assembly is resting on the inlet needle valve.
5. Measure the distance between the fuel bowl and the free end of the float (Figure 15). The float should have a 0.02 ± 0.02 inch (0.5 ± 0.5 mm) clearance from the machined mating surface (without gasket).

LUA series carburetors have the float assembly mounted in the fuel bowl section of the carburetor. Float measurement is made by inverting the fuel bowl section and measuring the distance from the float to a straight edge laid across the body of the fuel bowl (Figure 15).

6. If the setting is incorrect, remove the float assembly to adjust. Bend the assembly slightly at the location specified in Figure 15.

CAUTION

Attempting adjustments with the float assembly installed may result in deformation of the inlet needle and seat.

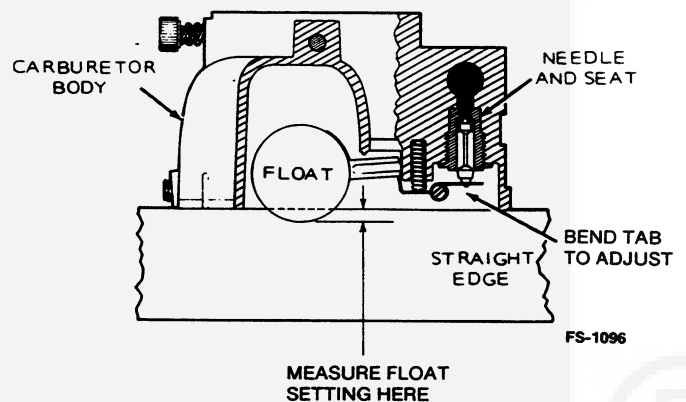


FIGURE 15. FLOAT LEVEL ADJUSTMENT

CAUTION

If float adjustment is necessary, be careful not to lose the buoyancy spring or the tension spring on the vitron tip float needle and seal assembly.

7. Reassemble carburetor and reinstall carburetor and spacer on intake manifold.
8. Check carburetor for proper operation.

ALTITUDE COMPENSATION NEEDLE

Lower atmospheric pressures (thinner air) at higher altitudes (about 5000 feet) demand leaner fuel-air mixtures for best performance. Adjustment is accomplished by replacing the screw plug that covers the main fuel jet with an adjustable power needle (Onan 146-0214), Figure 16. After installing the power needle, adjust the needle as follows:

Weld (High) Speed Adjustment

1. Allow engine to run at least 10 minutes to warm up.
2. Set weld current for maximum output.
3. Position POWER/WELD switch to WELD.
4. Position AUTOMATIC IDLE switch to OFF.
5. Adjust altitude (power) compensation needle for best weld current output with welder operating at continuous load.
6. Adjust idle needle to position of highest speed.
7. Adjust governor - solenoid linkage to make a full stroke with engine running at 3000 rpm.

Re-adjustment may be necessary to improve performance each time the welder is moved to a different altitude. If the welder is moved to an altitude below 5000 feet, replace the altitude compensation needle with the original screw plug for best performance. Readjust idle needle, too.

CAUTION Consult Miller Electric Company Service Department for approved methods of loading welder.

CAUTION If the high speed solenoid is not properly adjusted, it is possible to burn out the solenoid.

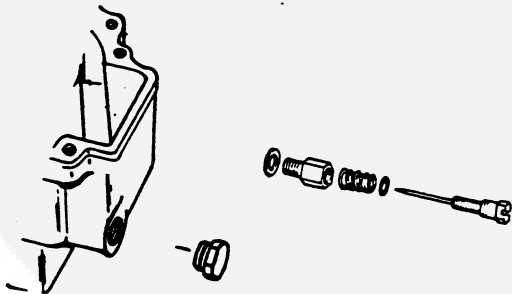


FIGURE 16. INSTALLING ALTITUDE COMPENSATION NEEDLE

CARBURETOR (Prior to Spec 3670J)

The carburetor has an idle jet and a main jet. The adjustable, idle jet affects engine operation at no-load speed. The main jet adjustment affects operation under load or high speed. Under normal circumstances, factory carburetor adjustments should not be disturbed. If the idle adjustment has been disturbed, turn the main adjustment needle clockwise until it gently seats, then turn it counterclockwise off its seat 1 to 1-1/2 turns to permit starting the engine (Figure 17), then readjust as follows:

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

Carburetor Idle Adjustment

1. Allow the engine to run at least 10 minutes to warm up.
2. Move engine speed control to idle position.
3. Turn the idle needle out (counterclockwise) until engine begins to slow down or run unevenly. Remember this position; see Figure 17.
4. Turn needle in (clockwise) past the position where the engine runs smoothly until it begins to slow down or run unevenly.
5. Back the needle out to a position approximately halfway between the two positions. This should provide a smooth running idle.

CAUTION Loosen packing nut before turning main fuel adjustment and tighten to a snug fit after adjustment has been made. Hold the adjustment while tightening packing nut.

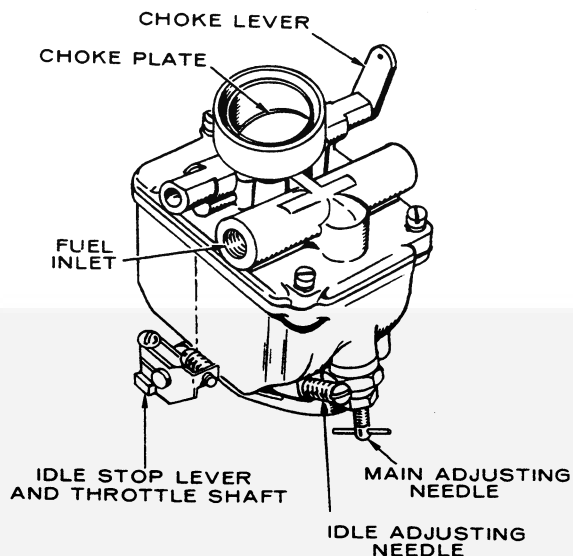


FIGURE 17. GASOLINE IDLE ADJUSTMENT

Carburetor Main (Load) Adjustment

If engine runs unevenly under load due to faulty carburetion, the main adjusting needle may need readjustment (Figure 17).

1. Loosen packing nut and turn the main adjusting needle in until it gently seats, then back out 2 full turns.

CAUTION Forcing the mixture adjustment screws tight will damage the needle and seat. Turn in only until light tension is felt.

2. Start engine and allow it to warm up.

- Place speed control in the idle position.
- Set idle adjustment so engine runs smoothly.
- Place speed control in the weld position.



Consult Miller Electric Company Service Department for approved methods of loading the welder.

- With engine operating under load turn adjusting screw out until engine speed slows. Turn adjustment screw back in 1/2 to 3/4 of a turn or until engine runs smooth.

If this does not correct the condition, the governor sensitivity adjustment should be adjusted.

Carburetor Float Adjustment

- Disconnect throttle control, choke cable, and fuel line from carburetor.
- With a screwdriver, remove the three screws on the top of the carburetor and lift off top.
- With the carburetor casting inverted and the float resting lightly against the needle and 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), Figure 18.
- If it is necessary to reset the float level, bend the float near the shaft to obtain the correct level.

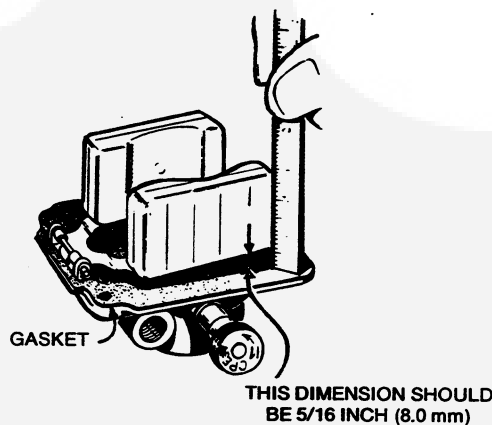


FIGURE 18. FLOAT LEVEL ADJUSTMENT

CARBURETOR OVERHAUL

Carburetion problems that are not corrected by mixture or float adjustments are usually a result of gummed-up fuel passages or worn internal parts. The most effective solution is a complete carburetor overhaul.

In general, overhauling a carburetor consists of complete disassembly, a thorough cleaning, and replacement of worn parts. Carburetor repair kits are available that supply new gaskets and replacements for those parts most subject to wear.

General instructions for overhauling a carburetor are given below. Carefully note the position of all parts while removing to assure correct placement when reassembling. Read through all the instructions before beginning for a better understanding of the procedures involved. Carburetor components are shown in Figures 19 and 20.

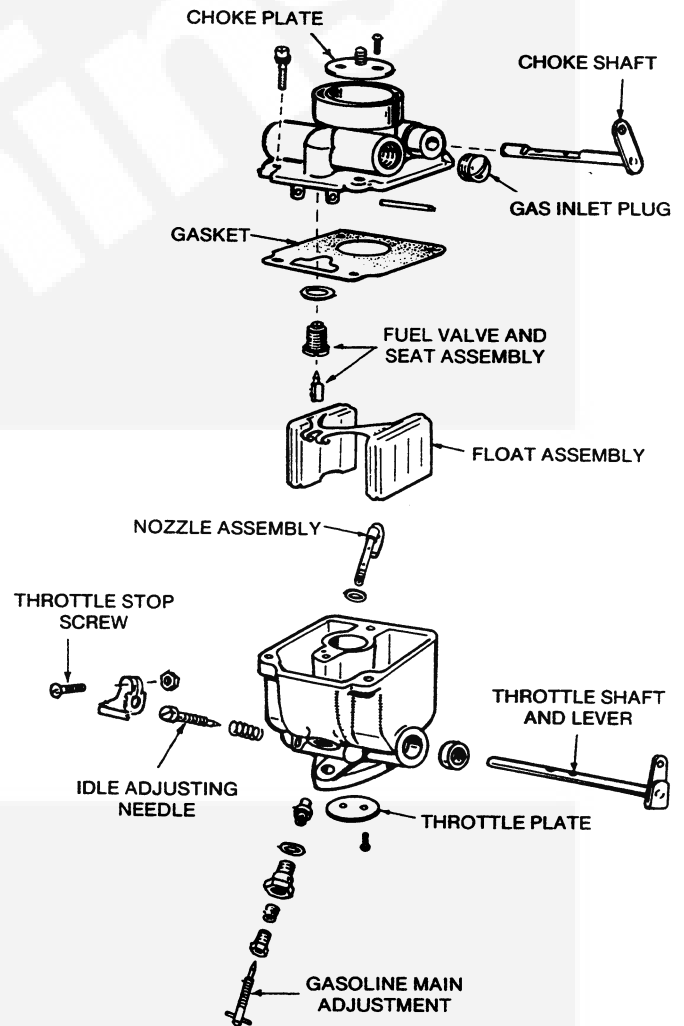


FIGURE 19. CARBURETOR ASSEMBLY

Removal and Disassembly

- Disconnect all lines, linkages, wires and attaching nuts or bolts, then remove the carburetor from the engine. (Downdraft carburetors may require removal of the intake manifold to disconnect.)
- Remove throttle and choke plate retaining screws, then plates. Pull out throttle and choke shafts, being careful not to damage the teflon coating applied to some throttle shafts.
- Remove main and idle mixture screw assemblies.
- Remove attaching screws and separate upper and lower carburetor sections.

- Carefully note position of float assembly parts, then slide out retaining pin and remove the float assembly, any springs or clips, and the needle valve.
- Unscrew and remove needle valve seat.

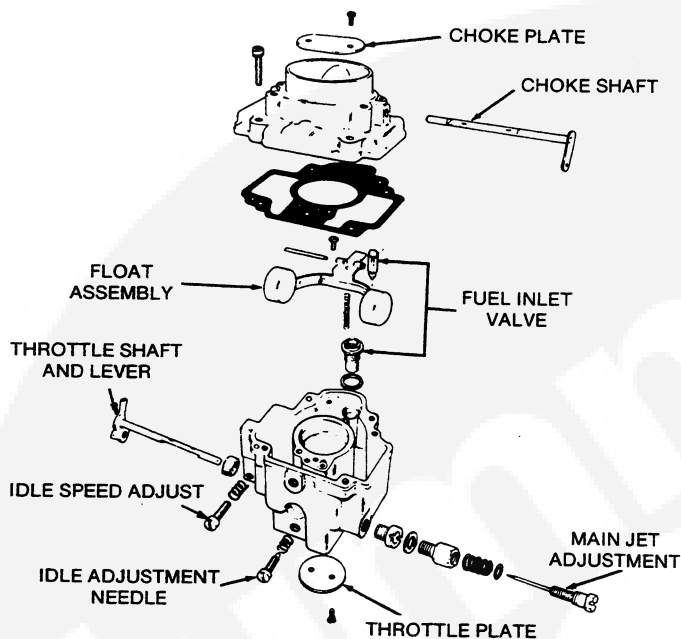


FIGURE 20. LUA CARBURETOR ASSEMBLY

Cleaning and Repair

- Soak all metal components not replaced by repair kit in carburetor cleaner. Do not soak non-metal floats or other non-metal parts. Follow the cleaning manufacturer's recommendations.
- Clean all carbon from the carburetor bore, especially where the throttle and choke plates seat. Be careful not to plug the idle or main fuel ports.
- Dry out all passages with low pressure air (35 PSI). Avoid using wire or other objects for cleaning that may increase the size of critical passages.
- Check the condition of any needle valve not included in repair kit and replace if damaged (Figure 21). Replace float if loaded with fuel or damaged.
- Check the choke and throttle shafts for excessive play in their bore and replace if necessary.
- Replace old components with new parts included in repair kit.

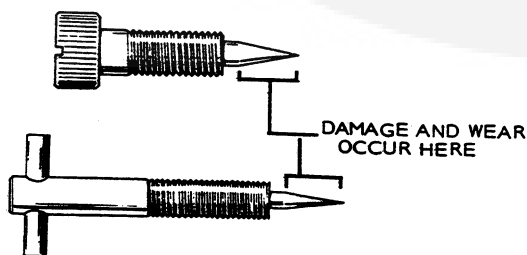


FIGURE 21. MIXTURE NEEDLE INSPECTION

Reassembly and Installation:

- Install needle valve and seat, fuel bowl gasket and float assembly. Make sure that all clips and springs are properly placed and that the float moves freely without binding. Check float level and adjust as necessary (see "Float Level Adjustment").
- Rejoin upper and lower carburetor sections.
- Slide in throttle shaft and install throttle plate using new screws, if furnished in repair kit. Before tightening the screws, the plate must be centered in the bore. To do so, back off the throttle stop screw as necessary and completely close the throttle lever. Seat the plate by tapping with a small screwdriver, then tighten screws. Install the choke shaft and plate in the same manner.
- Install main and idle mixture screw assemblies. Turn in screws until lightly seated.



Forcing the mixture adjustment screws tight will damage the needle and seat. Turn in only until light tension is felt.

- Reinstall carburetor on engine and connect fuel lines, linkages and wires.
- Set mixture screws according to directions given earlier in this section. Install air cleaner adapter, where used, and air cleaner.

FUEL PUMP OVERHAUL

Figure 22 shows a diaphragm-type fuel pump. If fuel does not reach the carburetor, check the fuel pump before dismantling it.

- Disconnect the fuel line at the carburetor.
- Crank the engine and observe if fuel comes from the line at the carburetor.

WARNING

Direct the fuel flow into a container so gasoline does not spill on ignition wires. Use extreme care in this step due to hazard of fire or explosion. Perform in a well-ventilated area to prevent an accumulation of gasoline fumes.

- If there is fuel in the tank, and line does not have fuel flowing, the pump needs replacing.

Pump failure is usually caused by a leaking diaphragm, valve or valve gasket, a weak or broken spring, or wear in the drive linkage. Gasoline diluted with oil can also indicate a faulty pump.

Fuel Pump Removal and Repair

Removal:

- Remove the fuel inlet and outlet lines from the pump.
- Remove the two capscrews holding the pump to the engine.
- Remove the pump, spacer (if used) and gasket from the engine and discard the gasket.

Repair:

Repair kits are available that provide replacements for those parts of the pump most subject to wear. If the operator chooses to repair the pump rather than install a new one, the use of all parts included in the repair kit is recommended. Proceed as follows:

1. After the pump is removed from the engine, scribe a line on the flanges of the upper and lower pump bodies to assure correct positioning when reassembling.
2. Remove the securing screws and separate the upper and lower pump bodies.
3. Detach the valve cage retainer from the pump upper body. Noting their position, remove the valve and cage assemblies and their gaskets from the retainer (Figure 22).
4. Detach the pump diaphragm by pressing its metal base into the pump body and turning it 1/4 turn.
5. The rocker arm return spring can normally be removed without removal of the rocker arm from the pump body. Use a small screwdriver or tweezers to compress the spring and tip it off the rocker arm catch. When installing the new spring, make sure it is properly placed before remounting the pump.
6. Clean in solvent all pump parts that will not be replaced and allow to dry.
7. Install the new valve and cage assemblies and their gaskets in the retainer. Be sure the assemblies are in proper position and fully seated. Reinstall the retainer and assemblies in the pump upper body.
8. To install the new pump diaphragm, turn the pump lower body upside-down and place the diaphragm and spring in the body. Press the base of the diaphragm up into the body of the pump and turn 1/4 turn.
9. Install new rocker arm return spring. Check for proper spring placement.
10. Place the upper and lower bodies of the pump together with the scribe marks aligned. Start the four securing screws, making sure they do not chew into the diaphragm fabric. Leave the screws 2 to 3 turns loose.
11. Operate the rocker arm several times to fully flex the new diaphragm. While holding the rocker arm fully flexed, tighten the body screws.

CAUTION

Failure to fully flex the rocker arm while tightening the pump bodies together will result in excessive pump pressure and possible engine flooding or pump diaphragm failure.

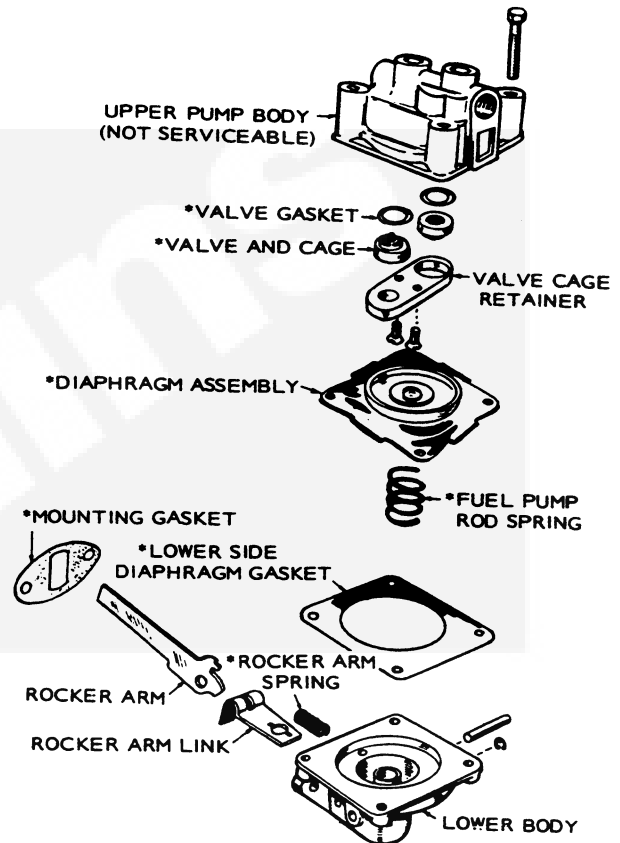


FIGURE 22. MECHANICAL FUEL PUMP - EXPLODED VIEW

Installation:

1. Remove all gasket material from mounting faces and spacer (if used). Apply oil-resistant sealer to both sides of the gasket(s) and to the threads of the attaching capscrews.
2. Place the gasket (and spacer if used) on the mounting face of the pump. Slide the mounting capscrews through the pump and gasket (and spacer) to prevent the gasket from slipping out of place.
3. Lightly place the pump in position on the engine making sure the rocker arm is riding on the camshaft lobe. Start both capscrews and check for proper gasket placement. Alternately torque capscrews to specifications.
4. Connect the fuel inlet and outlet lines.
5. Operate the engine and check for leaks.

GASEOUS FUEL (Prior to Spec 3670J)

Figure 23 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 (carburetor early models). See also, the following 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.

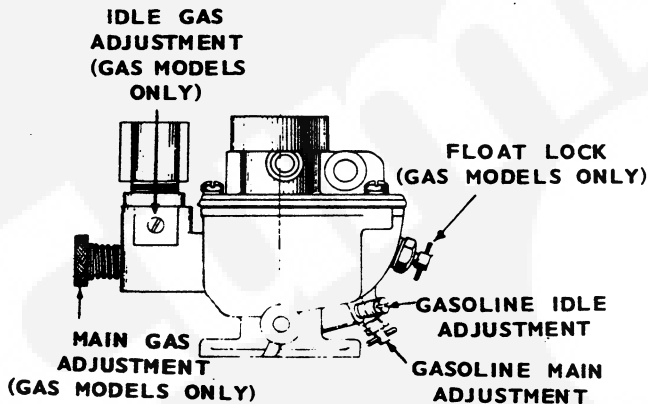


FIGURE 23. CARBURETOR ADJUSTMENT

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 24.

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 type regulator.

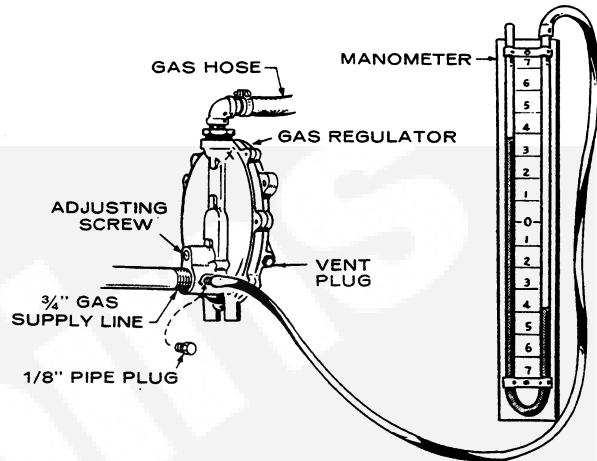


FIGURE 24. TESTING GAS REGULATOR

1. Use a manometer which reads up to 14 inches water column.

Conversion Factors:

Ounces of pressure x **1.73** =
inches of water column or
Inches water column x **.58** =
ounces of pressure 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 25). 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 expended and becomes gas.

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.

WARNING

LP gas is an extremely flammable substance which **MUST** be handled with extreme care. Do NOT operate the welder in an enclosed area. Do NOT smoke. All bulk tank(s) are pressurized but require vaporization to operate appliances or use as a vehicle engine fuel source. Keep a type ABC fire extinguisher handy.

