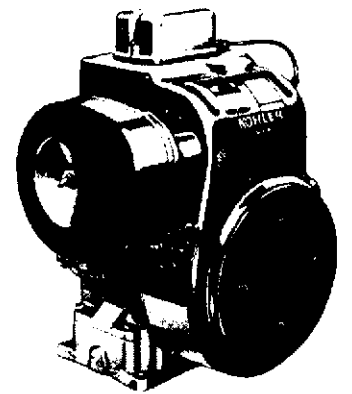


KOHLER **engines**

model K361



**service
manual**

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SECTION 1 - GENERAL INFORMATION

This manual covers the Kohler single cylinder, horizontal crankshaft, overhead valve engine. When ordering replacement parts and in any communication involving an engine, always report the MODEL, SPECIFICATION and SERIAL numbers as found on the nameplate which is mounted on top of engine blower housing (see Figure 1-1). The significance of these numbers is explained as follows.

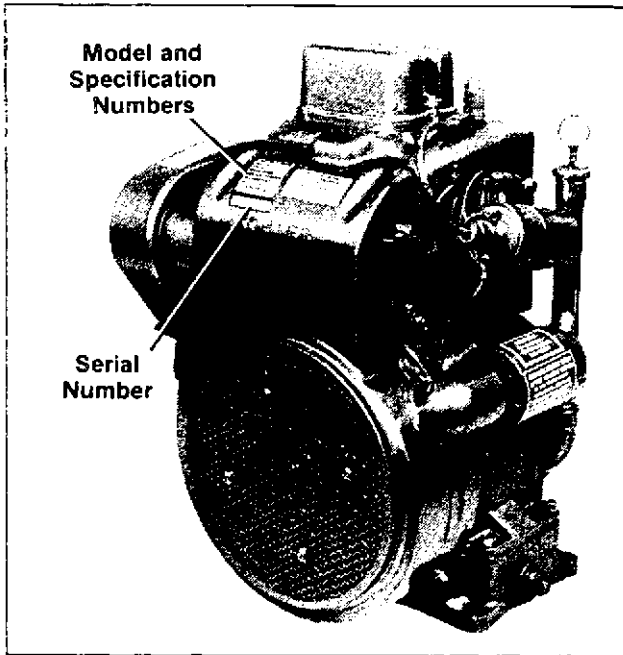


Figure 1-1. Engine Identification

Model Number is the model series within which the engine is built and indicates (a) the cubic inch displacement, and (b) number of cylinders. The model K361 denotes a 36 cubic inch displacement, single cylinder engine. Letter suffixes following the model number designate a specific version - the letter code is as follows:

Suffix	Designates
A	Oil Pan Type
C	Clutch Model
P	Pump Model
Q	Quiet Model
S	Electric Start
T	Retractable Start

Model number without a letter suffix indicates a rope start version.

Specification Number is the model variation and is used to indicate the combination of various parts groups used to build an engine. It may have a suffix letter which determines supersession of parts. The first three digits of the spec. number designate the engine model: 231, for instance, designates the K361 engine. The remaining numbers are issued in numerical sequence as each new specification is released - for example 23100, 23101, 23102.

Serial Number is the order in which the engine was built. If a change occurs to a model or specification, the serial number is used to indicate the point at which this change was made. The first digit in the serial number is the code designation for year of manufacture. The chart following shows the year and corresponding first digit code for the serial number.

Year	First Digit	Year	First Digit
1969	1	1974	6
1970	2	1975	7 (0-2)*
1971	3	1976	7 (3)*
1972	4	1977	8
1973	5	1978	9

*Both 1975 and 1976 first digit numbers are 7, however, the digit following the 7 (second digit) starts at 0 and runs to 2 for 1975 and starts at 3 for 1976.

GENERAL SPECIFICATIONS

Bore (Nominal)	3-3/4" (95 mm)
Stroke	3-1/4" (83 mm)
Displacement (Cubic Inches)	35.89 (588 cc)
Horsepower (at 3600 RPM)	18 (13.4 kw)
Weight (Approximate Pounds)	124 (55.8 kg)
Oil Capacity (U.S. Quarts)	2 (1.9 L)*
Spark Plug Gap (Standard)	.035" (0.89 mm)
Spark Plug Gap (Resistor)	.035" (0.89 mm)
Spark Plug Size (Millimeters)	14
Breaker Point Gap	.020" (.508 mm)

*K361A engine models have a 1-1/2 qt. (1.4 L) capacity.

SAFETY WARNINGS

Type of Hazard	Warning	Reasons
Gasoline	<ol style="list-style-type: none"> 1. Store gasoline only in approved containers. 2. Store gasoline away from sources of heat such as: radiators, open flames, sparks and unventilated sunlit storage areas. 3. Do not add gasoline while engine is running or start engine around spilled gasoline. 	<ol style="list-style-type: none"> 1. Approved containers can be readily identified, preventing mix-ups. 2. Exposing gasoline to sources of heat may result in explosion. 3. Ignition spark or hot exhaust gases could ignite gas fumes resulting in an explosion.
Lethal Exhaust Gas	<ol style="list-style-type: none"> 1. Never inhale exhaust fumes or run engine in a closed building or confined area. 	<ol style="list-style-type: none"> 1. All exhaust contains poisonous carbon monoxide gas. Prolonged breathing will result in death.
Moving Parts, Hot Parts	<ol style="list-style-type: none"> 1. Never operate equipment with safety guards removed. 2. Always remove spark plug lead when working on engine or equipment it powers. 3. Never touch the engine cylinder block, exhaust system, cylinder head, baffles and shrouds while engine is running or immediately after engine shutdown. 	<ol style="list-style-type: none"> 1. Hands, feet, clothing and hair can get caught in moving parts resulting in injury to you. 2. Engine could accidentally start, if turned over, while you are working on equipment. 3. These engine components become extremely hot when engine is running and remain so for a short time after engine is shut down. These hot parts can burn you.
Batteries	<ol style="list-style-type: none"> 1. Handle storage batteries carefully. 2. Never charge batteries in an enclosed area or cause arcing or a spark near battery. 3. Never leave ignition switch on when charging. 	<ol style="list-style-type: none"> 1. Storage batteries contain corrosive acid that can burn you. 2. Storage batteries give off highly explosive hydrogen gas. Accumulations of this gas exposed to heat or spark can explode and hurt you. 3. A switch left on with the battery connected can cause the ignition coil to overheat and possibly explode.
Electrical Wiring and Components	<ol style="list-style-type: none"> 1. Never touch any electrical wires or components while engine is running. 	<ol style="list-style-type: none"> 1. Electrical wires and components may be sources of electrical shock. Electrical shock can severely injure or kill you.
Excessive Engine Speed	<ol style="list-style-type: none"> 1. Never tamper with governor settings to increase the maximum speed of the engine. 	<ol style="list-style-type: none"> 1. Overspeeding can cause equipment parts to exceed design limitations, resulting in component failures. Parts breaking under excess stress can become lethal missiles if thrown off by the equipment. These broken parts flying through the air can injure or kill you.

WARNING: Before working on engine or equipment always remove spark plug leads to prevent engine from starting accidentally.

SERVICE SCHEDULE

Service	Daily (Pre-start)	Every 25 Hours	Every 50 Hours	Every 100 Hours	Every 500 Hours
Clean Air Intake Screen	X				
Check Oil Level	X				
Replenish Fuel Supply	X				
Change Lube Oil		X			
Check Air Cleaner (Replace if Dirty)			X		
Clean Cooling Fins and External Surfaces			X		
Service or Replace Spark Plugs				X	
Have Breaker Points Checked and Serviced*					X
Have Ignition Timing Checked*					X
Have Valve - Tappet Clearance Checked*					X
Have Service Cylinder Heads Serviced*					X†

* Have these services done only by qualified engine specialist.

NOTE: Intervals stated are for good, clean operating condition only - service more frequently (even daily) if extremely dusty or dirty conditions prevail.

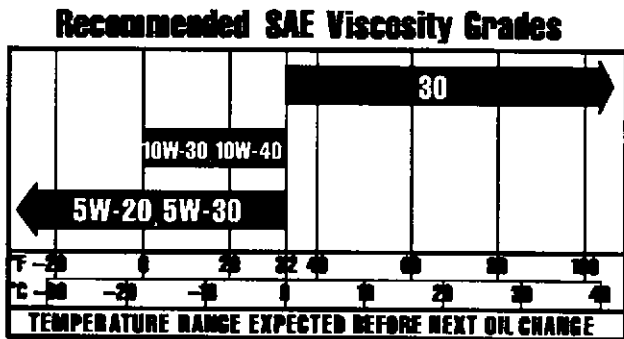
† If leaded gasoline is used service cylinder head every 250 hrs.

OIL RECOMMENDATIONS

The importance of checking and changing oil at the prescribed intervals cannot be overemphasized under the operating conditions usually encountered with most air-cooled engine applications. To obtain maximum service life, perform these services at recommended intervals.

Oil Type

Use high quality detergent oil of API (American Petroleum Institute) service class SF or SG. Select the viscosity based on the air temperature at the time of operation as shown below:



Use straight weight oils as specified. Do not use multi-viscosity oils above 32°F as considerable increases in oil consumption and combustion deposits will result.

Oil Change

On a new engine, change oil after the first 5 hours of operation and then at 25 hour operating intervals thereafter. Change oil more frequently under dirty, dusty conditions.

Drain the engine oil when the engine is warm, for it flows more freely, thus carrying away more impurities.

After completely draining oil, reinstall drain plug, then remove oil filler cap and add 2 quarts (1.9 liters) of oil.* Check the oil level on the dipstick before adding more oil. On engines with the threaded type plug-dipstick, turn the plug all the way out of crankcase, wipe oil off dipstick, then reinsert - DO NOT turn plug in to check oil level. After checking, turn plug all the way into the crankcase. With the oil fill tube and dipstick arrangement, wipe off the dipstick before inserting it all the way into the tube, then remove the dipstick to observe the level. Engine must be level for accurate reading. Bring the oil level up into the SAFE range, but do not exceed the "F" mark. (NOTE: overfilling can cause engine to overheat.)

*K361A engine models have a 1-1/2 quart (1.4 liters) capacity.

FUEL RECOMMENDATIONS

WARNING: Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well-ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spoilage during refueling.

Do not use gasoline left over from the previous season, to minimize gum deposits in your fuel system and to insure easy starting.

Do not add oil to the gasoline.

Do not overfill the fuel tank. Leave room for the fuel to expand.

Fuel Type

For best results, use only clean, fresh, unleaded gasoline with a pump sticker octane rating of 87 or higher. In countries using the Research method, it should be 90 octane minimum.

Unleaded gasoline is recommended, as it leaves less combustion chamber deposits. Leaded gasoline may be used in areas where unleaded is not available and exhaust emissions are not regulated. Be aware however, that the cylinder head will require more frequent service.

Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends are not approved.

Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

SECTION 2 - ENGINE ANALYSIS

TROUBLESHOOTING

When troubles occur, don't overlook simple causes which might seem too obvious to be considered. A starting prob-

lem could, for example, be attributed simply to an empty fuel tank. The chart below lists some common causes of engine troubles - use this as a guide to locate causing factors.

Condition	Possible Cause
Hard Starting or Loss of Power	<ol style="list-style-type: none"> 1. Faulty ignition. <ol style="list-style-type: none"> a. Loose or grounded high tension or breaker point leads. b. Improper breaker point gap and timing. c. Defective breaker points. d. Faulty spark plug or improper gap. e. Battery not fully charged. f. Faulty condenser. 2. Faulty fuel system. <ol style="list-style-type: none"> a. Gasoline not getting to carburetor. <ol style="list-style-type: none"> 1. Dirt or gum in fuel line. 2. Fuel pump faulty. 3. Vent in fuel tank cap plugged. b. Dirt in carburetor. c. Carburetor improperly adjusted. 3. Wrong lube oil. 4. External loads engaged. <ol style="list-style-type: none"> a. Clutch out and transmission in gear.
Overheating	<ol style="list-style-type: none"> 1. Insufficient cool air available. 2. Dirty air intake screen, shroud or cooling fins. 3. Improper fuel. 4. Fuel mixture too lean. 5. Improper ignition timing. 6. Engine overloaded. 7. Tight tappet clearance. 8. Too much lube oil.
Backfiring	<ol style="list-style-type: none"> 1. Fuel mixture too lean. 2. Improper timing. 3. Valve "sticking".
High Speed "Skip"	<ol style="list-style-type: none"> 1. Spark plug gap incorrect. 2. Improper carburetor setting or lack of fuel. 3. Wrong type spark plug. 4. Improper timing. 5. Faulty condenser.
Operating Erratically	<ol style="list-style-type: none"> 1. Clogged fuel line. 2. Water in fuel. 3. Faulty choke control. 4. Improper fuel mixture. 5. Loose ignition connections. 6. Air leaks in carburetor or manifold connections. 7. Vent in gas cap plugged. 8. Fuel pump faulty.
Engine Will Not Idle	<ol style="list-style-type: none"> 1. Improper carburetor idling adjustment. 2. Carburetor clogged. 3. Spark plug gap set too close. 4. Leaking carburetor or manifold gaskets.

BASIC ENGINE TESTS

Crankcase Vacuum Test

A partial vacuum should be present in the crankcase when engine is operating at normal temperatures. An engine in good condition will have crankcase vacuum of 5" to 10" water column as read on "U" tube water manometer or 3/8" to 3/4" Hg. as calibrated on mercury vacuum gauge. Crankcase vacuum check is best accomplished with the "U" tube manometer. If vacuum is not in the specified range, this could be attributed to one or more of the following factors - the condition easiest to remedy should be checked first:

- A. A clogged crankcase breather or plugged or kinked breather tube can cause positive pressures to build up in the crankcase. Disassemble breather assembly, thoroughly clean, then recheck pressure after reassembling.
- B. Worn oil seals can cause lack of vacuum. Oil leakage is usually evident around worn oil seals. (See Oil Seal Replacement Instructions.)
- C. Blowby and leaky valve stems can also cause positive pressures.
- D. Faulty seal in oil dipstick cap.

Construction - "U" Tube Manometer

Vacuum gauges, mercury and water manometers are available commercially. A water "U" tube manometer (see Figure 2-1) is simple to construct if limited usage does not warrant purchase of commercial product. To construct water manometer, proceed as follows:

- A. Procure length of clear plastic tubing. Bend tube to form "U" and mount on board as shown in accompanying illustration. Make gradual, rather than sharp bend in tube.
- B. Measure inside, straight section of tube and mark inch increments from 0 to 12".
- C. Procure rubber stopper having outside diameter which will be a snug fit in the oil fill hole. Drill hole in center of stopper to receive one end of tube.
- D. Pour water (colored for easier reading) into tube until level reaches the approximate halfway mark on scale.

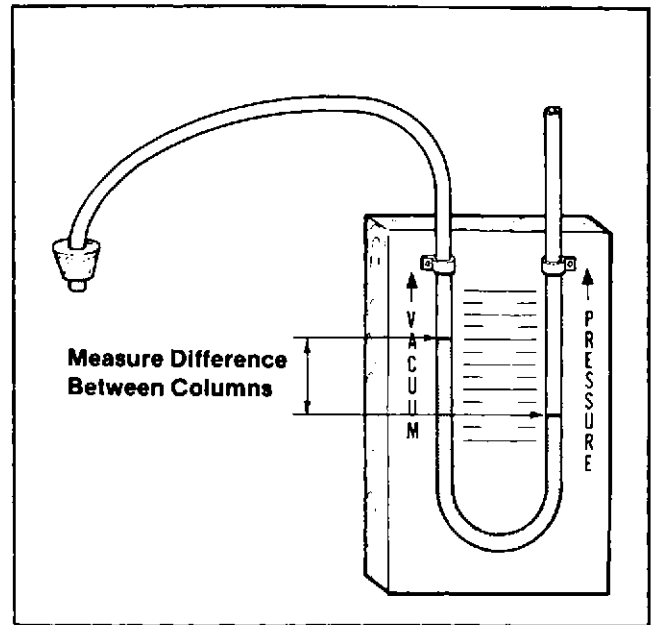


Figure 2-1. "U" Tube Water Manometer

When using manometer, place stopper into oil fill hole (other end open to atmosphere) and measure difference between columns. If water column is higher in tube connected to engine, vacuum or negative pressure is indicated. If the higher column is on the atmospheric side of manometer, positive pressure is present.

Compression Test

To check compression on the K361 engine, rotate the flywheel backwards (counterclockwise) against the power stroke, if little or no resistance is felt compression is faulty. If low or faulty compression is indicated, one or several of the conditions listed here may be the cause:

Possible Cause	Remedy
A. Cylinder head gasket blown.	A. Remove head, replace gasket, reinstall head, recheck compression.
B. Cylinder head warped or loose.	B. Remove head, check for flatness (see cylinder head service), reinstall and secure in proper sequence to specified torque value. Check heat baffle tube in exhaust manifold.
C. Piston rings worn - blowby occurring.	C. Recondition engine.
D. Valves leaking.	D. Recondition head assembly.

SECTION 3 - AIR INTAKE AND COOLING

AIR CLEANER SERVICE

This engine is equipped with a dry type air cleaner element, which should be checked every 50 operating hours and replaced if dirty. It should be checked and if necessary replaced more often under extremely dirty, dusty conditions. Do not wash element in any liquid or attempt to blow dirt off with air hose as this will puncture filter element. When replacing element, use only genuine Kohler element. Carefully handle new element - do not use if gasket surfaces are bent or twisted. Check the following when installing new element:

1. Back plate must be securely tightened to carburetor. Replace back plate if bent or cracked. Replace air horn gasket if damaged (see Figures 3-1 and 3-2 for air horn gasket installation instructions).

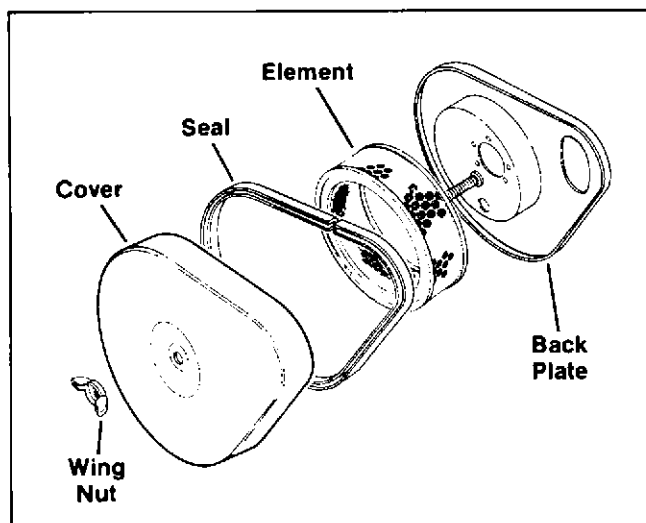


Figure 3-1. Air Cleaner Components

2. Gasket surfaces of element must be flat against back plate and cover to seal effectively.
3. Seal on cover must be in place to reduce noise and vibration of the cover. Vibration can cause stud hole in cover to enlarge thus permitting dirt to enter carburetor.
4. Wing nut must be finger tight - do not overtighten.
5. Angled end of tube must be installed into blower housing, short end of tube length up and long end length down (see Figure 3-3 for tube position). Lips on other end of tube must form tight seal on back plate.

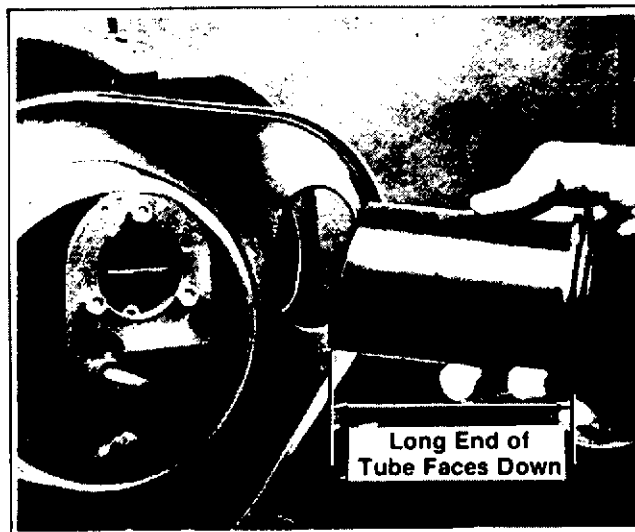


Figure 3-3. Air Cleaner Tube Installation

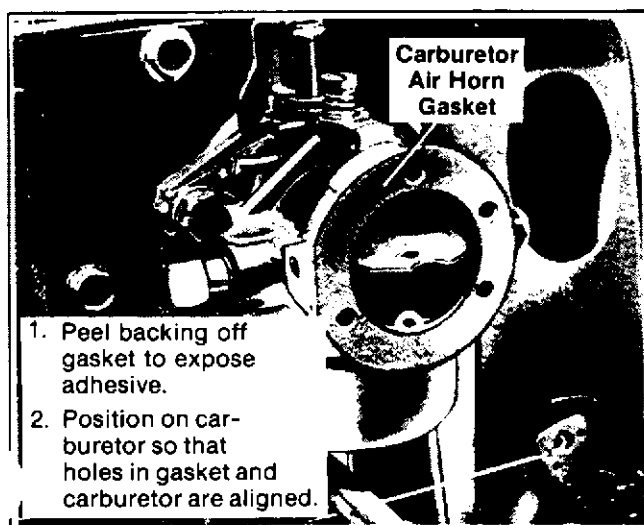


Figure 3-2. Air Horn Gasket Installation

COOLING SYSTEM SERVICE

Air is drawn into the cooling shroud by fins on the flywheel. The grass screen and cooling fins on the block and cylinder head must be kept clean and unobstructed at all times. (IMPORTANT: Never operate engine with blower housing or cooling shrouds removed. These direct air flow past cooling fins. Removal results in improper air circulation, overheating and engine damage.)

External surfaces must be maintained in clean condition, free of oil and dirt accumulation. This is done not only for safety and appearance, but because poor cooling efficiency results from dirty external surfaces (see Figure 3-4).

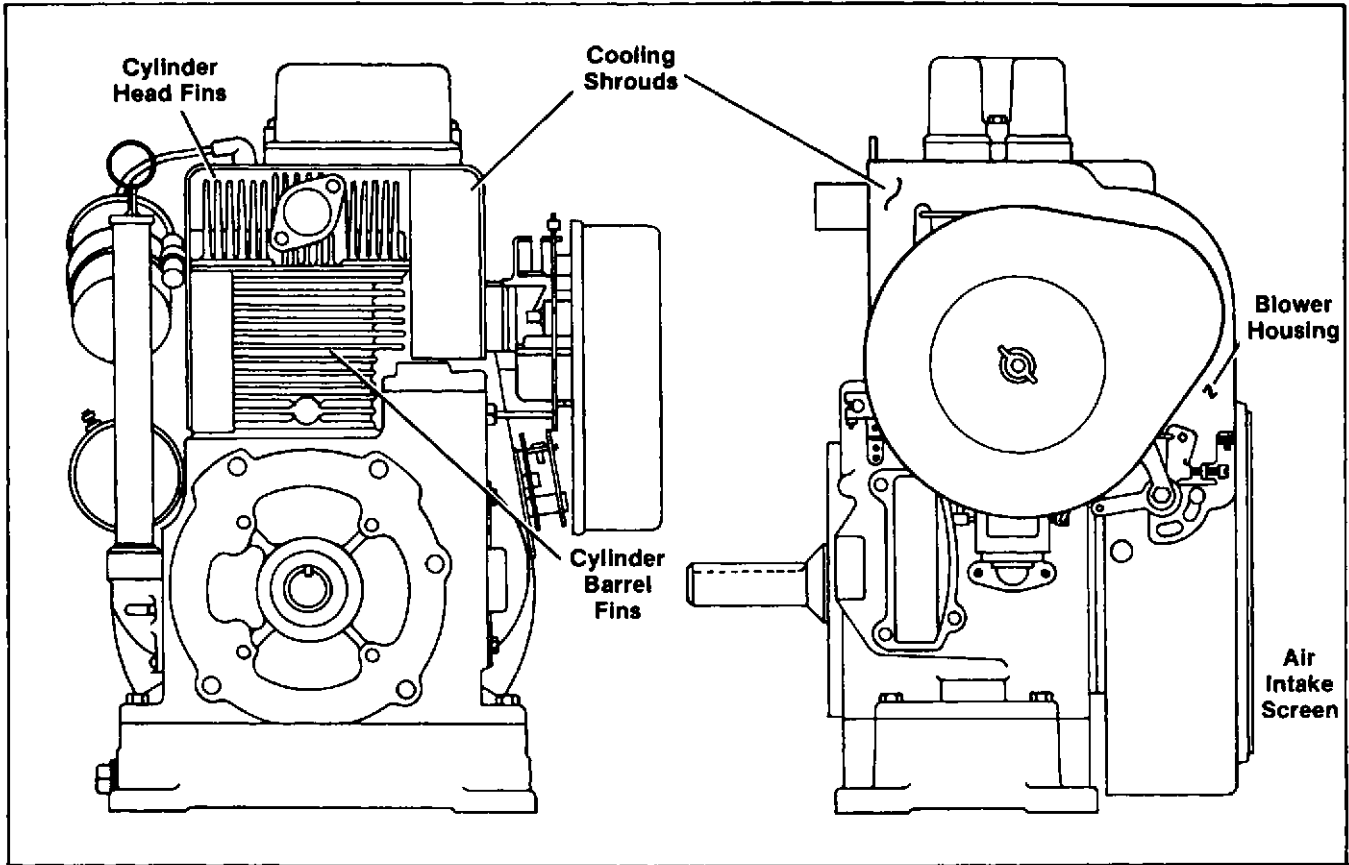


Figure 3-4. Keep These Areas Clean and Free of Debris

SECTION 4 - FUEL SYSTEM

CARBURETOR

The K361 engine is equipped with a side draft, adjustable jet carburetor. It is adjusted in the factory and should not have to be reset. If, however, one of the following conditions is noted, readjust carburetor immediately as incorrect setting can lead to fouled spark plugs, overheating, excessive valve wear or other problems (see chart below).

CARBURETOR ADJUSTMENTS

If readjustment becomes necessary, stop the engine, then turn the MAIN and IDLE fuel adjusting screws all the way in, until they bottom lightly.

CAUTION: Do not force adjusting screws closed as damage to needle valves will result.

Main Fuel Adjustment

Preliminary setting – turn screw out 2-1/2 turns. Final setting – start engine and raise engine speed to maximum governed, no load speed. Turn screw in just until engine speed decreases and note the position of the screw. Now turn the screw out. The engine speed will first increase, but then decrease as screw is turned out. Note the position of screw when engine speed starts to decrease. Set the screw midway between the two points noted above. (For location of main fuel screw see Figure 4-1.)