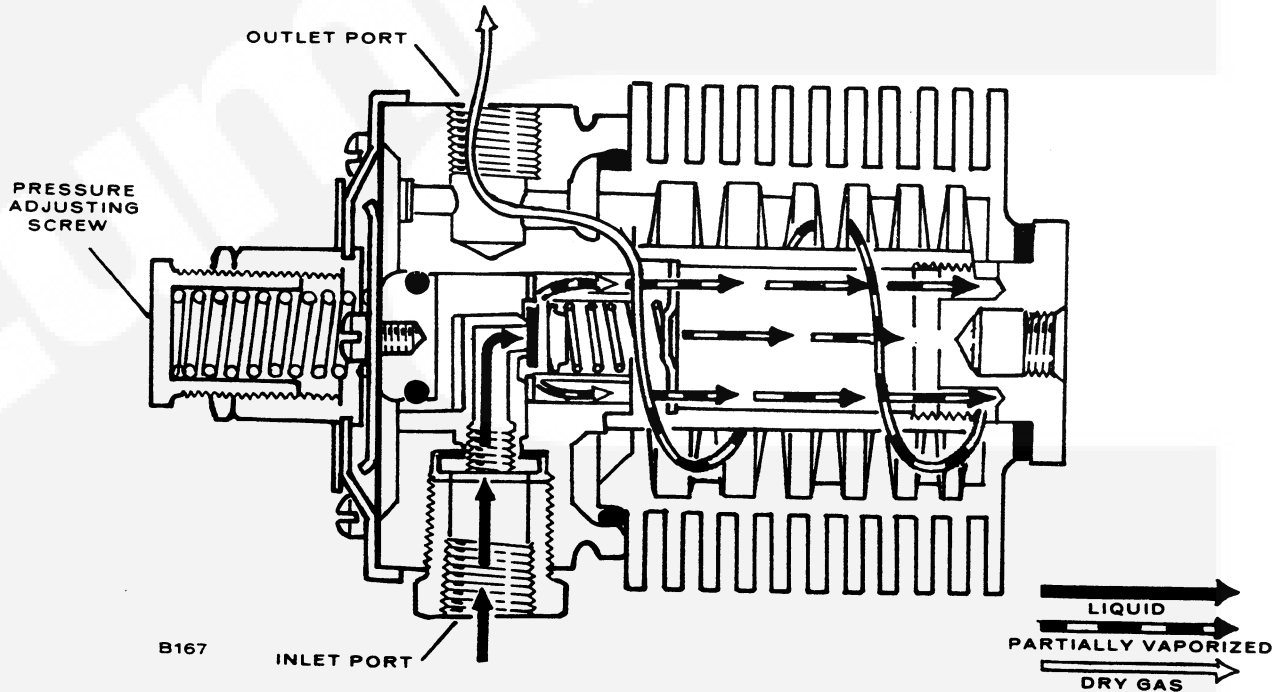


FIGURE 25. LPG VAPORIZER

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 26).
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.

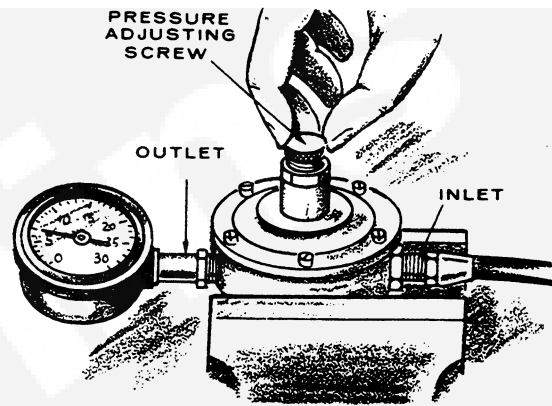


FIGURE 26. VAPORIZER ADJUSTMENT

WARNING

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 (ABC) 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 igniton 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). Both spark plugs fire simultaneously, thus the need for a distributor is eliminated. Always check timing after replacing ignition points or if noticing poor engine performance. Figure 27 shows magneto ignition while Figure 28 shows the battery ignition system.

IGNITION TIMING (Top Adjust Breaker Points)

The timing on the engine is preset at the factory. A non-movable breaker point box is used, however a slight timing change could be made by adjusting points.

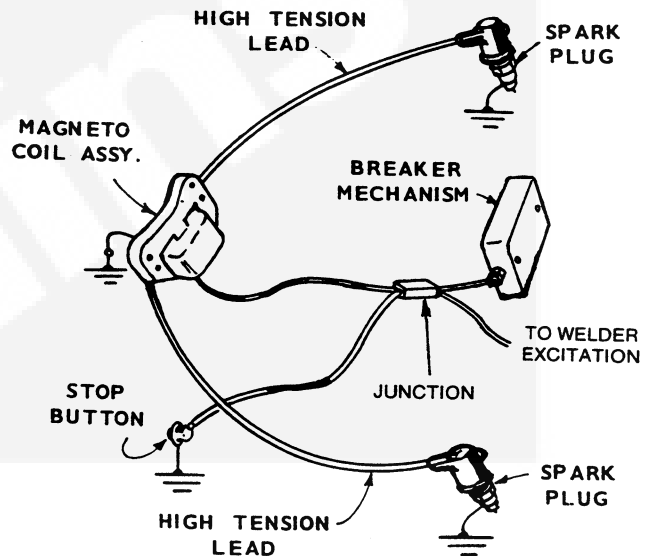


FIGURE 27. MAGNETO IGNITION SYSTEM

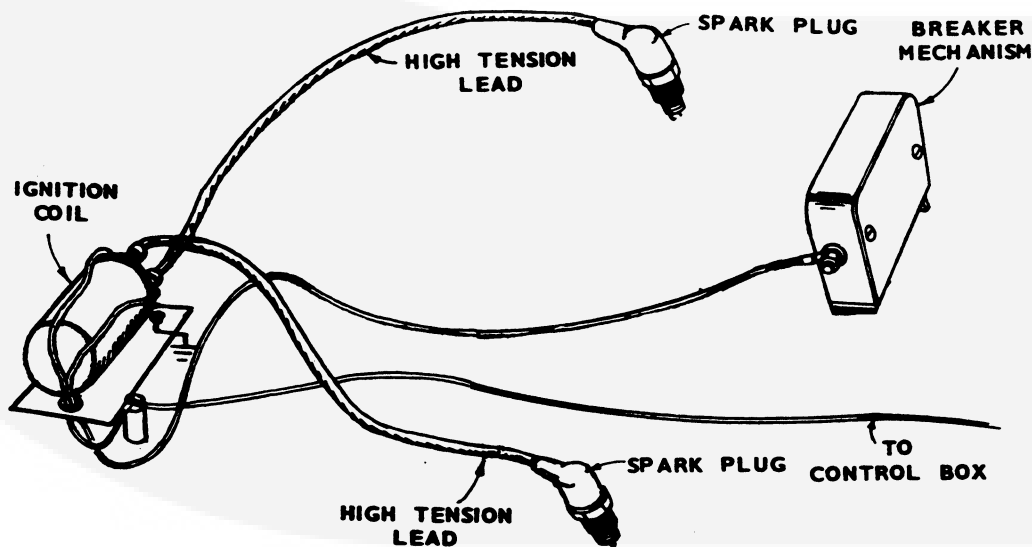


FIGURE 28. BATTERY IGNITION SYSTEM

Timing Procedure — Engine Running and Hot

1. To accurately check ignition timing, use a timing light when engine is running. Connect timing light according to its manufacturer's instructions.
2. Start the engine and check the timing. The TC mark on the flywheel should line up with the specified degree mark (see *SPECIFICATIONS* for correct ignition timing) on the gear cover (Figure 29).
3. If timing marks do not line up, readjust point gap. On engines with Top Adjust Breaker Points (Figure 30) to advance timing, slightly open gap on breaker points, to retard timing slightly close gap on breaker points. On early engines if timing needs adjustment loosen the mounting screws on breaker box (Figure 31) and move it left to advance or right to retard the timing.
4. Recheck timing and breaker point gap after making this adjustment.
5. Replace breaker box and any other hardware removed.

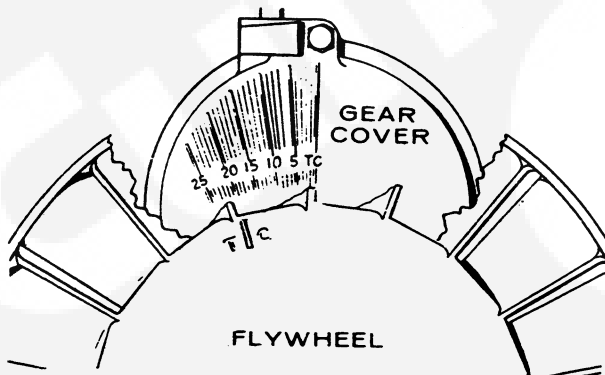


FIGURE 29. IGNITION TIMING

TOP ADJUST BREAKER POINTS—REPLACEMENT (Begin Spec 3670J)

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

1. Remove spark plugs and rotate flywheel TC mark clockwise to 20° BTC (points open).
2. Remove breaker box cover and unplug coil wire at coil (+) terminal.
3. Remove condenser (screw A) and detach condenser lead and coil lead (screw B), Figure 30.
4. Remove two allen screws (C) and lift breaker assembly from engine.
5. Replace condenser and point assembly with new parts and reinstall using above procedure in reverse order of removal.

BREAKER POINT ADJUSTMENT
.020 INCH (0.5 mm) GAP

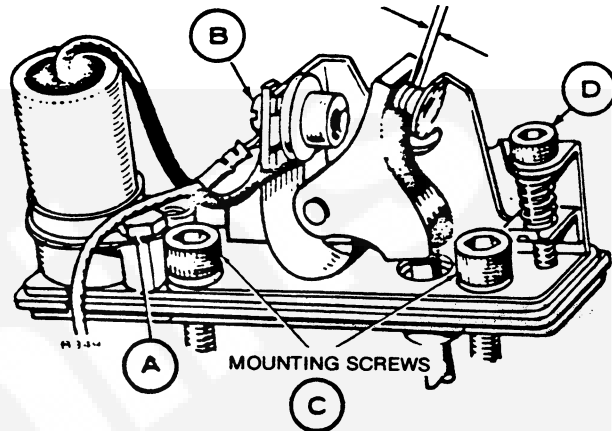


FIGURE 30. BREAKER POINTS—TIMING

6. Connect an ohmmeter or a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.
7. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
8. The lamp should go out just as the points break which is the time at which ignition occurs (20° BTC).
9. If timing is early (large point gap) or late (small point gap), adjust point gap using Allen screw (D) so that lamp goes out at 20° BTC with crankshaft rotation clockwise.

If a continuity lamp or an ohmmeter is not available, use a clean flat feeler gauge as follows: Rotate crankshaft clockwise (facing flywheel) by hand until TC mark on flywheel aligns with 20° BTC mark on gear cover. Then rotate flywheel another 1/4 turn clockwise (90°) to ensure points open fully. Using allen screw (D), set point gap at .020 inch (.51 mm).

10. Replace breaker box cover, coil wire and spark plug cables.

SIDE ADJUST BREAKER POINTS—REPLACEMENT (Prior to Spec 3670J)

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.

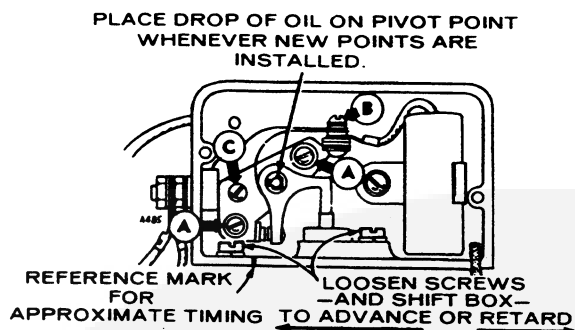


FIGURE 31. BREAKER POINTS—TIMING

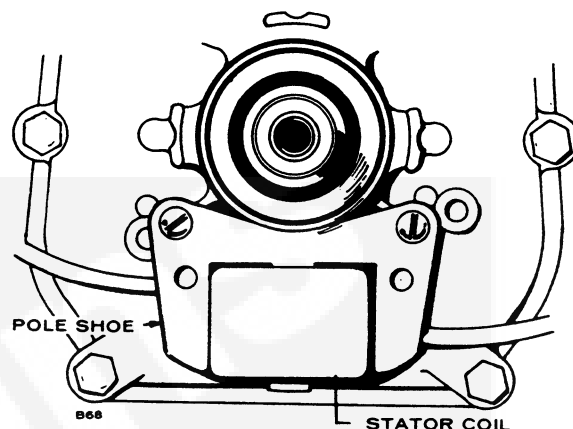
3. Remove the two mounting screws (A) and pull the points out of the box just far enough so screw (B) can be removed. See Figure 31. Replace points with a new set but do not completely tighten mounting screws (A).
 4. Rotate flywheel clockwise (facing flywheel) by hand until points are fully open. Turn screw (C) until point gap measures .020 inch with a flat thickness gauge.
 5. Tighten mounting screws and recheck gap.
- Each time new breaker points are installed, place a drop of oil on the point's pivot point (Figure 31).
6. 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.
 7. Turn crankshaft against rotation (counter-clockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
 8. The buzzer should sound just as points break.
 9. If timing needs adjustment, loosen the mounting screws on breaker box and move it left to advance or right to retard the timing.
 10. Replace breaker box cover, coil wire and spark plug cables.

MAGNETO

The magneto coil assembly (Figure 32) 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. Connect the larger magneto coil assembly lead to the breaker box insulated terminal.

SPARK PLUGS

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



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

FIGURE 32. MAGNETO STATOR ASSEMBLY

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

IGNITION CIRCUITS

The wiring diagrams for the battery voltage and magneto voltage systems are shown in Figure 34.

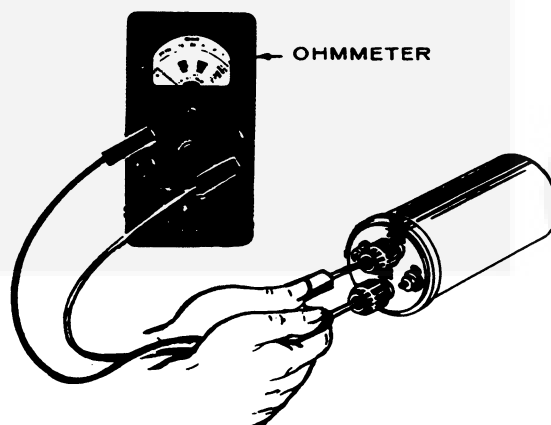
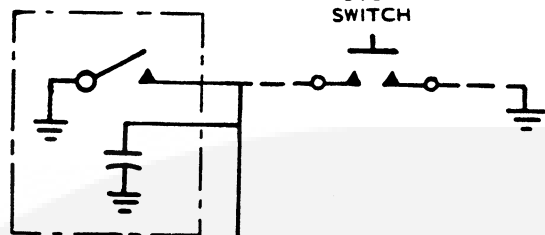


FIGURE 33. TESTING IGNITION COIL

IGNITION POINTS
AND CAP ASSEMBLY

STOP
SWITCH



MAGNETO



SPARK
PLUGS

MAGNETO IGNITION
(622-0075)

BATTERY IGNITION
(622-0382)

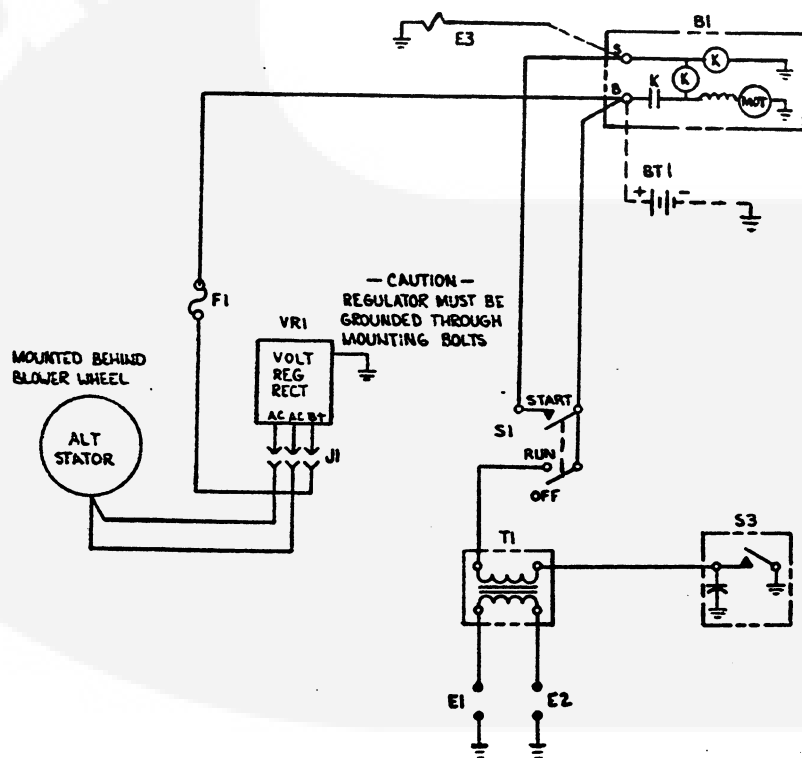


FIGURE 34. WIRING DIAGRAM FOR CCKA ENGINES

BATTERY CHARGING SYSTEM

FLYWHEEL ALTERNATOR

This unit is equipped with a permanent magnet flywheel alternator and solid-state voltage regulator-rectifier (output control). See Figure 35. As with all solid-state electrical units, precautions are necessary when servicing. Observe the following.

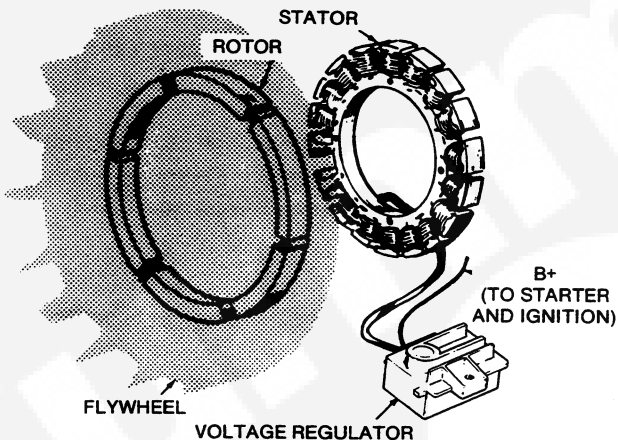


FIGURE 35. FLYWHEEL ALTERNATOR SYSTEM

Weak ignition spark or a discharged battery indicate trouble in the charging system. But before testing the engine's charging system, always check the battery for serviceability.

Keep these points in mind when testing or servicing the flywheel alternator.

1. Be sure output control plug (connector) is inserted properly. Plug must bottom in receptacle—eliminates any resistance due to a poor connection. Keep clean and tight.
2. Make sure alternator stator leads are not shorted together.
3. Be sure regulator-rectifier output control has a good ground connection. Mating surface for mounting must be clean and fasteners tightened properly.
4. Never reverse the battery leads.

Charging system tests require a full charged battery.

BATTERY INSPECTION

Check battery cells with a hydrometer. The specific gravity reading should be approximately 1.260 at 77° F (25° C), Figure 36.

If one or more cells are low on water, add distilled water and recharge. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

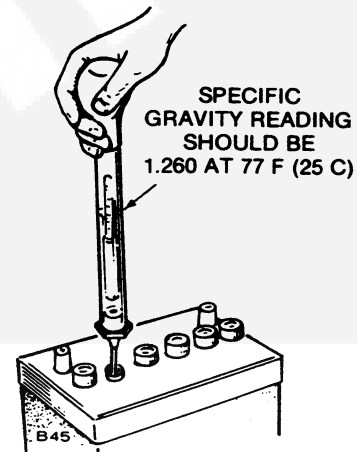


FIGURE 36. SPECIFIC GRAVITY TEST

BATTERY JUMP STARTING

Occasionally, it may be necessary to jump start (charge) a weak battery using a charged booster battery to start your engine. If jump starting is necessary, the following procedure is recommended in order to prevent battery damage and personal injuries.

1. Disconnect engine load.
2. Turn ignition switch to ON so engine will start.
3. Use only a battery of the same voltage (12V) as is used with your engine.
4. Attach one end of the positive booster cable (red) to the positive (+) terminal of the booster battery. Attach the other end of the positive cable to the positive (+) terminal of your engine battery.
5. Attach one end of the negative (-) booster cable (black) to negative (-) terminal of booster battery. Attach other end of negative cable to a solid chassis ground on your engine.

WARNING Do not allow the positive and negative cable ends to touch each other because it will short the battery causing hazardous arcing.

6. Jump starting in any other manner may result in damage to the battery or the electrical system.

WARNING Never jump start a frozen battery. To do so may cause the battery to explode. Never expose the battery to an open flame or an electrical spark because a battery creates highly explosive hydrogen gas.

ALTERNATOR TESTING

With the engine running between 1800 to 2600 rpm, observe the panel ammeter (if not already equipped, connect a test ammeter). If no charging is evident, proceed with the *No Charge Test*. If ammeter shows a constant higher charge rate, follow the *High Charge Rate Test* procedure.

No Charge Test

1. Check the B+ to ground voltage using a DC voltmeter. See Figure 37 for wiring diagram.
2. If voltmeter reads 13.8 volts or higher, add a load to system (e.g. headlights) to reduce battery voltage to below 13.6 volts.
3. Observe ammeter. If charge rate increases, consider the system as satisfactory. If charge rate does not increase, proceed with testing.
4. Disconnect plug from regulator-rectifier and test the AC voltage at the plug with engine running near 3600 rpm. If AC voltage reads less than 28 volts, replace the stator. If AC voltage is more than 28 volts, replace the regulator-rectifier assembly.

High Charging Rate Test

Perform this test as follows:

1. Check B+ to ground voltage with a DC voltmeter.
2. If voltmeter reads over 14.7 volts, replace regulator-rectifier assembly.
3. If reading is under 14.7 volts, the system is probably okay. Recheck the battery and connections. If the battery does have a low charge, but accepts recharging, system is okay.

Precautions

1. Do not connect battery cables in the wrong polarity.

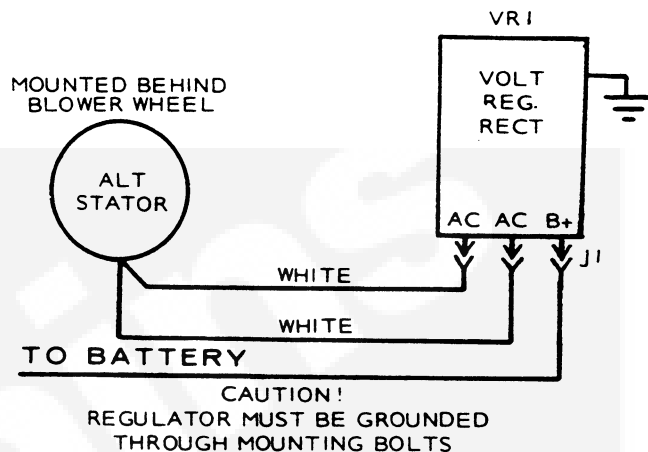


FIGURE 37. 15-AMPERE PHELOM SYSTEM DIAGRAM

2. Do not short together alternator stator leads.
3. Do not run without a battery. Damage will occur to regulator and battery ignition coil.

Preservice Checks

1. Check for a good ground between equipment and regulator-rectifier case.
2. Be sure output control plug (connector) is properly inserted into stator receptacle. This means plug must push in and solidly bottom in the receptacle to eliminate any resistance due to a poor connection. Keep it clean and tight.
3. Check battery and its connection to be sure it is serviceable.

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

TABLE 1. TESTING PHELOM 15-AMPERE SYSTEM

BASIC TEST	PROCEDURE	TEST VALUES
1. Battery	Battery Voltage — unit not running	12 VDC
2. Regulator	Battery Voltage after unit is running 3 to 5 minutes	13.6 to 14.7 VDC
3. Alternator Stator and Wiring with Fully Charged Battery.	Ohmmeter reading from stator output — unit not running. Check at plug.	0.11 to 0.19 Ohms
4. Alternator and Wiring	Measure AC open circuit stator voltage with unit running. Measure between two stator leads with plug disconnected and unit running at approximately 3600 rpm.	28 VAC

STARTING SYSTEM

ELECTRIC STARTING

The standard starting motor on older models with electric start engines is the gear-drive starter shown in Figure 38. 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.

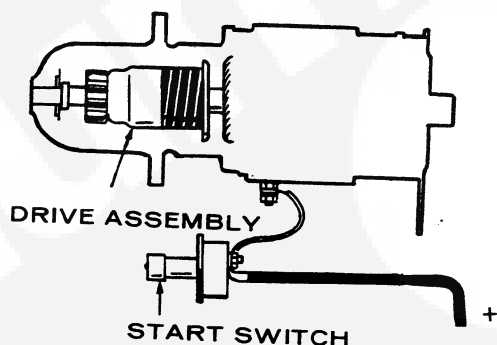


FIGURE 38. GEAR-DRIVE STARTER

The solenoid-shift starter (standard on engines beginning Spec J) is shown in Figure 39. 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,

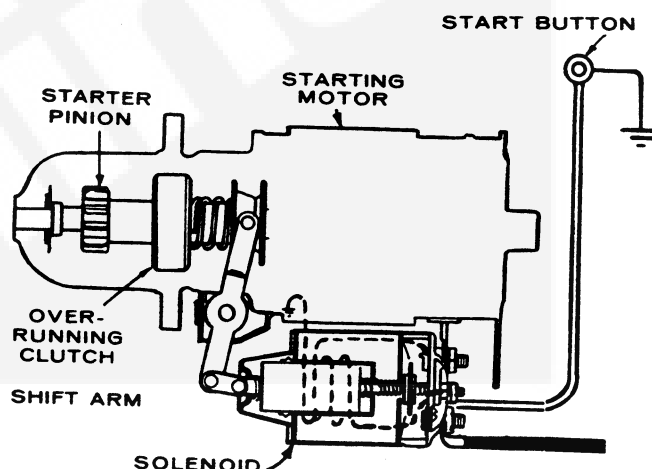


FIGURE 39. SOLENOID-SHIFT STARTER

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 40).

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 41. The spacers on the solenoid starter in Figure 41 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.

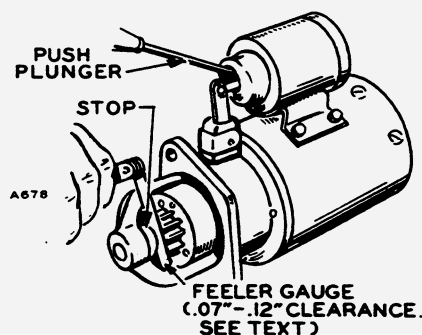
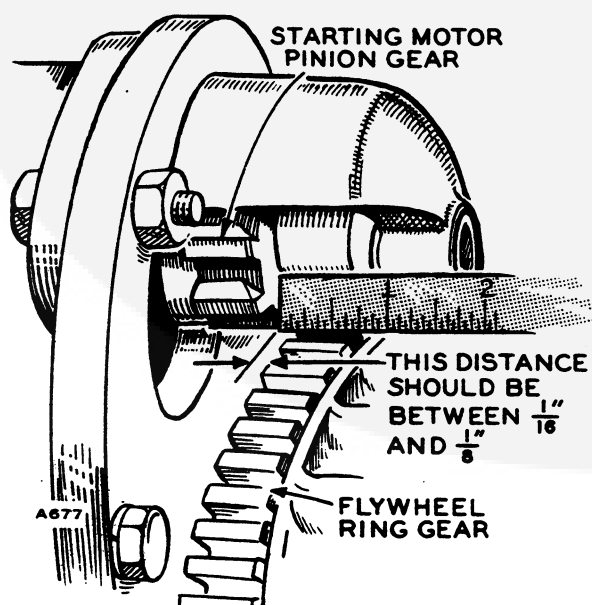


FIGURE 40. PINION CLEARANCES

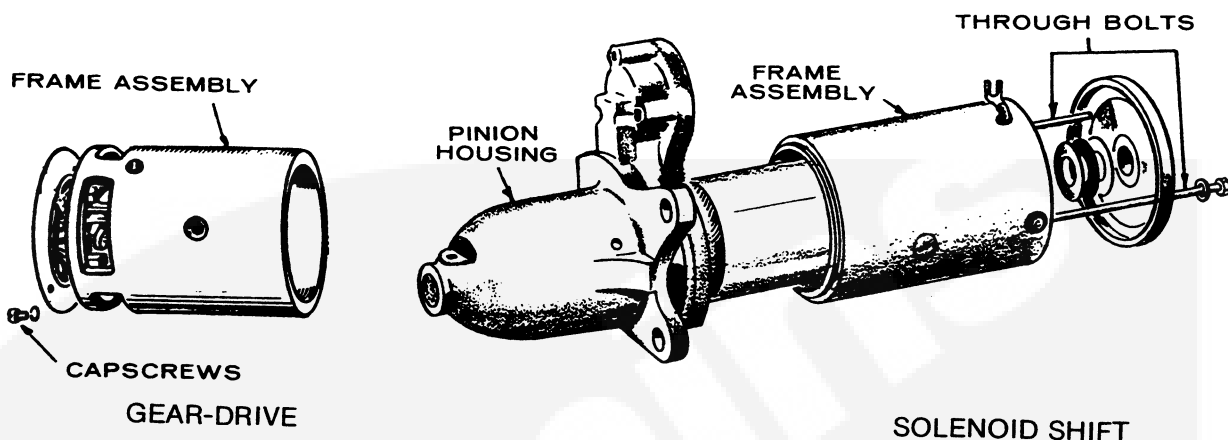


FIGURE 41. STARTER DISASSEMBLY

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 42.

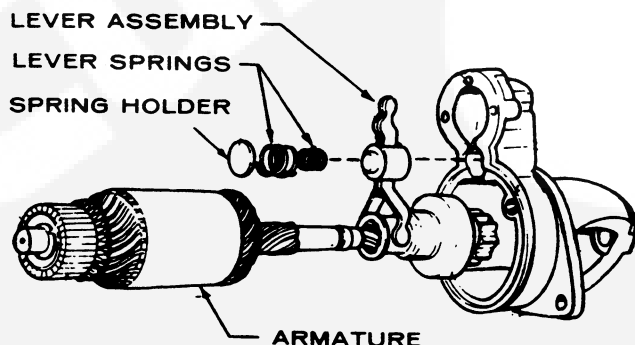


FIGURE 42. REMOVING ARMATURE FROM SOLENOID SHIFT STARTER

5. **Solenoid Starter Only:** Remove the ring after driving the pinion stopper toward the pinion gear using a cylindrical tool, Figure 43. 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 44. 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.

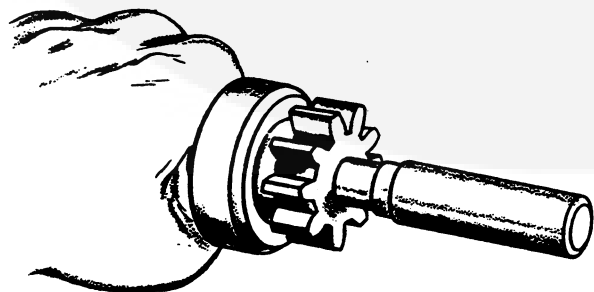


FIGURE 43. TOOL FOR DRIVING PINION STOPPER

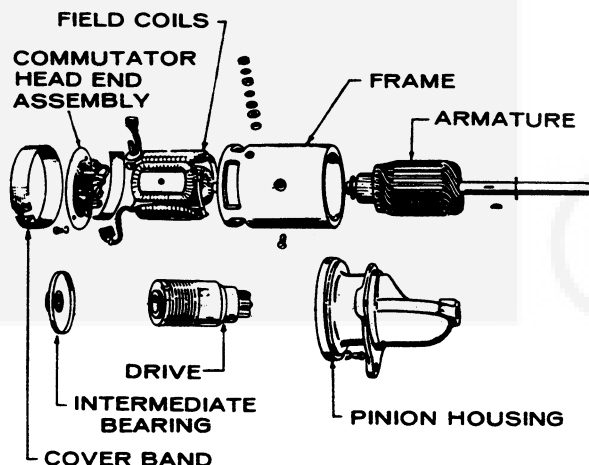


FIGURE 44. GEAR DRIVE STARTER

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 45. A shorted armature causes the blade to vibrate and move toward the core. A shorted armature must be replaced.

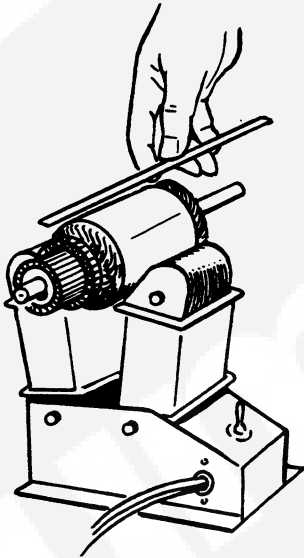


FIGURE 45. TEST FOR SHORTED ARMATURE

Testing Armature for Grounds: Touch armature shaft or core and the end of each commutator bar with a pair of ohmmeter leads, Figure 46. If the ohmmeter reading is low, it indicates a grounded armature. Replace grounded armature.

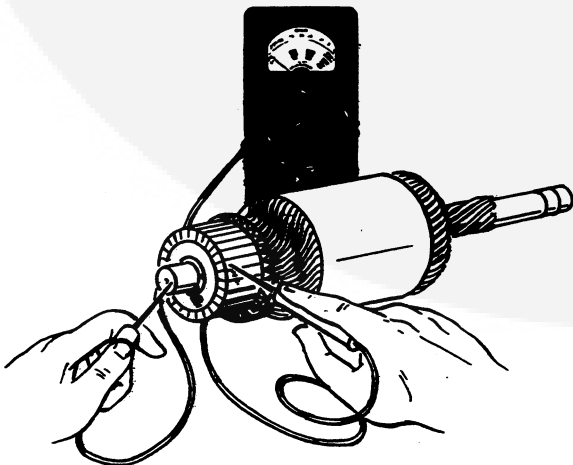


FIGURE 46. TEST FOR GROUNDED ARMATURE

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 47. When commutator runout exceeds .004 inch, reface the commutator.

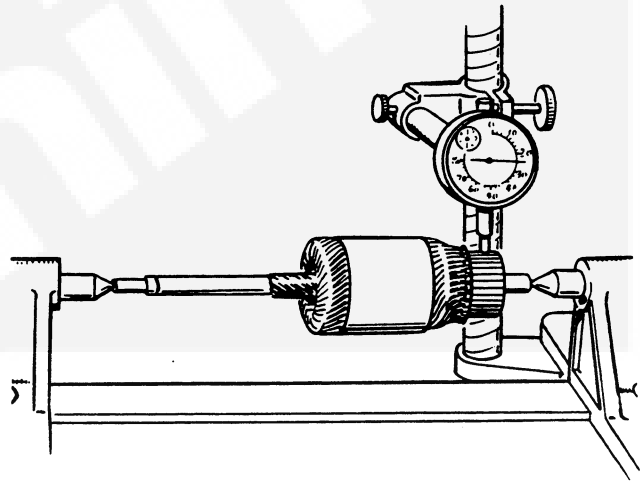


FIGURE 47. CHECKING COMMUTATOR RUNOUT

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 48.

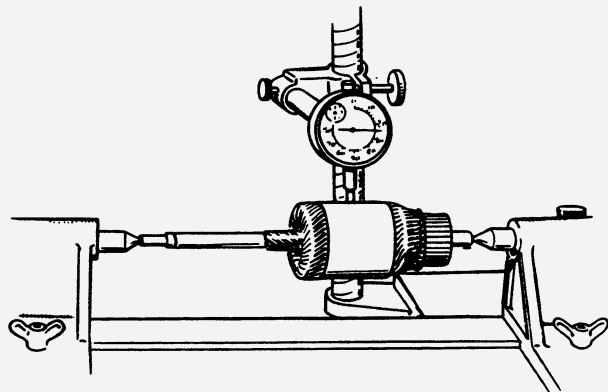
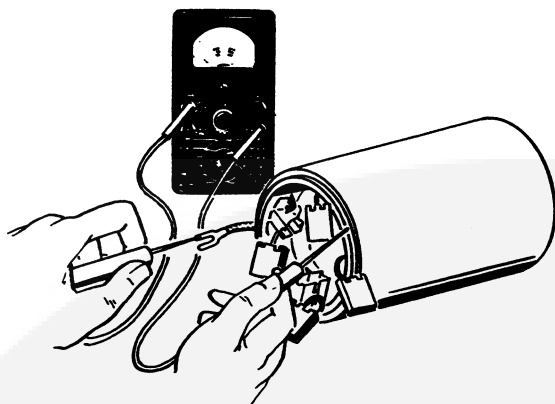


FIGURE 48. CHECKING ARMATURE SHAFT RUNOUT

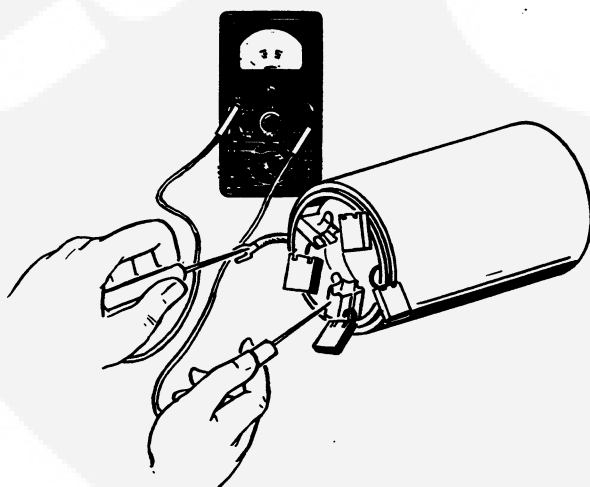
Testing Field Coils for Grounds: Place one test probe on the connector and the other on a clean spot on the frame after unsoldering the shunt field coil wire. If the ohmmeter reading is low, the fields are grounded either at the connector or in the windings, Figure 49.



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

FIGURE 49. 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 50. 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 50. TEST FOR OPEN FIELD COIL

Inspection of Brushes: When brushes are worn more than 0.3 inch, replace them. Figure 51 shows the wear limit. See that the brushes move smoothly in the brushholders.

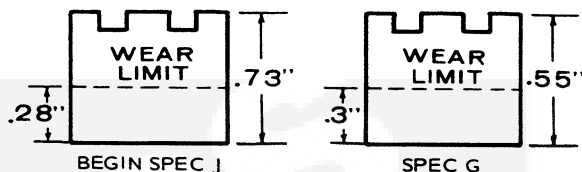


FIGURE 51. BRUSH WEAR LIMITS

Inspection for Brush Spring Tension: Measure brush spring tension with a tension meter, Figure 52. 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.

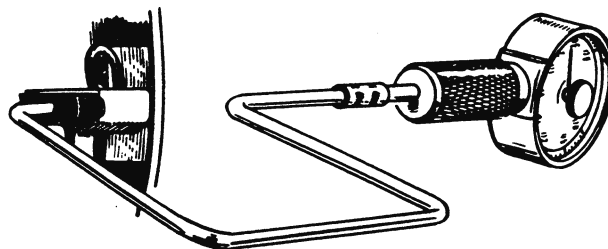


FIGURE 52. MEASURING BRUSH SPRING TENSION

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

PRESSURE LUBRICATION

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 PUMP

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 53. If oil pressure is low, the pump should be checked.

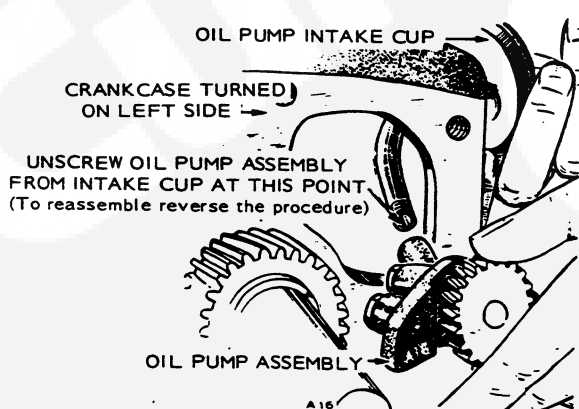


FIGURE 53. OIL PUMP ASSEMBLY

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.

OIL BYPASS VALVE

The bypass valve (located to the right and behind gear cover (Figure 54), controls oil pressure by allowing excess oil to flow directly back to the crankcase.

The valve is nonadjustable 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" - 24 x 1 inch capscrew 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.

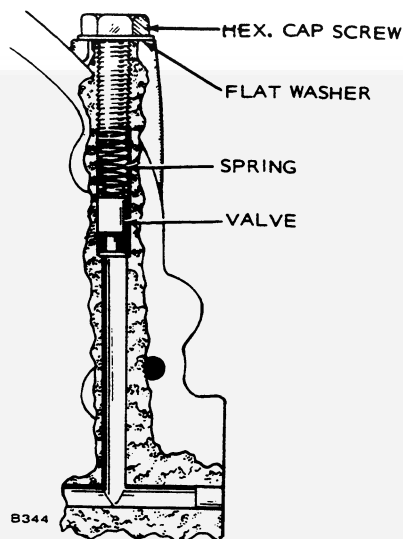


FIGURE 54. BYPASS VALVE

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 55.

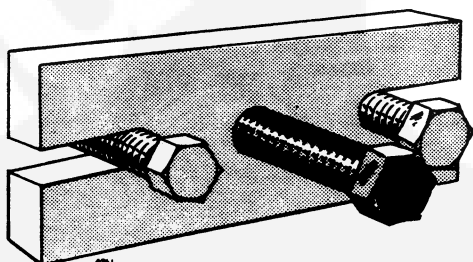


FIGURE 55. ONAN FLYWHEEL PULLER

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.

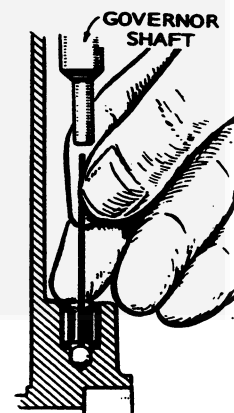
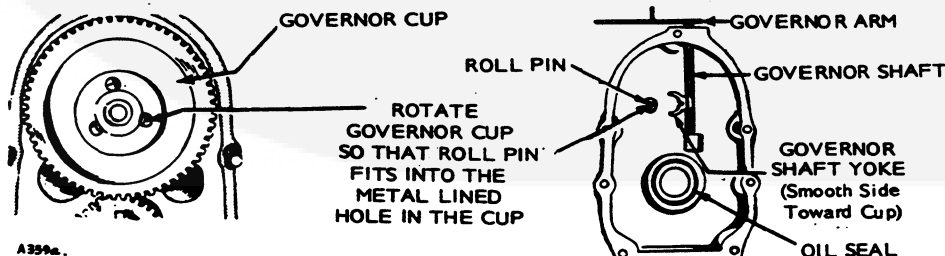
GEAR COVER

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 56.

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.



IF FEELER WILL ENTER HOLE 1/2" BALL HAS FALLEN OUT

FIGURE 56. 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 57).

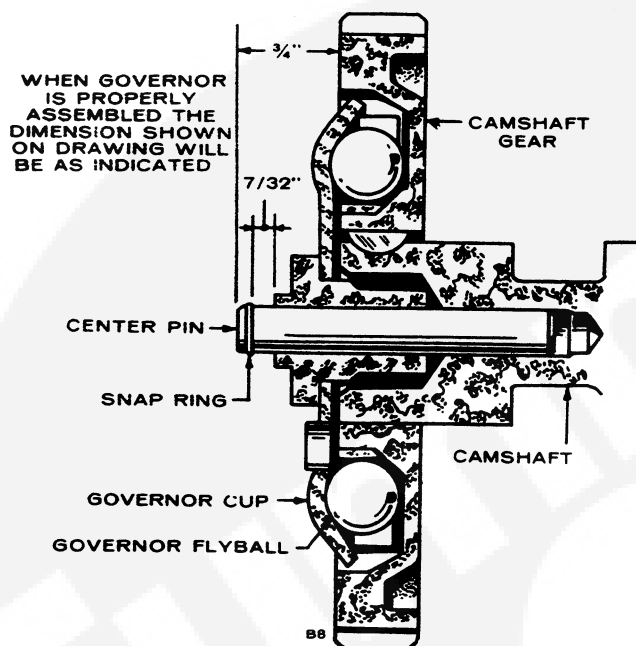


FIGURE 57. GOVERNOR CUP

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.

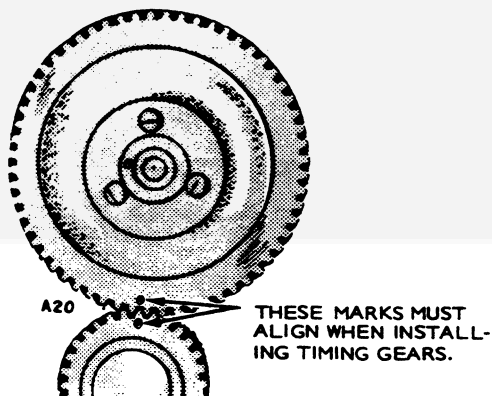
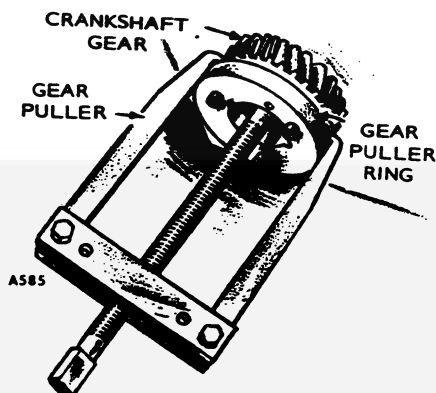


FIGURE 58. TIMING GEAR REMOVAL AND INSTALLATION

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 58. 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 59 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.

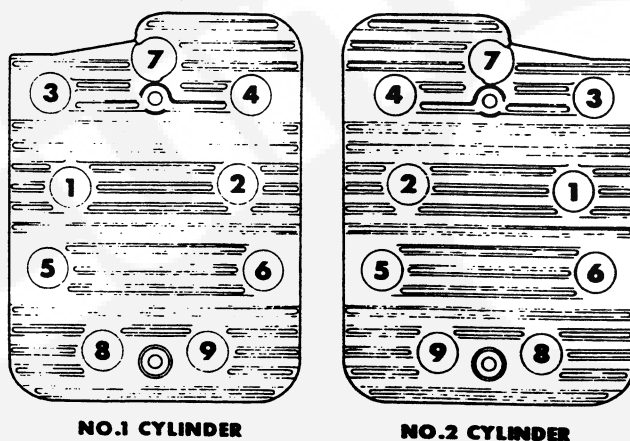


FIGURE 59. HEAD BOLT TIGHTENING SEQUENCE

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 60. A valve stem seal and guide seal is provided on the intake valve guide 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 61.