Idle Speed Adjustment

Run engine at maximum governed, no load speed for a minimum of 30 seconds, then allow engine speed to fall to idle, or put throttle into idle position. Set engine speed to 1800 RPM \pm 75 RPM or per engine spec., turning in or out on the idle speed screw. (See Figure 4-1 for location of idle speed screw.)

Idle Fuel Adjustment

Set the idle fuel mixture by turning the idle fuel screw out, from the closed position, 3/4 to 1 full turn. (For location of idle fuel screw see Figure 4-1.)

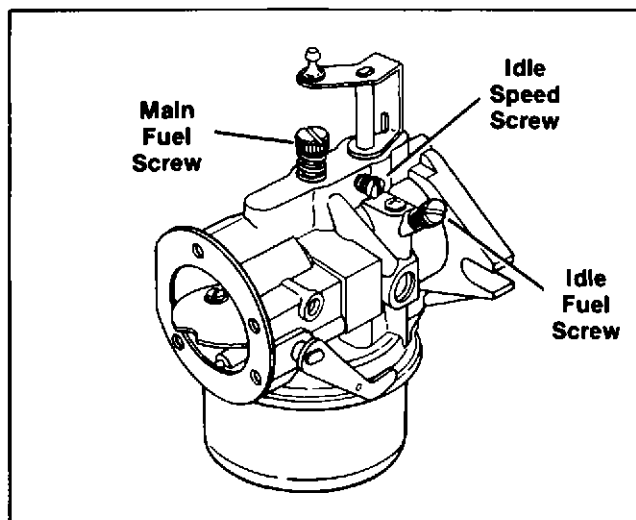


Figure 4-1. Carburetor Adjustments

CARBURETOR RECONDITIONING

Service difficulties with fuel systems usually originate from improper carburetor adjustment or dirt, gum or varnish in components. It will be necessary to completely disassemble carburetor to clean thoroughly. Normally only pre-season cleaning will be required; however, the frequency of cleaning will depend upon use and operating conditions.

All parts should be cleaned in a solvent. Gum is easily removed with acetone solvent. (NOTE: Always follow manufacturers' instructions when using cleaning solvents.) Be sure all deposits are removed from bore, especially where throttle plate seats in casting. Blow out all passages with compressed air. Replace all worn and damaged parts. Always use new gaskets. Carburetor repair kits are available for most carburetors. They include the bowl nut gasket (if required), bowl ring gasket, float pin, bowl baffle gasket and fuel inlet needle and seat.

Condition	Possible Cause/Probable Remedy
1. Black, sooty exhaust smoke, engine sluggish.	1. Mixture too rich – readjust main fuel screw.
2. Engine misses and backfires at high speed.	2. Mixture too lean – readjust main fuel screw.
3. Engine starts, sputters and dies under cold weather starting.	3. Mixture too lean – turn main fuel adjustment 1/4 turn counterclockwise.
4. Engine runs rough or stalls at idle speed.	4. Idle speed too low or improper idle adjustment – readjust speed, then idle fuel screw, if needed.
5. Erratic operation, engine starving for fuel.	5. Air horn gasket is improperly aligned or wrong gasket – realign or replace gasket. Shutdown control not functioning – replace solenoid.

Disassembly of Carburetor - Side Draft (see Figure 4-2 for location of parts).

1. Remove carburetor from engine.
2. Remove bowl nut, gasket and bowl.
3. Remove float pin, float, needle and needle seat. Check float for dents, leaks and wear on float lip or in float pin holes.
4. Remove bowl ring gasket.
5. Remove idle fuel adjusting needle, main fuel adjusting needle and springs.
6. Do not remove choke and throttle plates and shafts. If these parts are worn, replace carburetor assembly.

Assembly of Carburetor - Side Draft (see Figure 4-2 for location of parts).

1. Install needle seat, needle, float and float pin.
2. Set float level. With carburetor casting inverted and float resting lightly against needle in its seat, there should be $11/64$ " plus or minus $1/32$ of an inch clearance between machined surface of casting and free end of float (side opposite needle seat).
3. Adjust by bending lip of float with small screwdriver.
4. Install new bowl ring gasket, bowl baffle gasket, new bowl nut gasket (when required) and bowl nut. Tighten securely after making sure bowl is centered on gasket.

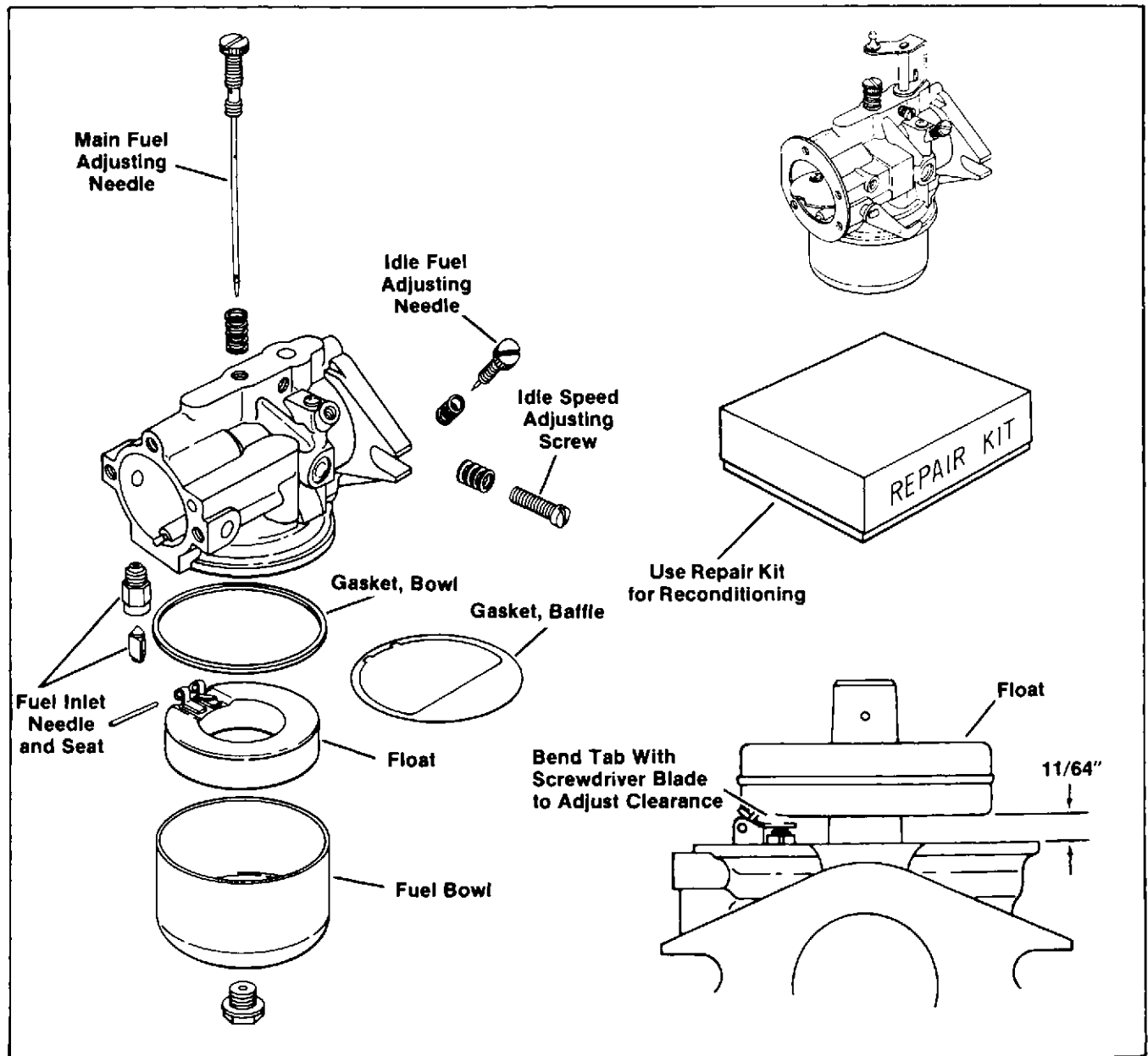


Figure 4-2. Side Draft Carburetor

5. Install main fuel adjustment needle and spring. Turn in until needle seats in nozzle and back out 2-1/2 turns.
6. Install idle fuel adjustment needle and spring. Back out approximately 3/4 to 1 full turn after seating lightly against jet.

CAUTION: Do not use force on adjustment needles.

AUTOMATIC CHOKE AND SHUTDOWN CONTROL

Some K361 engines are equipped with an optional Thermo-Electric Automatic Choke and Fuel Shutdown Solenoid. The automatic choke and shutdown solenoid function as follows:

Automatic Choke Function

The choke valve position is determined by two systems. First, a thermostatic (heat sensitive) spring positions the choke valve based on air temperature. Second, a rotary solenoid (electro magnet pulling on rotatable shaft) is engaged during cranking and operates through the thermostatic spring to close the choke further. When the cranking circuit is de-energized, the rotary solenoid disengages and the choke plate is returned to a position determined by the thermostatic spring. As the engine starts to run and warm up, the thermostatic spring is heated by a thermistor, which fully opens the choke valve. The full open valve position is maintained as the thermistor continues to heat the spring by its regulation of current flow. (See Figure 4-3 for additional automatic choke information.)

Automatic Choke Service Guide

WARNING: Before working on or near the carburetor or choke area, or when checking choke operation, during cranking, always remove spark plug lead to prevent engine from starting accidentally and to avoid personal injury.

Use this service guide to help maintain proper choke function.

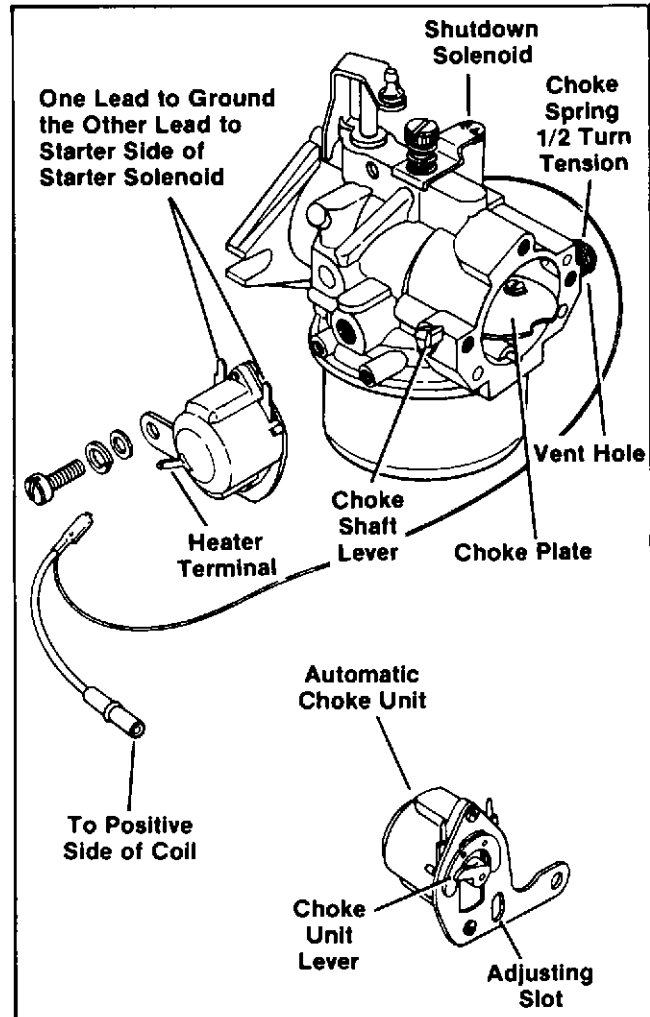


Figure 4-3. Carburetor With Thermo-Electric Automatic Choke and Shutdown Solenoid

Problem	Causes	Solutions
Choke Won't Close When Cranking	<ol style="list-style-type: none"> 1. Faulty lead wires or terminals. 2. Air cleaner gasket interference with choke shaft lever. 3. Open circuit in solenoid winding. 4. Choke lever lacks sufficient travel or smooth movement. 	<ol style="list-style-type: none"> 1. Change lead wires or replace choke. 2. Reposition flat of gasket to provide clearance for choke shaft lever. 3. Check continuity with ohmmeter between the two solenoid terminals. Replace choke unit if open circuit. 4. Manually move choke lever to fully closed. Replace if choke does not move freely.
Choke Will Not Fully Open	<ol style="list-style-type: none"> 1. Choke spring not properly adjusted. 2. Choke shaft fails to move freely. 3. Faulty choke adjustment. 	<ol style="list-style-type: none"> 1. Remove spring and, with choke wide open, wind up spring 1/2 turn. 2. Replace carburetor. 3. Adjust choke.

Choke Unit Replacement and Adjustments (see Figure 4-3).

1. Position the choke unit on the two mounting screws so that it is slightly loose.
2. Hold the choke plate in the wide open position.
3. Rotate the choke unit clockwise on the carburetor (viewed from the choke side) with a slight pressure until it can no longer be rotated. Make sure the choke shaft lever is below the choke unit lever.
4. While holding the choke unit in the above position, tighten the two mounting screws. (NOTE: With engine not running and before any cranking, the choke valve will be closed 5° to 10° at a temperature of about 75°F. As the temperature decreases the choke valve will close even more.)
5. Check choke function by removing the spark plug lead and cranking the engine. The choke valve should close a minimum of 45° at a temperature about 75°F. The valve will close more at lower temperatures.

Engine Shutdown Control - Function

The engine shutdown control is a device which prevents the engine from "running on" after the ignition is turned off. This is accomplished by a solenoid-operated valve which is energized when the ignition is turned on, causing the valve to open. In this open position, normal bowl venting is permitted from the air cleaner to the air space above the fuel in the bowl. When the ignition is turned off the valve closes and normal bowl venting is prohibited and no fuel will flow. The engine shutdown control has only one wire and it is connected to the positive (+) terminal on the ignition coil.

In order to make the control effective, the throttle lever should not be in the OFF or IDLE position when the ignition switch is turned off.

Shut-down Control - Test

Disconnect shut-down control from carburetor body by loosening the main fuel adjusting screw so the bracket that holds the control can be shifted from it. Do not disconnect the lead wire from the ignition coil. Pull the shut-down control (solenoid and plunger) out of the carburetor and ground the case of the solenoid on the carburetor or other convenient engine surface. Hold the plunger approximately 1/4" in front of the solenoid, then turn ignition switch to "ON". Release the plunger. If the plunger is drawn into the solenoid, the shut-down control is functioning properly. The solenoid is faulty and must be replaced if the plunger is not drawn in. Refer to Figure 4-4 for identification of parts.

As a temporary fix, the plunger can be removed from the shut-down control and the solenoid reinstalled (minus plunger), until a replacement solenoid can be obtained. (NOTE: Do not discard plunger, as it must be reused with replacement solenoid.) After replacing solenoid reset main fuel adjusting screw according to specification (see "Carburetor Adjustments" Section 4).

**The removal of the plunger will not affect normal carburetor function; however, it is important to reinstall defective solenoid over shut-down control vent hole, after plunger removal, to prevent unfiltered air from entering the carburetor.*

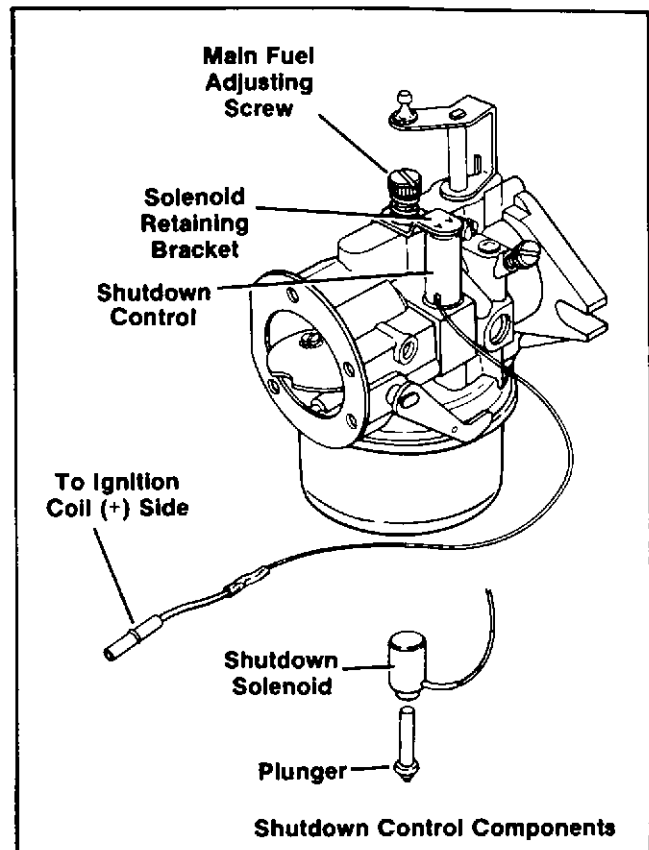


Figure 4-4. Engine Shutdown Control

FUEL PUMP

The K361 has a mounting pad and provision on crankcase for a mechanically operated fuel pump. On some applications with gravity feed systems, the pad is covered and the fuel pump is not used.

Fuel Pump Operation

The mechanical pump operates off a cam on the camshaft. The fuel pump lever rides on the cam and transmits this mechanical action to a diaphragm within the pump body (see Figure 4-5). Some mechanical pumps have an external lever for priming.

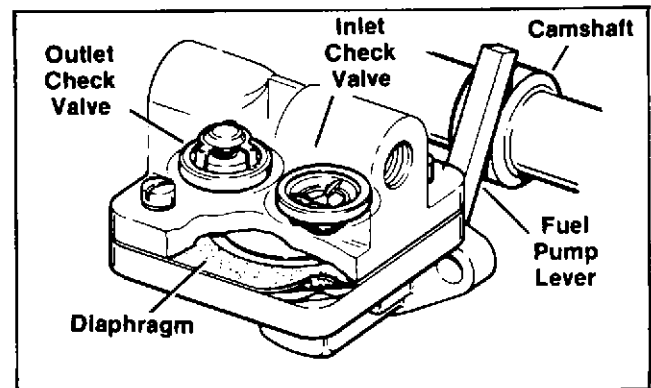


Figure 4-5. Fuel Pump Function

Fuel Pump Check

WARNING: When performing this test be sure to wipe up any spilled fuel and make sure no sources of heat, flame or sparks are near, as these can cause gasoline fumes to explode.

To check the operation of the fuel pump disconnect the spark plug lead. Remove the fuel line at the carburetor and crank the engine. If no fuel comes out of fuel line check the fuel flow into pump. This can be done by removing the fuel line at the inlet side of the fuel pump and holding the line lower than the gas tank. If fuel flows freely from the fuel line the pump is faulty and should be replaced.

The replacement fuel pumps are of a thermoplastic design which effectively insulates and prevents fuel from vaporizing inside the pump. The pumps are interchangeable with the metal pumps and are available in kit form. The kits include the pump, new mounting gasket and two flat washers.

Some important points regarding the non-metallic bodied pumps are as follows:

1. FUEL FITTINGS: Apply small amount of Permatex 300 or Hercules GRIPP sealant on threads, then turn fittings into pump 5 full turns and continue in same direction until required position is attained.
2. Use *only* the gasket provided in the kit. If a thick insulating gasket was used with the metal pump, discard it. It is not only unnecessary, but could cause distortion of the flange while tightening the mounting cap-screws.
3. Make sure the flat washers provided in the kits are installed next to the flange to prevent the lockwasher from damaging the flange. The lockwashers and mounting screws from the old pump can be reused with the new pump, but make sure the screws are tightened to 70 in. lbs. – overtightening can also damage the flange.

GOVERNOR SYSTEM

The K361 engine is equipped with a centrifugal flyweight mechanical governor. The governor gear/flyweight mechanism is mounted within the crankcase and driven off a gear on the camshaft.

Governor Operation

Centrifugal force causes the flyweights to move outward with increase in speed and inward with decreasing speed. As the flyweights move outward, they force the rod portion of the assembly to push outward. Tension of the governor spring pulls the flyweights back inward with decrease in engine speed. The rod, in turn, contacts a tab on the governor cross shaft causing it to rotate with changing speed. One end of the cross shaft protrudes through the side of the crankcase. Through external linkage, the action of the cross shaft is transmitted to the throttle (or butterfly) valve in the carburetor. When the engine is at rest with throttle in "Fast" position, the tension of the governor spring should hold the throttle valve in open position. When a normal load is applied and engine (and governor) speed tends to decrease, the resulting rotation of the cross shaft acts against the governor spring to open the throttle

valve wider which, in turn, admits more fuel and restores engine speed. With governor properly adjusted, this action takes place so rapidly that a reduction in speed is hardly noticed. As speed again reaches governed setting, the shaft rotates to either open or close the throttle valve to maintain speed at a relatively constant level (see Figure 4-6).

Governed speed may be at a fixed point as on constant speed type settings or variable as determined by the throttle lever on variable speed type governor settings.

Adjustments

Governors are adjusted at the factory and further adjustment should not be necessary unless governor arm or linkage works loose and becomes disconnected. Governor re-adjustment may be indicated if engine speed surges or hunts with changing load or if speed drops considerably when *normal* load is applied.

Speed Adjustment

Maximum allowable speed under load for the K361 is 3600 RPM, no load speed is 3800 RPM. Check operating speed with a hand tachometer. Do not exceed this speed. If adjustment is necessary, tighten or loosen the governor speed adjusting screw until proper engine speed is attained (see Figure 4-6).

Sensitivity Adjustment

Governor sensitivity can be adjusted by repositioning the governor spring in the holes on the governor arm and throttle control lever. If set too sensitive, speed surging will occur with change of load. If a big drop in speed occurs when normal load is applied, the governor should be set for greater sensitivity.

Normally, the governor spring is placed in the third hole from the bottom on the governor arm and in the second hole from the top on the throttle control lever. To make governor control more sensitive, increase governor spring tension by moving the spring end upward in governor arm. Conversely, decreasing spring tension by moving the spring end downward in governor arm allows broader governor control, but less sensitivity.

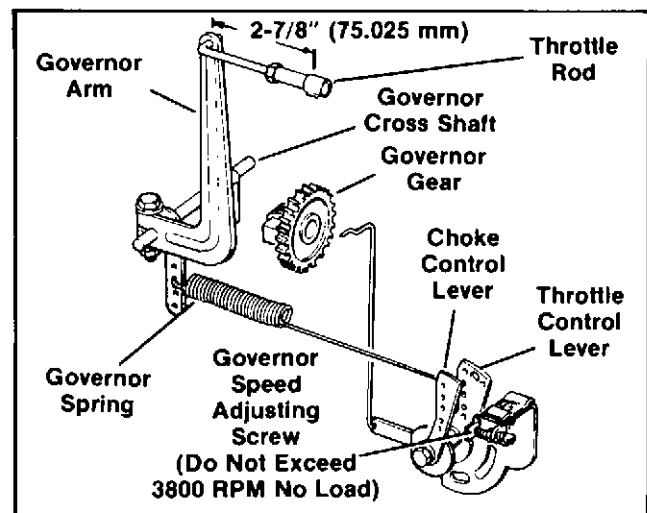


Figure 4-6. Governor Components (Automatic Choke Models Will Not Have Choke Control Lever)

SECTION 5 - ELECTRICAL SYSTEMS

BATTERY IGNITION

The K361 engine uses a battery ignition system. This type of system uses the electrical charge stored in the battery to induce high voltage current in the ignition coil. This high voltage current is conducted to the spark plug where it jumps the gap, producing a spark, which then ignites the air fuel mixture in the cylinder.

The basic components of the battery ignition system are the battery, ignition coil, condenser, breaker points and spark plug (see Figure 5-1).

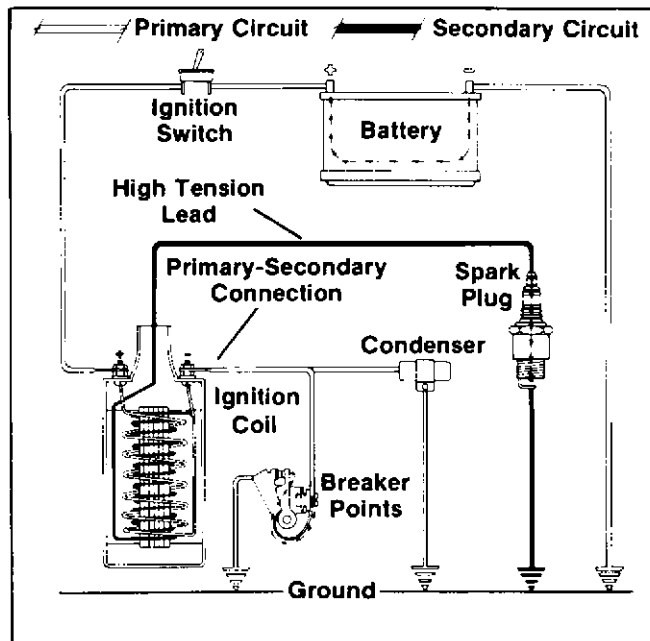


Figure 5-1. Schematic of a Typical Battery Ignition System

Ignition System Service

Several factors contribute to the overall performance of an ignition system - all components must be in good condition and the spark must be properly timed. Hard starting, low power and erratic operation can often be attributed to faulty ignition. If poor ignition is suspected, first, determine if the ignition system is actually at fault. A simple operational test will determine this.

Operational Test

WARNING: Wipe up spilled gasoline and cover containers of flammable liquids. Performing this test near explosive gases could result in bodily injury from explosion.

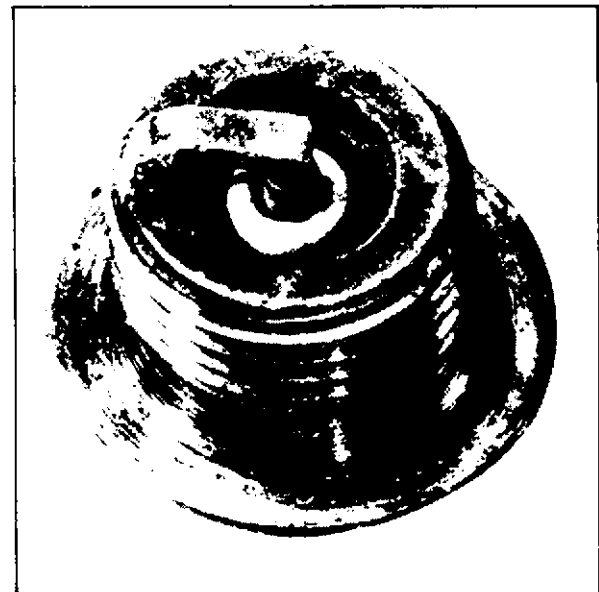
Remove the high tension lead at the spark plug, bend a paper clip and insert into boot, then hold the end about 1/16" to 1/8" away from the cylinder head while cranking the engine. (Make sure engine is cranked fast enough to produce a spark.) If a sharp snappy spark occurs, the trouble apparently is not in the ignition coil, condenser or breaker points, although it could still be attributed to a poor spark

plug. If no spark or a very weak spark occurs, ignition trouble is indicated. When checking out an ignition system, the components most commonly requiring service or adjustment should be checked first.