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

NOTE: USE A STANDARD AUTOMOTIVE TYPE WRENCH TO ADJUST THE TAPPETS

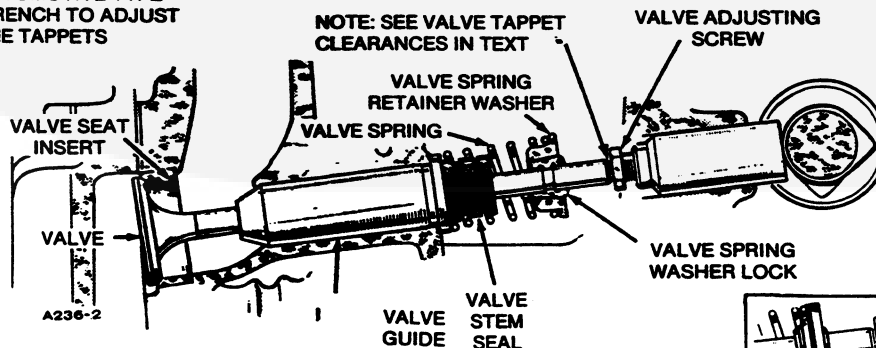


FIGURE 60. CCK AND CCKA VALVE STEM

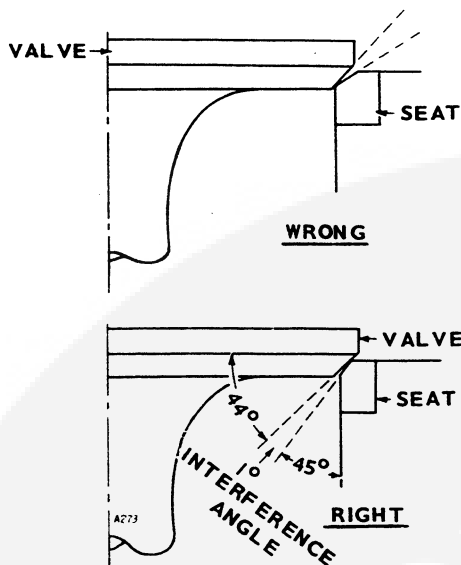


FIGURE 61. VALVE FACE AND SEAT ANGLES

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 62.

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)

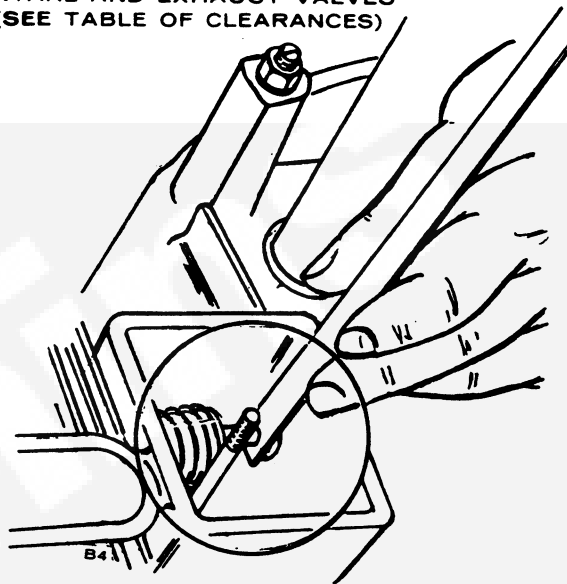
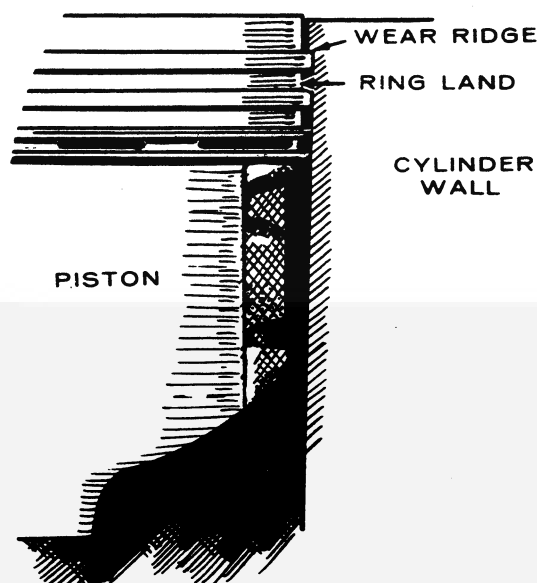


FIGURE 62. ADJUSTING TAPPETS



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

FIGURE 63. 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 63.

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

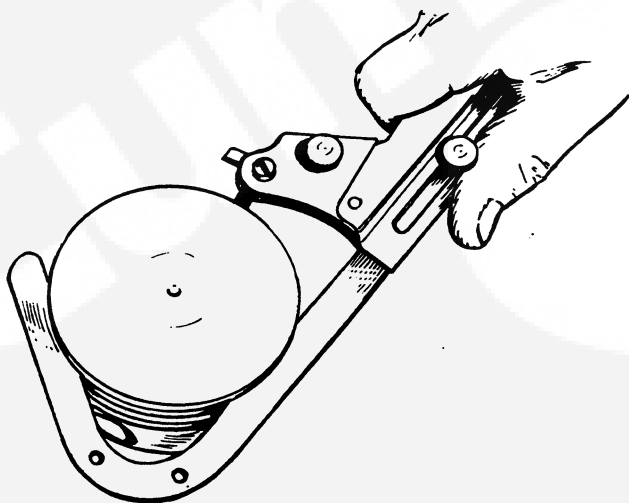
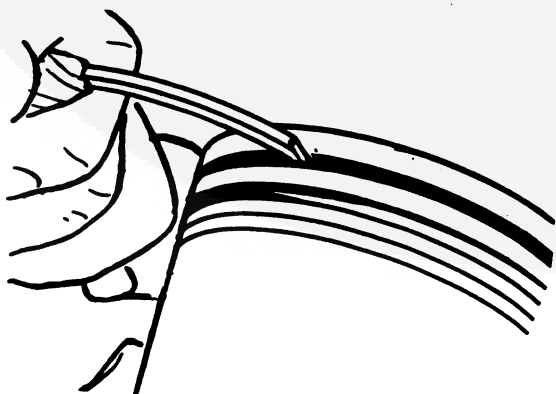


FIGURE 64. CLEANING RING GROOVES



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

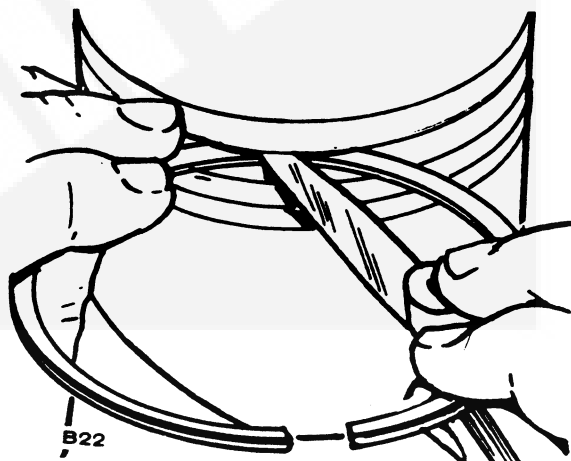


FIGURE 65. INSPECTING RING LANDS

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 66.

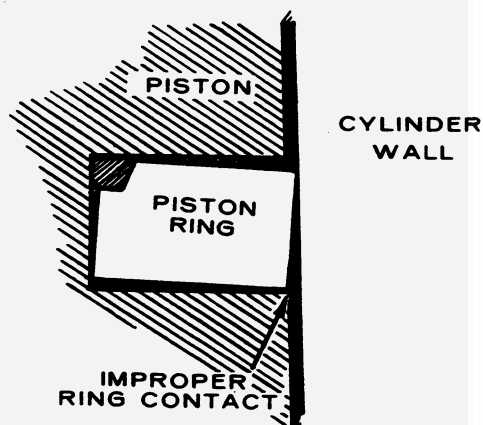


FIGURE 66. NEW RING IN WORN PISTON RING GROOVE

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 67. 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.

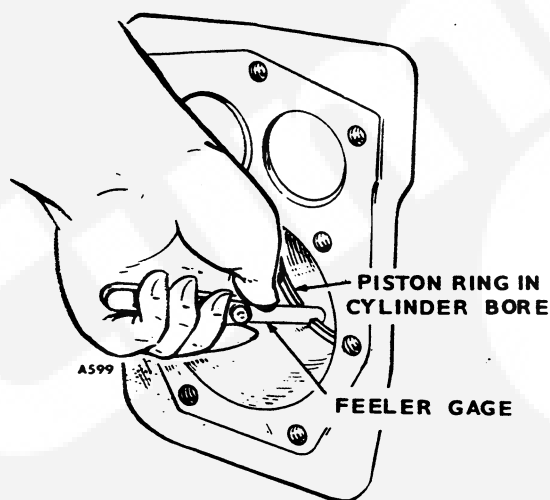


FIGURE 67. FITTING PISTON RINGS TO CYLINDER

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 68).

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.

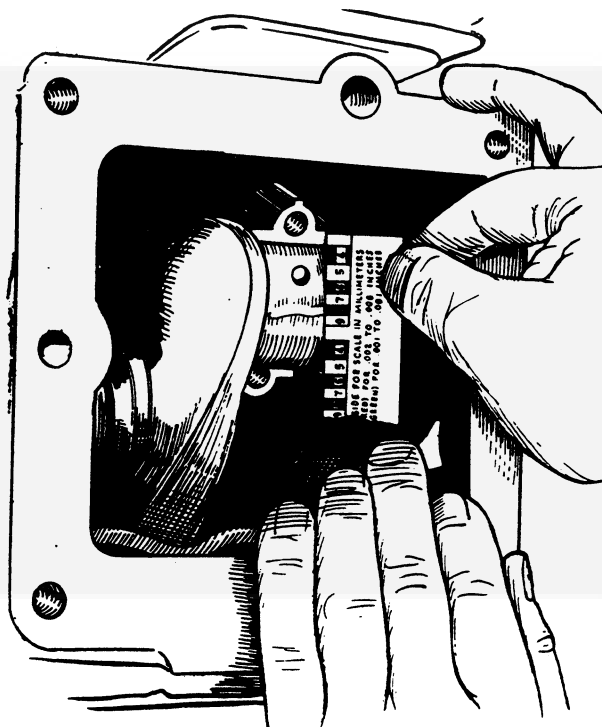


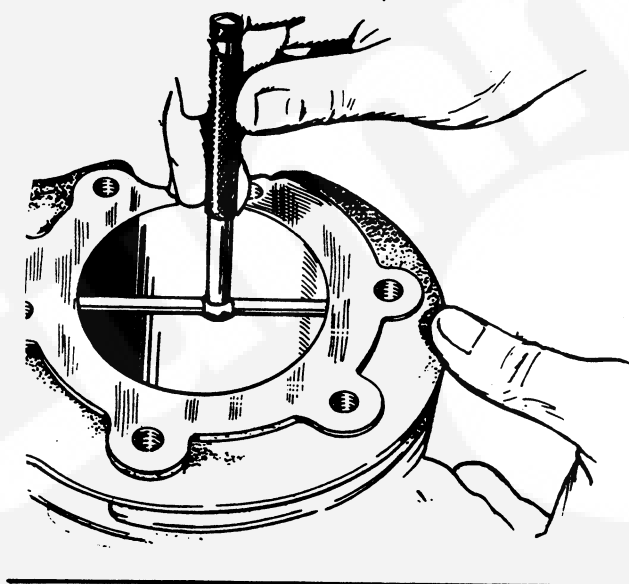
FIGURE 68. MEASURING BEARING CLEARANCE WITH PLASTIGAUGE

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.



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 69. 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 70. 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

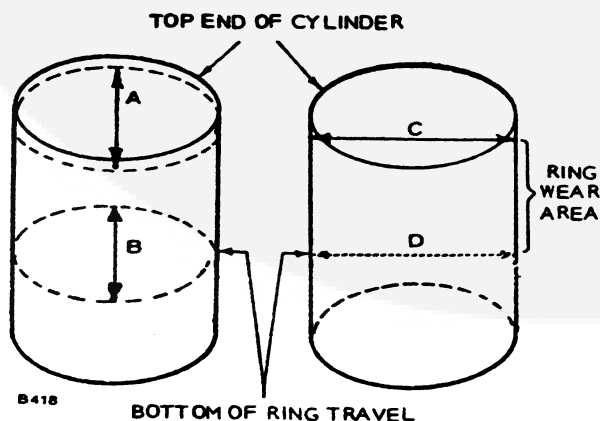


FIGURE 69. METHODS OF CYLINDER BORE INSPECTION

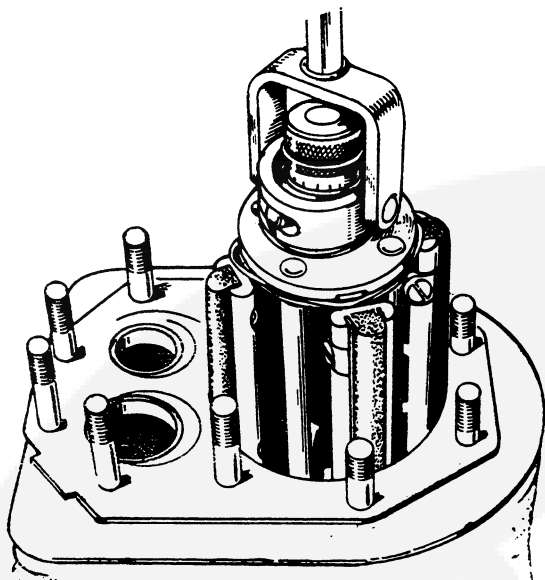
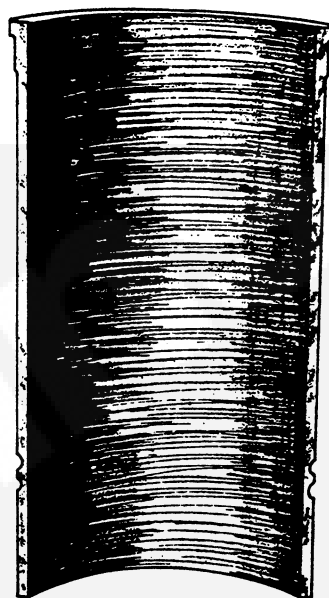


FIGURE 70. HONING CYLINDER



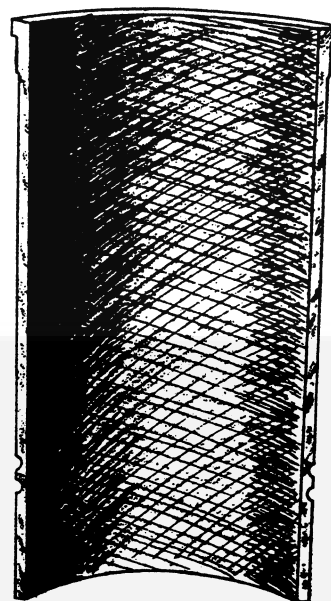
AVOID THIS FINISH

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 71. 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-



PRODUCE CROSS HATCH SCRATCHES
FOR FAST RING SEATING

FIGURE 71. CORRECT HONE FINISH

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, Figure 72. Use combination bearing driver 420-0324 to install the camshaft bearings.

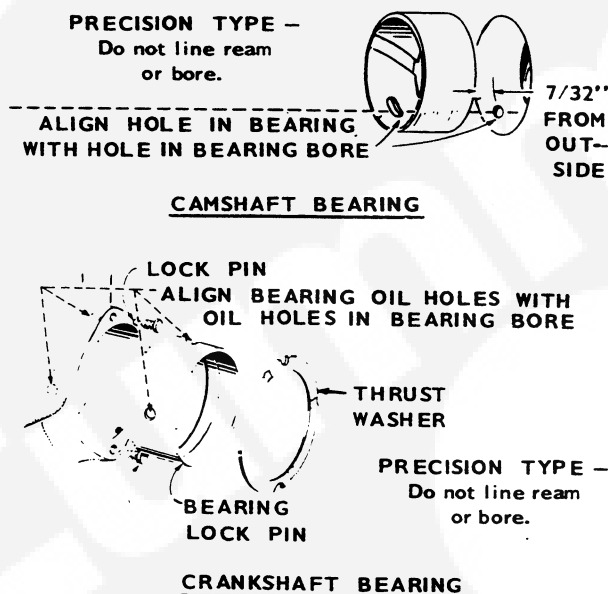


FIGURE 72. INSTALLATION OF CAM AND CRANKSHAFT BEARINGS

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.

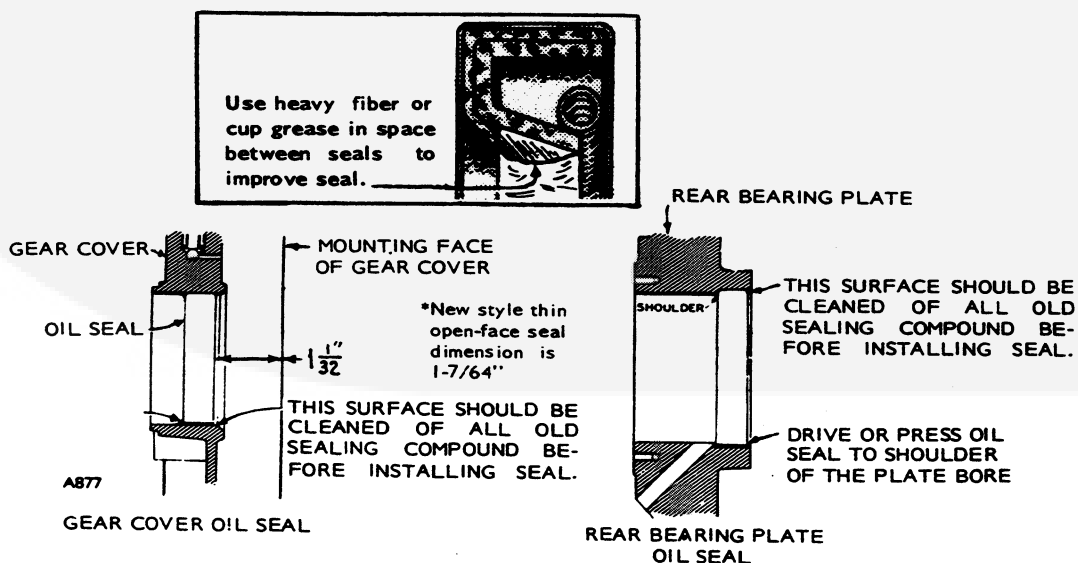


FIGURE 73. GEAR COVER AND REAR BEARING PLATE OIL SEALS

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, Figure 73.

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 74. 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

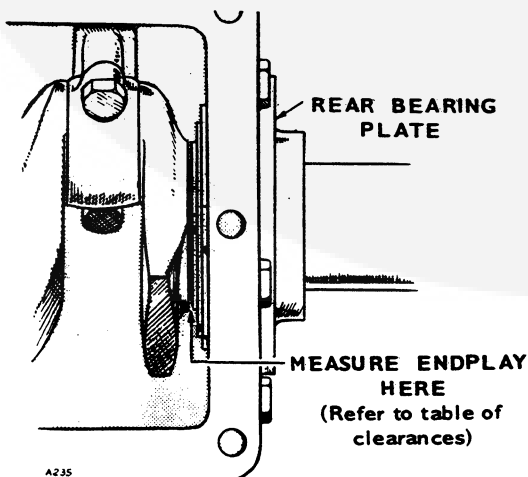


FIGURE 74. MEASURING CRANKSHAFT ENDPLAY

plate and replace the gasket with a thicker one. Reinstall the end plate making sure the thrust washer notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

OIL PUMP

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling, Figure 75. 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.

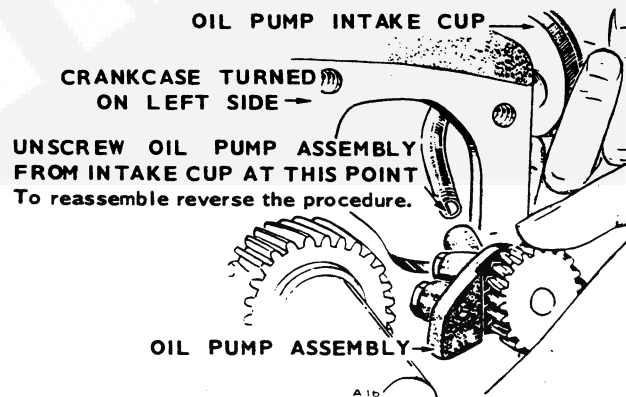


FIGURE 75. OIL PUMP

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Box, Breaker - Keys 1, 2, 3, 4, 5, 6, 7, 8, 9	58
Box, Breaker - Keys 10, 11, 12, 13, 14	58
Camshaft	56
Carburetor Parts - Keys 1, 2, 3, 4, 5, 6, 7, 8, 9	60
Carburetor Parts - Keys 10, 11, 12, 13, 14	62
Crankshaft and Flywheel	52
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Fuel System - Keys 1, 2, 3, 4, 5, 6, 7, 8, 9	59
Fuel System - Keys 10, 11, 12, 13, 14	61
Gearcase	51
Governor - Keys 1, 2, 3, 4, 5, 6, 7, 8, 9	53
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Housing, Air	55
Ignition System	57
Oil System	50
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Starter Parts - Key 6	65
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Vacuum Speed Booster - Keys 1, 2, 3, 4, 5, 6, 7, 8, 9	55

PARTS CATALOG

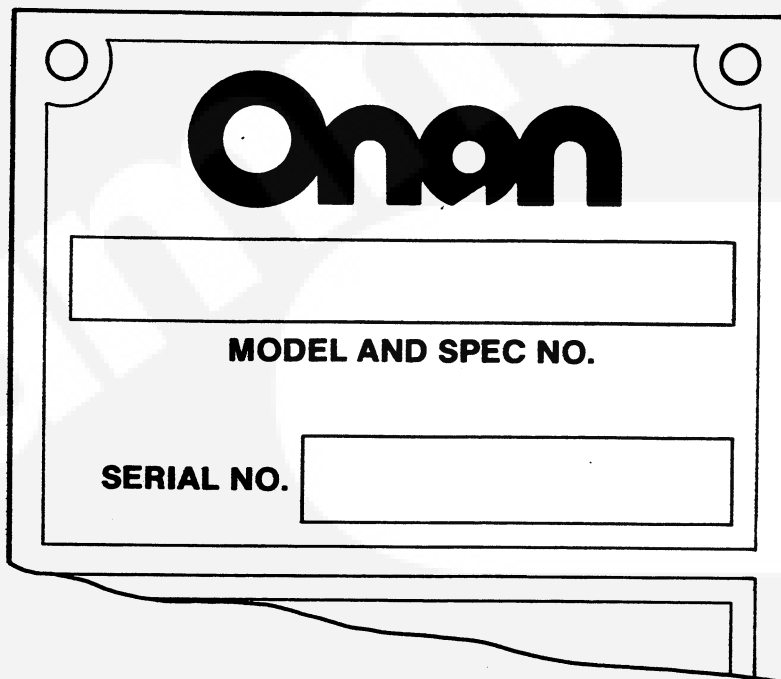
INSTRUCTIONS FOR ORDERING REPAIR PARTS

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 diagram shows a rectangular nameplate with rounded corners and two circular mounting holes at the top. The Onan logo is prominently displayed at the top center. Below the logo is a large rectangular box labeled "MODEL AND SPEC NO.". At the bottom left, the text "SERIAL NO." is followed by a smaller rectangular box for the serial number.

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."