SPARK PLUGS

Engine misfire or generally poor operation is often caused by spark plugs in poor condition or with improper gap setting. Every 100 hours remove plug, check condition and reset gap to .035". Do not sandblast, wire brush, scrape or otherwise service plug in poor condition - best results are obtained with a new plug. Tighten plug to 18-22 ft. lbs. (2.5-3.1 Kgm).

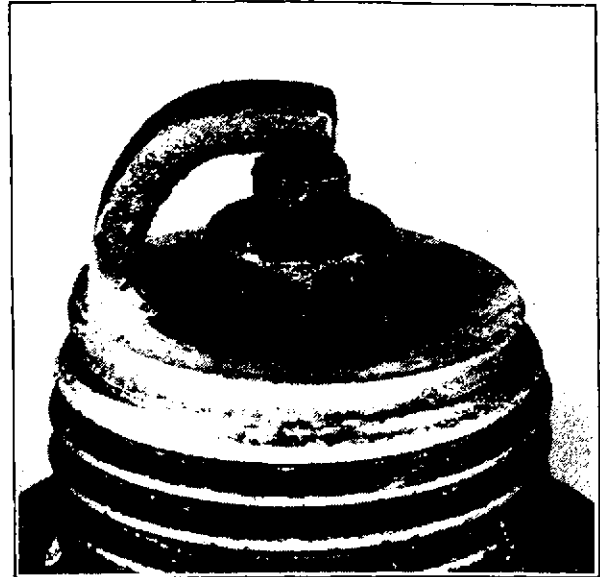
When removing spark plugs, always make an analysis of the firing end as the appearance gives a very good indication of operating conditions. If the firing end has a light coating of gray or tan deposits, this usually indicates good operating conditions. A dead or chalk white, blistered coating may indicate overheating. Black, sooty, carbon deposits on the firing end are caused by incomplete combustion. Incomplete combustion can usually be attributed to an "overrich" condition caused by improper carburetor adjustment. If abnormal conditions are indicated, always check the number of the plug - if may be of the wrong heat range for the engine. If the center electrode is eroded round, don't try to square it with a file for reuse - replace the plug to prevent misfiring, which is commonly encountered when using eroded plugs. Some common firing end indicators are shown in the accompanying illustrations - use these as guides for spark plug analysis.



Normal: A plug from an engine operating under good conditions will have light tan or gray colored deposits. If the center electrode is not rounded off, a plug in this condition could be regapped and reused.



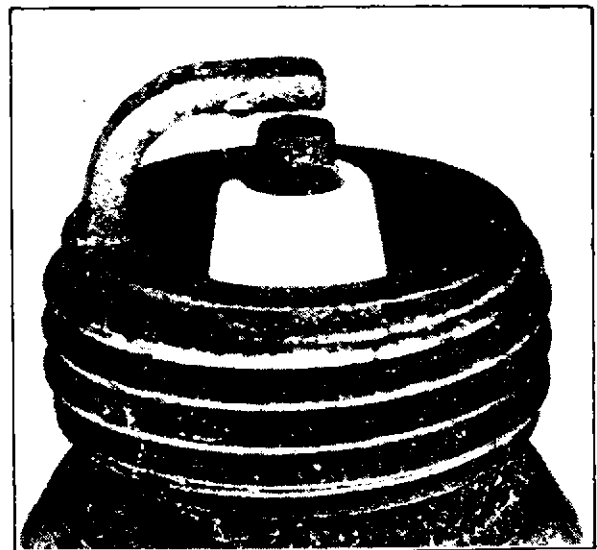
Worn Out: On a plug which has been in service too long, the center electrode will be rounded off and the gap will be eroded .010" or more than the original setting. Replace worn plugs as they will require excessive voltage to fire properly.



Wet Fouled: A wet fouled plug could be caused by drowning with raw fuel or oil in the combustion chamber. The raw fuel problem may be caused by operating with too much choke. Oil in the combustion chamber area is usually caused by worn rings or valve guides.



Carbon Fouled: Soft, sooty black deposits indicate incomplete combustion which could be attributed to rich carburetion, weak ignition, retarded timing or poor compression.



Overheated: Overheating will be indicated by chalk white colored deposits, not burned black as might be expected. This condition is also usually accompanied by excessive gap erosion. Overadvanced timing, lean carburetion, clogged air intake and blocked cooling fins are some of the causes of overheating.

When changing spark plug keep this in mind. (NOTE: Certain federal, state and local laws require the use of resistor or shielded spark plugs. Resistor or shielded plugs lessen interference to radio transmissions, while standard spark plugs do not. Check the laws in your area so you can be sure of using the right plug.)

Use Champion spark plugs RH-10 (resistor), H-10 (standard) or equivalent plug when making replacement.

BREAKER POINTS

Engine operation is greatly affected by breaker point condition and adjustment. If points are burned or badly oxidized, little or no current will pass. As a result, the engine may not operate at all or if it does run, it is likely to miss particularly at full throttle. Adjusting breaker point gap affects the time that the contacts are opened and closed. If points are adjusted to a wider gap, the ignition spark will be advanced and the engine may knock or kick back during starting. If the points are set too close, the ignition spark will be retarded and the engine will lose power.

Breaker points can become dirty or oxidized if the engine is stored for any length of time. Dirty or oxidized points provide poor continuity and should be cleaned with "600" grit sandpaper before start-up.

CONDENSER

If the condenser shorts out, the coil will be unable to produce output voltage. On the other hand, if it opens or decreases in capacitance, the output voltage will be reduced and the ignition points will burn excessively. If badly burned breaker points occur too frequently, the condition of the condenser should be suspected.

If capacitance of condenser is too low, metal will transfer from the stationary contact to the movable contact. If capacitance is too high, the metal will build up on stationary contact (see Figure 5-2).

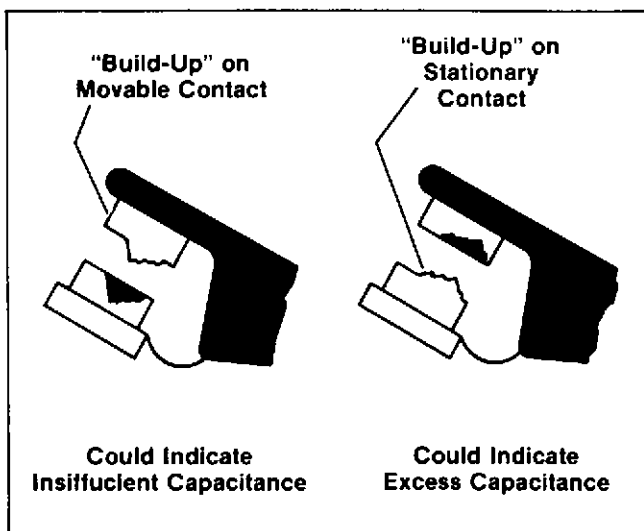


Figure 5-2. Metal Transfer on Points

Condenser Check

The condenser can be tested with an ohmmeter or a commercial condenser tester. To check with the ohmmeter, ground the condenser lead or terminal, then set ohmmeter on the Rx10,000 scale and connect the meter leads between the condenser lead or terminal and a good ground. On a good condenser the indicator on the meter should bounce up into the scale and then quickly fall back to infinity. On a faulty condenser the needle will either not fall back to infinity (indicating a short) or will not move at all when the test is performed (indicating an open circuit). This test is not foolproof as the condenser could be intermittent and actually appear good when it is faulty. When using a commercial condenser tester, follow the instructions provided by the manufacturer.

IGNITION COIL

The ignition coil functions to transform or step up the low voltage primary energy to the high voltage energy necessary to bridge the gap between the center and side electrodes on the spark plug.

There are two terminals provided on the ignition coil and they must be connected correctly for the coil to function properly. The positive (+) terminal must be connected to the positive side of the battery. The breaker points and condenser are connected to the negative (-) terminal.

Ignition Coil Check

(NOTE: Ignition parts should be checked with the engine stopped.) Check the continuity of the primary winding by connecting an ohmmeter between the (+) and (-) terminals of the coil. The reading on the meter when set on the Rx1 scale should be 4-8 ohms (see Figure 5-3).

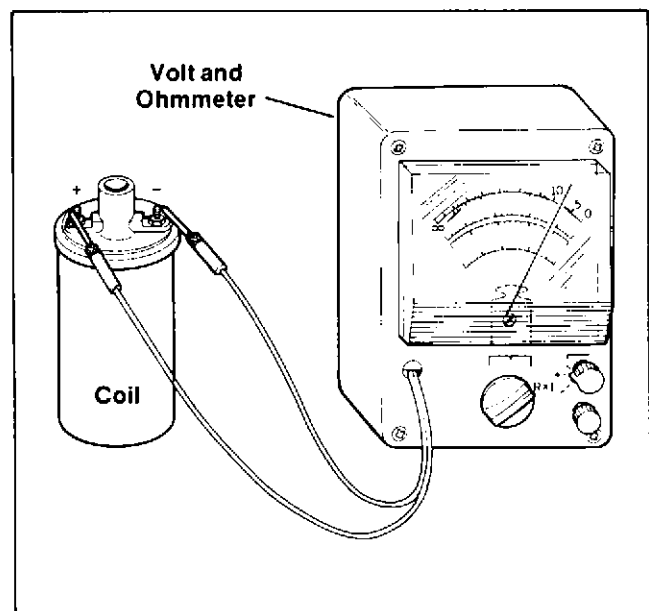


Figure 5-3. Continuity Check in Primary of Coil

To check the secondary resistance, connect one lead to the high tension terminal and the other to the (+) terminal on the ignition coil. The reading here should be in a range between 7,000 and 12,000 ohms on a good coil (see Figure 5-4). If not within $\pm 10\%$ of this, the secondary is faulty and the coil should be replaced. Note that a coil could pass these tests and still be breaking down under operating conditions. This can only be detected by expensive laboratory instruments.

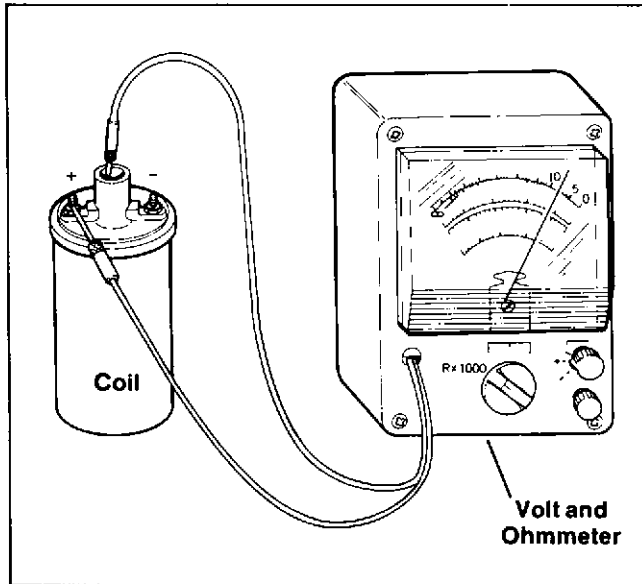


Figure 5-4. Resistance Check in Secondary of Coil

BATTERY

WARNING: Handle a storage battery carefully: it contains corrosive acid that can burn you. Never charge a battery in an enclosed area or cause a spark near battery: it gives off highly explosive hydrogen gas that can hurt you if it explodes. Never leave ignition switch "On" when charging battery: a switch left "On" with the battery connected can cause the ignition coil to overheat and possibly explode.

Use a 12 volt negative ground battery with amp hour rating of 32-45 on the K361 engine. Make sure the battery is maintained at full charge, especially in winter. Keep the engine and battery warm to insure better starts. Warm batteries have greater cranking capacity than cold batteries. When removing the battery from equipment, to avoid causing sparks always disconnect the negative cable first. When replacing battery connect the negative cable last.

Battery Check

Test battery voltage by connecting a DC voltmeter across the battery terminals. Crank the engine - if battery voltage falls below 9 volts while cranking, the battery is run-down or defective (see Figure 5-5).

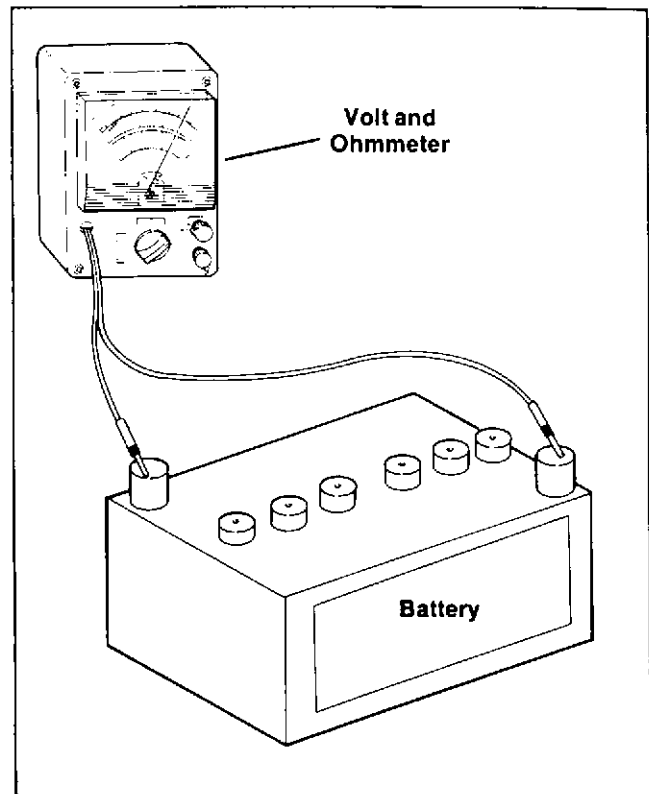


Figure 5-5. Checking Battery Charge

Battery Maintenance

A buildup of corrosive acid across the top of the battery can cause the battery to self-discharge. Even a light coating of this grayish-white substance can complete a circuit to drain and exhaust the energy in the battery - especially bad when moisture is present.

To maintain a battery in top condition, check and perform the following services at frequent intervals:

1. Regularly check level of electrolyte - add water as necessary to maintain level above plates - do not overfill as this can cause poor performance or early failure due to loss of electrolyte.
2. Keep terminals and top of battery clean. Wash with baking soda and rinse with clear water. Do not allow soda solution to enter cells as this will destroy the electrolyte.

IGNITION TIMING

Engines are equipped with a timing sight hole in the blower housing. Two timing marks are stamped on the flywheel - the T mark indicates Top Dead Center (TDC) while the S mark indicates the Spark or Spark Run point which is 20° before top dead center.

Two methods can be used for timing - the timing light method is the more precise way of achieving exact timing.

Method 1 - Static Timing

Disconnect spark plug lead from battery ignition coil to prevent unintentional starting. Remove breaker point cover. Rotate engine by hand in direction of normal rotation (clockwise when viewed from front or flywheel end). Points should just begin to break as the S mark appears in the center of the timing sight hole. (NOTE: To check when points break, connect an ohmmeter or continuity tester across the points.) Continue rotating engine until points reach maximum opening. Measure gap with feeler gauge - gap should be .020" fully open. If necessary, loosen point gap adjustment screw and readjust gap to .020" full open. Maximum gap setting can vary a few thousandths (.017"-.022") to achieve smoothest running. Securely tighten adjusting screw after timing (see Figure 5-6).

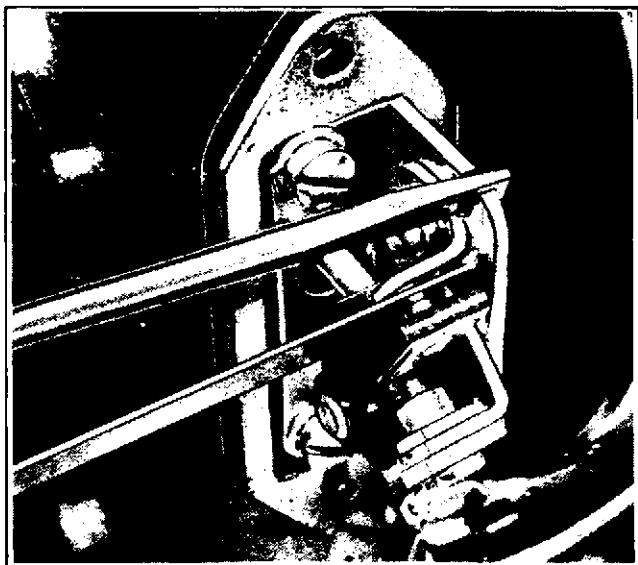


Figure 5-6. Point Gap Adjustment

Method 2 - Timing Light

Several different types of timing lights are available - follow manufacturer's instructions for type used. The following timing procedure can be used with most timing lights:

- Remove high tension lead at spark plug - wrap one end of a short piece of fine wire around spark plug terminal. Reconnect lead to terminal - free end of wire must protrude from under boot. (NOTE: Step A for timing lights with alligator clips - some lights have sharp prongs on spark lead - on these simply push prong through boot until it contacts metal connector.)
- Connect *one* timing light *lead* to the wire that has just been wrapped around spark plug terminal.
- Connect *second* timing light *lead* to hot (ungrounded) side of battery - see timing light instructions for battery size, wiring, etc.
- Connect *third* timing light *lead* to ground.
- Rotate (by hand) engine until S mark visible - chalk S line for easy reading.

- Start engine, run at 1200-1800 RPM, aim timing light into sight hole - light should flash just as S mark is centered in sight hole or even with center mark on bearing plate or blower housing (see Figure 5-7).

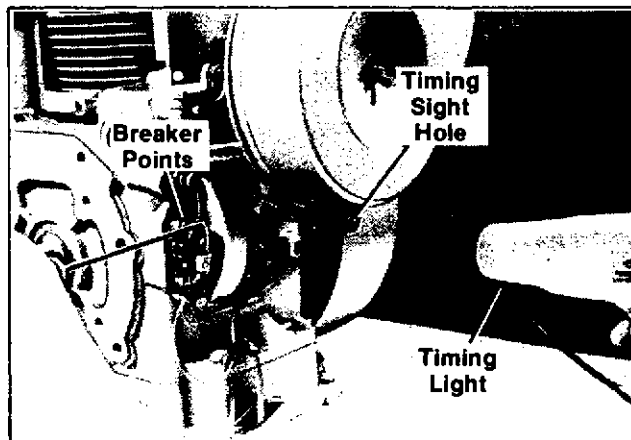


Figure 5-7. Timing Light Method

- If timing is off - remove breaker point cover, loosen gap adjusting screw, shift breaker plate until S mark is exactly centered. Retighten adjusting screw and recheck timing before replacing breaker point cover.

5

ALTERNATOR CHARGING SYSTEMS

3 amp, 3 or 6 amp and 15 amp alternator charging systems are used on the K361 engine. The 15 amp system has a rectifier-regulator mounted on the starter motor side of the blower housing, while the 3 amp and 3 or 6 amp systems do not use a rectifier-regulator. Besides the rectifier-regulator, other components of the three systems differ; therefore, there can be no interchangeability of parts between the systems. No adjustments are possible on these alternator systems and field service on these systems is not recommended. All faulty parts should be replaced. The systems are described separately in the following pages.

3 Amp Alternator Charging System

The 3 amp alternator system consists of three major components: a permanent magnet ring with five or six magnets on the inside rim of the flywheel, an alternator stator assembly which is affixed to the engine bearing plate, and a diode which is located in the charging output lead from the stator. The accompanying test guide can be used to pinpoint any source of trouble.

- CAUTION:
- Battery polarity must be correct. Negative ground systems are used with Kohler Engines.
 - Prevent alternator leads (AC) from touching or shorting. This could permanently damage the stator.

3. Disconnect rectifier-regulator plug before electric welding is done on equipment powered by the engine and in common ground with engine.
4. Do not operate for any length of time without a battery in the system.

3 Amp System Service (See Figure 5-8)

NOTE: Always zero voltmeters and ohmmeters on each scale before testing, or inaccurate readings will result.

Problem - Battery Not Charging

Test 1 - Check battery voltage across the battery terminals using DC voltmeter, with engine running at 3000 RPM. If voltage is 12.5 or less, the stator or diode is defective.

Test 2 - Disconnect battery charging lead from battery, measure DC voltage from charging lead to ground with engine running at 3000 RPM. If voltage is over 45 the stator is OK.

Test 3 - Disconnect battery charge lead from battery, measure resistance of lead to ground. Now reverse the ohmmeter leads and take the resistance reading again. In one instance a reading of infinity ohms (open circuit) should be noted. In the other instance the needle should read about mid-scale with meter set at Rx1. If both resistance readings are low the diode is shorted. If both resistance readings are high, the diode or stator is open.

Test 4 - Cut the sleeving on the battery charge lead to expose the diode connections. Check resistance on the stator side of diode to ground. The reading should be 1 ohm. If the reading is 0 ohms, the winding is shorted. If infinity ohms, the stator winding is open or the lead wire is broken.

Problem - No Lighting

Test 1 - Disconnect lighting lead from wiring harness. Measure open circuit voltage with AC voltmeter from lighting lead to ground with engine running at 3000 RPM. If 15 volts or more the stator is OK, if less than 15 volts wiring may be shorted.

Test 2 - Check resistance of lighting lead to ground. If 0.5 ohms the stator is OK, if 0 ohms the stator is shorted and if infinity ohms the stator is open or the lead is broken.

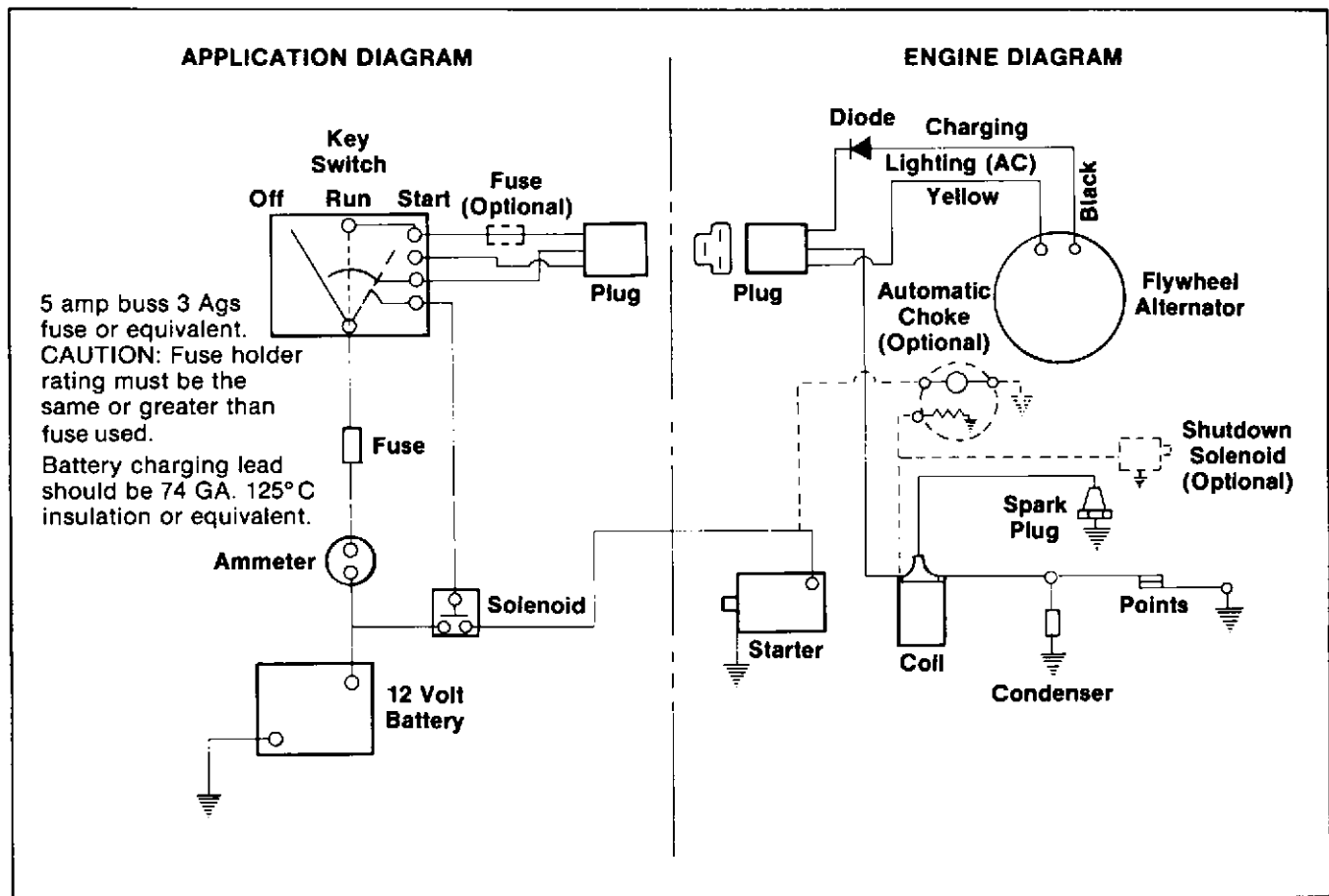


Figure 5-8. 3 Amp System Wiring Diagram

3/6 Amp Alternator Charging System

The 3/6 amp alternator charging system is similar to the 3 amp system. It has three major components: a permanent magnet ring with six magnets on the inside rim of the flywheel, an alternator stator assembly which is affixed to the engine bearing plate and two diodes, one of which is located in the battery charging lead and the other in the auxiliary load lead. Use the test procedure below to check for failed parts.

- CAUTION:**
1. Battery polarity must be correct. Negative ground systems are used with Kohler Engines.
 2. Prevent alternator leads (AC) from touching or shorting. This could permanently damage the stator.
 3. Disconnect plug before electric welding is done on equipment powered by the engine and in common ground with it.
 4. Do not operate for any length of time without a battery in the system.

3/6 Amp System Service (See Figure 5-9)

NOTE: Always zero voltmeters and ohmmeters on each scale before testing, or inaccurate readings will result.

Problem - Battery Not Charging

Test 1 - Check battery voltage across the battery terminals using DC voltmeter, with engine running at 3000 RPM. If voltage is 12.5 or less, the stator or diode is defective.

Test 2 - Disconnect battery charging lead from battery, measure DC voltage from charging lead to ground with engine running at 3000 RPM. If voltage is over 17 the stator is OK.

Test 3 - Disconnect auxiliary load lead from switch, measure DC voltage from auxiliary lead to ground with engine running at 3000 RPM. If voltage is over 17 the stator is OK.

Test 4 - Disconnect battery charge lead from battery and auxiliary load lead from switch, measure resistance of both leads to ground. Now reverse the ohmmeter leads and take the resistance reading again. In one instance a reading of infinity ohms (open circuit) should be noted. In the other instance the needle should read about mid-scale with meter set at Rx1. If both resistance readings are low the diode is shorted. If both resistance readings are high the diode or stator are open.