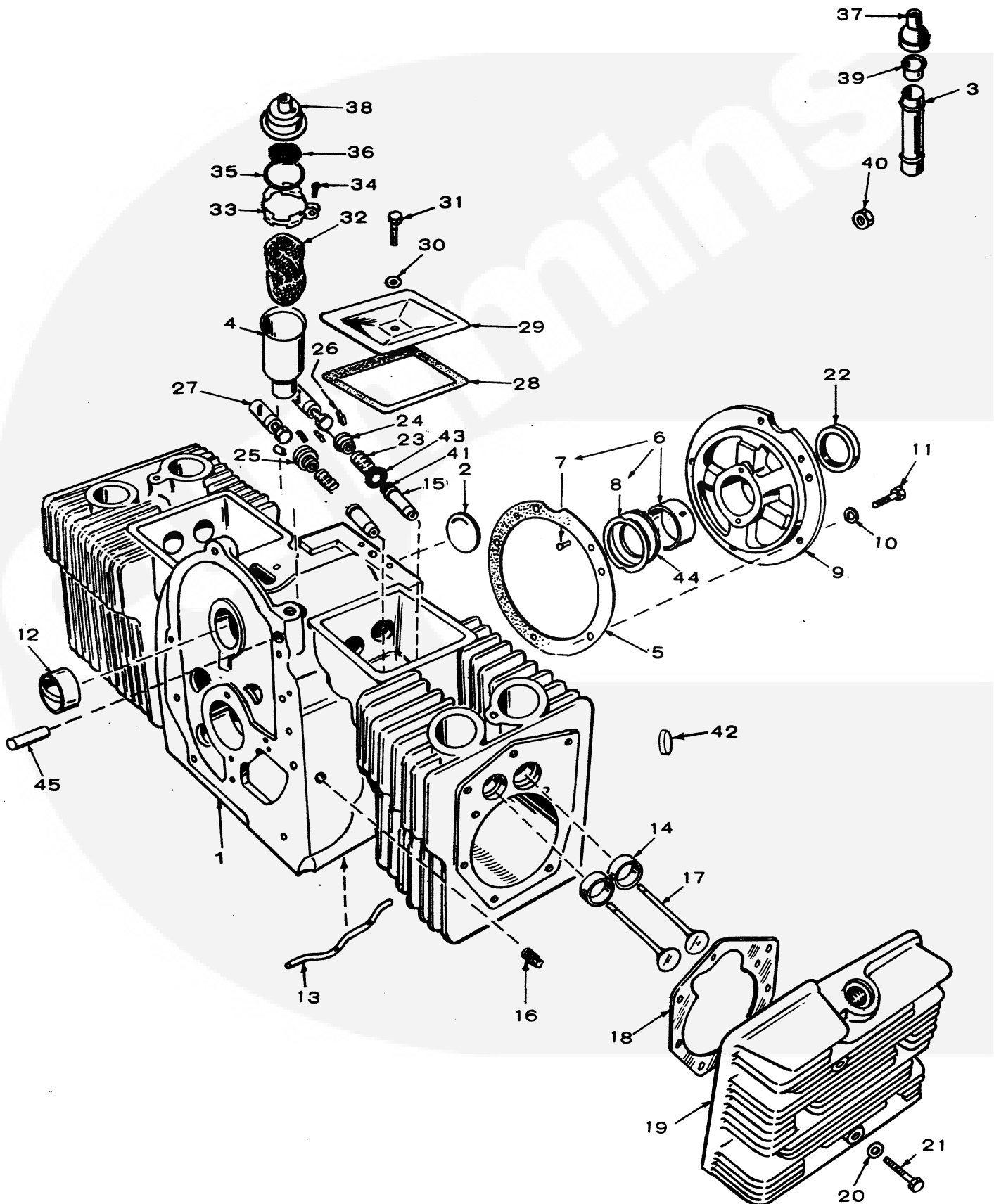
Consiga los precios vigentes de su distribuidor de productos "ONAN".

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
CCKA-MS/3670J	10
CCKA-S/3671J	11
CCKA-MS/3718J	12
CCKA-MS/3848J	1
CCKA-S/3871J	14

CYLINDER BLOCK

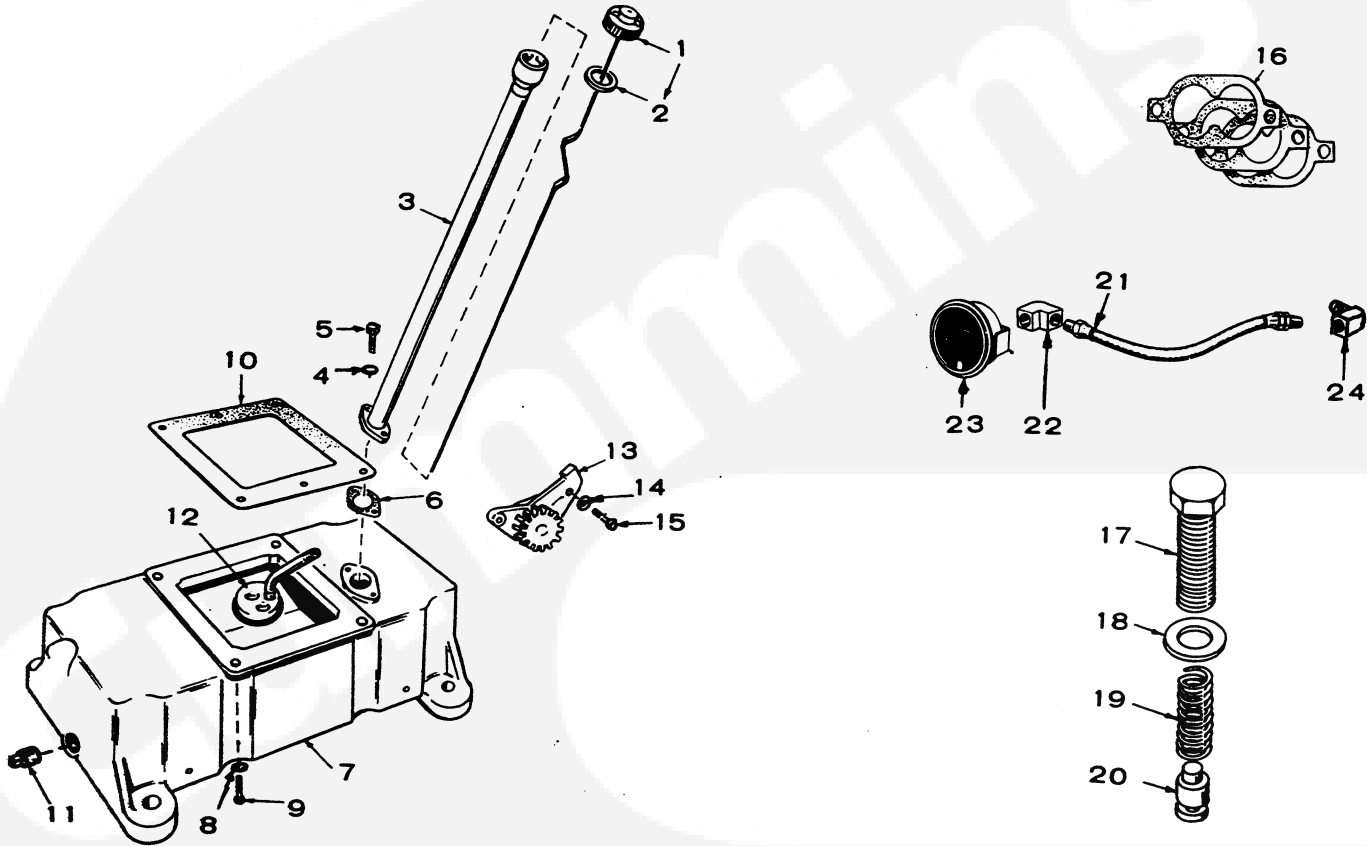


CYLINDER BLOCK

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	BLOCK ASSEMBLY, CYLINDER (Includes Parts Marked *)			21	SCREW, CAP - HEX HEAD (Hardened)		
	110-1516	1	Keys 1, 2, 3, 4, 5, 6		110-0879	8	Special
	110-2358	1	Keys 7, 8, 9, 10, 11, 12		114-0022	10	Special
	110-2942	1	Keys 13, 14	22	509-0041	1	Seal, Oil - Bearing Plate - (Note: Available in Gasket Kit 168-0103 and 168-0150.)
2	517-0048	1	*Plug, Camshaft - Expansion	23	110-0539	4	Spring, Valve
	*TUBE, BREATHER			24	WASHER, VALVE SPRING RETAINER		
3	123-0129	1	Keys 1, 2, 3, 4, 5, 6		110-0893	2	Intake, Keys 3, 4, 5, 6, 7, 8, 9
4	123-0953	1	Keys 7, 8, 9, 10, 11, 12, 13, 14		110-0893	2	Exhaust, Key 9
5	101-0115	1	*Gasket Kit, Bearing Plate	25	ROTOCAP, VALVE		
6	BEARING, CRANKSHAFT (Includes Pins and Thrust Washer)				110-0904	2	Intake, Keys 1, 2, 10, 11, 12, 13, 14
	101-0450	2	*Standard		110-0904	2	Exhaust, Keys (All Except Key 9)
	101-0450-02	2	.002" Undersize	26	110-0639	8	Lock, Valve Spring Retaining
	101-0450-10	2	.010" Undersize	27	TAPPET, VALVE		
	101-0450-20	2	.020" Undersize		115-0006	4	Standard
	101-0450-30	2	.030" Undersize		115-0006-05	4	.005" Oversize
7	516-0072	2	*Pin, Main Bearing Stop (4 used Key 13, 14)	28	110-0667	2	Gasket, Valve Cover
8	104-0575	2	*Washer, Crankshaft Bearing	29	110-0666	2	Cover, Valve Compartment
9	101-0316	1	*Plate, Bearing (Excludes Bearing)	30	526-0063	2	Washer, Flat - Copper - (17/64" ID x 7/16" OD x 1/32" Thk)
10	850-0045	5	*Washer, Lock - Spring (5/16")	31	800-0012	2	Screw, Cap - Hex Head (1/4-20 x 2-1/4")
11	800-0512	5	*Screw, Cap - Hex Head (5/16-18 x 1")	32	123-0865	1	Baffle, Breather Tube - Keys 7, 8, 9, 10, 11, 12, 13, 14
12	101-0367	2	*Bearing, Camshaft (Precision)	33	123-0951	1	Clamp, Breather Tube - Keys 7, 8, 9, 10, 11, 12, 13, 14
13	120-0386	1	*Tube, Oil	34	809-0035	1	Screw, Tapping - Round Head (#8 x 3/4") - Keys 7, 8, 9, 10, 11, 12, 13, 14
14	INSERT, VALVE SEAT			35	509-0117	1	Seal, "O" Ring - Breather Tube - Keys 7, 8, 9, 10, 11, 12, 13, 14
			Exhaust	36	123-0958	2	Screen, Breather Tube - Keys 7, 8, 9, 10, 11, 12, 13, 14
	110-0872	2	*Standard				CAP, BREATHER TUBE
	110-0872-02	2	.002" Oversize	37	123-0073	1	Keys 1, 2, 3, 4, 5, 6
	110-0872-05	2	.005" Oversize	38	123-0954	1	Keys 7, 8, 9, 10, 11, 12, 13, 14
	110-0872-10	2	.010" Oversize	39	123-0104	1	Valve, Breather Tube - Keys 1, 2, 3, 4, 5, 6
	110-0872-25	2	.025" Oversize	40	110-0445	5	Nut, Bearing Plate Mounting - Special - Keys 2, 3, 4, 5, 6
			Intake	41	509-0090	2	Seal, Oil - Intake Valve - Key 13, 14 (Includes Retaining Rings)
	110-1000	2	*Standard	42	110-1283	1	Cover, Timing Advance (Included in 110-2942 Cylinder Block Assembly - Key 13, 14)
	110-1000-02	2	.002" Oversize	43	110-3136	2	*Gasket, Intake - Valve Guide
	110-1000-05	2	.005" Oversize	44	104-0776	1	Shim, Rear Bearing Plate (.005")
	110-1000-10	2	.010" Oversize	45	516-0141	2	*Pin, Gear Cover Alignment
	110-1000-25	2	.025" Oversize				
15	110-0902	4	*Guide, Valve - used on Valves W/O seals				
16	505-0057	1	Plug, Pipe - Wet Hole				
17	VALVE						
	110-1037	2	Intake, Stellite - Keys 1, 2, 10, 11, 12, 13, 14				
	110-0881	2	Intake, Steel - Keys 3, 4, 5, 6, 7, 8, 9				
	110-0880	2	Exhaust, Stellite				
18	110-0892	2	Gasket, Cylinder Head				
19	HEAD, CYLINDER						
	110-0884	1	Right (#2 Cylinder)				
	110-0883	1	Left (#1 Cylinder)				
20	526-0122	18	Washer, Flat (11/32" ID X 23/32" OD x 10 Gauge Thk)				

* - Included in Cylinder Block Assembly.

OIL SYSTEM



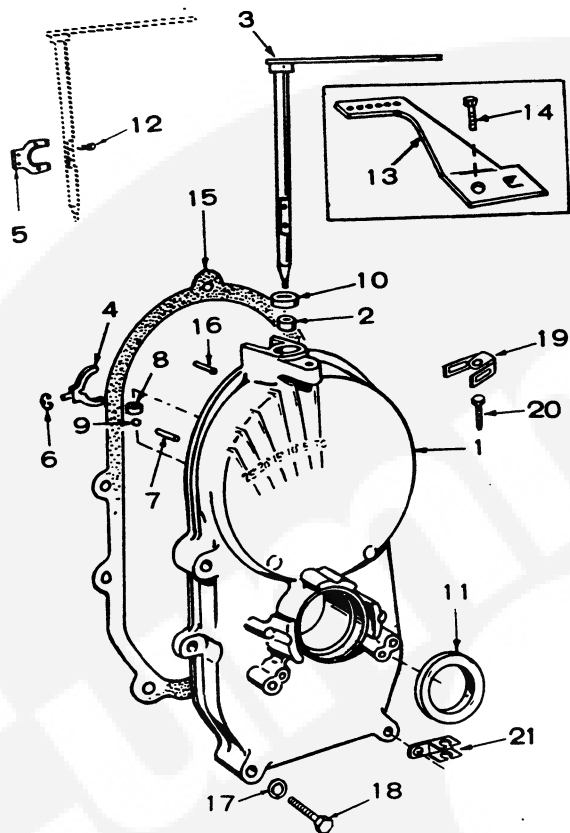
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
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1	CAP AND INDICATOR, OIL FILL		
	123-0489	1	Keys 1, 4, 8, 11, 14
	123-0527	1	Keys 2, 3, 5, 6
	123-0694	1	Keys 7, 9, 10, 12, 13
2	123-0191	1	Gasket, Oil Fill Cap
3	TUBE, OIL FILL		
	123-0508	1	Keys 2, 3, 5, 6
	123-1149	1	Keys 7, 9, 10, 12, 13
	159-0617	1	Keys 11, 14 (Part of Oil Base 102-0402)
4	850-0040	2	Washer, Lock - Spring (1/4") Keys 2, 3, 5, 6, 7, 9, 10, 12, 13
5	800-0004	2	Screw, Cap - Hex Head (1/4-20 x 1-1/8") - Keys 2, 3, 5, 6, 7, 9, 10
6	141-0078	1	Gasket, Oil Fill Tube Mtg. - Keys 2, 3, 5, 6, 7, 9, 10, 12, 13
7	BASE, OIL		
	102-0402	1	Keys 1, 4, 8, 11, 14 (Includes Oil Fill Tube)
	102-0564	1	Keys 2, 3, 5
	102-0861	1	Keys 7, 9, 10, 12, 13 (Kit: Consists of: 1-102-0860 Oil Base; 4-505-0056 Plugs)
	102-0766	1	Key 6
8	850-0050	4	Washer, Lock - Spring (3/8")

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
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9	102-0455	4	Screw, Cap - Hex Head - Special
10	102-0158	1	Gasket, Oil Base Mounting
11	505-0056	1	Plug, Oil Drain (1/2")
12	CUP - OIL PUMP INTAKE (Includes Cup, Screen and Pipe)		
	120-0400	1	Keys 1, 4, 8, 11, 14
	120-0648	1	Keys 2, 3, 5, 6, 7, 9, 10, 12, 13
13	120-0491	1	Pump, Oil (Internal Parts Not Sold Separately)
14	850-0040	2	Washer, Lock - Spring (1/4")
15	800-0007	2	Screw, Cap - Hex Head (1/4-20 x 1")
16	120-0161	1	Gasket Kit, Oil Pump
17	801-0048	1	Screw, Oil By-Pass Valve
18	526-0066	1	Washer, Oil By-Pass Valve
19	120-0140	1	Spring, By-Pass Valve
20	120-0398	1	Valve, Oil By-Pass
21	501-0004	1	Line, Oil Gauge (Flexible) - Keys 1, 2, 3, 4, 5, 6
22	ELBOW, OIL LINE TO OIL GAUGE		
	502-0005	1	Keys 1, 2, 3, 4
	502-0017	1	Keys 5, 6
23	193-0068	1	Gauge, Oil Pressure - Keys 1, 2, 3, 4, 5, 6
24	502-0020	1	Elbow, Oil Line to Cylinder Block - Keys 1, 2, 3, 4, 5, 6

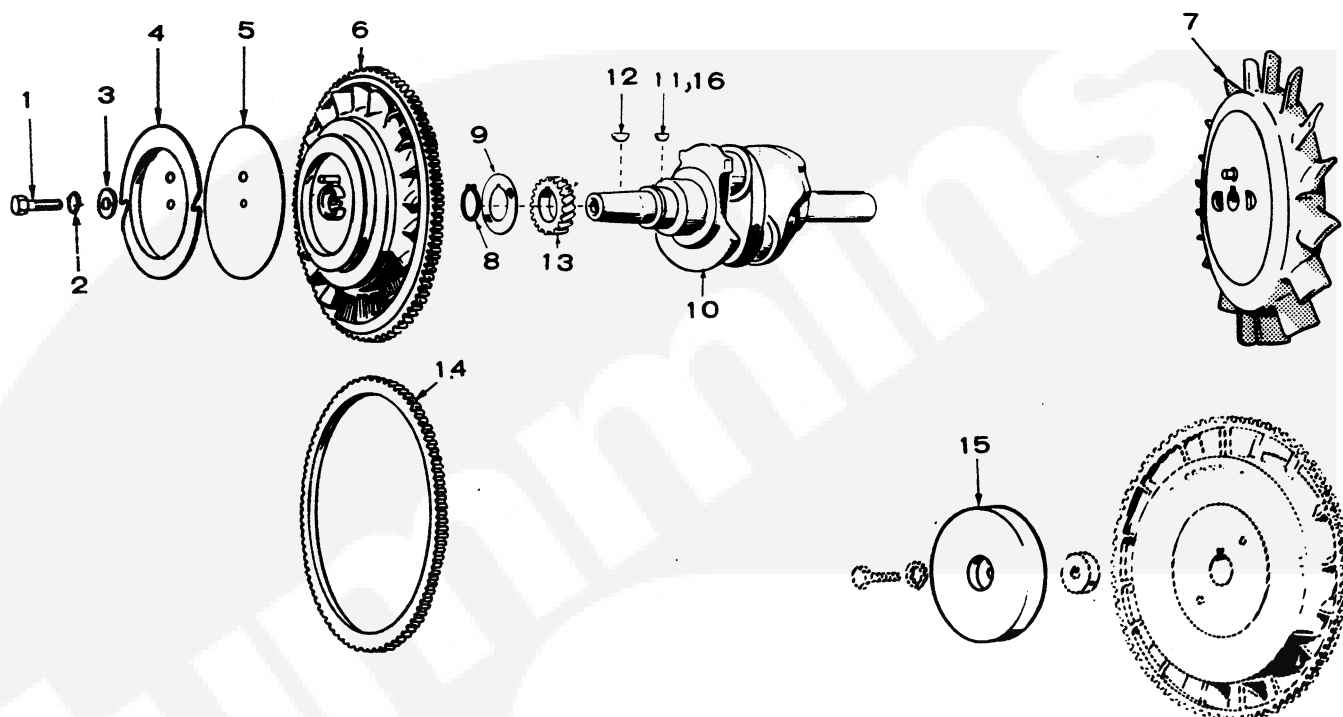
GEARCASE



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	COVER ASSEMBLY, GEAR (Includes Parts Marked*)		
	103-0641	1	Keys 1, 2, 3, 4, 5, 6
	103-0667	1	Keys 7, 8, 9, 10, 11, 12, 13, 14
2	510-0013	1	*Bearing, Governor Shaft - Upper
3	*SHAFT AND ARM, GOVERNOR		
	150-0377	1	Keys 1, 2, 3, 4, 5, 6
	150-1542	1	Keys 7, 8, 9, 10, 11, 12, 13, 14
	*YOKE, GOVERNOR SHAFT		
4	150-0620	1	Keys 1, 2, 3, 4, 5, 6
5	150-1187	1	Keys 7, 8, 9, 10, 11, 12, 13, 14
6	518-0129	1	*Ring, Yoke Retainer - Keys 1, 2, 3, 4, 5, 6
7	516-0130	1	*Pin, Governor Cup Stop
8	*BEARING, GOVERNOR SHAFT (Lower)		
	510-0008	1	Keys 1, 2, 3, 4, 5, 6
	510-0013	2	Keys 7, 8, 9, 10, 11, 12, 13, 14
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") - Keys 7, 8, 9, 10, 11, 12, 13, 14
13	150-0988	1	Extension, Governor Arm
14	815-0181	1	Screw, Tapping - Hex Head w/ET (#10-32 x 3/4")
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"
19	150-0678	1	*Clip, Adjusting Sensitivity
20	815-0193	2	*Screw, Hex Head (1/4-20 x 1-3/8" lg) - Keys 1, 2, 3, 4
21	167-0188	2	Clip, Stator Harness - Bottom LH & RH Gearcase - Keys 13, 14 (NOTE: Key 14 uses 4)

* - Included in Gear Cover Assembly.

CRANKSHAFT AND FLYWHEEL

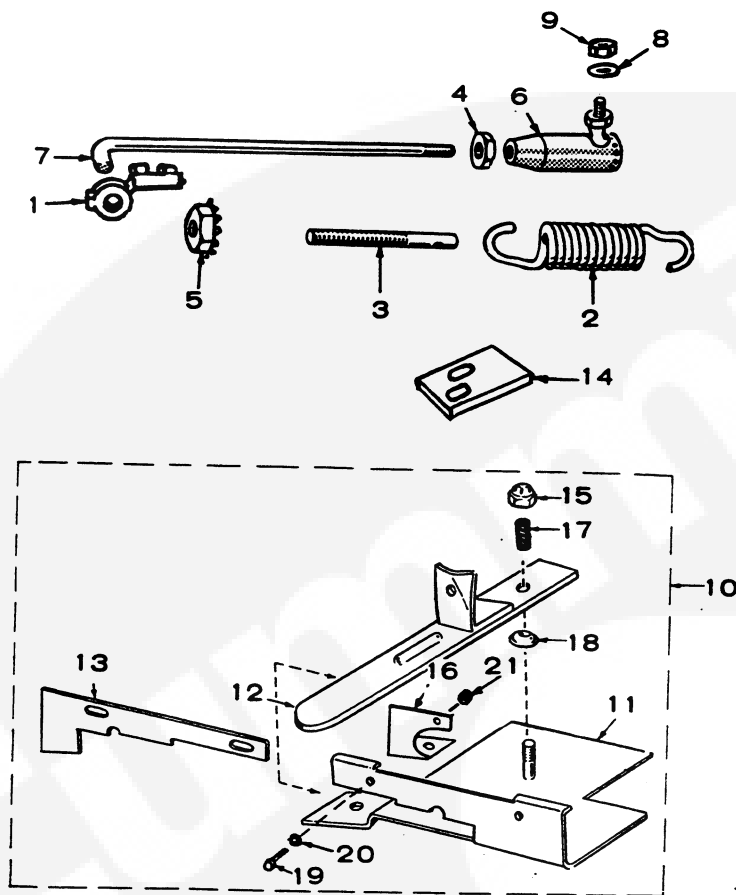


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	SCREW, CAP — HEX HEAD (Flywheel Mounting) 104-0170	1	Special - Keys 1, 4, 7, 8, 9, 10, 11, 12, 13, 14
	104-0369	1	Special - Keys 2, 3, 5, 6
2	850-0055	1	Washer, Lock - Spring (7/16")
3	WASHER, FLAT (Flywheel Mounting) 526-0017	1	15/32" ID x 1-1/4" OD x 1/4" Thk - Keys 1, 4, 8, 11
	526-0128	1	15/32" ID x 1-1/2" OD x 1/4" Thk - Keys 2, 3, 5, 6, 7, 9, 10, 12, 13
4	192-0308	1	Sheave, Rope - Keys 1, 2, 3, 4, 5, 6, 8, 11, 14
5	192-0296	1	Backplate, Rope Sheave - Keys 2, 3, 5, 6
6	FLYWHEEL (Includes Ring Gear) 134-1550	1	Keys 2, 3, 5, 6
	134-2728	1	Keys 7, 9, 10
	134-3018	1	Keys 12, 13

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
7	160-0937	1	Keys 1, 4, 8, 11, 14
8	518-0014	1	Lock, Crankshaft Gear Washer
9	104-0043	1	Washer, Crankshaft Gear Retaining
10	104-1323	1	Crankshaft (Kit) (Includes Parts Marked *)
11	515-0001	1	*Key, Crankshaft Gear Mounting
12	515-0227	1	Key, Flywheel Mounting
13	104-0032	1	Gear, Crankshaft - Timing
14	134-0673	1	Gear, Ring - Flywheel - Keys 2, 3, 5, 6, 7, 9, 10, 12, 13
15	134-2824	1	Guard, Flywheel Capscrew - Keys 7, 8, 9
16	515-0098	1	*Key, Key 14

* - Parts Included in 104-1323 Crankshaft Kit.

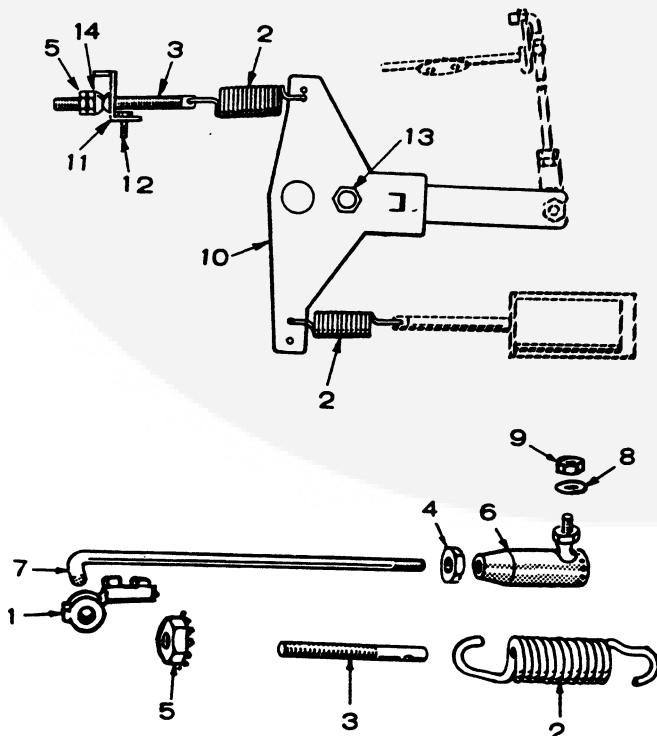
GOVERNOR — KEYS 1,2,3,4,5,6,7,8,9



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)

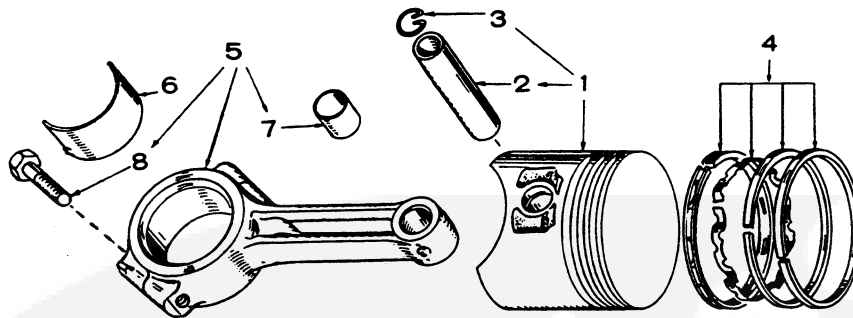
* - Included in 152-0212 Variable Speed Control Assembly.
† - Included in 152-0147 Variable Speed Control Assembly.

GOVERNOR KEYS 10,11,12,13,14



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	518-0004	1	Clip, Rod End
2	SPRING, GOVERNOR 150-1740	1	Low Speed
	150-1741	1	High Speed - Keys 10,11,12
3	150-1753	1	Stud, Governor Adjusting
4	870-0053	1	Nut, Hex (#10-32)
5	870-0053	1	Nut, Hex (#10-32)
6	150-0639	1	Joint, Ball
7	150-1732	1	Rod, Governor Control
8	526-0196	1	Washer, Flat (7/32" ID x 7/16" OD x 1/8" Thk)
9	870-0131	1	Nut, Hex (#10-32)
10	150-1734	1	Arm, Governor
11	150-1736	1	Bracket, Low Speed Governor
12	821-0004	2	Screw, Cap - Self Locking (#10-32 x 5/16")
13	815-0181	3	Screw, Cap - Hex Head, w/Et Governor Arm (10-32 x 1/2") Key 14 use one
14	150-0621	1	Spacer, Governor Adjust

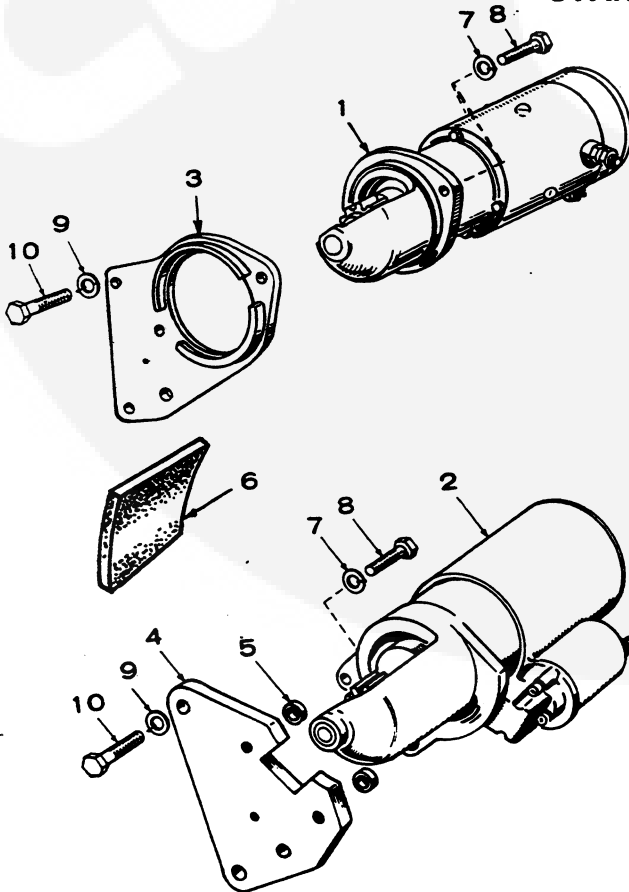
PISTON AND ROD



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PISTON AND PIN (Includes Retaining Rings)		
	112-0179	2	Standard
	112-0179-05	2	.005" Oversize
	112-0179-10	2	.010" Oversize
	112-0179-20	2	.020" Oversize
	112-0179-30	2	.030" Oversize
	112-0179-40	2	.040" Oversize
2	112-0069	2	Pin, Piston
3	112-0003	4	Ring, Retainer - Piston Pin
4	RING SET, PISTON		
			Keys 10, 11, 12, 13, 14
	113-0152	2	Standard
	113-0152-05	2	.005" Oversize
	113-0152-10	2	.010" Oversize
	113-0152-20	2	.020" Oversize
	113-0152-30	2	.030" Oversize
	113-0152-40	2	.040" Oversize
			Keys 1, 2, 3, 4, 5, 6, 7, 8, 9

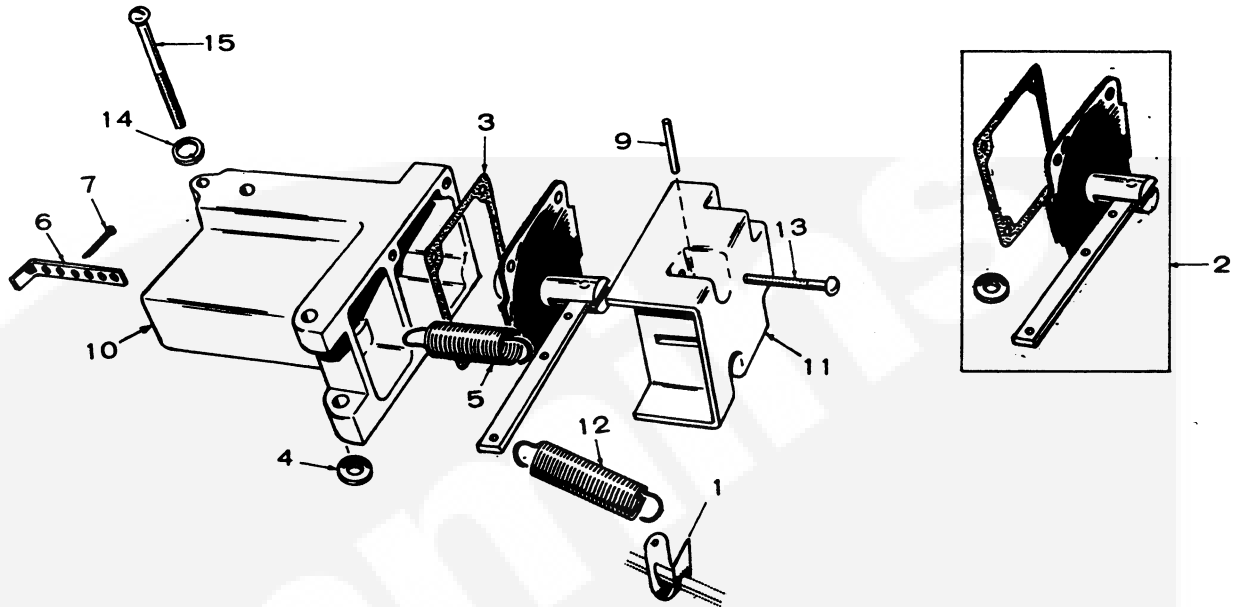
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	113-0088	2	Standard
	113-0088-05	2	.005" Oversize
	113-0088-10	2	.010" Oversize
	113-0088-20	2	.020" Oversize
	113-0088-30	2	.030" Oversize
	113-0088-40	2	.040" Oversize
5	114-0203	2	Rod Assembly, Connecting (Includes Bushing & Place Bolts)
6	BEARING HALF, 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")

STARTER MOTOR



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	MOTOR, STARTER (NOTE: See separate groups for components)		
1	191-0511	1	Key 2
2	191-0790	1	Keys 3, 5
2	191-0922	1	Key 6
2	191-1052	1	Keys 7, 9, 10, 12, 13
	FLANGE, STARTER MOTOR		
3	191-0508	1	Keys 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 - Keys 7, 9, 10, 12, 13
7	850-0050	2	Washer, Lock - Spring (3/8") - Keys 2, 3, 5, 6, 12, 13
8	SCREW, CAP - HEX HEAD (Starting Motor to Flange)		
	800-0050	1	Keys 2, 3, 5, (3/8-16 x 1")
	800-0049	1	Keys 2, 3, 5, (3/8-16 x 7/8")
	800-0051	2	Key 6 (3/8-16 x 1/2")
9	850-0050	2	Washer, Lock - Spring (3/8") - Keys 2, 3, 5, 6, 7, 9, 12, 13 (Starter Motor Flange to Engine)
10	SCREW, CAP - HEX HEAD (Starter Motor Flange to Engine)		
	800-0051	2	Keys 7, 9, 10, 12, 13 (3/8-16 x 1-1/2")
	102-0455	2	Keys 2, 3, 5, 6 (Special)

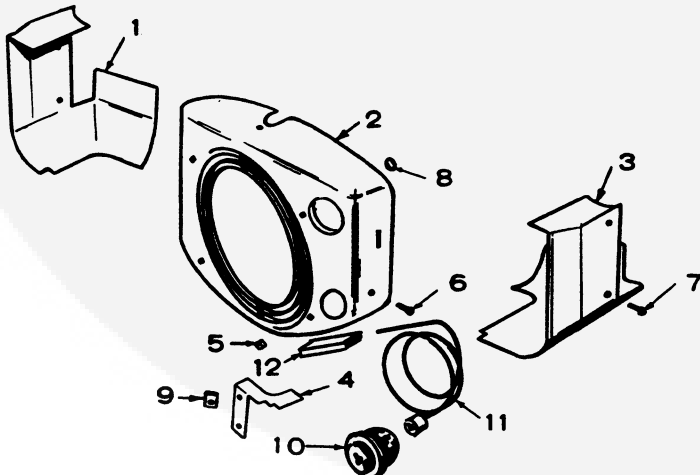
VACUUM SPEED BOOSTER — KEYS 1,2,3,4,5,6,7,8,9



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				
4	150-0425	1	†Gasket, Booster to Manifold				
5	150-0475	1	*Spring, Internal				
6	150-0376	1	*Bracket, Internal Spring Adjusting				
7	516-0039	1	*Pin, Cotter - Adjusting Bracket				

* - Included in Vacuum Speed Booster Replacement Kit
† - Included in Diaphragm Replacement Kit

AIR HOUSING

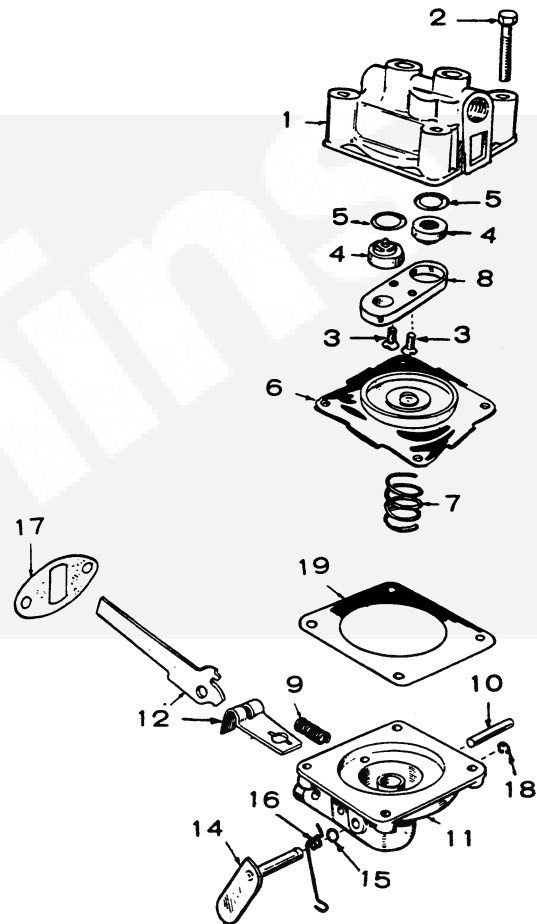


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	134-0589	1	Housing, Cylinder Air (Left)		134-3783	1	Keys 10, 12, 13
2	HOUSING, BLOWER				134-3852	1	Keys 11, 14
	134-1579	1	Keys 1, 4	3	HOUSING, CYLINDER AIR (Right)		
	134-0705	1	Key 2		134-0588	1	Keys 1, 4, 8, 11, 14
	134-2209	1	Key 3		134-0674	1	Key 2
	134-2390	1	Key 5		134-2134	1	Keys 3, 5, 6
	134-2946	1	Key 8		134-2791	1	Keys 7, 9, 10, 12
	134-2935	1	Keys 7, 9		134-3976	1	Key 13
	134-2845	1	Key 6	4	BAFFLE, AIR		
					134-0670	1	Key 2
					134-0798	1	Keys 1, 4, 8, 11, 14
					134-2131	1	Keys 3, 5, 6
				5	870-0110	4	Nut, Retaining - Keys 8, 11, 14 (1/4-20)
				6	SCREW, CAP - HEX WASHER HEAD		
					821-0010	2	1/2-20 x 1/2" - Keys 10, 12, 13 uses 3
					815-0261	2	1/4-20 x 7/16" - Keys 10, 13 uses 1
				7	815-0261	4	Screw, Cap - Hex Washer Head (1/4-20 x 7/16")
				8	508-0095	2	Grommet, Blower Housing - Keys 1, 4, 8, 11
				9	CLIP, AIR BAFFLE		
					518-0178	1	Key 11
					518-0177	1	Key 14
				10	313-0018	1	Switch, Stop - Key 11, 14
				11	336-4722	1	Lead, Stop Switch - Key 11, 14
				12	332-2263	1	Connector, Stop Switch - Key 11, 14

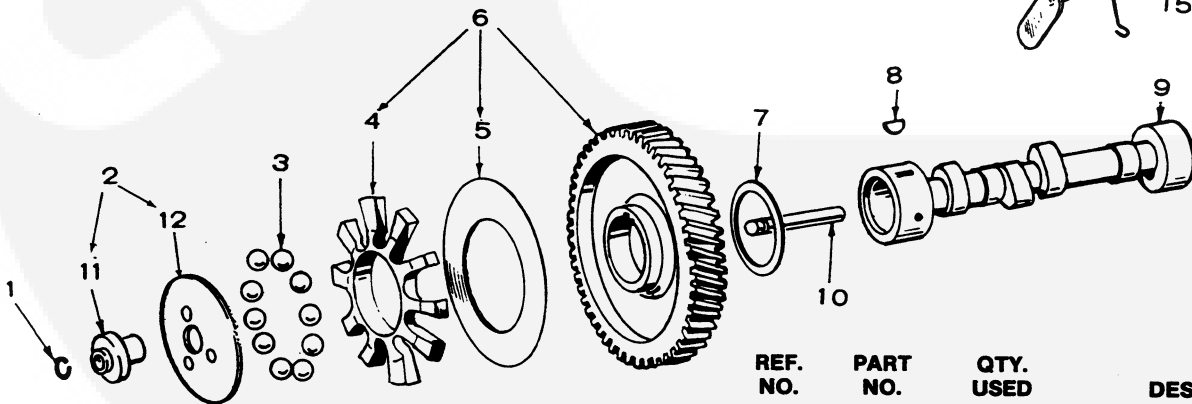
FUEL PUMP PARTS (149-0693 And 149-1784)

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	149-1784	1	Pump, Fuel - Complete (Includes 149-0693 Pump and Mounting Gasket)
	149-0526	1	Repair Parts Kit, includes Parts Marked *
1		1	Body, Not Sold Separately
2	815-0148	4	Screw, Hex Head - Slotted (8-32 x 7/8")
3	815-0147	2	Screw, Phillips, Valve Retainer (6-32 x 5/8")
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

* - Parts Contained in Repair Kit 149-0526.



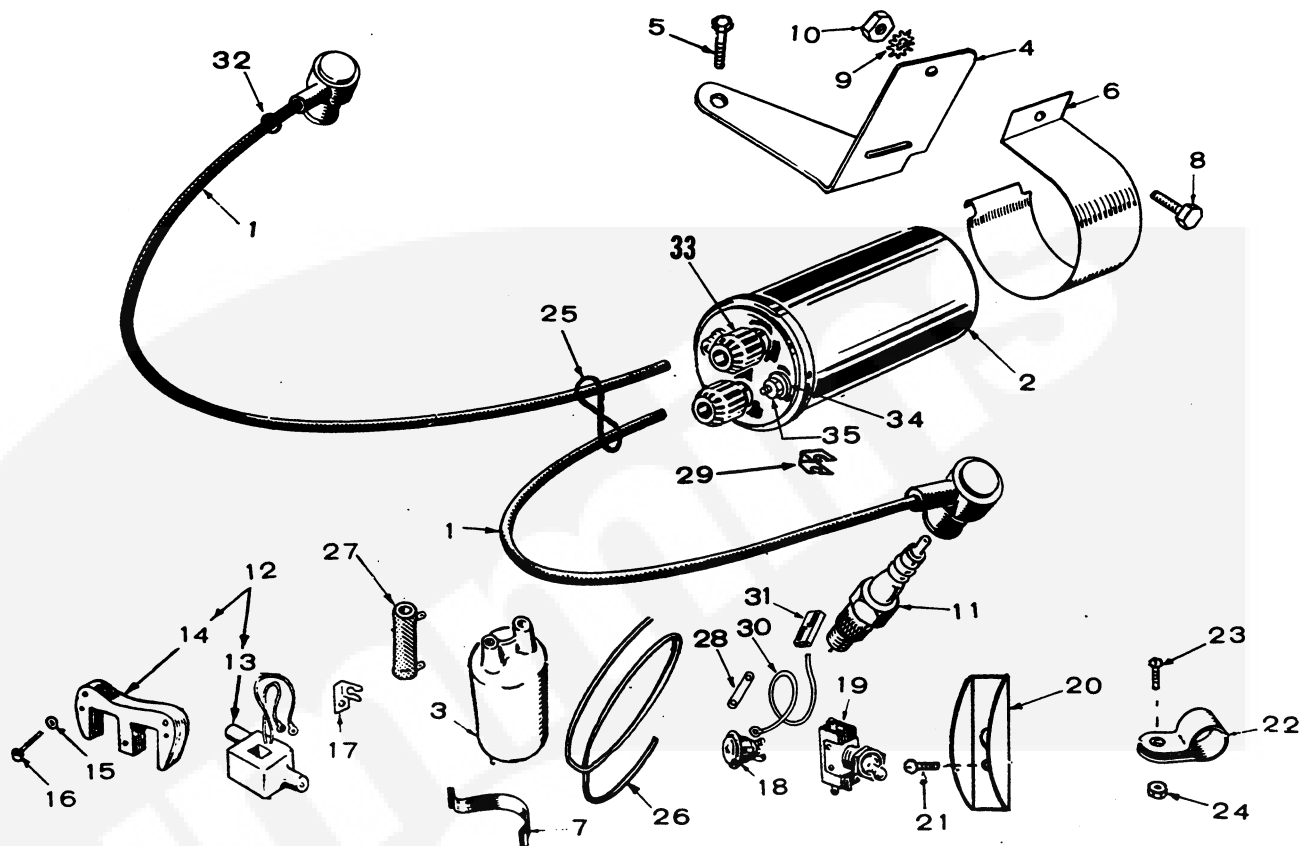
CAMSHAFT



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150-0078	1	Ring, Camshaft Center Pin
2	150-1695	1	Kit, Governor Cup Replacement (Includes Parts Marked *)
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	CAMSHAFT (Includes Center Pin)		
	105-0500	1	Keys 10,11,12,13,14
	105-0238	1	Keys 1,2,3,4,5,6,7,8,9
10	150-0075	1	Pin, Camshaft Center
11	150-1519	1	*Hub, Governor Cup
12	150-1520	1	*Cup, Governor

* - Parts Included in 150-1695 Governor Cup Replacement Kit.