Test 5 - Cut the sleeving on both the battery charge lead and auxiliary load lead to expose the diode connections. Check resistance on the stator side of diode to ground. The reading should be 0.5 ohms. If the reading is 0 ohms, the winding is shorted. If infinity ohms, the stator winding is open or the lead wire is broken.

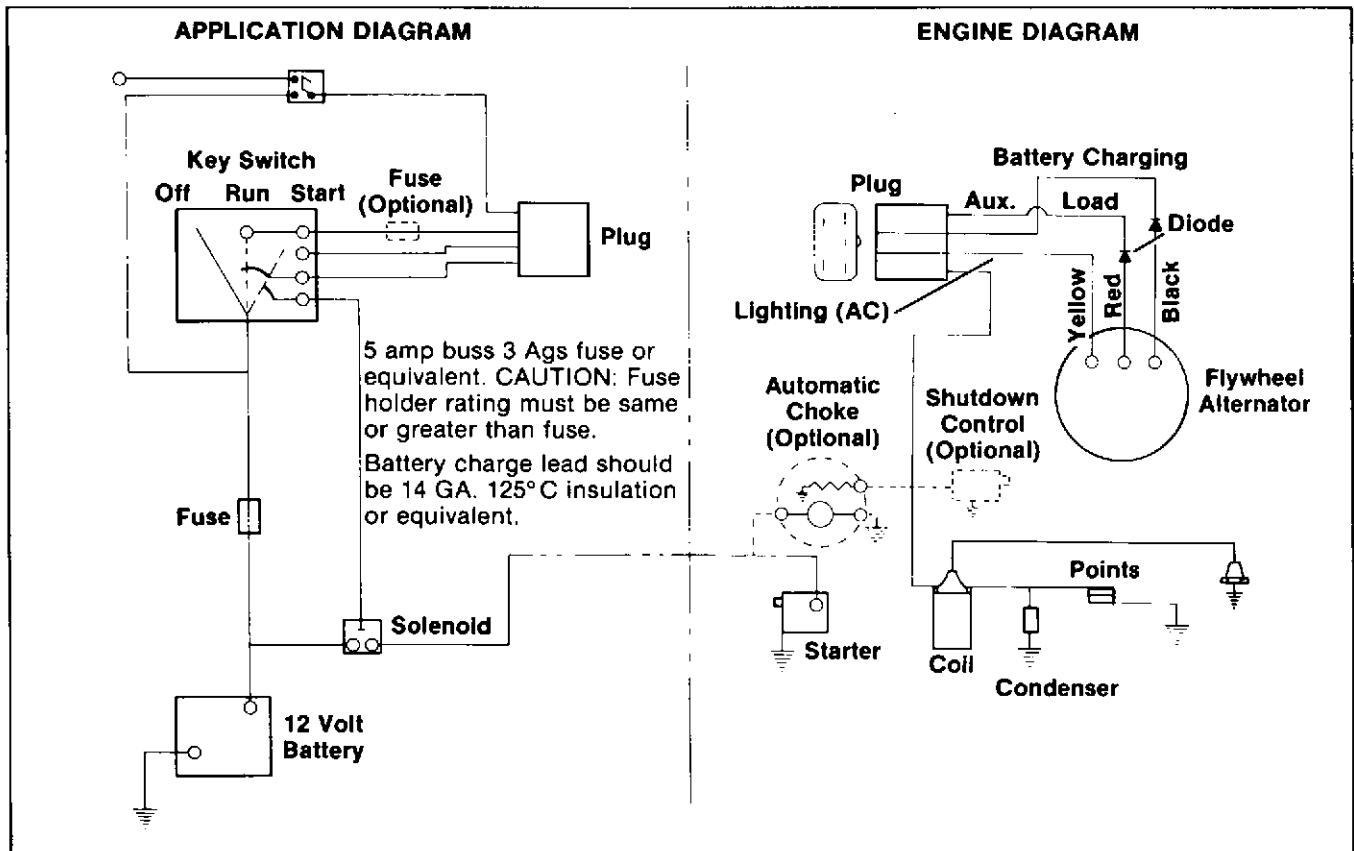


Figure 5-9. 3/6 Amp System Wiring Diagram

Problem - No Lighting

Test 1 - Disconnect lighting lead from wiring harness. Measure open circuit voltage with AC voltmeter from lighting lead to ground with engine running at 3000 RPM. If 22 volts or more the stator is OK, if less than 15 volts wiring may be shorted.

Test 2 - Check resistance of lighting lead to ground. If 0.5 ohms the stator is OK, if 0 ohms the stator is shorted and if infinity ohms the stator is open or the lead is broken.

15 Amp Alternator Charging System

The 15 amp alternator circuit includes three major components which are: a ceramic magnet ring which is permanently affixed to an inner rim of the flywheel, the alternator stator mounted on the bearing plate of the engine and a rectifier-regulator unit which is mounted on the starter motor side of the blower housing. Use the testing procedures below when servicing this system.

CAUTION: 1. Do not attempt to run the engine without an

activated (acid filled) battery in the system, as damage to the rectifier-regulator will result.

2. Make sure battery polarity is correct. Negative ground systems are used.
3. Prevent alternator leads (AC) from touching or shorting. This could permanently damage the stator.
4. Disconnect leads at rectifier-regulator before electric welding is done on equipment in common ground with the engine.

15 Amp System Service (See Figure 5-10)

NOTE: Always zero voltmeters and ohmmeters on each scale before testing or inaccurate readings will result.

Problem - Battery Not Charging

Test 1 - At 3600 RPM no load and with B+ cable connected, check B+ (at terminal on rectifier-regulator) to ground with DC voltmeter. If 13.8 volts or higher, place minimum

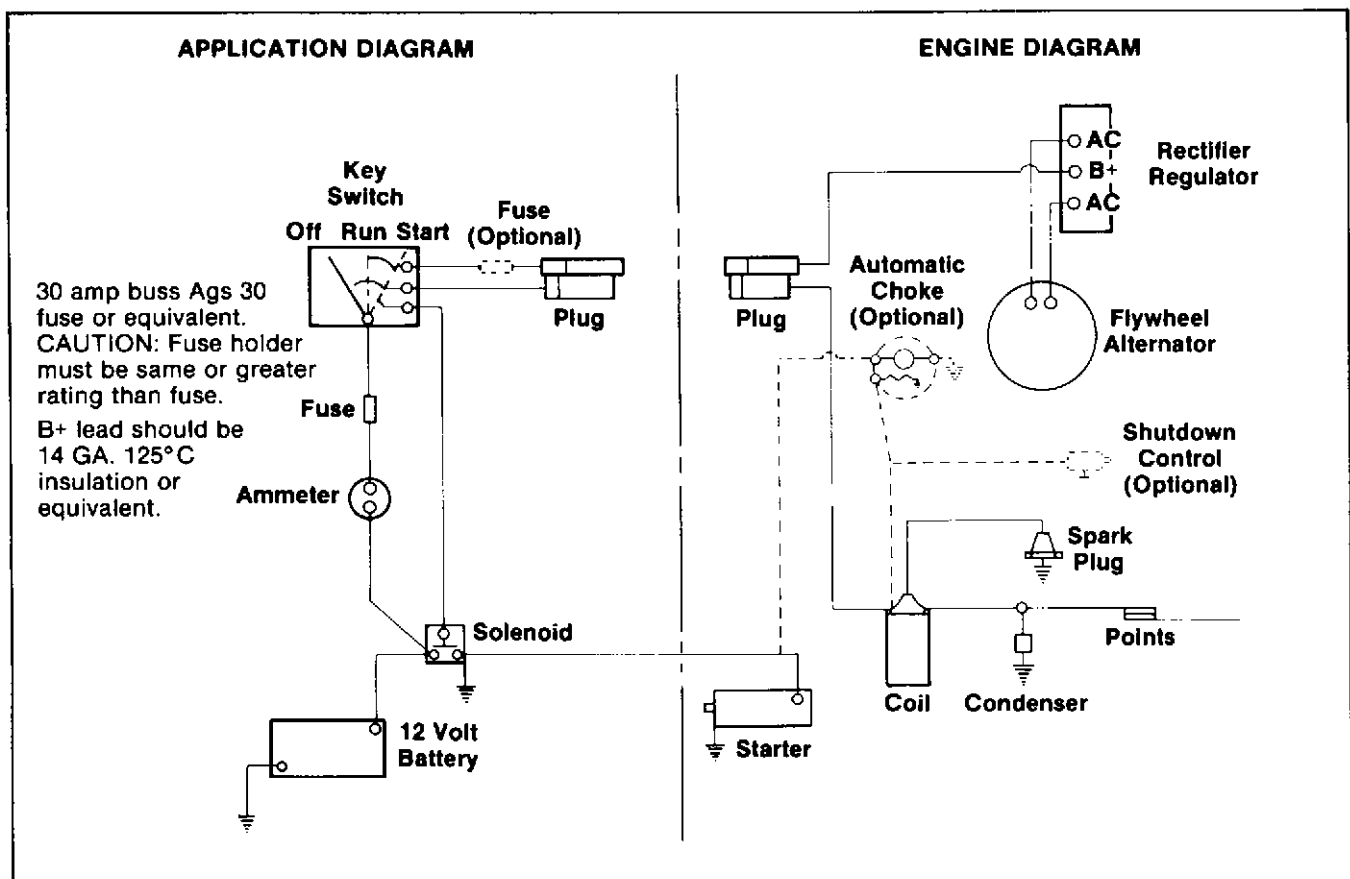


Figure 5-10. 15 Amp System Wiring Diagram

load of 5 amps* on battery to reduce voltage. If the charge rate increases, the alternator is OK and battery was fully charged. If charge rate does not increase, check for defective stator or rectifier-regulator (Test 2).

*Turn lights on if 60 watts or more or simulate load by placing a 2.5 ohm 100 watt resistor across battery terminals.

Test 2 - At 3600 RPM no load unplug both AC leads at rectifier-regulator, connect AC voltmeter across leads, check AC voltage. If voltage less than 28, the stator is defective. If voltage more than 28, the rectifier-regulator is defective.

Problem - Battery Continuously Charging at High Rate

Test 1 - At 3600 RPM no load check B+ to ground with DC voltmeter. If less than 14.7 volts, the alternator is OK, but battery unable to hold charge - check specific gravity of battery. If more than 14.7 volts, the rectifier-regulator is not functioning properly.

STARTING MOTOR

A permanent magnet starting motor is used on the K361 engine. The magnets are of ceramic construction and can be damaged quite easily if the starting motor is dropped or struck sharply.

Starting Motor Operation

When the starting circuit is closed and the armature starts to rotate, the drive pinion moves laterally on a splined sleeve into mesh with the flywheel ring gear. When the pinion butts against a stop washer at the end of the armature shaft, the pinion rotates along with the armature to crank the engine. The armature and pinion remain in positive engagement until the engine fires and attains the speed where the flywheel begins overriding the armature. At this instant, the greater momentum of the flywheel throws the pinion out of mesh and back into the retracted or disengaged position. After the starting circuit is opened and as the armature coasts to a stop, a small anti-drift spring holds the pinion in the retracted position (see Figure 5-11).

CAUTION: In the event of "false start"; that is, if the engine gets up sufficient speed to disengage the starter, but fails to continue running, the engine must be allowed to come to a complete halt before a restart attempt is made. If the flywheel is still rotating when the starter is engaged, the pinion and ring gears may clash.

DO NOT attempt to crank the engine continuously more than 10 seconds at a time.

If starter motor will not turn over the engine, shut off starter motor immediately and make no further attempt to start engine until the condition is corrected.

Always allow a starter motor cool-down period between cranking attempts, if the engine does not start. A 60-second cool-down period is required after a 10-second cranking period. Failure to follow these guidelines may result in burn-out of the starter motor.

If the starter motor fails to start as the result of a low charged battery, recharge the battery.

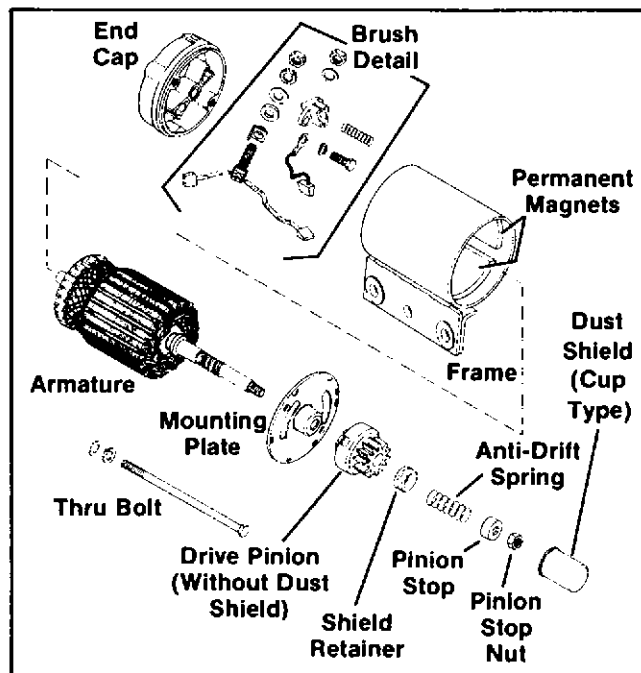


Figure 5-11. Exploded View of Typical PM Starter

Jumping the battery is not recommended, however, if a charger is not available jumping can be done, provided the battery used does not exceed the recommended amp hour rating for the engine. Recommended amp hour ratings for this engine are 32 through 45. (NOTE: If higher amp hour rated battery is used, the higher amperage could damage the armature windings in the starter motor.)

Make sure the special shouldered capscrews (and lockwashers) are used. In addition to securing the starter to the machined surface on the crankcase, these special capscrews properly align the pinion to the ring gear on the engine. Use of ordinary capscrews will allow the starter to shift which could result in clashing of the gears.

DRIVE ASSEMBLY

If pinion is badly worn or has broken teeth, replace drive as a unit (see Figure 5-11). To do this, hold armature shaft and remove dust shield, stop nut, spacer, anti-drift spring, and shield retainer, then slip drive unit off over spline and armature shaft. Leave new drive unit off if further disassembly of starter is required - drive unit is the last part to be reinstalled. Before reinstalling the drive unit, thoroughly clean the drive shaft and pinion gear, then apply a small amount of Lubriplate AERO grease to the shaft. To reinstall the drive unit, slip the pinion gear onto the armature shaft then replace the shield retainer, anti-drift spring, pinion stop, stop nut (coat threads with Loctite retaining compound and tighten to 160 in. lbs. torque), and finally snap on the dust shield.

RING GEAR

If inspection of the ring gear reveals broken, excessively worn or otherwise damaged teeth, the flywheel must be replaced.

Starter Motor Service

Problems that can occur during normal usage are listed in the accompanying chart. The symptom, possible cause and the suggested remedy are stated. If these steps do not solve the problem the starting motor should be replaced. Replacement of the end cap assembly, which includes the negative brush and spring, is the only recommended field service that requires partial disassembly of the motor.

Problem - Starter Fails to Energize

Possible Fault and Correction - Wiring: check for badly corroded or loose connections, also broken or frayed insulation. Clean and tighten connections, replace wires in poor condition.

Possible Fault and Correction - Starting Switch or Solenoid: bypass the switch or solenoid with jumper wire - if starter cranks normally, replace defective part.

Possible Fault and Correction - Battery: check specific gravity of battery - if low, recharge or replace battery as necessary.

Problem - Starter Energizes but Turns Slowly

Possible Fault and Correction - Battery: check specific gravity of battery - if low, recharge or replace battery as necessary.

Possible Fault and Correction - Brushes: remove end cap, check for excessively worn or dirty brushes and commutator. Use a coarse cloth (not emery cloth) to clean. Replace brushes if excessively or unevenly worn (see brush replacement procedure).

BRUSH REPLACEMENT

The starter must be completely disassembled to service brushes and commutator; however, disassembly can be done quickly and easily (see Figure 5-11). Proceed as follows:

1. Remove drive pinion unit.
2. Remove thru bolts.

3. Remove end bracket capscrew from end cap, then turn bracket so that it will not interfere with removal of mounting bracket.
4. Slip mounting bracket and frame off over drive end of armature.
5. Separate end cap from armature - NOTE: Brush springs will probably fall out when brushes pull free of commutator.
6. Clean up commutator with a coarse, lint-free cloth - if badly worn or grooved, turn down on lathe.
7. Replace brushes as follows: The input brushes are part of the terminal stud assembly. To replace, remove nuts, and pull stud out through inside of end cap. Insert new stud terminal-brush unit after transferring insulation bushing from old unit. To replace insulated brushes, simply remove capscrew and lockwasher. Always use new brushes and springs. Assemble brushes with chamfered side away from springs. Keep brush leads away from contact with metal of end cap.
8. To keep brushes in position so that they will fit over the commutator as the end cap is reinstalled, use a brush holder tool as shown, which can easily be cut out of thin sheet metal (see Figure 5-12).

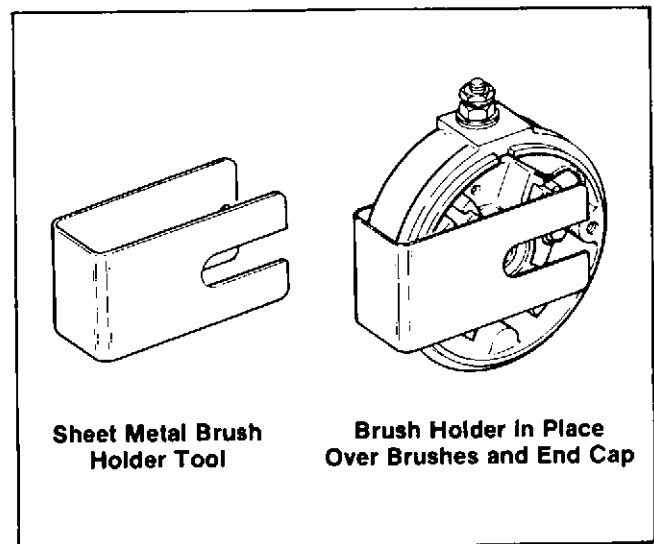


Figure 5-12. Brush Holder Tool

SECTION 6 - AUTOMATIC COMPRESSION RELEASE (ACR)

ACR OPERATION

ACR is the trademark for the Automatic Compression Release mechanism patented by Kohler Co. The Model K361 is equipped with ACR. The ACR mechanism functions to release compression at low cranking speeds to alleviate the amount of energy necessary to start an engine.

The ACR is comprised of a centrifugal flyweight mechanism which is attached to the gear hub of the engine camshaft. The ACR mechanism is shown in the starting and running positions in Figure 6-1. The flyweights are spring-held in the inner position while the engine is at low cranking speeds. In this position, the tab on the larger flyweight protrudes above the profile of the exhaust cam and thus lifts the exhaust valve off its seat during the first part of compression stroke. The compression pressures thus released result in an effective ratio of about 2 to 1 during cranking.

After the engine speed increases to about 500 RPM, centrifugal force moves the flyweights to the outer position dropping the tab into the recess in the exhaust cam. In the retracted position, the tab is below the surface of the cam and has no effect on the exhaust valve which allows the engine to operate at full compression with no loss of power. When the engine stops, the spring returns the flyweights into the retracted position ready for the next start.

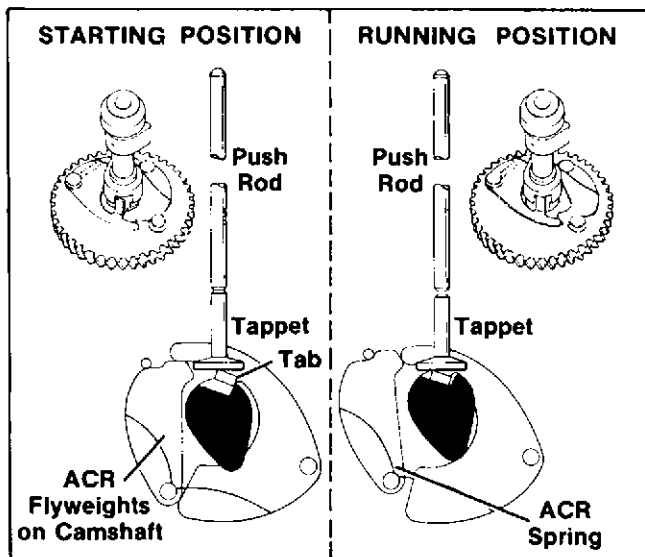


Figure 6-1. ACR Operation

Benefits

In addition to lowering the cranking effort, ACR eliminates the need for a spark retard mechanism. Spark retard is necessary on engines without ACR to prevent "kickback" - since ACR releases compression, kickback cannot occur. To the engine operator, the ACR mechanism offers less critical choking - in the event of flooding, excess fuel is blown out through the lifted exhaust valve and does not hamper starting. Faster starting is also achieved in cold weather on ACR engines. Tests also revealed that ACR engines can be started on spark plugs in very bad condition,

whereas engines without ACR could not be started with these same plugs.

Service

Extensive testing and consequent use of ACR has proved that the mechanism is extremely rugged and is virtually trouble-free. On rare occasions, the ACR spring has become unhooked which usually results in starting at full compression. To service the spring, remove the cam cover and rehook or replace. The flyweights are non-serviceable - if they become permanently stuck or excessively worn, a new camshaft is required.

ACR Check (See Figure 6-2)

The ACR is checked by measuring the amount of push rod lift on the exhaust push rod. The correct amount of lift is established by the height of the lifting tab in relation to the camshaft. If improper lift is suspected, the setting can be checked as follows:

- Step 1: Remove the rocker arm housing cover and spark plug.
- Step 2: Turn the engine over by hand until you reach bottom dead center of the intake stroke (intake valve will be closing).
- Step 3: Mount a dial indicator on the top of the exhaust clearance adjusting screw on the exhaust valve rocker arm.
- Step 4: Position the exhaust rocker arm so the clearance adjusting screw is in direct contact with the exhaust push rod and zero the dial indicator.
- Step 5: Slowly turn the flywheel clockwise and watch the dial indicator. The push rod lift should be .051-.059.

If the ACR lift does not fall within the specified range, replace the camshaft. The ACR tab is through hardened and cannot be adjusted.

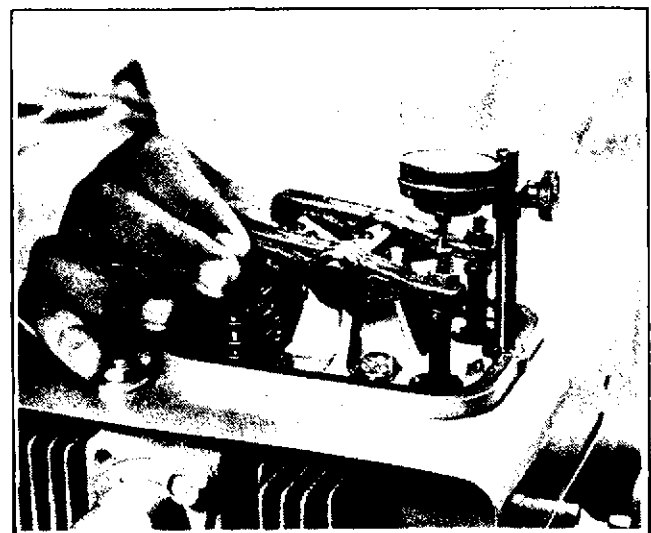


Figure 6-2. Checking ACR Function

SECTION 7 – DISASSEMBLY, INSPECTION, OVERHAUL

WORK AREA

Before starting disassembly of an engine, make sure work area is in clean, neat condition and that adequate tools are on hand. Good lighting is also essential for proper inspection and reconditioning. Observe all rules of safety when working on an engine. Make sure cleaning solvents and other flammable liquids are properly identified and stored in covered containers safely away from danger of combustion from open flames, sparks, etc. The best protection against accidents in all situations is provided mainly through the use of good common sense.

INSPECTION – GENERAL

When disassembling an engine, carefully inspect and note the physical appearance of each of the components. Often the appearance of parts will indicate operation under other than ideal conditions. In observing these indicators, you may be able to suggest improved service and operating techniques which will result in prolonged engine service life. Some of the things to look for are:

1. Excessive sludge and varnish formation.
2. Scoring of the cylinder walls.
3. Severe piston damage.
4. Evidence of external oil leakage.

These are just a few of the more common indicators. Numerous others exist and are obvious to the experienced mechanic. Often the cause will become apparent in view of the particular condition of the part. Always look for these signs when disassembling an engine prior to reconditioning.

Excessive sludge: This is a natural by-product of combustion and a small accumulation is normal. Excessive sludge formation could indicate several things. The most common cause is perhaps too infrequent oil changes. It can also indicate operation with improper ignition timing or overrich carburetor adjustment.

Scoring of the cylinder wall: Unburned fuel not only adds to sludge formation but can, in severe cases, cause scuffing and scoring of the cylinder walls. As raw fuel seeps down the cylinder walls, it washes the necessary lubricating oils off the piston and cylinder walls so that the piston rings make metal to metal contact with the walls. Scoring of the cylinder walls can also be caused by localized hot spots resulting from blocked cooling fins or from inadequate or contaminated lubrication.

Severe piston damage: Major damage to pistons and rings can take various forms. The top of the piston ring may be burned through or the top groove may be excessively worn and the ring broken or stuck in the groove. This can be attributed to abnormal combustion. If ignition timing is overadvanced, ignition will occur while the piston still has a long distance to travel on its compression stroke. As a result, the combined heat of compression plus the heat of preignited fuel raises temperatures to values comparable to that of an acetylene torch. This, of course, acts mainly on the top land and top ring of the piston and results in early failure.

Evidence of external oil leakage: If excessive oil leakage is evident, this may indicate improperly serviced breather systems. Normally, an engine operates internally at pres-

ures less than atmospheric or, in other words, with a negative crankcase pressure. If positive pressures build up within the crankcase from a clogged breather or from piston blowby, oil will be forced out of an engine at oil seals, gaskets or any other available spot.

DISASSEMBLY

Prior to disassembly, remove drain plugs and allow ample time for complete drainage of fuel and lubricating oil. It is good practice to do this outside or at a location away from the work bench to keep this area in clean condition. If engine is dirty externally, it should be steam cleaned or thoroughly cleaned in some other manner before being moved to the work bench. Keep the work area in cleanest possible condition at all times.

After disassembly, all parts should be thoroughly cleaned – dirty parts cannot be accurately gauged or inspected properly for wear or damage. There are many commercially available cleaners that quickly remove grase, oil and grime accumulation from engine parts. If such a cleaner is used, make sure that all trace of the cleaner is removed before the engine is reassembled and placed in operation. Even small amounts of these cleaners quickly break down the lubricating properties of engine oils.

CAUTION: To prevent unintentional starting, disconnect battery and/or spark plug leads before doing any work on engine or equipment driven by engine.

The following sequence is suggested for complete disassembly of the engine.

EXTERIOR COMPONENTS

Follow the steps below when removing external components. Refer to the appropriate sections in this manual when servicing these parts.

1. Disconnect spark plug lead, then remove cylinder baffle and coil assembly.
2. Remove head baffle, air cleaner and carburetor assemblies and side air baffle.
3. Remove the blower housing and flywheel. Use a strap wrench to hold the flywheel when loosening the flywheel nut. Use a flywheel puller to extract the flywheel from the crankshaft (see Figure 7-1).

WARNING: *Improper procedures for removal of the flywheel can lead to a cracked flywheel and broken crankshafts. This not only results in extensive engine damage, but presents a serious threat to the safety of persons close to the engine.*

When removing the flywheel:

DO NOT strike end of the crankshaft to remove the flywheel as this practice can seriously weaken the threaded end of the shaft. When thus weakened, the end of the shaft along with the retaining nut could later break off while the engine is running allowing the flywheel to come off the shaft.

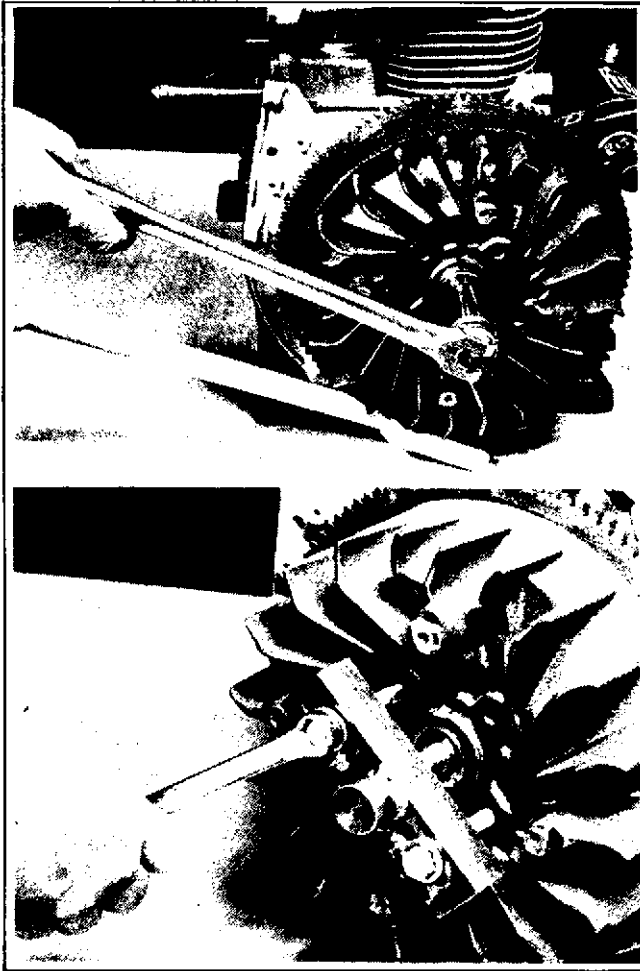


Figure 7-1. Removing the Flywheel

DO NOT use any type of bar between the flywheel fins when loosening the flywheel screw. This practice can crack flywheel fins which may fly off when the engine is running.

4. Disconnect the starter motor from the crankcase.
5. Exterior component removal is almost complete except for the dipstick and oil fill tube, breaker point assembly and fuel pump. Remove these components.

CYLINDER HEAD, ROCKER ARMS AND PUSH RODS

1. Remove the rocker arm housing cover and rocker arm housing.
2. The rocker arm assembly can be further dismantled in case of rocker arm breakage. Remove the retaining rings that secure the rocker arm to the shaft and slide the arm off the shaft.
3. Pull the push rods and tubes out of their sockets in the crankcase. There should be an O-ring at the top and bottom of each tube. Examine each ring for signs of de-

terioration and replace if necessary when reassembling.

4. Loosen the cylinder head bolts and remove the cylinder head.

VALVE ASSEMBLY

The valves on the K361 are located in the cylinder head. They can be removed by using a valve spring compressor. Compress the valve spring until the valve keepers can be removed, then release the compressor and remove the valve, retainers and spring (see Figure 7-2).

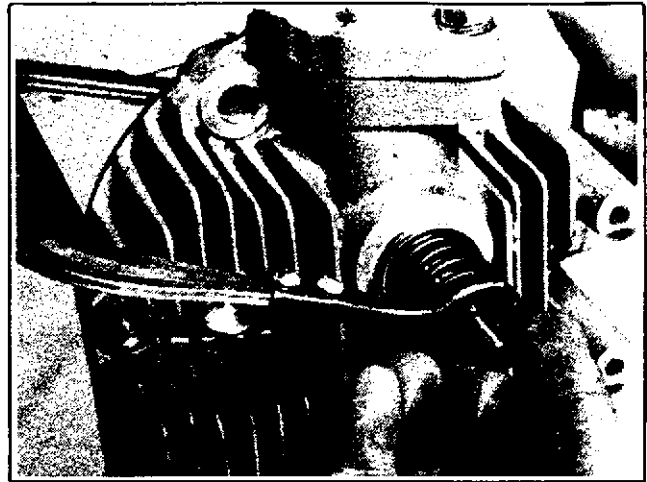


Figure 7-2. Disassembly of Valve Components

Inspection and Service - Cylinder Head

Blocked cooling fins often cause localized "hot spots" which can result in "blown" cylinder head gaskets. If gasket fails in area surrounding one of the retaining cap-screws, high temperature gases can burn away portions of aluminum alloy head. If no evidence of this is found, head should be checked for flatness. Carefully clean carbon deposits from cylinder head if it is to be reused. Use a block of wood to scrape deposits (see Figure 7-3). Be careful not to nick or scratch aluminum, especially in gasket seat area.



Figure 7-3. Cleaning Cylinder Head

Cylinder head flatness can be checked with a surface plate and a feeler gauge. If a surface plate is not handy, a piece of plate glass may be substituted. Cylinder head flatness should not vary more than .003 in. If it does, replace the cylinder head and screws (see Figure 7-4).

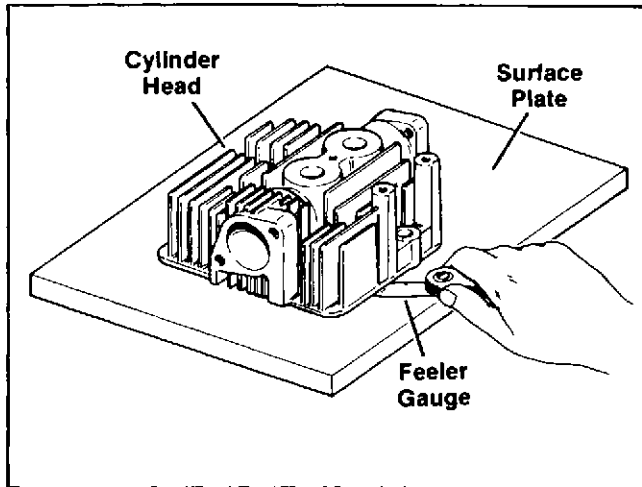


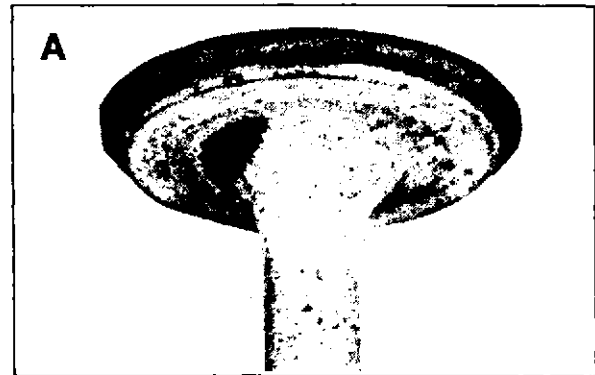
Figure 7-4. Checking Cylinder Head Flatness

It is also important to replace the head bolts, for if they were exposed to high temperature gas, they will become ductile and stretch when torque is applied.

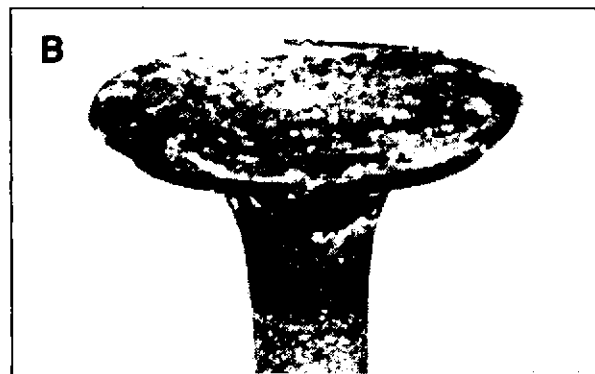
Inspection and Service - Valves

Carefully inspect valve mechanism parts. Check valves and valve seat area or inserts for evidence of deep pitting, cracks or distortion. Check clearance of valve stems in guides (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9).

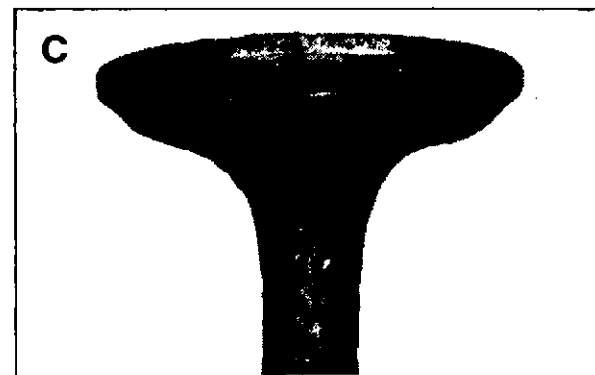
Hard starting, or loss of power accompanied by high fuel consumption may be symptoms of faulty valves - these symptoms could also be attributed to worn rings. Remove and check valves first. After removal, clean valve head, face and stem with power wire brush then carefully inspect for defects such as warped head, excessive corrosion, worn stem ends. Replace valves found to be in bad condition. Some of the conditions that may be found are depicted in the accompanying valve diagrams - an explanation of each condition follows (see Figure 7-5 for valve details).



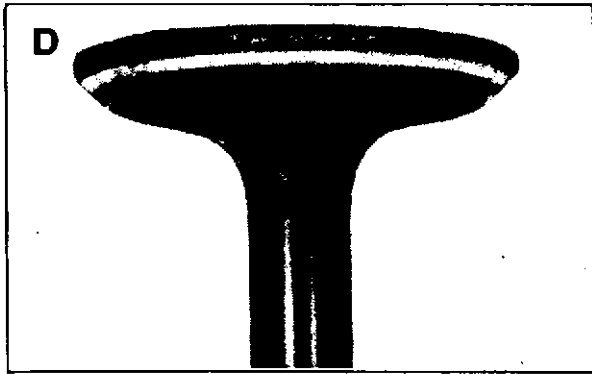
Normal: Even after long hours of operation, a valve can be reconditioned and reused if the face and margin are in good shape as shown in View A. If a valve is worn to where the margin is less than 1/32" do not reuse it. The valve shown was in operation for almost 1000 hours under controlled test conditions.



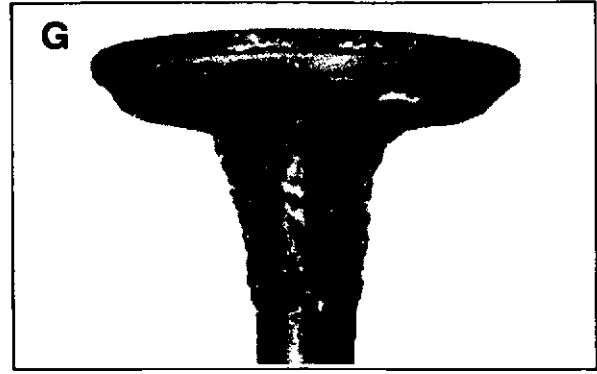
Bad Condition: The valve depicted in View B should be replaced. Note the warped head; margin damaged and too narrow. These conditions could be attributed to excessive hours or a combination of poor operating conditions.



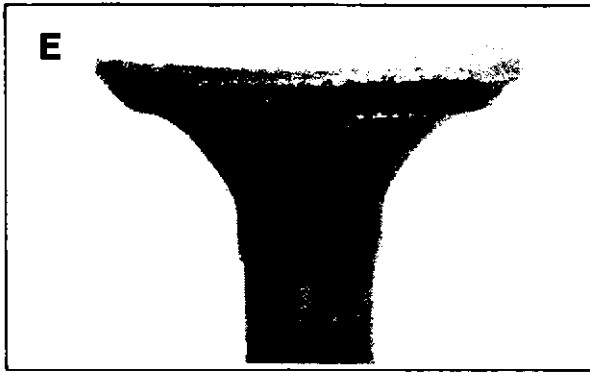
Stem Corrosion: Moisture in fuel or from condensation are the most common causes of valve stem corrosion as shown in View C. Condensation occurs from improper preservation during storage and when the engine is repeatedly stopped before it has a chance to reach normal operating temperatures. Replace corroded valves.



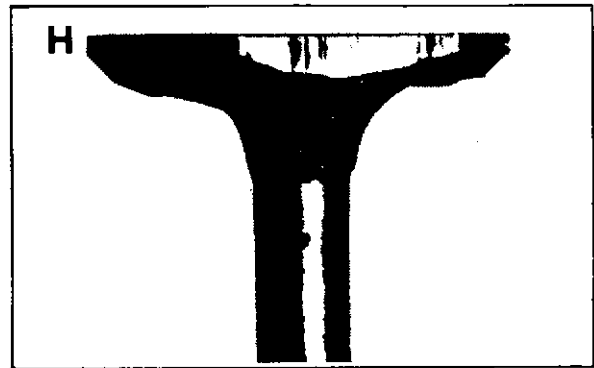
Overheating: An exhaust valve subject to overheating will have dark discoloration in area above valve guide. Worn guides and faulty valve springs may cause this condition. Also check for clogged air intake, blocked fins, and lean fuel mixture when this valve condition is noted.



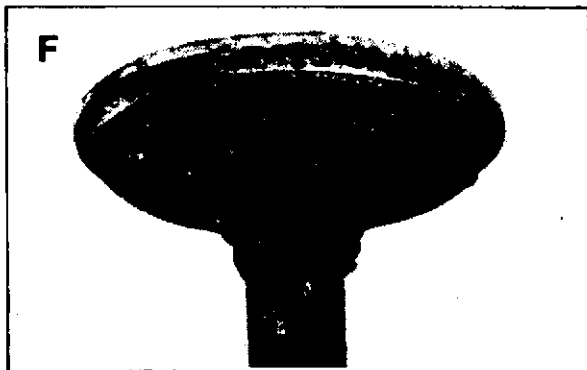
Gum: Gum deposits usually result from using stale gasoline. This condition is often noted in applications where fuel is not drained out of tank during the off season. Also check carburetor if gummy substance is found on the valve stem. Gum is a prevalent cause of valve sticking. The cure is to ream the valve guides and clean or replace the valves, depending on their condition.



Leakage: Here is another example of a burned valve. In this case, however, it is only burned on one side. This type of problem can result from a poor grind on face or seat allowing leakage.



Carbon Cut: Excessive build-up of carbon in the combustion chamber may result in valve damage as shown in View H. Carbon can become hard enough to cut the valve. Cleaning of the cylinder head at proper intervals could prevent such damage.



Coking: Coking, as shown in View F, is normal on intake valves and is not harmful. If the seat is good, this valve could be reused after cleaning.

VALVE GUIDES

If valve guides become sufficiently worn to allow the valve stem to guide clearance to exceed the limits stated in "Specifications, Wear Tolerances, Torques and Special Tools" Section 9, the cylinder head must be replaced.

Valve guides may be cleaned using a valve guide reamer, so long as the specified tolerance for inside diameter is maintained (see Figure 7-5). Make sure valve guide is cleaned thoroughly after reaming.

VALVE SEATS

The valve seats in the K361 engine are hardened steel inserts that are permanently cast into the head. If the valve seats become worn or damaged the entire cylinder head must be replaced.

Seating surfaces should be held between .037" and .045" width. Seats with more than .045" must be reconditioned with a 45° cutter and overcutting or undercutting with 30° and 60° cutters to obtain the proper seat width is recommended (see Figure 7-5 for valve seat details).

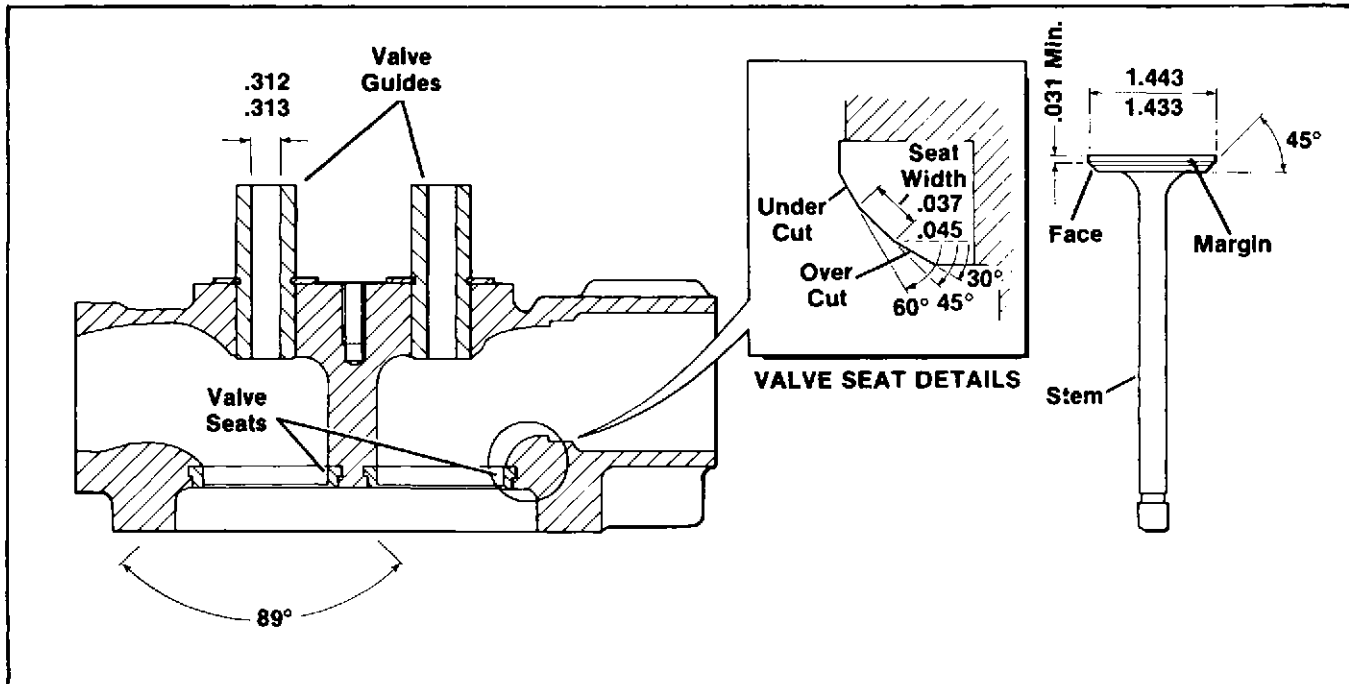


Figure 7-5. Valve Details

Reground or new valves must be lapped in to provide proper fit. Use a hand valve grinder with suction cup for final lapping. Lightly coat valve face with "fine" grade of grinding compound, then rotate valve on seat with grinder. Continue grinding until smooth surface is obtained on seat and on valve face (see Figure 7-6).

IMPORTANT: Always readjust valve tappet clearance after resurfacing valves and seats.

VALVE SPRINGS

Intake and exhaust springs on the K361 are identical. Both springs are progressively wound, that is, coils are tighter on one side than the other. Both springs have a free length of 1.965". Valve springs seldom wear out and if they do, they will usually break. Broken springs should be replaced.

BEARING PLATE, CAM COVER AND OIL PAN

1. Remove the stator from the bearing plate and then remove the bearing plate. The bearing plate must be re-

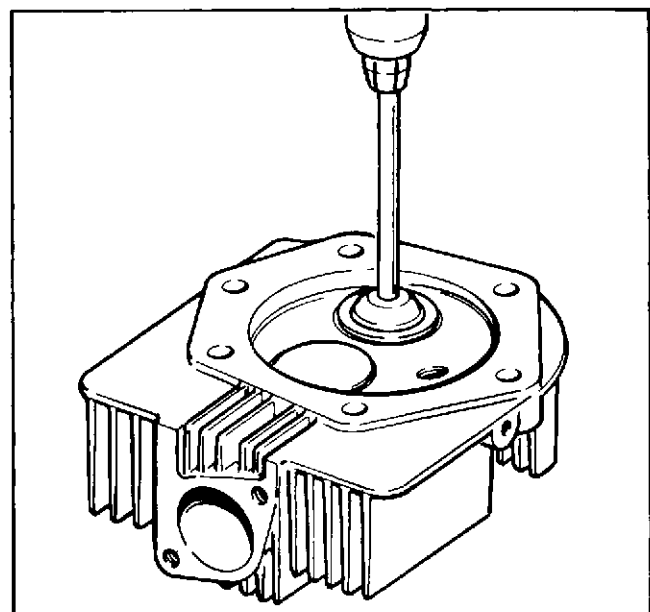


Figure 7-6. Lapping Valves

moved evenly to avoid distorting the plate. This can best be accomplished by using a bearing plate removal tool or puller.

2. The cam cover should now be unscrewed and the block turned over to rest on its barrel. Loosen the oil pan screws and lift the pan off the block. (NOTE: When turning block over onto barrel be sure not to damage cylinder head gasket seating surface.)

CONNECTING ROD AND PISTON ASSEMBLY

1. Before removing the piston assembly the ridge formed at the top of the piston travel zone must be removed. Use a ridge reamer to remove this ridge. (NOTE: Removal of piston assembly before ridge is removed could cause piston land damage.)
2. Remove the connecting rod screws and cap. Lay the engine on its side. With the butt end of a wooden or plastic handled hammer push on the connecting rod until the piston and rod are clear of the cylinder barrel (see Figure 7-7).
3. To disconnect the connecting rod from the piston, remove the piston pin retainers and drive the pin free with a brass drift.

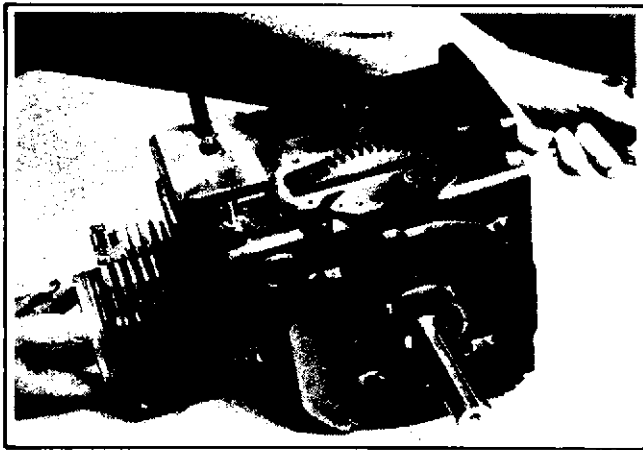


Figure 7-7. Connecting Rod and Piston Removal

Inspection - Pistons and Rings

Scuffing and scoring of pistons and cylinder walls occurs when internal temperatures approach the melting point of the piston. Temperatures high enough to do this are created either by friction, which is usually attributed to improper lubrication, and/or overheating of the engine itself, due to improper cooling.

Normally, very little wear takes place in the piston boss pin area. If the original piston and connecting rod can be reused after new rings are installed, the original pin can also be reused but new piston pin retainers are required. Piston pins are included as part of the piston assemblies - if the pin boss in piston or pin are worn or damaged, a new piston assembly is required.

Ring failure is usually indicated by excessive oil consumption and blue exhaust smoke. When rings fail, oil is allowed to enter the combustion chamber where it is burned along with the fuel. High oil consumption can also occur when ring gap is incorrect, as rings cannot properly conform to the cylinder walls. Oil control is also lost when ring gaps are not staggered during installation.

When cylinder temperatures get too high, lacquer and varnish collect on pistons causing rings to stick which results in rapid wear. A worn ring takes on a shiny or bright appearance. Scratches on rings and pistons are caused by abrasive material such as carbon or pieces of hard metal (see Figure 7-8).

Detonation damage occurs when a portion of the fuel charge ignites spontaneously from heat and pressure shortly *after* ignition. This creates two flame fronts which meet and explode to create extreme hammering pressures on a specific area of the piston. Detonation generally occurs from using fuels with too low an octane rating. Preignition or ignition of the fuel charge *before* the timed spark can cause damage similar to detonation. Preignition damage is often more severe than detonation damage - often, a hole is quickly burned right through the piston dome by preignition. Preignition is caused by a hot spot in the combustion chamber from sources such as: glowing carbon deposits, blocked fins, improperly seated valves or wrong spark plugs.

Service - Pistons and Rings

Service ring replacement sets and piston assemblies are available in the standard size, plus .010", .020" and .030" oversize sets. Service type rings and piston assemblies are used when the cylinder is worn out within wear and out-of-round limits (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9). Service ring sets usually include expanders or other arrangement to provide uniform pressure on ring and better conformity to cylinder wall regardless of wear. Cylinder bore must be deglazed before service ring sets are used.

Some important points to remember when servicing piston rings:

1. If the cylinder block does not need reboring and if the old piston is within wear limits and free of score or scuff marks, it may be reused. *Never* reuse old rings.
2. Remove old rings and clean up grooves.
3. Before installing new rings on piston, place top two rings each in turn in its running area in cylinder bore and check end clearance. End clearance in a new bore is .010/.020". Maximum end clearance in used bore is .030" (see Figure 7-9).
4. Rings must be installed according to markings on rings. Compression rings must be installed with groove or bevel up when this is on inside diameter of ring. The chrome ring, when used, must be installed in the top groove. When bevel is on outside of ring, install in down



Figure 7-8. Some Common Forces of Piston and Ring Damage

position or toward skirt (see Figure 7-10). Ring installation instructions are usually included with new ring sets. Follow instructions carefully. Use ring expander to install rings and check side clearance of each ring after installation (see Figure 7-11). For side clearances see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9.

Inspection - Connecting Rod

Check bearing area (big end) for excessive wear, score marks, running and side clearance (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9). Replace rod and cap if scored or excessively worn. Connecting rods with bearing area .010" undersize are available for use with reground crankpin.