IGNITION SYSTEM



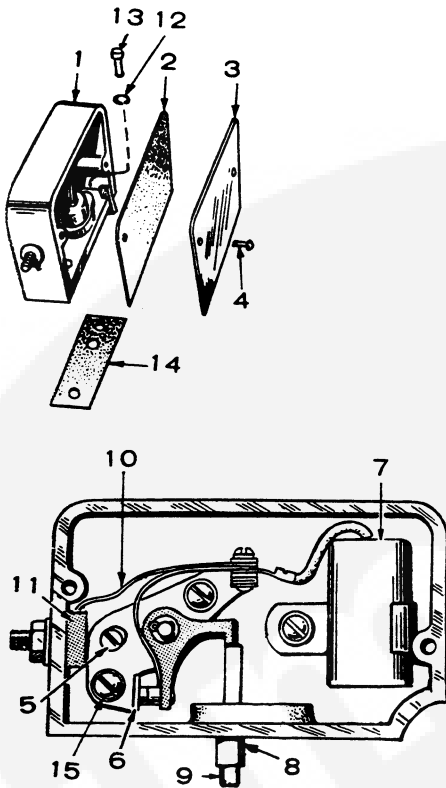
Note: See separate group for breaker box and associated parts.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	†CABLE KIT, SPARK PLUG			15	WASHER, FLAT (Magneto Stator Assembly Mounting)		
	167-1593	1	24" Non Resistor Type		526-0015	2	9/32" ID x 9/16" OD x 1/16" Thk
	167-1594	1	16-3/4" Non Resistor Type		526-0184	2	17/64" ID x 5/8" OD x 10 Gauge Thk
	167-1595	1	27" Resistor Type - Key 14 use 2	16	815-0259	2	Screw, Cap - Hex Head - Tapping (1/4-20 x 1-1/4") - Keys 1, 4, 8, 11, 14
	167-1596	1	16" Resistor Type	17	167-0188	4	Clip, Spark Plug Cables - Keys 1, 4, 8, 11
	COIL, IGNITION			18	313-0018	1	Switch, Stop - Keys 1, 4, 8, 11
2	166-0535	1	Keys, 3, 5, 6, 7, 9, 10, 12, 13	19	308-0140	1	Switch, Toggle - Start-Stop - Keys 5, 6, 7, 9, 10, 12
3	160-1299	1	Key 2	20	308-0356	1	Guard, Start Stop Switch - Keys 7, 9
4	166-0628	1	Bracket, Coil Mounting - Keys 7, 9, 10, 12, 13	21	808-0022	1	Screw, Tapping - Round Head (#8 x 3/8") - Keys 7, 9
5	821-0010	1	Screw - Hex Washer Head (1/4-20 x 1/2") - Keys 7, 9, 10, 12, 13	22	332-0051	1	Clip, Wire Support - Keys 7, 9
	CLAMP, COIL MOUNTING			23	813-0098	1	Screw, Machine - Round Head (#10-32 x 3/8") - Keys 7, 9
6	166-0588	1	Keys 7, 9, 10, 12, 13	24	870-0131	1	Nut, Machine - Hex (#10-32) - Keys 7, 9
7	160-0488	1	Key 2	25	509-0035	1	Ring, "O" - Spark Plug Cables - Key 3
8	800-0004	1	Screw, Cap - Hex Head (1/4-20 x 5/8") - Keys 7, 9, 10	26	334-0028	1	Lead (4 foot piece of wire)
9	856-0006	1	Washer, Lock - EIT (1/4") - Keys 7, 9, 10, 12	27	304-0060	1	Resistor, Ignition (1.72-Ohm, 25 Watt)
10	862-0001	1	Nut, Machine - Hex (1/4-20) - Keys 7, 9, 10, 12	28	332-0592	1	Jumper, Switch - Keys 5, 6, 7, 9, 10, 12
11	PLUG, SPARK			29	167-0229	1	Clip, Spark Plug Lead #2 - Keys 10, 12, 13
	167-0262	2	Keys 11, 12, 13, 14	30	336-4722	1	Lead, Stop Button - Key 11
	167-0241	2	Non Resistor Type	31	332-2263	1	Connector, Stop Button - Key 11
	167-0237	2	Resistor Type	32	508-0095	2	Grommet, Rubber - Keys 11, 14 (17/32" Hole)
12	160-0752	1	Magneto Stator Assembly (Includes Parts Marked *) - Keys 1, 4, 8	33	166-0604	2	Nut, Ignition, Coil
12	160-1279	1	Magneto Stator Assembly (Includes Parts Marked †) - Keys 11, 14	34	850-2005	1	Washer, Metric (M5)
13	160-1278	1	†Coil, Magneto Stator - Keys 11, 14	35	166-0554	1	Nut, Hex (Metric)
13	160-0750	1	*Coil, Magneto Stator - Keys 1, 4, 8				
14	160-0749	1	†*Shoe, Pole - Magneto Stator - Keys 1, 4, 8, 11, 14				

† - Included in 160-1279 Magneto Stator Assembly.

* - Included in 160-0752 Magneto Stator Assembly.

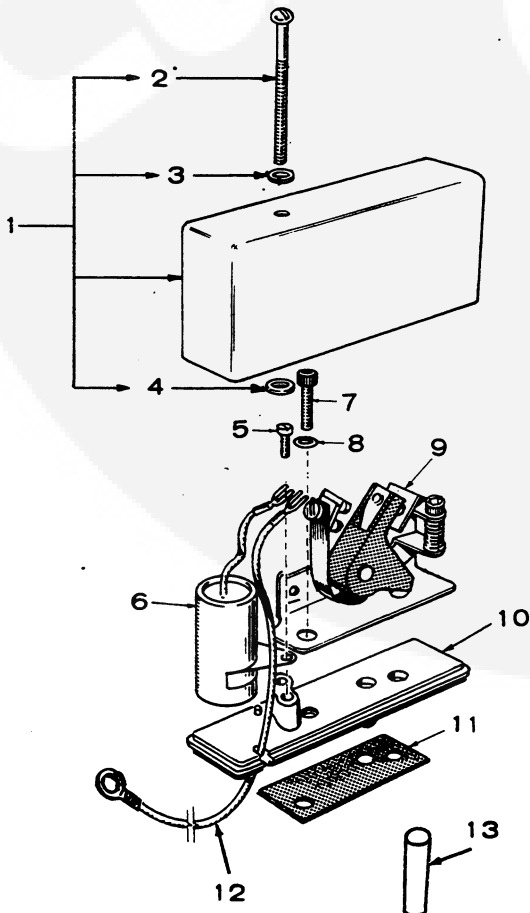
BREAKER BOX — KEYS 1,2,3,4,5,6,7,8,9



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.

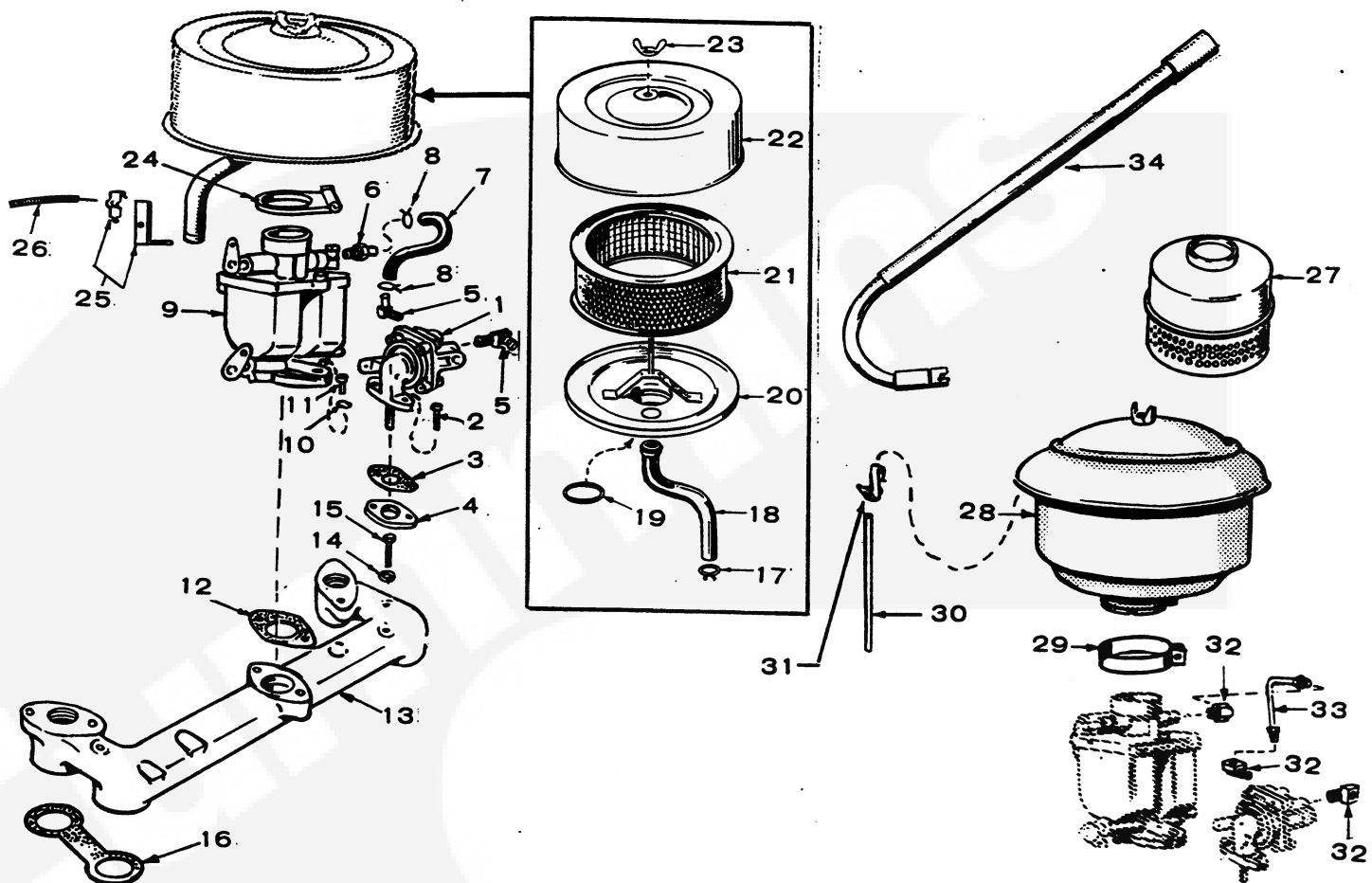
BREAKER BOX — KEYS 10,11,12,13,14



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	160-1287	1	Box Assembly, Breaker (Complete - Includes Parts Marked *)
1	160-1285	1	*Cover Assembly, Breaker Box
2	812-0108	1	Screw, Machine - Roundhead (#10-24 x 1-1/2")
3	526-0008	1	Washer, Flat (13/64" ID x 7/16" OD x 1/32" Thk)
4	509-0065	1	Retainer, "O" Ring
5	815-0358	1	*Screw, Tapping - Hex Head (8-32 x 5/16")
6	312-0196	1	*Condenser, Ignition (30 Mfd)
7	802-0034	2	*Screw, Cap - Socket Head (1/4-20 x 3/4")
8	850-0040	2	*Washer, Lock - Spring (1/4")
9	160-1183	1	*Point Assembly, Breaker
10	160-1286	1	*Base, Breaker Box
11	160-1150	1	*Gasket
12	LEAD, COIL TO BREAKER POINTS		
	336-4723	1	Keys 11, 14
	336-2378	1	Keys 10, 12, 13
13	160-1151	1	Plunger, Breaker Points

* - Parts Included in 160-1287 Breaker Box Assembly.

GASOLINE FUEL SYSTEM AND EXHAUST — KEYS 1,2,3,4,5,6,7,8,9



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	149-1784	1	Pump, Fuel - Includes Mounting Gasket (See Separate Group for Components)
2	806-0009	1	Screw, Cap - Counter Bore (1/4-20 x 1.1")
3	149-0003	2	Gasket, Fuel Pump Mounting
4	149-0045	1	Spacer, Fuel Pump Mounting
5	ELBOW, ADAPTER TO HOSE		
	502-0313	1	Fuel Pump Inlet - Key 7, 8, 9
	502-0313	1	Fuel Pump Outlet - Key 8
6	CONNECTOR, FUEL HOSE		
	502-0395	1	Fuel Pump Outlet - Key 7, 9
	502-0395	1	Carburetor Inlet - Key 7, 8, 9
7	HOSE, FUEL		
	503-0694	1	Key 7, 9 (7")
	503-0744	1	Key 8 (4-1/8")
8	503-0301	2	Clamp, Hose - Key 7, 8, 9
9	CARBURETOR - Includes Mounting Gasket (See Separate Group for Components)		
	142-0651	1	Key 1, 2, 3, 4, 5, 6, 7, 8 (Gasoline)
	142-0627	1	Key 9 (Gas-Gasoline)
10	850-0040	2	Washer, Lock - Spring (1/4")
11	800-0009	2	Screw, Cap - Hex Head (1/4-20 x 1-1/2")
12	141-0078	1	Gasket, Carburetor Mounting
13	MANIFOLD, INTAKE		
	154-0688	1	Key 1, 2, 3, 4, 5, 6, 7, 8
	154-1639	1	Key 9
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

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
17	503-0171	1	Clamp, Breather tube - Key 7, 8, 9
18	123-1264	1	Tube, Breather - Key 7, 8, 9
19	509-0124	1	Ring "O" - Seal - Key 7, 8, 9
20	140-1356	1	Base, Air Cleaner - Key 7, 8, 9
21	140-1216	1	Element, Air Cleaner - Key 7, 8, 9
22	140-1295	1	Cover, Air Cleaner - Key 7, 8, 9
23	865-0020	1	Nut, Wing (1/4-20) - Key 7, 8, 9
24	140-1058	1	Clamp, Air Cleaner Mounting - Key 7, 8, 9
25	153-0263	1	Bracket and Clamp, Manual Choke
26	CABLE, CHOKE		
	153-0097	1	Key 7, 8, 9
	153-0351	1	Key 1, 2, 3, 4, 5, 6
27	155-0484	2	Muffler, Exhaust
28	140-0283	1	Cleaner, Air - Key 1, 2, 3, 4, 5, 6
29	503-0019	1	Clamp, Air Cleaner Mounting - Key 1, 2, 3, 4, 5, 6
30	140-0471	1	Pipe, Breather - Key 1, 2, 3, 4, 5, 6
31	140-0459	1	Bracket, Breather Pipe - Key 1, 2, 3, 4, 5, 6
32	ELBOW, STREET (90°)		
	502-0002	1	Fuel Pump Outlet - Key 1, 2, 3, 4, 5, 6
	502-0002	1	Carburetor Inlet - Key 1, 2, 3, 4, 5, 6
	502-0020	1	Fuel Pump Inlet - Key 1, 2, 3, 4, 5, 6
33	149-0611	1	Line, Fuel Pump to Carburetor - Key 1, 2, 3, 4, 5, 6
34	420-0169	1	Wrench, Carburetor Adjusting

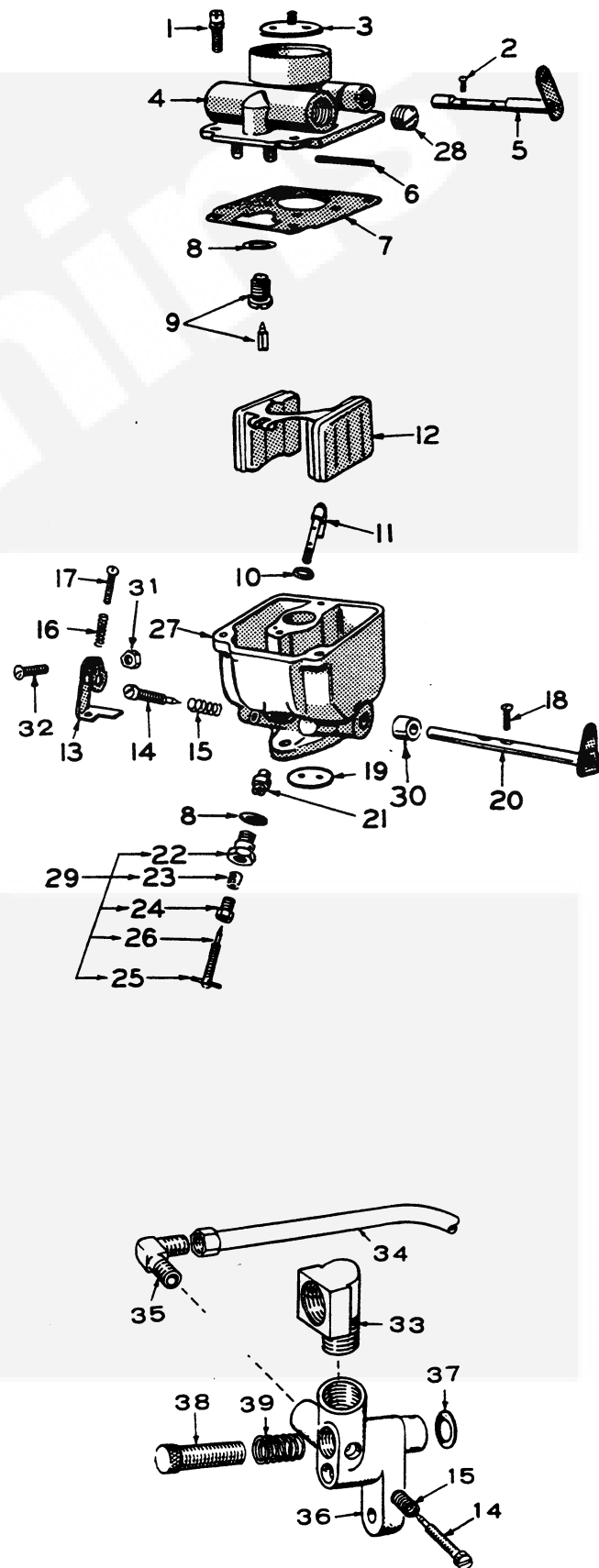
CARBURETOR PARTS — KEYS 1,2,3,4,5,6,7,8,9

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	CARBURETOR ASSEMBLY, COMPLETE (Includes Mounting Gasket)		
	142-0651	1	Keys 1, 2, 3, 4, 5, 6, 7, 8 (Gasoline) (Includes 142-0416 Carburetor)
	142-0627	1	Key 9 (Gas-Gasoline) (Includes 142-0436 Carburetor)
	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	142-0606	1	*†Gasket, Body to Bowl
8	142-0017	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 £) (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

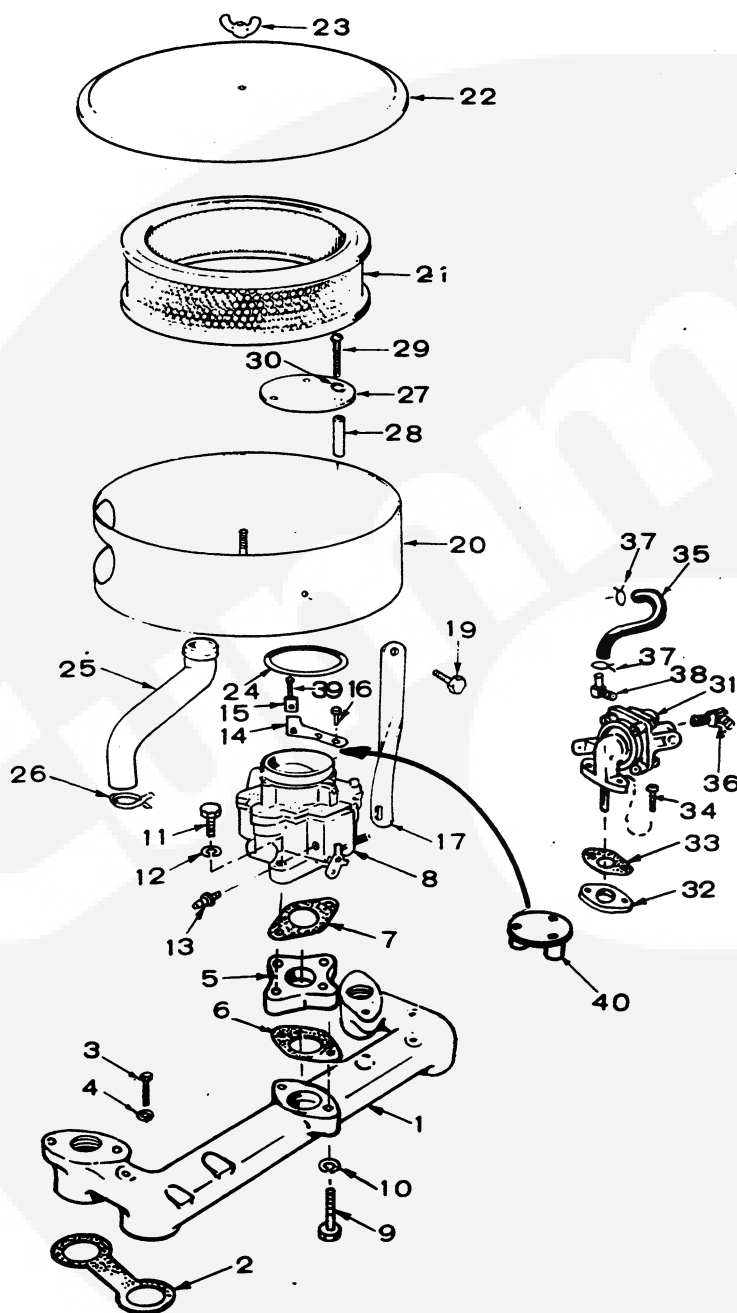
† - Included in 142-0371 Repair Kit.

* - Included in 142-0033 Gasket Kit.

£ - Included in 142-0042 Needle Assembly.