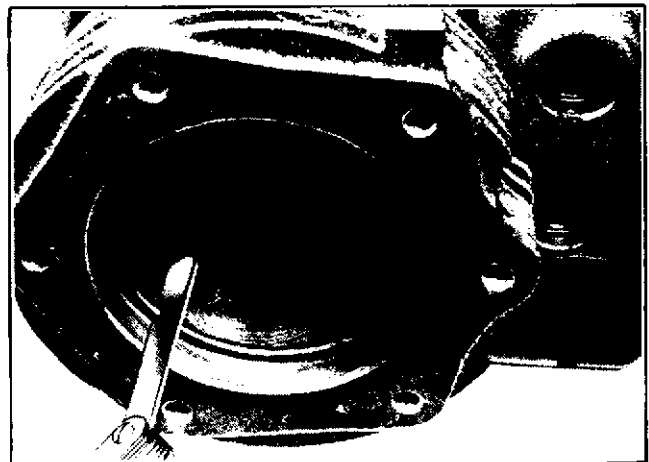


Figure 7-9. Checking Ring End Clearance in Bore

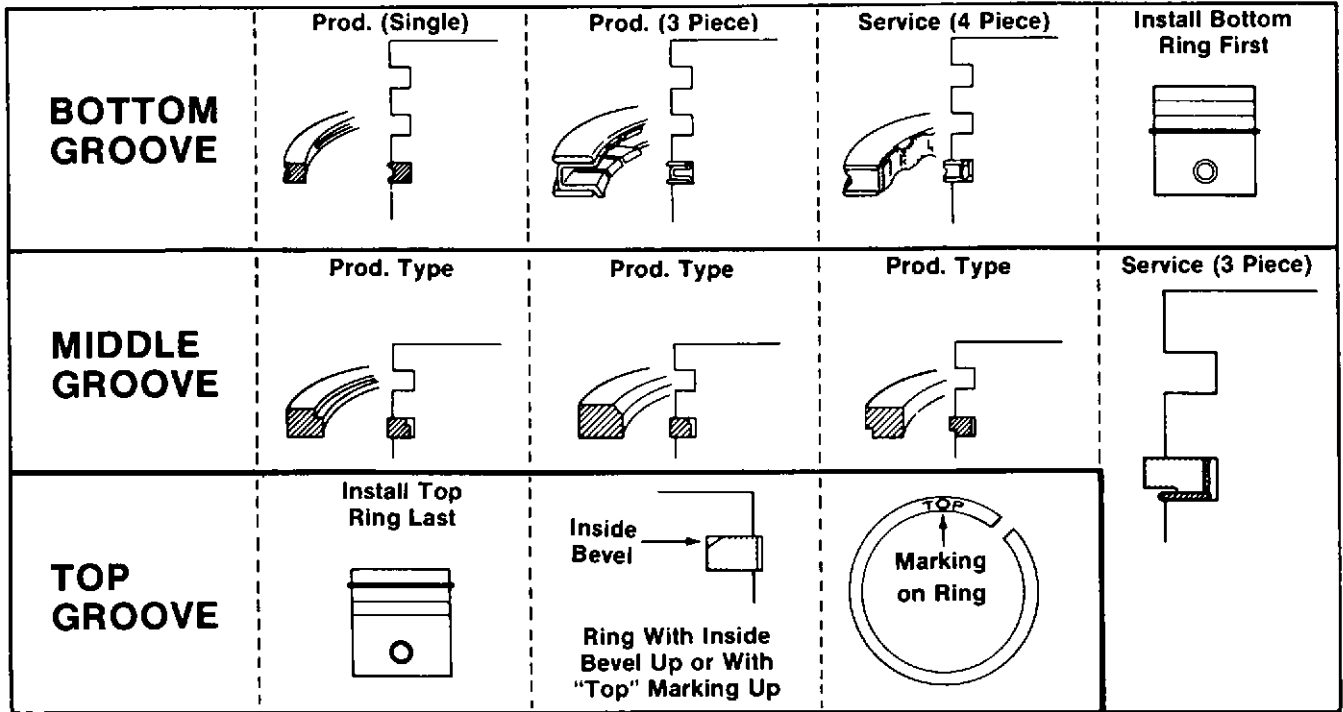


Figure 7-10. Production Type and Service Type Rings



Figure 7-11. Checking Ring Side Clearance

BALANCE GEARS

The balance gears can be separated from the engine block by removing the retaining ring that holds the gears to the stub shafts.

Inspection - Balance Gears

Balance gears should be checked for worn, cracked or broken teeth and for damaged or worn needle bearings. If any of these cases are noted, replace the gear or needle bearing.

The balance gear stub shafts can also be removed and should be replaced if excessively worn (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9).

CRANKSHAFT, CAMSHAFT AND TAPPETS

1. Remove crankshaft through hole in crankcase on bearing plate side of the engine. Remove oil seals from crankshaft.
2. Using a small punch, drive camshaft pin out from power-take-off (PTO) side of engine. Pin will slide out easily after it is driven free of block (see Figure 7-12). Lift camshaft out of crankcase.
3. Once the camshaft is removed the tappets can be lifted out of the case.

Inspection - Crankshaft and Camshaft

Inspect the gear teeth on both the crankshaft and camshaft. If the teeth are badly worn, chipped or some are

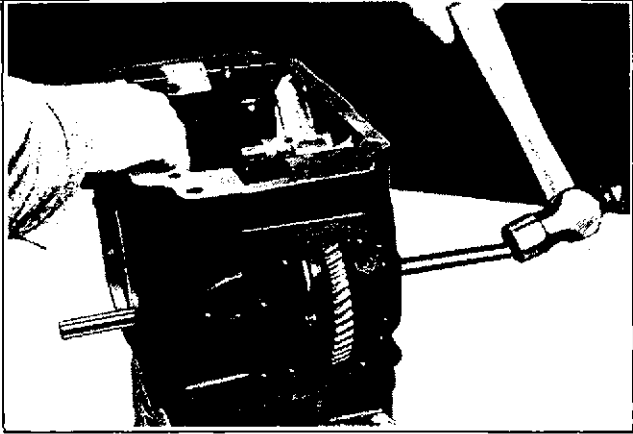


Figure 7-12. Camshaft Removal

missing, replacement of the damaged components will be necessary.

Also inspect the crankshaft bearings. One bearing is pressed into the cylinder block, the other is located in the bearing plate. Do not remove bearings unless they show signs of damage. (NOTE: Remove rear main bearing when boring or honing cylinder.) If bearings turn easily and noiselessly, and there is no evidence of scoring or grooving on the races, the bearings can be reused.

Check crankshaft keyways. If worn or chipped, replacement of the crankshaft may be necessary. Also inspect the crankpin for score marks or metallic pickup. Slight score marks can be cleaned with crocus cloth soaked in oil. If wear limits, as stated in "Specifications, Wear Tolerances, Torques and Special Tools" Section 9, are exceeded by more than .002" it will be necessary to either replace the crankshaft or regrind the crankpin to .010" undersize. If reground, the .010" undersize connecting rod (big end) must then be used to achieve proper running clearance.

GOVERNOR GEAR

To remove the governor gear, unscrew and remove the governor stop pin, then slide the governor gear off the stub shaft and out of cylinder block (see Figure 7-13). Now remove the governor cross shaft by unscrewing the governor bushing nut and removing the shaft from the inside of the cylinder block.

Inspection - Governor Gear and Cross Shaft

Inspect governor gear for worn, chipped or broken teeth. Check tab on governor cross shaft. It may be broken. Replace either of these parts if any of these conditions are noted.

CYLINDER BLOCK

Check all gasket surfaces to make sure they are free of gasket fragments and sealer materials. Surfaces must also be free of deep scratches or nicks.

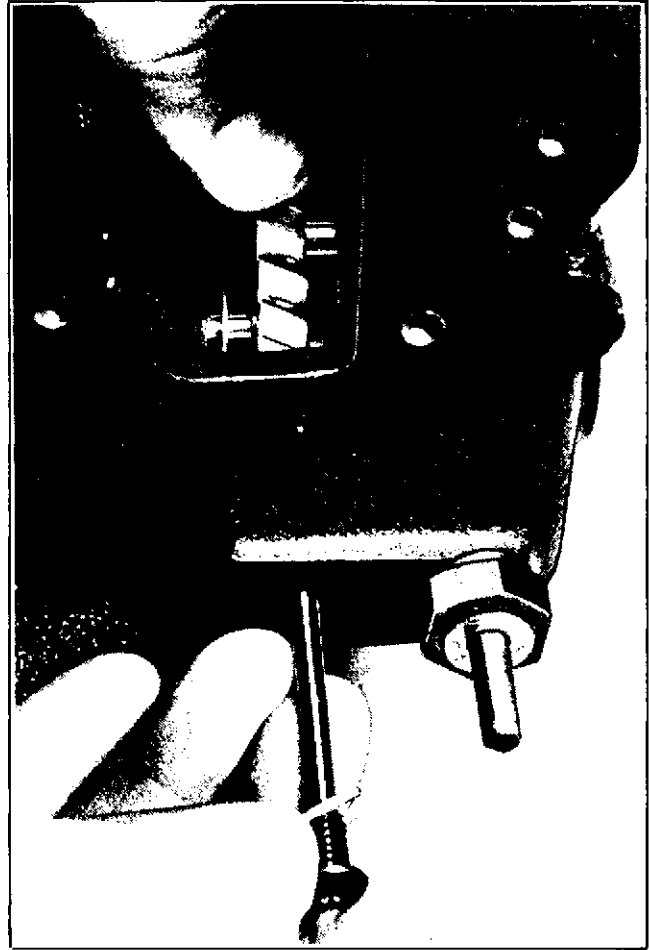


Figure 7-13. Governor Gear Removal

If the cylinder bore is badly scored, excessively worn or tapered out of round more than .005", reboring is necessary. Use an inside micrometer to determine amount of wear (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9). If cylinder bore is not damaged and is within tolerances, only light deglazing with a 220-280 finishing stone will be necessary.

Reboring Cylinder

Remove the old oil seals from the block but do not install new seals until after the crankshaft is reinstalled.

Check all gasket surfaces to make sure they are free of gasket fragments. Gasket surfaces must also be free of deep scratches or nicks.

If the cylinder bore is badly scored, excessively worn or tapered out of round more than .005" reboring is necessary. Use an inside micrometer to determine amount of wear (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9), then select the nearest suitable oversize of either .010", .020" or .030". Reboring to one of these oversizes will allow usage of the available oversize piston and ring assemblies.

While most commercially available cylinder hones can be used with either portable drills or drill presses, the use of a low speed drill press is preferred as it facilitates more accurate alignment of the bore in relation to the crankshaft crossbore. Honing is best accomplished at drill speed of about 250 RPM at 60 strokes per minute. After installing coarse stones in hone, proceed as follows:

1. Lower hone into bore and, after centering, adjust so that stones are in contact with walls. Use of a commercial cutting-cooling agent is recommended.
2. With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move hone up and down while reboring to prevent formation of cutting ridges. Check size frequently.
3. When bore is within .0025 of desired size, remove coarse stones and replace with burnishing stones. Continue with burnishing stones until within .0005 of desired size, then use finish stones (220-280) and polish to final size.

A cross-hatch should be observed if honing is done correctly. The cross-hatch should intersect at approximately 25°-30°. Too flat an angle could cause the rings to spin and not seat properly (see Figure 7-14).

4. After reboring, carefully clean cylinder wall with soap and water, then after drying thoroughly, apply light coat of SAE 10 oil to prevent rust.

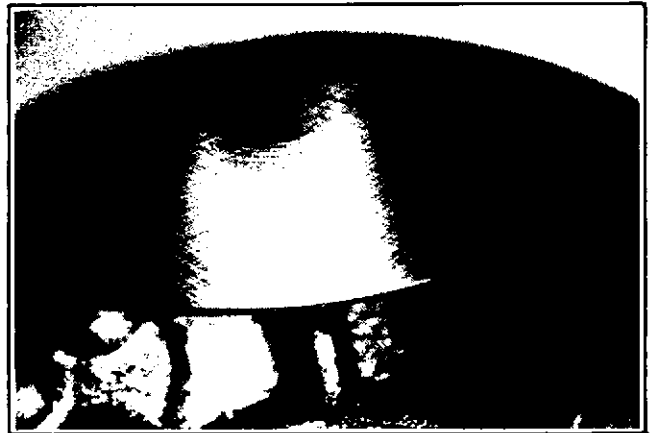


Figure 7-14. Cylinder Bore Cross-Hatch After Honing

SECTION 8 - ASSEMBLY

BEARINGS

If the crankshaft bearings were removed, or are being replaced it will be necessary to press them into place; one in the bearing plate and one in the cylinder block.

GOVERNOR GEAR

1. If the governor gear stub shaft was damaged or worn, press the replacement shaft into the block until it protrudes 3/8" above the boss.
2. The governor cross shaft, spacer and bushing nut should now be installed.
3. Place the thrust washer over the stub shaft, then slide the governor gear into place over the shaft. Finally, screw in the governor stop pin to prevent the governor gear from sliding off the stub shaft.

BALANCE GEARS

1. If the stub shaft is worn or damaged, press the old shaft out and install new shaft. Press the shaft in until it is 1.110" above the stub shaft boss - a 3/8" spacer must be used with the shaft (see Figure 8-1).

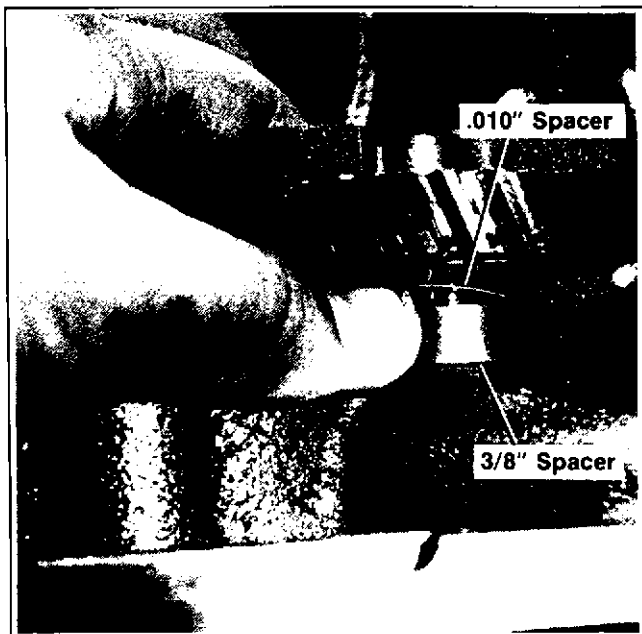


Figure 8-1. Installing Balance Gears

2. Slip one .010" spacer on stub shaft over the 3/8" spacer, then install gear-bearing assembly on stub shaft (with timing marks out) - if assembly tool is not being used, do not install bottom gear until after the crankshaft is reinstalled. Proper gear end play (.002-.010") is attained with one .005" spacer, one .010" spacer and one .020" spacer, which are installed on the snap ring retainer end of the shaft. Install the thickest spacer (.020") next to the retainer. After installing retainer, recheck end play (see Figure 8-2), and adjust (add or subtract .005" spacers) if needed. (NOTE: Install retainer with rounded edge facing spacers.)

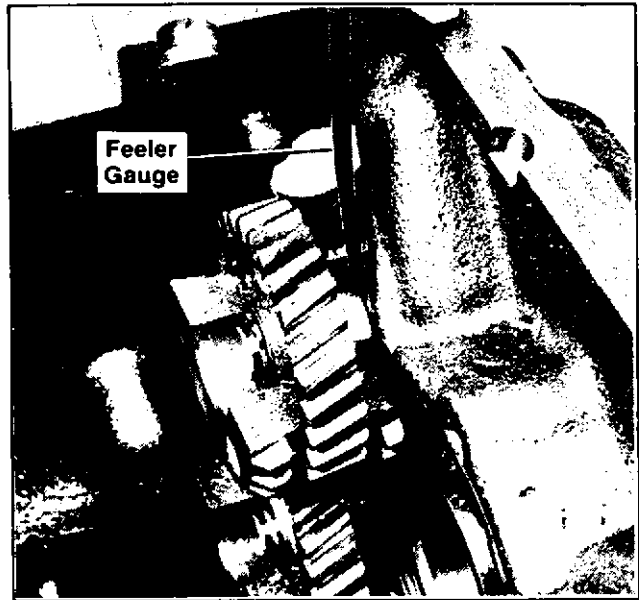


Figure 8-2. Checking Balance Gear End Play

CAMSHAFT AND TAPPETS

1. With cylinder block upside down, lubricate and insert tappets in valve guides.
2. Position camshaft inside block, then lubricate camshaft pin and insert into the block from the bearing plate side of the engine. Before pushing pin through camshaft, slip one .005" washer (end play) between end of camshaft (opposite gear end) and block. Push rod through camshaft and tap lightly until pin just starts into bore at P.T.O. end of block. Check end play with feeler gauge. If within tolerance (see "Specifications, Wear Tolerances, Torques and Special Tools" Section 9), press pin into final position or remove pin and add (or subtract) .005 and .010" washers as necessary to attain proper end play (see Figure 8-3).

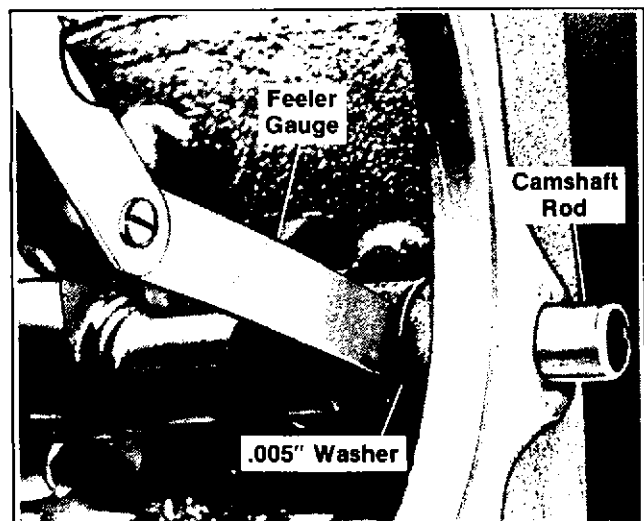


Figure 8-3. Checking Camshaft End Play

CRANKSHAFT

Assembly tool Y-357 simplifies procedure for timing balance gears to crankshaft. Retiming is necessary whenever the crankshaft is reinstalled.

1. Turn both balance gears so that primary timing marks line up with teeth on tool, then insert tool in mesh with gears (see Figure 8-4).

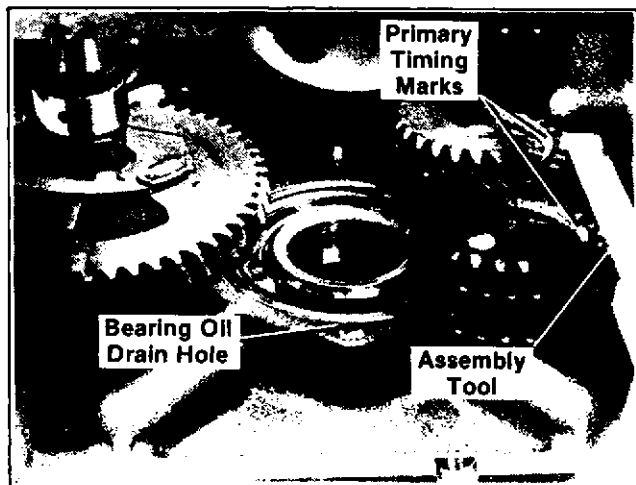


Figure 8-4. Aligning Balance Gears and Assembly Tool

2. Hold gears with tool butted against gasket surface of block, align standard marks on crankshaft with bearing oil drain hole, then lower shaft until crankgear is just started into mesh (about 1/16") in balance gears.
3. Remove tool, align crankshaft and camshaft timing marks then press crankshaft all the way into crankcase (see Figure 8-5).

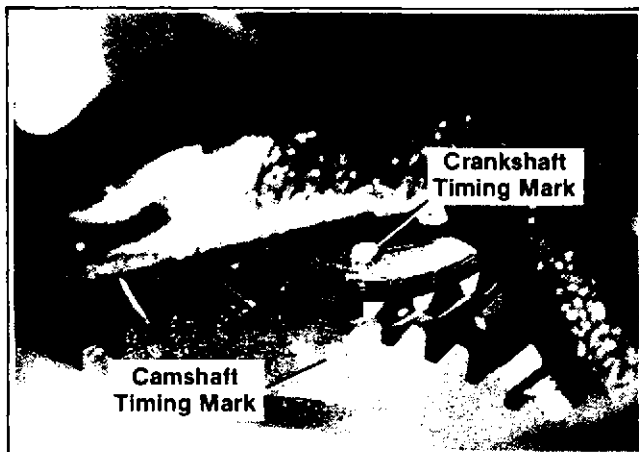


Figure 8-5. Aligning Crank Gear to Cam Gear

4. As a final check, turn crankshaft to see if standard timing mark on crankshaft lines up with the secondary timing mark on the bottom balance gear - if these marks cannot be lined up, timing is off and must be corrected (see Figure 8-6).

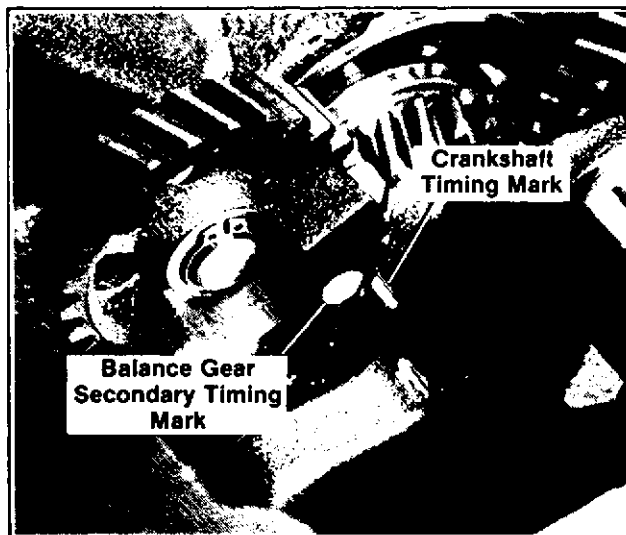


Figure 8-6. Final Check for Crankshaft to Balance Gear Timing

If the assembly tool is not available, use the following procedure to time the balance gears to the engine.

1. **Crankshaft:** Press crankshaft into block - align *primary* timing mark on top balance gear with *standard* timing mark next to crankgear - press shaft until crankgear is engaged 1/16" into top gear (narrow side). Rotate crankshaft to align timing marks on crankgear and cam gear, then press crankshaft remainder of the way into the block.
2. **Bottom Balance Gear-Bearing Assembly:** Rotate crankshaft until it is approximately 15° past BDC then slip one .010" spacer over stub shaft before installing bottom gear-bearing assembly. Align *secondary* timing mark on this gear with *secondary* timing mark (on counterweight) of crankshaft then install gear-bearing on shaft. Secondary timing mark will also be aligned with *standard* timing mark on crankshaft after installation, if properly timed (see Figure 8-6). Use one .005" spacer and one .020" spacer (largest next to retainer) to obtain proper end play of .002 to .010". Install snap ring retainer, then recheck and adjust end play as needed.

STATOR AND BEARING PLATE

1. Press front main bearing into bearing plate. Make sure bearing is straight and true in bore and bottomed properly. If cocked, crankshaft end play will be adversely affected.

Crankshaft end play is determined by thickness of gaskets used between block and bearing plate. Initial use of one .020" and one .010" gasket should bring end play within limits - this must be checked after bearing plate is installed. Install with thicker gasket next to block (see Figure 8-7).

2. Place bearing plate on crankshaft and carefully press plate onto shaft and into position on block. Install retaining capscrews and lockwashers and secure bearing plate to block. Draw screws up evenly to avoid distortion of bearing plate.

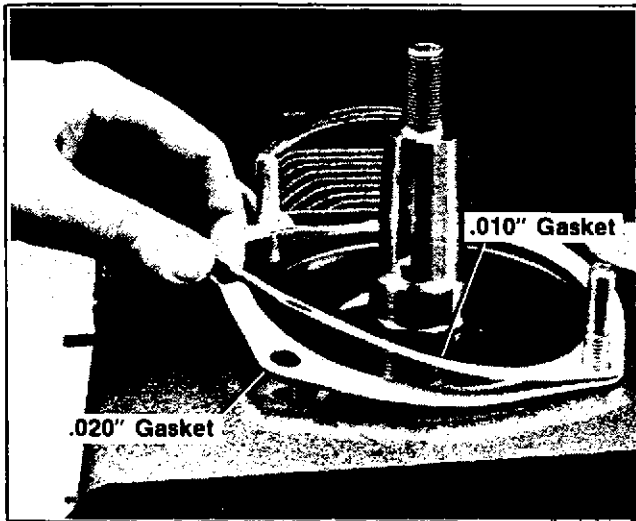


Figure 8-7. Installing Gaskets for Crankshaft End Play

3. Crankshaft end play is measured (with feeler gauge) between inner race of rear bearing (P.T.O. end) and shoulder on crankshaft (see Figure 8-8). If end play is not within tolerance as stated in "Specification, Wear Tolerances, Torques and Special Tools" Section 9, remove bearing plate and add or subtract gaskets to achieve proper clearance.

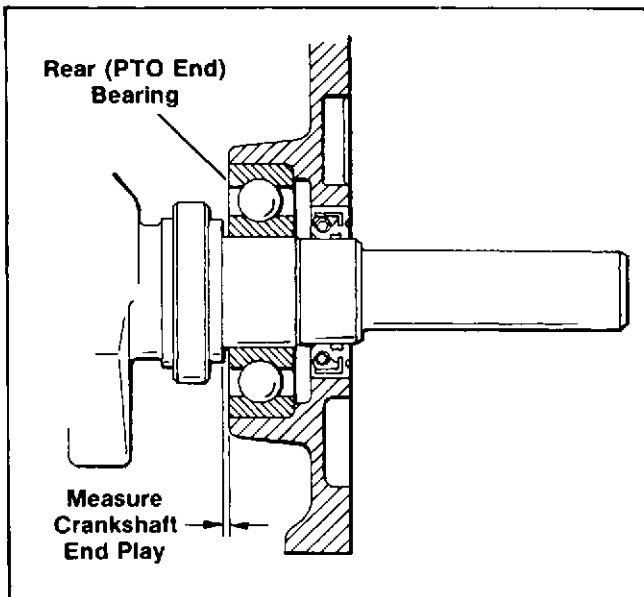


Figure 8-8. Measuring Crankshaft End Play

4. Install the stator first, by sliding it over crankshaft and securing it to the bearing plate and second, by threading the lead wires through the hole in the plate and out between the plate and the cylinder block.

PISTON AND ROD ASSEMBLIES

1. Lubricate piston pin, then assemble piston to connecting rod and secure piston pin with retainer rings. Always use new retainer rings. Be sure retainer rings are fully engaged in grooves in piston bosses. (Ring installation procedure described on page 32.)
2. After making sure rings are in proper position in correct grooves, oil complete assembly, stagger ring gaps so they are not in line and insert complete assembly into cylinder bore. Be sure connecting rod match mark is toward flywheel side of engine. Use a ring compressor to prevent ring breakage during installation. Gently push piston into bore with wooden or plastic hammer handle, *Do Not Pound* (see Figure 8-9). (NOTE: Position crankshaft to prevent rod from striking crankpin.)