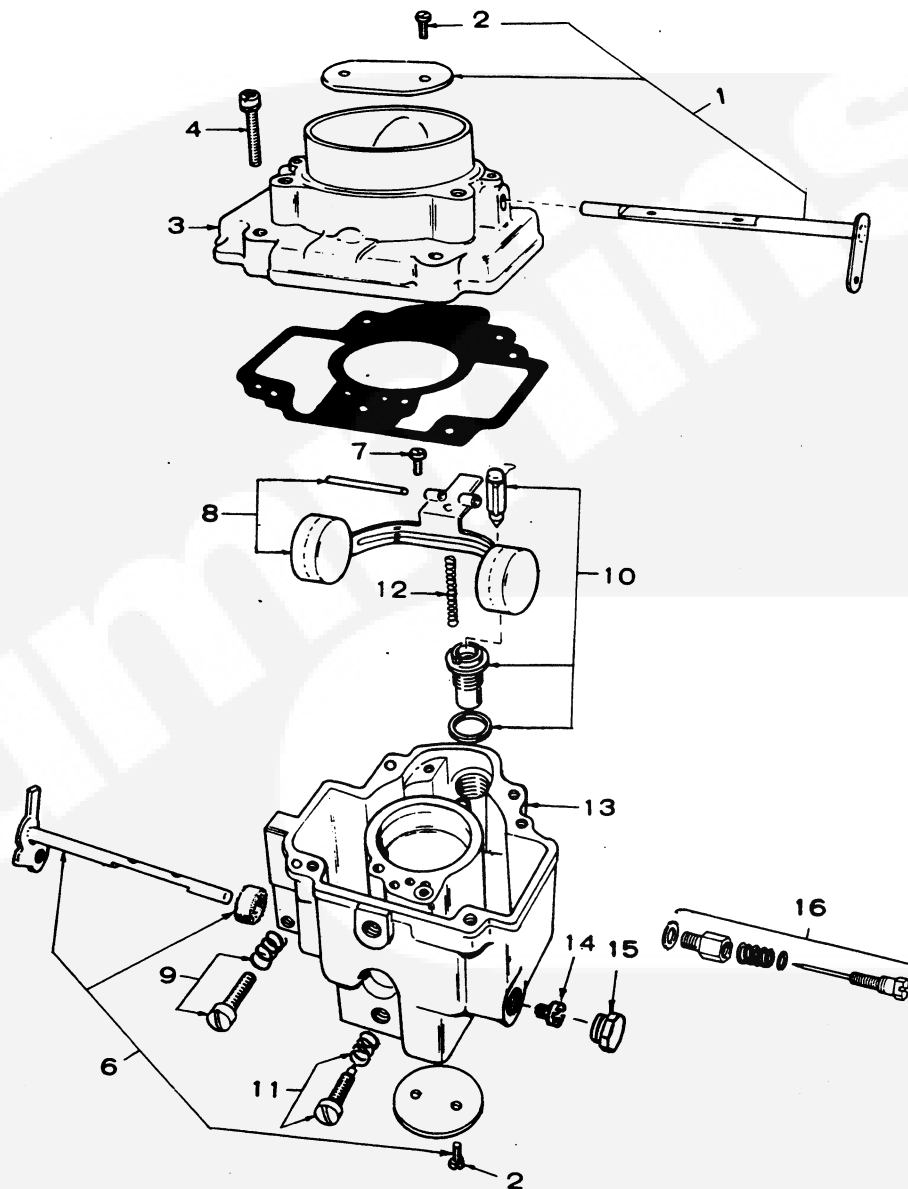


FUEL SYSTEM — KEYS 10,11,12,13,14



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	154-2157	1	Manifold, Intake
2	154-0013	2	Gasket, Intake Manifold
3	800-0059	2	Screw, Cap - Hex Head (3/8-16" x 3-1/4")
4	850-0050	2	Washer, Lock - Spring (3/8")
5	154-2077	1	Adapter, Carburetor
6	141-0859	1	Gasket, Carburetor Adapter
7	141-0858	1	Gasket, Carburetor Mounting
8	146-0314	1	Carburetor (Includes Mounting Gasket - See Separate Group for Complete Breakdown of Components)
9	800-0028	2	Screw, Cap - Hex Head (5/16-18 x 1")
10	850-0046	2	Washer, Lock - Spring (5/16")
11	800-0006	2	Screw, Cap - Hex Head (1/4-20 x 7/8")
12	850-0040	2	Washer, Lock - Spring (1/4")
13	502-0395	1	Connector, Hose
14	153-0515	1	Bracket, Choke Cable
15	153-0514	1	Clip, Cable
16	821-0002	2	Screw, Cap - Self Locking (#10-32 x 1/4" lg)
17	140-1653	1	Bracket, Air Cleaner Mtg.
19	821-0010	1	Screw, Cap - Self Locking (1/4-20 x 1/2")
20	140-1626	1	Housing, Air Cleaner
21	140-1228	1	Element, Air Cleaner
22	140-1652	1	Cover, Air Cleaner
23	865-0020	1	Nut, Wing (1/4-20)
24	509-0145	1	Seal, "O" Ring
25	123-1462	1	Tube, Breather
26	503-0171	1	Clamp, Breather Tube
27	140-1500	1	Plate, Carburetor Splash
28	140-1501	3	Spacer, Carburetor Splash Plate
29	815-0470	3	Screw, Machine - Hex Head (#10-32 x 1-1/2")
30	850-0030	3	Washer, Lock - Spring (#10)
31	149-1784	1	Pump, Fuel (Includes Mounting Gasket - See Separate Group for Complete Breakdown of Components)
32	149-0045	1	Shim, Fuel Pump
33	149-0003	1	Gasket, Fuel Pump Mounting
34	806-0009	2	Screw, Cap - Counter Bore (1/4-20 x 1.1")
35	HOSE, FUEL		
	503-0694	1	Key 10, 12, 13, (1/4" ID x 7")
	503-0744	1	Key 11, 14 (1/4" ID x 4-1/8")
36	502-0313	2	Elbow, Hose - Keys 12, 13 - Use 1
37	503-0301	2	Clamp, Hose
38	502-0395	1	Connector, Hose - Keys 10, 12, 13, 14
39	815-0391	1	Screw, Hex Head - Cable Clip (10-32 x 1/2")
40	145-0522	1	Deflector, Carburetor - Key 14

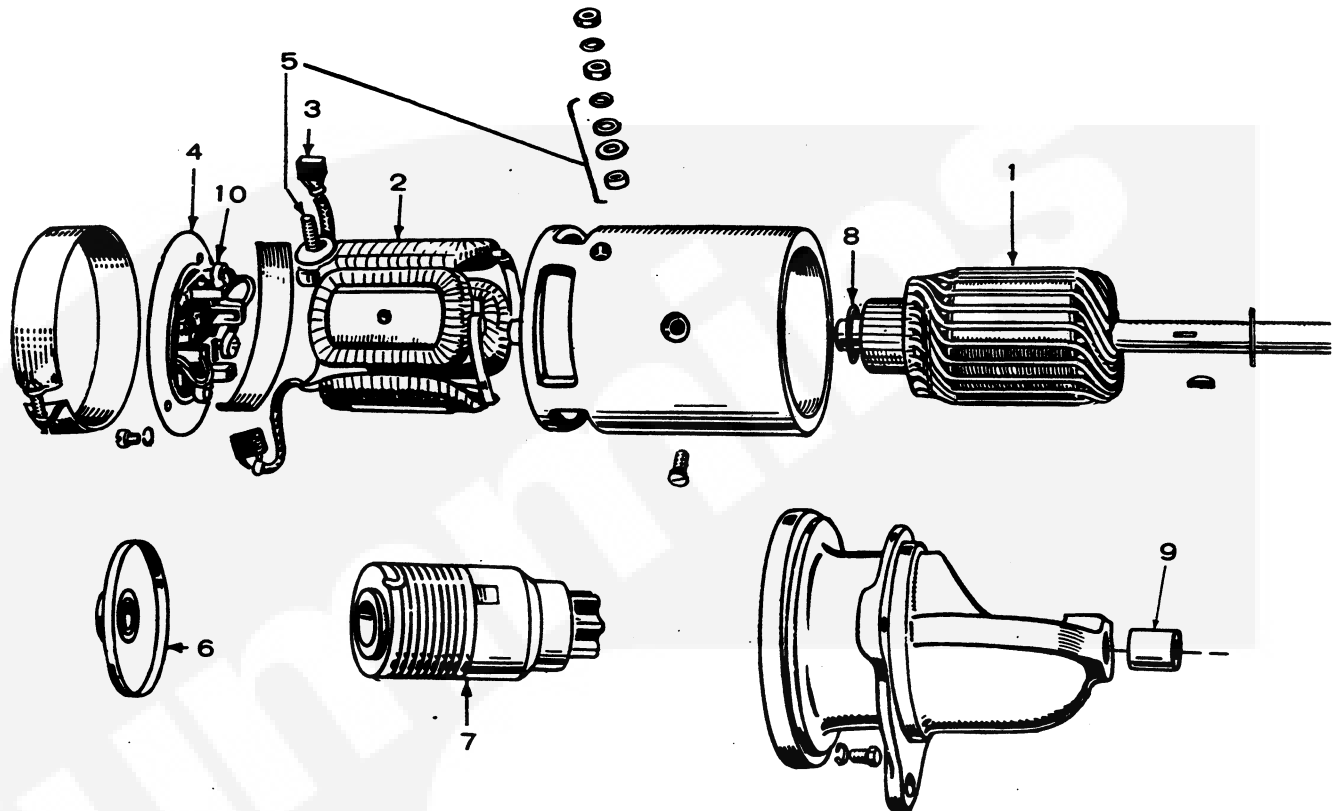
CARBURETOR PARTS **KEYS 10,11,12,13,14**



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	146-0314	1	Carburetor - Complete (Includes 146-0273 Carburetor and Mounting Gasket)
1	146-0260	1	Choke Shaft Package
2	146-0142	4	Screw, Valve Mounting
3		1	Intake, Air (Not Sold Separately)
4	146-0247	4	Screw, Body to Intake
6	146-0267	1	Throttle Shaft Package
7	146-0222	1	Screw, Lever Pin
8	146-0262	1	Float Package
9	146-0261	1	Idle Speed Adjusting Screw Package

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
10	146-0227	1	Valve and Seat Package
11	146-0209	1	Idle Needle Package
12	146-0208	1	Spring Buoyancy
13		1	Body (Not Sold Separately)
14	146-0277	1	Jet, Power
15	146-0278	1	Screw, Plug
16	146-0214	1	Needle Assembly, Altitude Compensation
	146-0292	1	Kit, Repair - Carburetor
	146-0220	1	Kit, Gasket - Carburetor

STARTER MOTOR PARTS - KEY 2

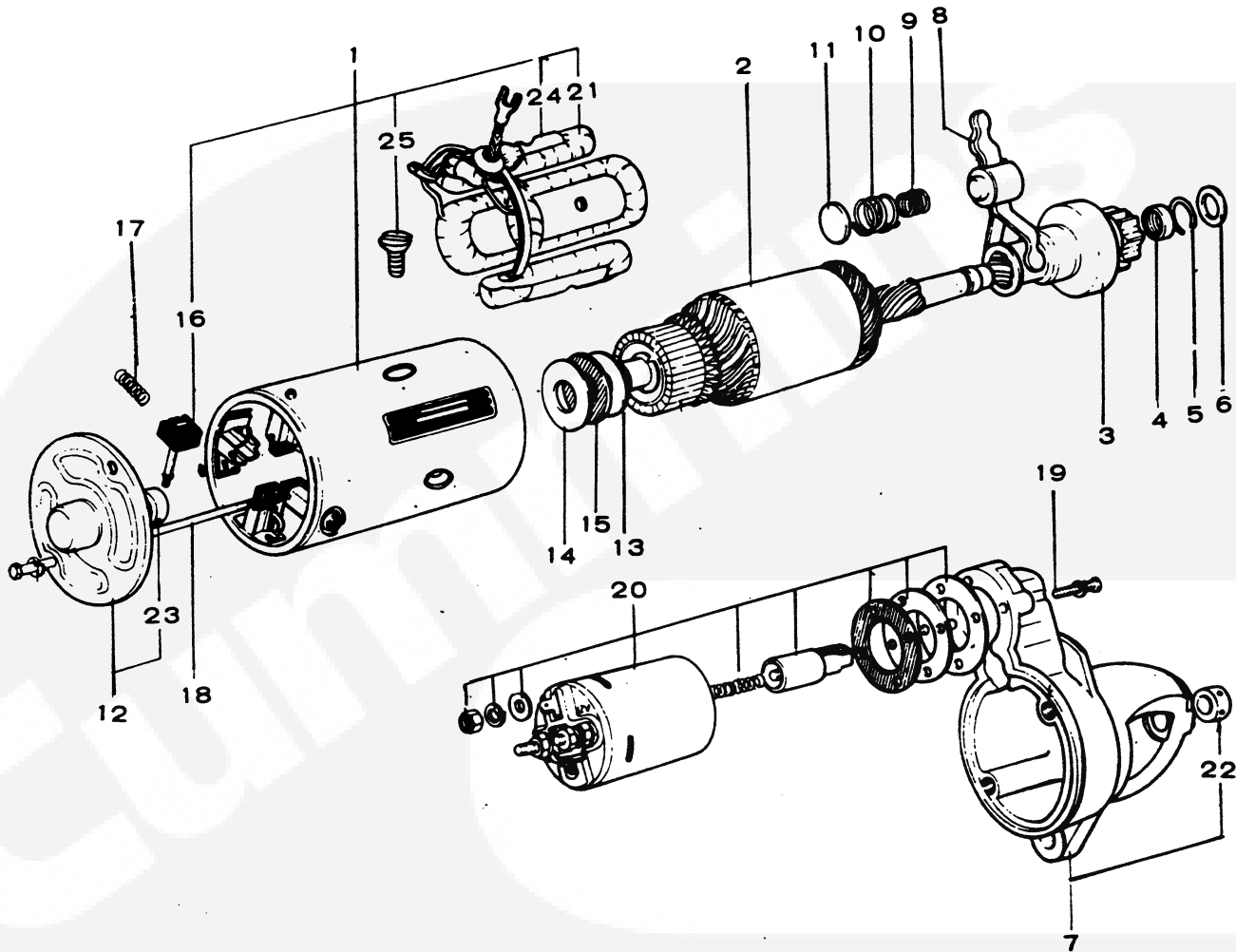


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0511	1	Motor Assembly, Starter (Complete)
1	191-0517	1	Armature
2	191-1017	1	Coil Assembly, Package - Field
3	191-0513	1	Brush Set, Service
4	191-1018	1	Head Assembly, Commutator End
5	191-1022	1	Stud, Terminal (Package)
6	191-1019	1	Bearing Assembly, Intermediate

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
7	191-0271	1	Drive Assembly
8	191-1021	1	Washer, Armature Thrust (Package)
9	191-0735	1	Bearing, Drive End
10	191-1020	1	Spring, Brush (Set of 4)

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

STARTER MOTOR PARTS - KEY 3, 5



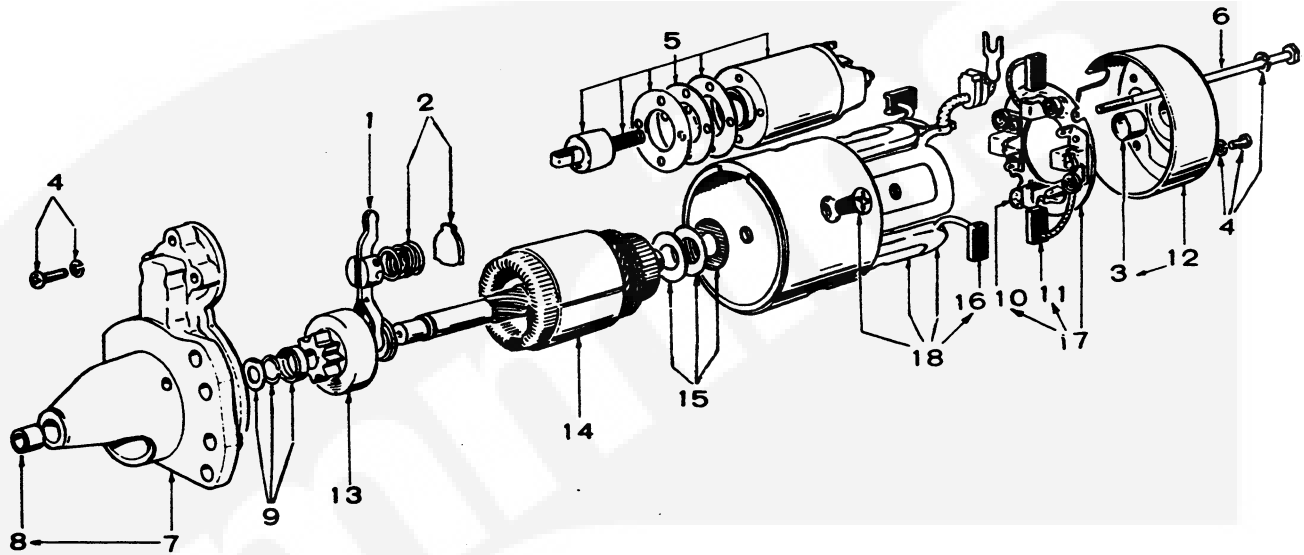
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0790	1	Motor Assembly, Starting - Complete
1	191-0806	1	Yoke Assembly (Frame) - Includes Parts Marked *
2	191-0743	1	Armature
3	191-0744	1	Clutch, Starter
4	191-0745	1	Stop, Pinion
5	191-0746	1	Ring
6	191-0747	1	Washer, Plain
7	191-0808	1	+Bracket Assembly, Front: (Not a Repair Part)
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 191-0806.

+ - Front & Rear Bracket Assys - Not Available As Repairs - If Needed, order 191-0790 Starter.

STARTER MOTOR PARTS - KEY 6



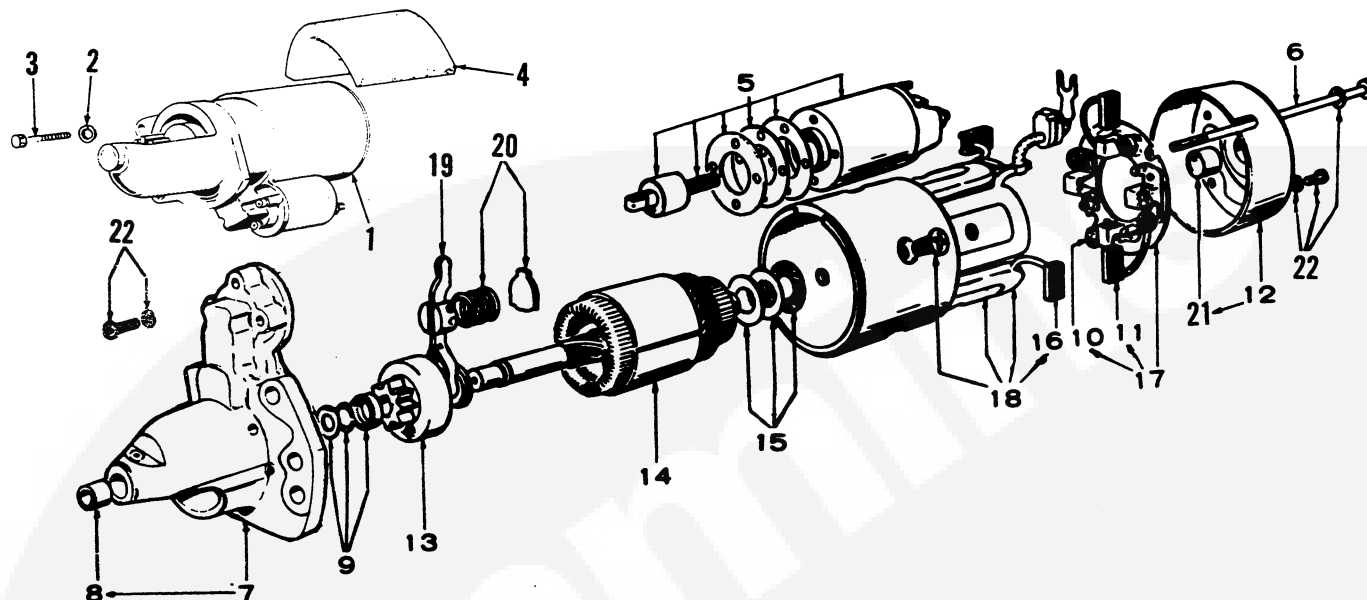
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0922	1	* Motor, Starting - Complete
1	191-0983	1	Lever Assembly
2	191-0984	1	Spring Set
3	191-1010	1	Bearing, Rear Bracket Assembly
4	191-1011	1	Screw Set
5	191-0987	1	Switch Assembly
6	191-0988	2	Bolt, Through
7	191-0989	1	Bracket Assembly, Front (Includes Bearing)
8	191-0990	1	Bearing, Front Bracket
9	191-0991	1	Stopper Set, Pinion
10	191-1007	4	£Spring, Brush

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
11	191-1008	2	£Brush, Negative
12	191-1009	1	Bracket Assembly, Rear (Includes Bearing)
13	191-0995	1	Clutch Assembly
14	191-0996	1	Armature
15	191-0997	1	Washer Set
16	191-1005	2	Brush, Positive
17	191-1006	1	Holder Assembly, Brush (Includes Parts Marked £)
18	191-1001	1	Field Coil Set (Includes Positive Brush)

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

* - 196-0922 Starter is No Longer Available - For Complete Replacement order 191-1052 Starter.

STARTER MOTOR PARTS — KEYS 7,9,10,12,13



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION	REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	191-1052	1	Motor, Starter - 12 Volt Solenoid Shift (Includes Parts Marked *)	15	191-0997	1	*Washer Set
2	850-0050	2	Washer, Lock - Spring (3/8")	16	191-1005	2	*Brush, Positive
3	800-0050	2	Screw, Cap - Hex Head (3/8-16 x 1")	17	191-1006	1	†*Holder Assembly, Brush (Includes Parts Marked Δ)
4	191-1076	1	Seal, Air	18	191-1089	1	*Yoke Assembly (Includes Frame, Pole Shoes, Field Coil and Positive Brushes)
5	191-0987	1	*Switch Assembly	19	191-0983	1	*Lever Assembly
6	191-0988	2	*Bolt, Through	20	191-0984	1	*Spring Set
7	191-1086	1	*Bracket Assembly, Front (Includes Bearing)	21	191-1010	1	*Bearing, Rear Bracket Assembly
8	191-0971	1	*Bearing, Front Bracket	22	191-1011	1	*Screw Set
9	191-0991	1	*Stopper Set, Pinion				
10	191-1007	3	†*ΔSpring, Brush				
11	191-1008	1	†*ΔBrush, Negative				
12	191-1009	1	*Bracket Assembly, Rear (Includes Bearing)				
13	191-1087	1	*Clutch Assembly				
14	191-1088	1	*Armature				

* - Parts Included in 191-1052 Starter Motor.

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

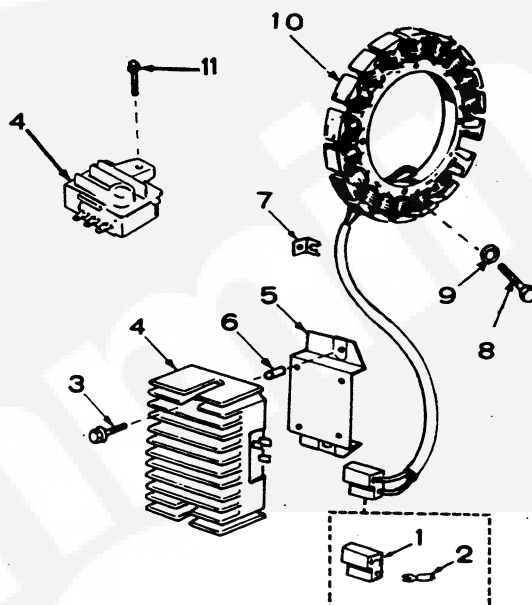
† - Early brush holder was equipped with two (2) negative brushes and four (4) brush springs. Completely interchangeable with current brush holder. When replacing negative brushes on early models only one (1) required, however two (2) may be used.

SERVICE KITS AND MISCELLANEOUS

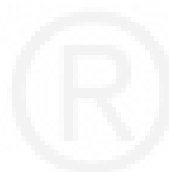
Note: For other kits refer to the group for the part in question.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	98-1100	1	Decal Kit
	GASKET KIT, COMPLETE ENGINE		
	168-0150	1	Keys 10, 11, 12, 13, 14
	168-0103	1	Keys 1, 2, 3, 4, 5, 6, 7, 8, 9
	IGNITION KIT, TUNE UP		
	160-1213	1	Keys 10, 11, 12, 13, 14
	160-0836	1	Keys 1, 2, 3, 4, 5, 6, 7, 8, 9
	168-0095	1	Carbon Removal Gasket Kit
	OVERHAUL KIT, ENGINE		
	522-0316	1	Keys 10, 11, 12, 13, 14
	522-0164	1	Keys 1, 2, 3, 4, 5, 6, 7, 8, 9
	110-1827	4	Guide, Valve - used When Valves Have Seals (to Stop Oil Seepage) - Key 10, 11, 12

FLYWHEEL ALTERNATOR (12 VOLT, 15 AMPERE) - KEYS 12,13



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	323-0853	1	Body, Connector
2	332-2073	2	Terminal, Wire
3	821-0012	2	Screw, Cap - HWH (1/4-20 x 1-1/8") - Key 12
4	REGULATOR, VOLTAGE (15 AMP)		
	191-0886	1	Key 12
	191-1206	1	Key 13
5	191-1107	1	Bracket, Regulator Mounting - Key 12
6	134-2100	2	Spacer, Sleeve - Key 12
7	167-0188	1	Clip, Alternator Lead - Key 13 Use 2)
8	813-0143	3	Screw, Machine - Round Head (#10-32 x 1-3/8")
9	850-0030	3	Washer, Lock - Spring (#10)
10	191-1256	1	Stator, Alternator
11	821-0008	1	Screw, Lock Head, Hex (1/4-20 x 5/16") - Key 13



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