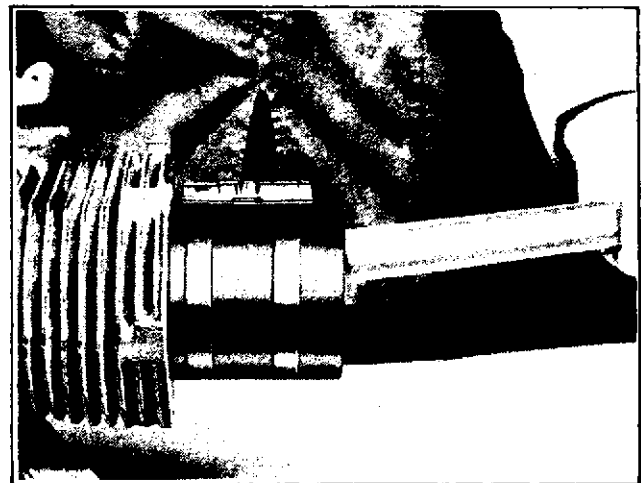


Figure 8-9. Pushing Piston into Cylinder Barrel

3. After piston assembly is installed, place block on end, then lubricate connecting rod big end, crankpin and threads on connecting rod capscrews.
4. It is important that match marks on connecting rod and cap line up. Align connecting rod on crank journal so that oil hole at the base of the rod dipper faces the camshaft (see Figure 8-10).

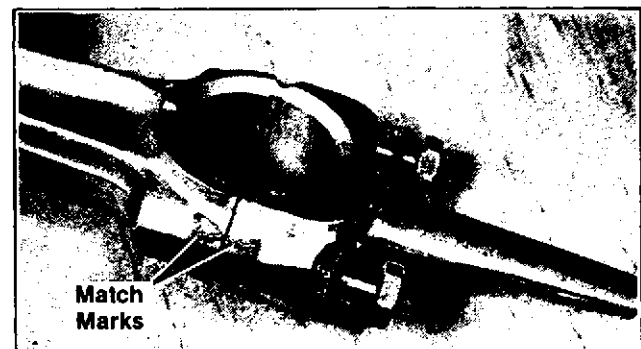


Figure 8-10. Connecting Rod Match Marks

5. Rod cap, lockwashers and capscrews are then attached to connecting rod. Use a torque wrench to over-torque capscrews to 390 in. lbs. then loosen screws and retorque to 300 in. lbs.

OIL PAN

Use pilot studs to align cylinder block, gasket and oil base. Always use a new gasket to prevent oil leakage. Assemble oil pan to block with four screws and torque to specification as shown in Section 9.

OIL SEALS

Installing oil seals requires the use of two special tools: a seal sleeve and a seal driver. A description of these tools and how they are constructed is shown in Section 9. These tools permit careful installation by preventing the seal lip from rolling and creasing.

1. To install seals, place seal sleeve over crankshaft. Apply a liberal amount of light grease, such as Lubriplate, on the seal lip area and slide the seal down over the sleeve (see Figure 8-11).

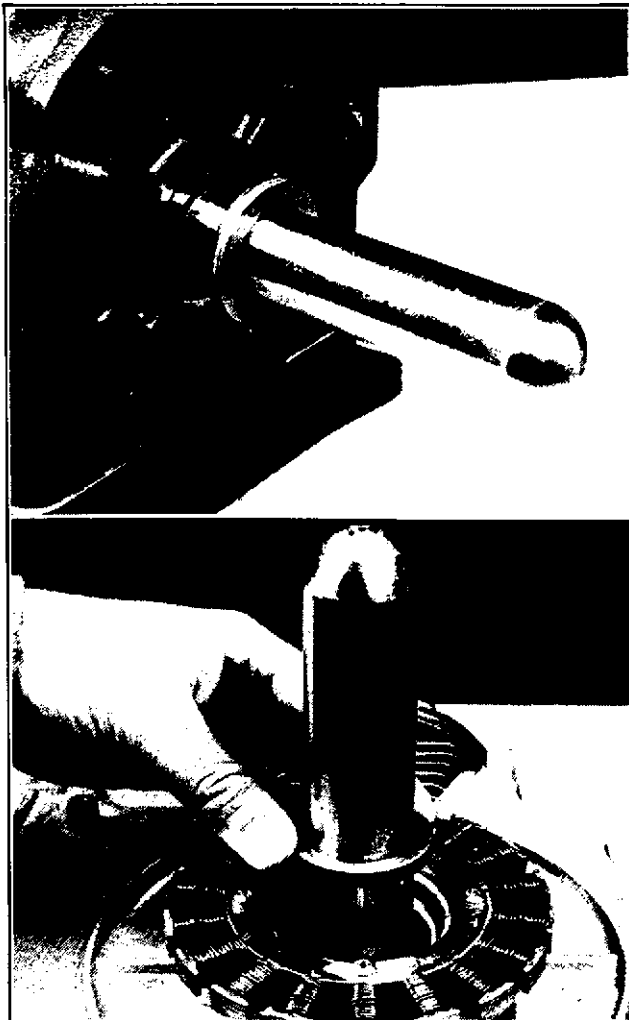


Figure 8-11. Installing Oil Seals

2. After oil seals are started on shaft, place block on its side. Slide the seal driver over the sleeve and drive the seal squarely into bearing plate and cylinder block. Drive seals to the specified depth as shown in Figure 8-12.

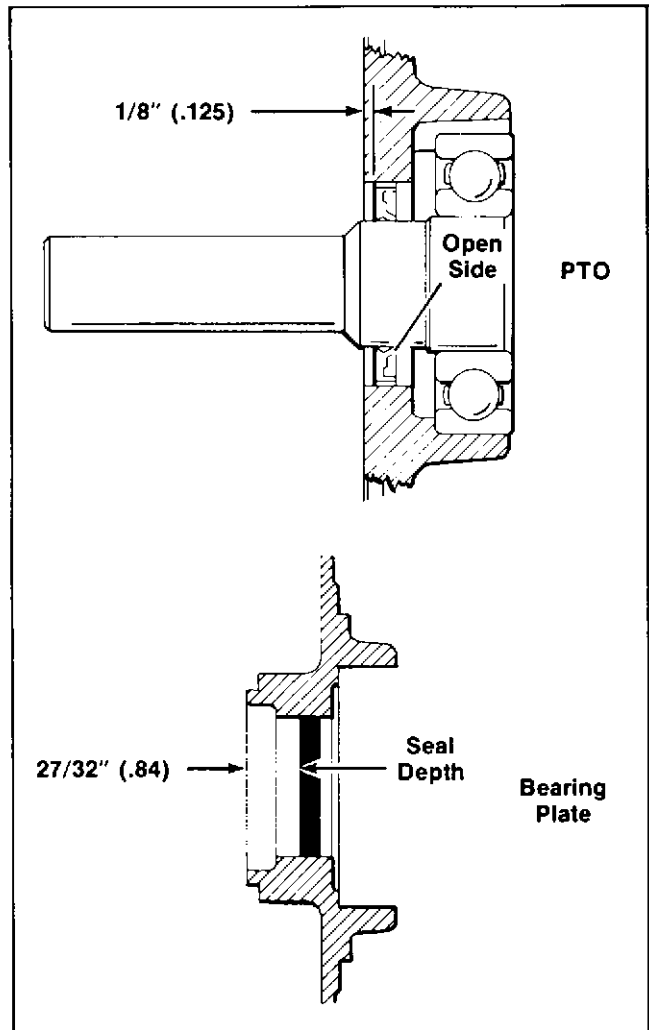


Figure 8-12. Drive Oil Seal to Specified Depths

EXHAUST AND INTAKE MANIFOLDS

Screw intake and exhaust manifolds onto the cylinder head. Always use new manifold gaskets when these parts have been removed for service.

CAUTION: Units using the exhaust manifold elbow also use a heat tube. This heat tube is placed in the exhaust port before the elbow is fastened to the cylinder head. If heat tube is left out, cylinder head damage will result. (NOTE: Heat tube is a loose fit in exhaust port and elbow.)

VALVE ASSEMBLY

The valve assembly should be installed in the following order.

1. Place valves into valve guides in cylinder head. Make sure exhaust valve marked "EXS" is on exhaust manifold side and intake valve marked "INS" is on intake manifold side.
2. Install retainers, valve springs (tight coils toward cylinder head) and valve rotators in that order.
3. Using a valve spring compressor, compress the spring and install valve keepers (see Figure 8-13).

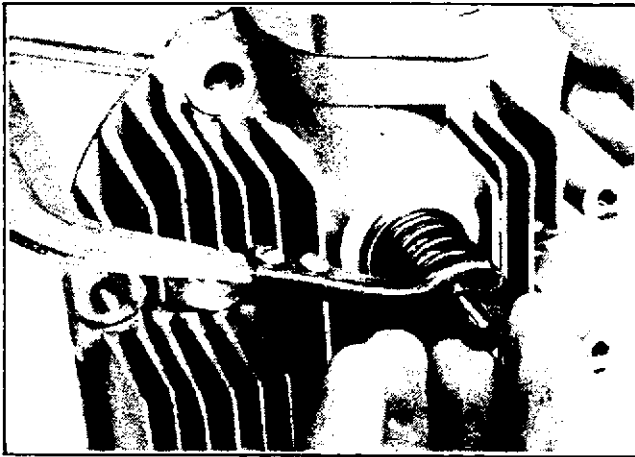


Figure 8-13. Installing Valve Springs

CYLINDER HEAD

Always use a new gasket when head has been removed for service work. Lubricate cylinder head capscrews, then tighten evenly using the proper sequence and torque as shown in "Specification, Wear Tolerances, Torques and Special Tools" Section 9.

PUSH RODS AND TUBES

1. On each end of the push rod tubes there is an O-ring seal. These seals must be installed into seats in the cylinder block and rocker arm housing before the push rod tubes are installed (see Figure 8-14).
2. Push tubes into holes in cylinder block, then insert push rod into tubes making sure rods rest on tappets.

ROCKER ARM ASSEMBLY AND VALVE ADJUSTMENT

1. Assemble rocker arms to rocker arm shaft with retainer rings. (NOTE: Always install retainer rings so that rounded edge is toward rocker arm.)
2. Screw valve adjusting screws into ends of rocker arms and secure with locknuts (see Figure 8-15).
3. Entire rocker arm assembly can now be attached to the rocker arm housing. Rest rocker arm shaft on cradle-like area on housing so that adjusting screws are over

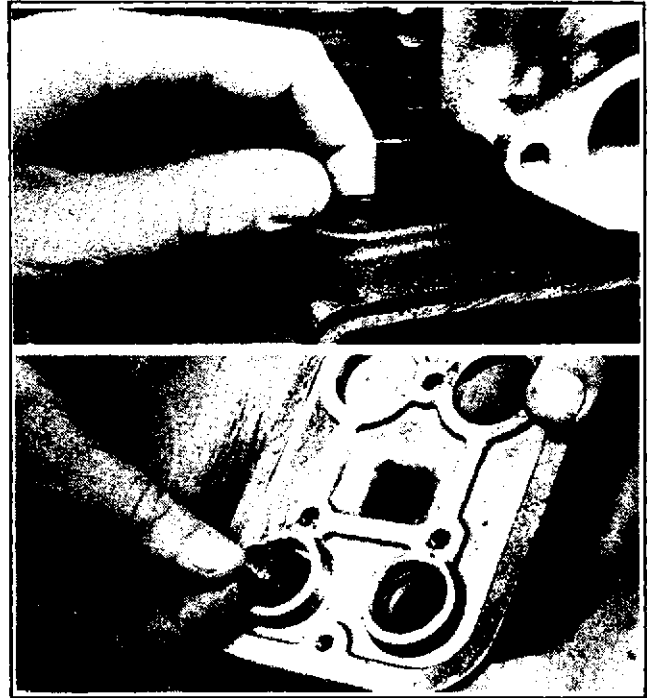


Figure 8-14. Installing Push Rod Tube "O" Rings

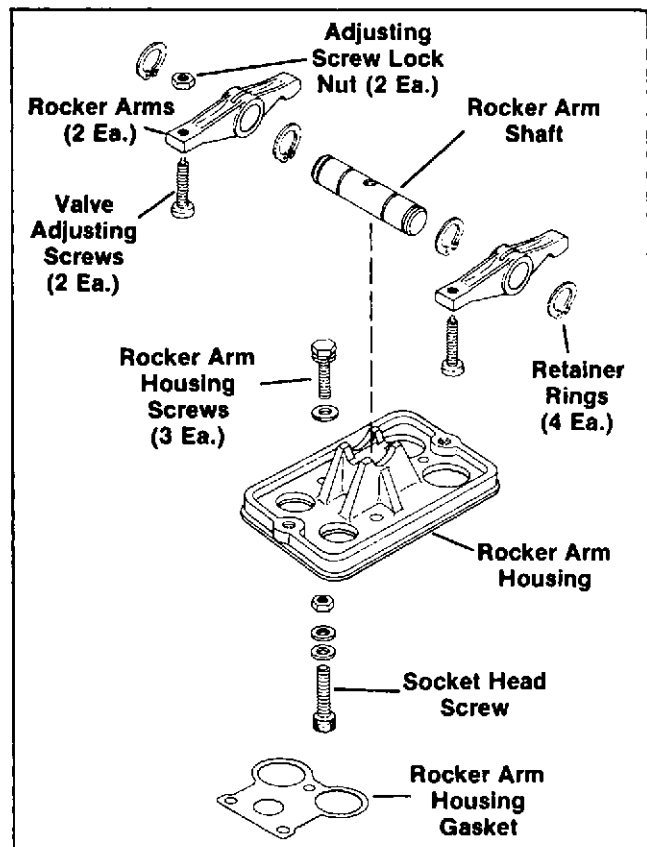


Figure 8-15. Rocker Arm Assembly

the smaller of the four large holes in the housing. Fasten the shaft to the housing with washers and socket head screw. Torque socket head screw to 180 in. lbs. (see Figure 8-15).

- Place rocker arm housing gasket over valve springs on cylinder head (always use new gasket when housing is serviced) and secure rocker arm housing to cylinder head with capscrews (see Figure 8-15).

Valve Adjustment

Valve clearance is measured between the end of the rocker arm and valve stem end. Both intake and exhaust valves should be adjusted (cold) to .005" (0.13 mm).

To adjust valve clearance turn engine by hand until both valves are seated or in compression (TDC). Loosen the valve adjusting screw locknut. Screw the adjusting screw in or out until the clearance is correct. Retighten locknut, then check clearance again (see Figure 8-16).

Now rest rocker arm housing cover gasket on housing gasket surface and fasten rocker arm cover to housing.

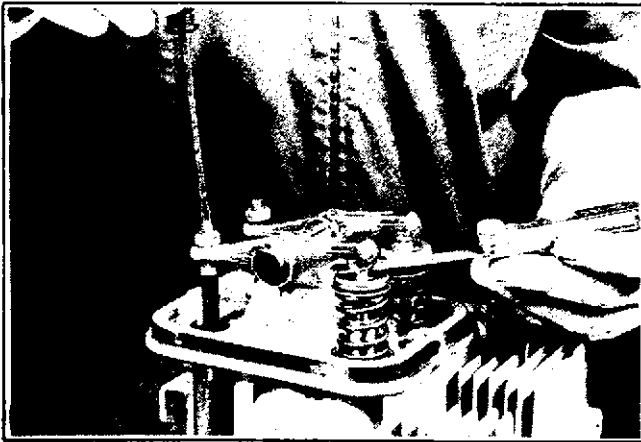


Figure 8-16. Adjusting Valve Clearance

FLYWHEEL

WARNING: Improper procedures for installation of flywheels can lead to cracked flywheels and broken crankshafts. This not only results in extensive damage to an engine but presents serious threat to the safety of persons close to the engine.

When installing the flywheel:

DO NOT use impact wrenches to install the flywheel retaining nut, as this may overstress the nut and crack the flywheel hub.

DO NOT apply grease, oil or any lubricant to the taper of the crankshaft or hub of the flywheel as this will cause excessive stress and possible cracking of the flywheel while tightening.

DO NOT allow the key to be pushed inward on the keyway while installing the flywheel. If

the key rides up on the rounded surface at the end of the keyway, as shown in Figure 8-17, it will act as a wedge and crack the flywheel hub.

DO NOT reuse a flywheel if it has been dropped or damaged in any way.

DO NOT use a steel bar or any other object (between the flywheel fins) to hold the flywheel when the flywheel nut is being torqued, as this practice could break or crack flywheel fins.

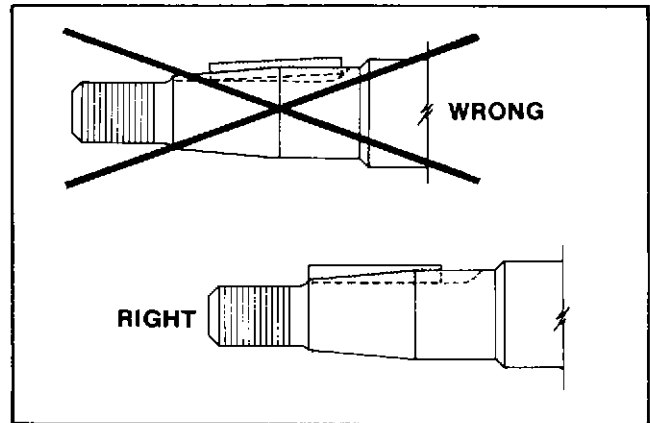


Figure 8-17. Right and Wrong Way to Install Flywheel Key

To install engine flywheel follow these steps:

- Make sure the flywheel hub and taper of the crankshaft are clean, dry and completely free of any lubricant before installing flywheel.
- Position key properly in keyway as shown in Figure 8-17 and carefully guide key slot in flywheel hub over the key, to avoid pushing the key inward.
- Use a torque wrench and tighten the flywheel retaining nut to 60-70 ft. lbs. Use a strap wrench to hold flywheel while torquing nut (see Figure 8-18).

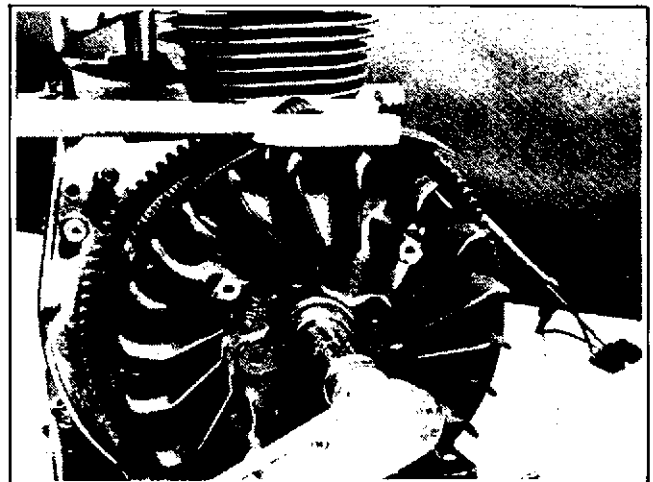


Figure 8-18. Torquing Flywheel

CAM COVER AND FUEL PUMP

1. Install cam cover gasket and cam cover. Also install lead wire as shown in Figure 8-19 and secure it with cable clamp held by cam cover screw. Thread one end of lead wire around fuel pump mounting pad and up along bearing plate. Thread the wire through at the top of bearing plate to the other side of the engine so it emerges along with the stator wires.
2. Connect fuel line to outlet elbow on fuel pump with spring clamp.
3. Install fuel pump and new fuel pump gasket. On plastic fuel pumps make sure flat washer is installed next to mounting flange on pump. Torque screws on plastic pumps to 70 in. lbs. (see Figure 8-19).

For further information on fuel pumps see Section 4 "Fuel System."

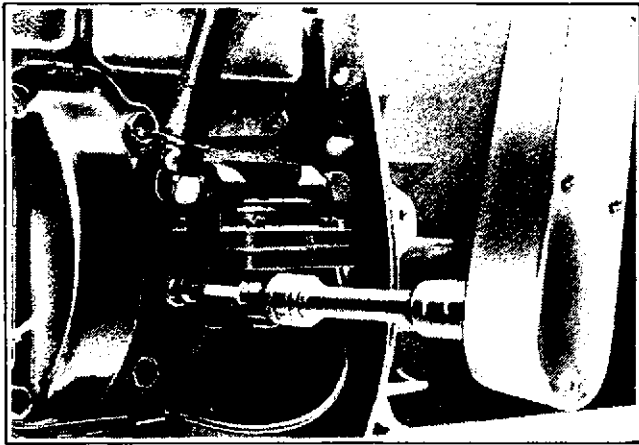


Figure 8-19. Cam Cover and Fuel Pump Installation

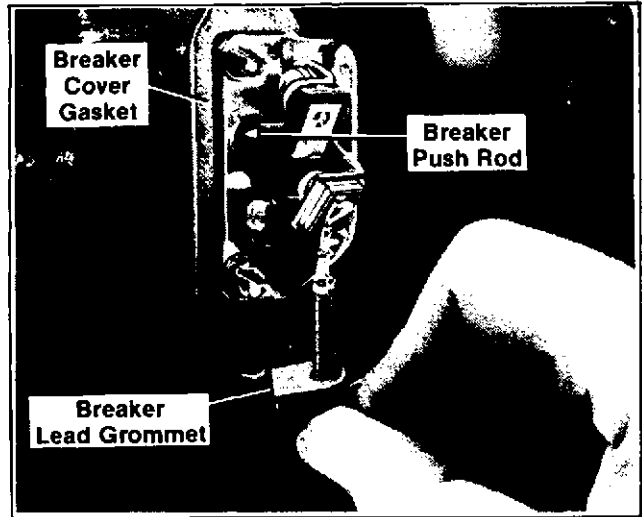


Figure 8-20. Breaker Wire Installation

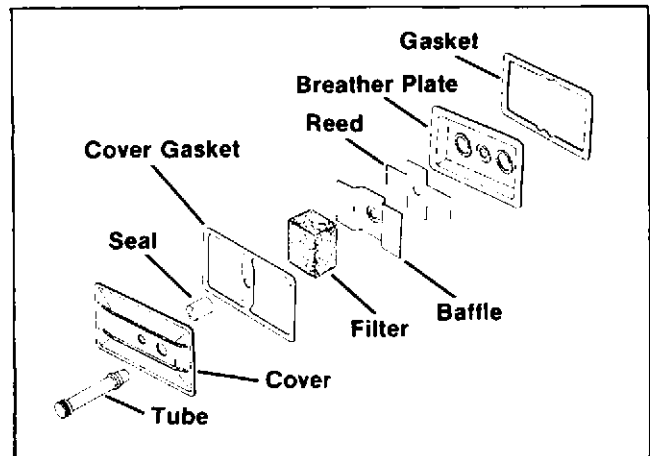


Figure 8-21. Assembling Sequence (Breather)

BREAKER POINT ASSEMBLY

1. Install push rod and then fasten breaker in place with two screws.
2. Place cover gasket in position and attach lead, that is attached at cam cover, to breaker point screw as shown in Figure 8-20.
3. Adjust breaker point gap with a feeler gauge to .020" full open, as a preliminary setting. For further breaker point information and ignition timing procedure see Section 5 "Electrical Systems".
4. Secure breaker point cover. Be sure breaker point lead grommet is in place in cover.

BREATHER ASSEMBLY

All breather components must be clean and in good condition. Use new gaskets, reed and filter when reconditioning. Assemble breather according to sequence as shown in Figure 8-21. Cover must be securely tightened to prevent oil leakage.

STARTING MOTOR

Attach starting motor to engine block. Make sure the special shouldered capscrews (and lockwashers) are used. In addition to securing the starter to the machined surface on the crankcase, these special capscrews properly align the pinion to the ring gear on the engine. Use of ordinary capscrews will allow starter to shift which could result in clashing of the gears.

IGNITION COIL AND BAFFLING

Attach the ignition coil and condenser to the cylinder baffle as in Figure 8-22. Now secure the rest of the baffling in this order: blower housing, side baffle and head baffle.

When the engine baffling is in place, the wiring connections to the coil, breaker points, condenser and rectifier-regulator should be made. Follow the wiring diagram in Section 5 "Electrical Systems" for the particular ignition system used.

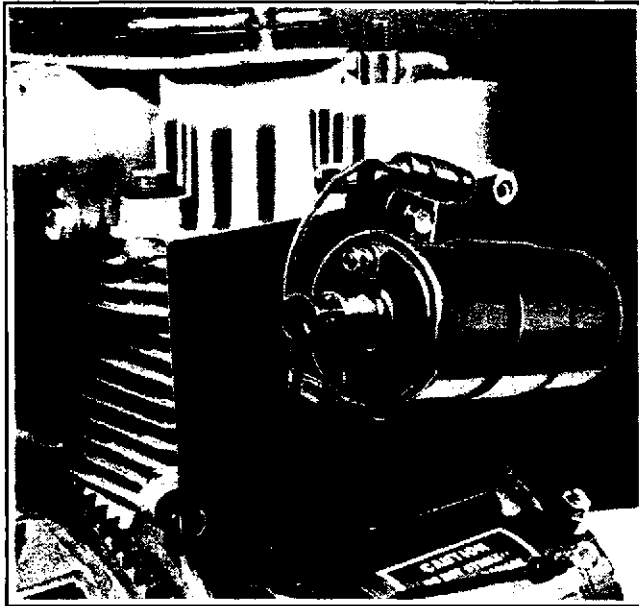


Figure 8-22. Securing Coil and Condenser to Side Baffle

DIPSTICK ASSEMBLY

If the dipstick assembly was removed for service, replace it at this point. Always use a new gasket when replacing the dipstick.

Governor Arm and Carburetor

1. Push governor arm onto governor cross shaft, but do not tighten the nut which holds arm to shaft.
2. Install a new carburetor gasket. Hold gasket in place with one of the carburetor screws. Slide mounting flange of carburetor under screw, then position other end of gasket beneath carburetor flange and screw carburetor to crankcase.
3. Attach choke linkage between choke control lever and choke lever on carburetor. Snap throttle rod onto ball that is connected to carburetor throttle lever. Attach governor spring between throttle control lever and governor arm. Connect the fuel line from the fuel pump outlet side to the carburetor using a spring clamp. (See Figure 8-23 for connections.)
4. Grasp end of governor cross shaft with pliers and turn (counterclockwise) as far as possible (tab on cross shaft will stop against rod on governor gear assembly). Now, while holding the cross shaft in the position just mentioned, pull the governor arm away from the carburetor (as far as possible), then tighten the governor arm nut (see Figure 8-24).

For further governor and carburetor adjustments see Section 4 "Fuel Systems".

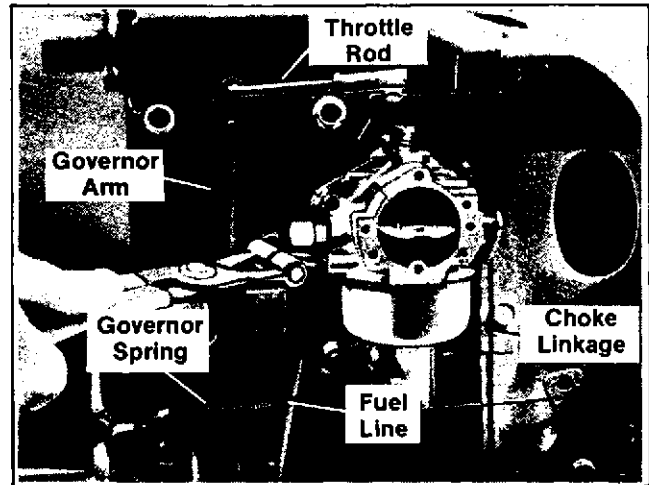


Figure 8-23. Connections to Carburetor (Throttle, Fuel and Governor)

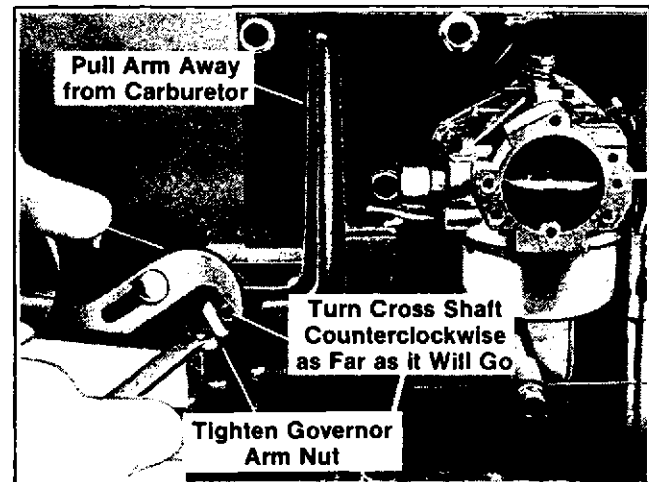


Figure 8-24. Adjusting Governor Arm

AIR CLEANER ASSEMBLY

1. Attach a new adhesive backed air horn gasket to carburetor. Peel backing off gasket then stick gasket to carburetor making sure that holes in gasket align properly with holes in carburetor (see Figure 8-25).
2. Connect air cleaner back plate. Make sure tube from breather assembly protrudes through hole in back plate as shown in Figure 8-26.
3. Slide air cleaner tube through back plate and into blower housing. (NOTE: Make sure tube is inserted so that the longest side of the angled tube end is facing downward, as in Figure 8-26. Also make sure lips of tube are in place around back plate hole.)

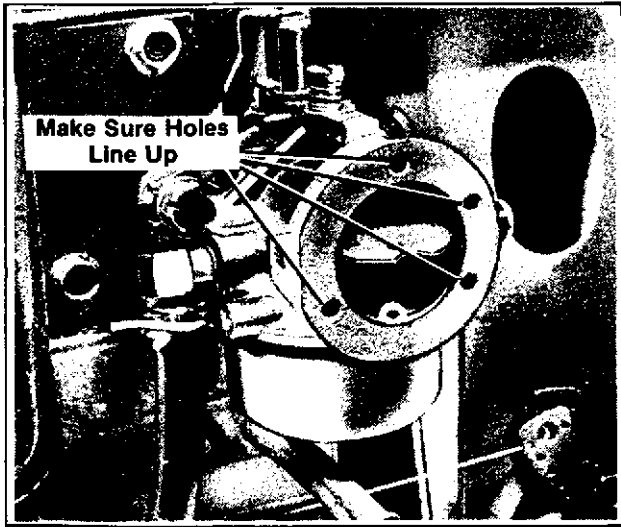


Figure 8-25. Carburetor Air Horn Gasket Installed

4. Place air cleaner element over raised area on back plate.
5. Put air cleaner cover over stud and tighten wing nut. Make sure cover forms a tight seal with back plate.

GRASS SCREEN

Screw grass screen to flywheel and torque screws to 115 in. lbs.

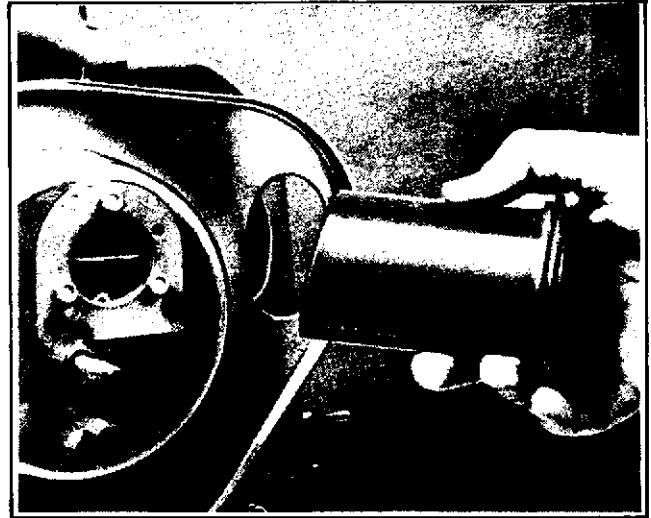


Figure 8-26. Installing Air Cleaner Back Plate and Tube

The engine is now completely assembled. Make sure the crankcase is filled with oil before starting the engine (see "Oil Recommendations" Section 1).

SECTION 9 – SPECIFICATIONS, WEAR TOLERANCES, TORQUES AND SPECIAL TOOLS

GENERAL SPECIFICATIONS

Bore (Nominal)	3-3/4 (95 mm)
Stroke	3-1/4 (83 mm)
Displacement (Cubic Inches)	35.89 (588 cc)
Horsepower (at 3600 RPM)	18 (13.4 kw)
Weight (Approximate Pounds)	124 (55.8 kg)
Oil Capacity (U.S. Quarts)	2 (1.9 l)
Spark Plug Gap (Standard) .....	.035 (0.89 mm)
Spark Plug Gap (Resistor) .....	.035 (0.89 mm)
Spark Plug Size (Millimeters)	14
Breaker Point Gap (Nominal) .....	.020 (.508 mm)

TOLERANCES, PARTS FITTED

Balance Gear End Play .....	.002/.010 (0.051/0.254 mm)
Crankshaft Free End Play .....	.003/.020 (0.076/0.508 mm)
Crankshaft-Connecting Rod Journal Size	1.5000/1.4995 (38.100/38.087 mm)
Connecting Rod to Crankpin Running Clearance .....	.001/.002 (0.025/0.051 mm)
Connecting Rod Side Play on Crankpin .....	.007/.0175 (0.178/0.444 mm)
Connecting Rod to Wrist Pin .....	.0003/.0008 (0.008/0.020 mm)
Wrist Pin to Piston Boss	Dry Slide Fit
Ring Side Clearance, Top Ring .....	.002/.004 (0.051/0.102 mm)
Ring Side Clearance, Middle Ring .....	.002/.004 (0.051/0.102 mm)
Ring Side Clearance, Oil Ring .....	.001/.003 (0.025/0.076 mm)
Ring End Gap .....	.010/.020 (0.254/0.508 mm)
Camshaft Pin to Camshaft .....	.001/.0035 (0.025/0.089 mm)
Camshaft Pin to Block (Bearing Plate End) .....	.0005/.002 (0.013/0.051 mm)
Camshaft Pin to Block (P.T.O.E.) (Interference Fit) .....	.0015/.003 (0.038/0.076 mm)
Camshaft End Play .....	.005/.010 (0.127/0.254 mm)
Tappet in Guide .....	.0005/.0024 (0.013/0.061 mm)
Valve Stem in Guide - Exhaust .....	.0029/.0056 (0.074/0.142 mm)
Valve Stem in Guide - Intake .....	.001/.0027 (0.025/0.069 mm)
Guide in Head (Interference Fit) .....	.0015/.003 (0.038/0.076 mm)
Governor Bushing to Governor Cross Shaft .....	.001/.0025 (0.025/0.064 mm)
Governor Gear to Governor Shaft .....	.0005/.002 (0.013/0.051 mm)
Piston to Cylinder Bore Clearance (Thrust Face/Bottom of Skirt) .....	.0030/.0045 (0.076/0.114 mm)
Piston to Cylinder Bore Clearance (Thrust Face/Top of Skirt) .....	.007/.0095 (0.178/0.241 mm)
Bearing Plate to Cylinder Block (Pilot Clear) .....	.001/.005 (0.025/0.127 mm)
Ball Bearing to Cylinder Block (Interference Fit) .....	.0006/.0022 (0.015/0.056 mm)
Ball Bearing to Bearing Plate (Interference Fit) .....	.0012/.0028 (0.030/0.071 mm)
Ball Bearing to Crankshaft	Interference .0004 (0.010 mm)
	Loose .0005 (0.013 mm)
Valve Clearance Intake (Cold) .....	.005 (0.13 mm)
Valve Clearance Exhaust (Cold) .....	.005 (0.13 mm)
Spark Plug Gap .....	.035 (0.89 mm)
Breaker Point Gap (Nominal) .....	.020 (0.51 mm)
Spark Timing (In Degrees)	20 B.T.D.C.
Starter Pinion to Ring Gear Backlash .....	.005/.025 (0.127/0.635 mm)
Governor Cross Shaft End Play .....	.005/.030 (0.127/0.762 mm)
Gear Reduction Shaft End Play .....	.008/.030 (0.203/0.762 mm)

WEAR TOLERANCES

Cylinder Bore - New Diameter	3.750 (95.25 mm)
Cylinder Bore - Maximum Wear Diameter	3.753 (95.33 mm)
Cylinder Bore - Maximum Taper .....	.0015 (0.038 mm)
Cylinder Bore - Maximum Out of Round .....	.005 (0.127 mm)
Crankshaft Crankpin - New Diameter	1.500 (38.1 mm)
Crankshaft Crankpin - Maximum Out of Round .....	.0005 (0.013 mm)
Crankshaft Crankpin - Maximum Taper .....	.001 (0.025 mm)
Connecting Rod Big End - Maximum Diameter	1.5025 (38.164 mm)
Piston Thrust Face - Maximum Wear Diameter	3.7425 (95.060 mm)
Valve to Guide - Maximum Clearance .....	.0065 (0.165 mm)

All dimensions in inches unless stated otherwise.

TORQUE SETTINGS - Special

Spark Plug (ft. lbs.)	18-22 (24-30 Nm) (2.5-3.1 Kgm)
*Cylinder Head (ft. lbs.)	30-35 (41-48 Nm) (4.2-4.9 Kgm)
*Connecting Rod (in. lbs.)	300 (34 Nm) (3.5 Kgm)
Flywheel Nut (ft. lbs.)	60-70 (81-95 Nm) (8.3-9.7 Kgm)
Grass Screen Screws (in. lbs.)	115 (13 Nm) (1.3 Kgm)
Fuel Pump Screws (Plastic Pump (in. lbs.)	70 (8 Nm) (.8 Kgm)

*Lubricate with oil at assembly.

General

Tightening Torque Into Cast Iron or Steel

Size	Grade 2	Grade 5	Grade 8
8-32	20 in. lb.	25 in. lb.	
10-24	32 in. lb.	40 in. lb.	
10-32	32 in. lb.	32 in. lb.	
1/4-20	70 in. lb.	115 in. lb.	165 in. lb.
1/4-28	85 in. lb.	140 in. lb.	200 in. lb.
5/16-18	150 in. lb.	250 in. lb.	350 in. lb.
5/16-24	165 in. lb.	270 in. lb.	30 ft. lb.
3/8-16	260 in. lb.	35 ft. lb.	50 ft. lb.
3/8-24	300 in. lb.	40 ft. lb.	60 ft. lb.
7/16-14	35 ft. lb.	55 ft. lb.	80 ft. lb.
7/16-20	45 ft. lb.	75 ft. lb.	105 ft. lb.
1/2-13	50 ft. lb.	80 ft. lb.	115 ft. lb.
1/2-20	70 ft. lb.	105 ft. lb.	165 ft. lb.
9/16-12	75 ft. lb.	125 ft. lb.	175 ft. lb.
9/16-18	100 ft. lb.	165 ft. lb.	230 ft. lb.
5/8-11	110 ft. lb.	180 ft. lb.	260 ft. lb.
5/8-18	140 ft. lb.	230 ft. lb.	330 ft. lb.
3/4-10	150 ft. lb.	245 ft. lb.	350 ft. lb.
3/4-16	200 ft. lb.	325 ft. lb.	470 ft. lb.

Tightening Torque Into Aluminum

Size	Grade 2	Grade 5
8-32	20 in. lb.	20 in. lb.
10-24	32 in. lb.	32 in. lb.
1/4-20	70 in. lb.	70 in. lb.
5/16-18	150 in. lb.	150 in. lb.

CONVERSIONS

in. lbs. × .083 = ft. lbs.
 ft. lbs. × 12 = in. lbs.
 ft. lbs. × .1383 = kgm
 ft. lbs. × 1.3558 = Nm

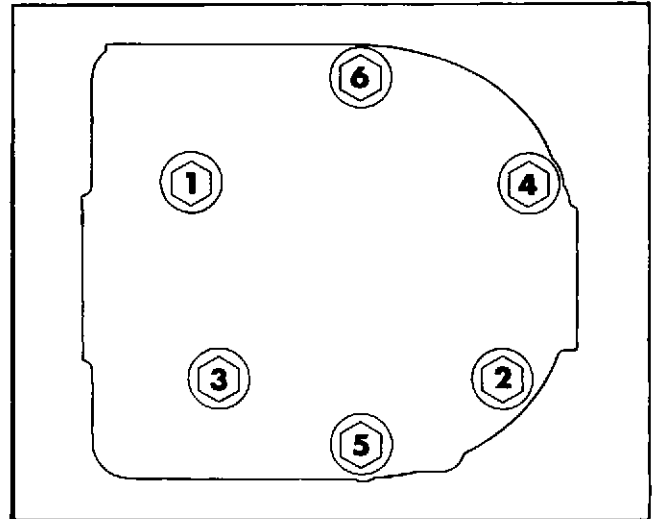


Figure 9-1. Headbolt Torque Sequence

SPECIAL TOOLS

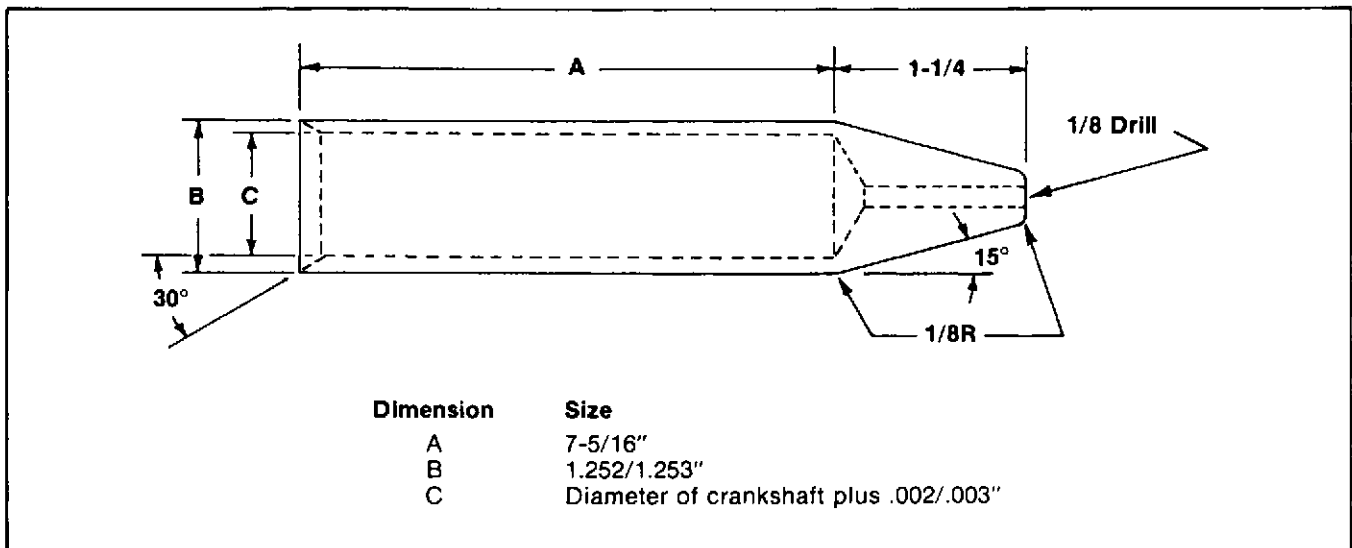


Figure 9-2. Dimensional Diagram - Seal Sleeve

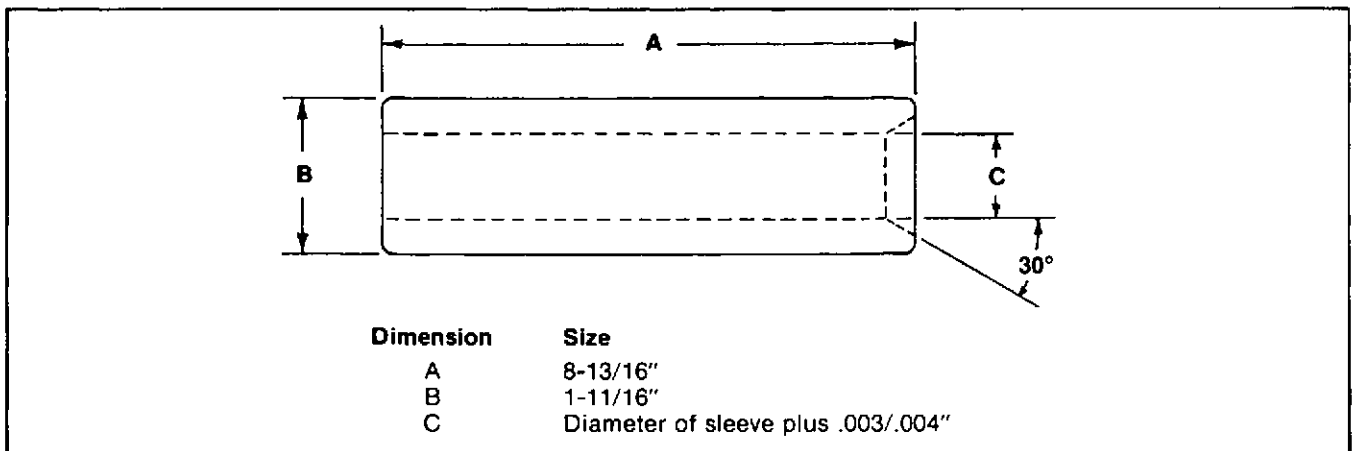
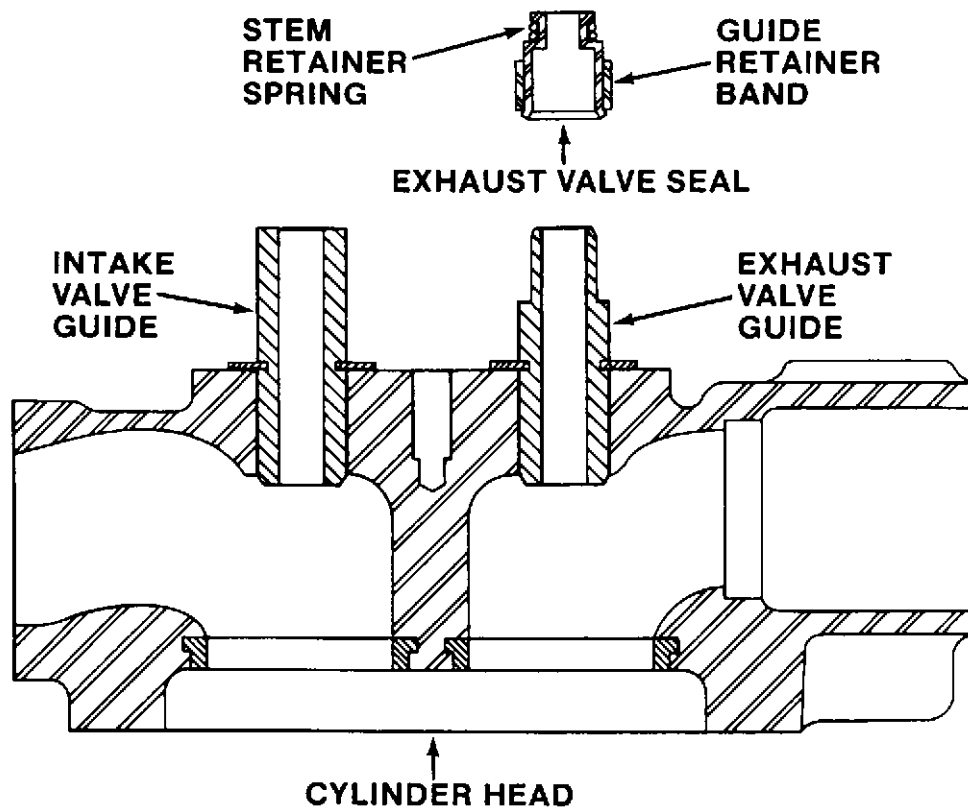


Figure 9-3. Dimensional Diagram - Seal Driver

K361 EXHAUST VALVE SEAL

Some K361 cylinder heads utilize an exhaust valve seal which is installed on the exhaust valve guide. If replacing this seal, use the following precaution to prevent seal failure due to improper or careless seal installation.

When pressing an exhaust valve seal onto an exhaust valve guide, press on the seal guide retainer band only. Pressing directly on this valve seal body or stem retainer spring will distort the seal and result in seal failure.



K361 VALVE GUIDE REPLACEMENT

Two types of valve guides have been used in K361 cylinder heads. (See figure 1). Some exhaust valve guides are machined to accommodate a teflon valve seal.

If valve guides are worn beyond the maximum allowable specifications, remove and replace the guides using the following procedure.

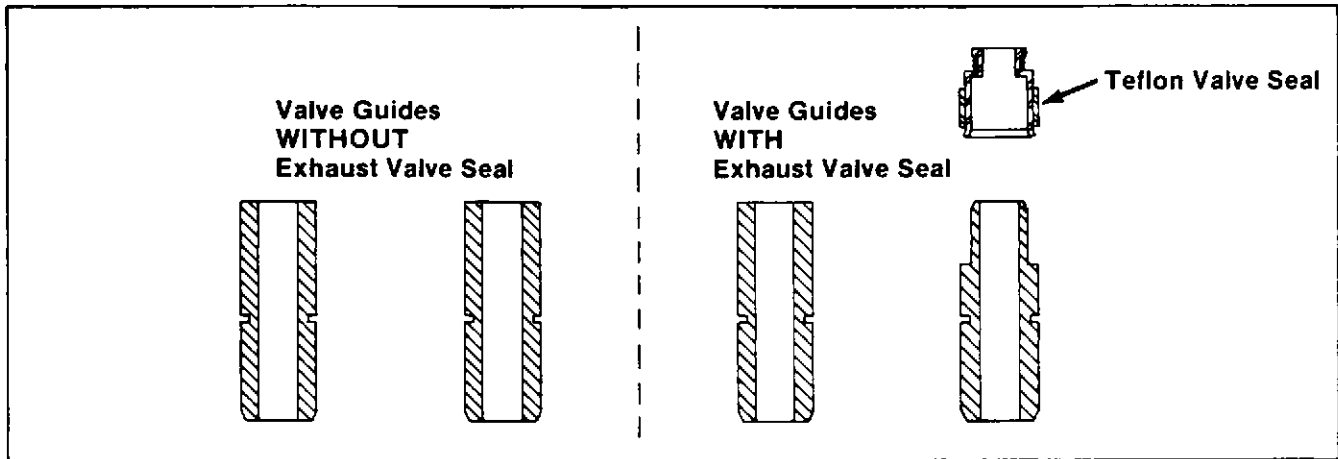


FIGURE 1

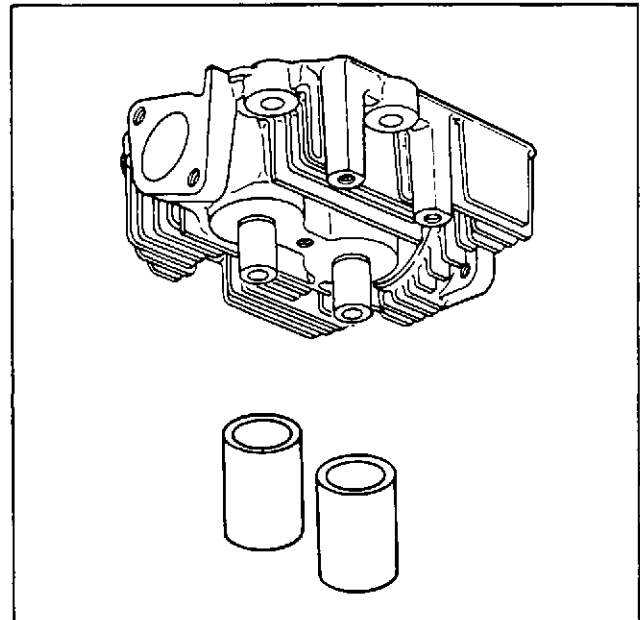
Valve Guide Removal

1. Remove cylinder head from engine, disassemble and clean as explained in the service manual.
2. Heat cylinder head in a 400° F (205° C) oven no less than 30 minutes.

WARNING: Use extreme care when working with hot oven. Carelessness in working area can result in serious burns.

3. Remove head from oven using fireproof insulated gloves, pliers, etc. Position on an arbor press table with the valve seats "up" and the valve guides inside two pieces of pipe (1" [25mm] I.D. x 1-3/4" [45mm] long with straight cuts). See figure 2.
4. Center a 1/2" (12mm) diameter drift punch on the valve guide. Press guide from head.

CAUTION: Misalignment of drift punch on guide during removal could damage cylinder head.



Valve Guide Installation

1. Heat cylinder head in a 400° F (205° C) oven no less than 30 minutes.
2. Install clip ring on guide with the flat edge side toward the chamfered end of guide. (See figure 3.) Place guide in a freezer compartment or on dry ice no less than 30 minutes.
3. Remove head from oven using fireproof insulated gloves, pliers, etc. Place head valve seat down on a flat piece of wood.

WARNING: *Cylinder head is extremely hot. Use extreme care in handling to avoid serious burns.*

4. Place chamfered end of "cooled" valve guide into cylinder head valve guide bore. Using an arbor press and a 1/2" (12mm) diameter drift punch, press guide into head until clip ring bottoms out in head. (See figure 3.)
5. Machine down the exhaust port guide to be flat with the aluminum machined surface using a drill

press and a 11/16" (.6875"/17.5mm) diameter spotface. Do not machine further than the aluminum surface.

6. Finish ream the guide using a 5/16" (.3125") reamer.

Position the valves in the head and check for proper seating. If necessary rework seats.

Exhaust Valve Seal Installation

1. Place valve guide seal on guide, pressing only on metal band of seal. (See figure 3.)

CAUTION: Press ONLY on metal band when installing valve guide seal. Pressing on teflon body or spring will distort seal and result in seal failure.

Assemble and install cylinder head as explained in the service manual.

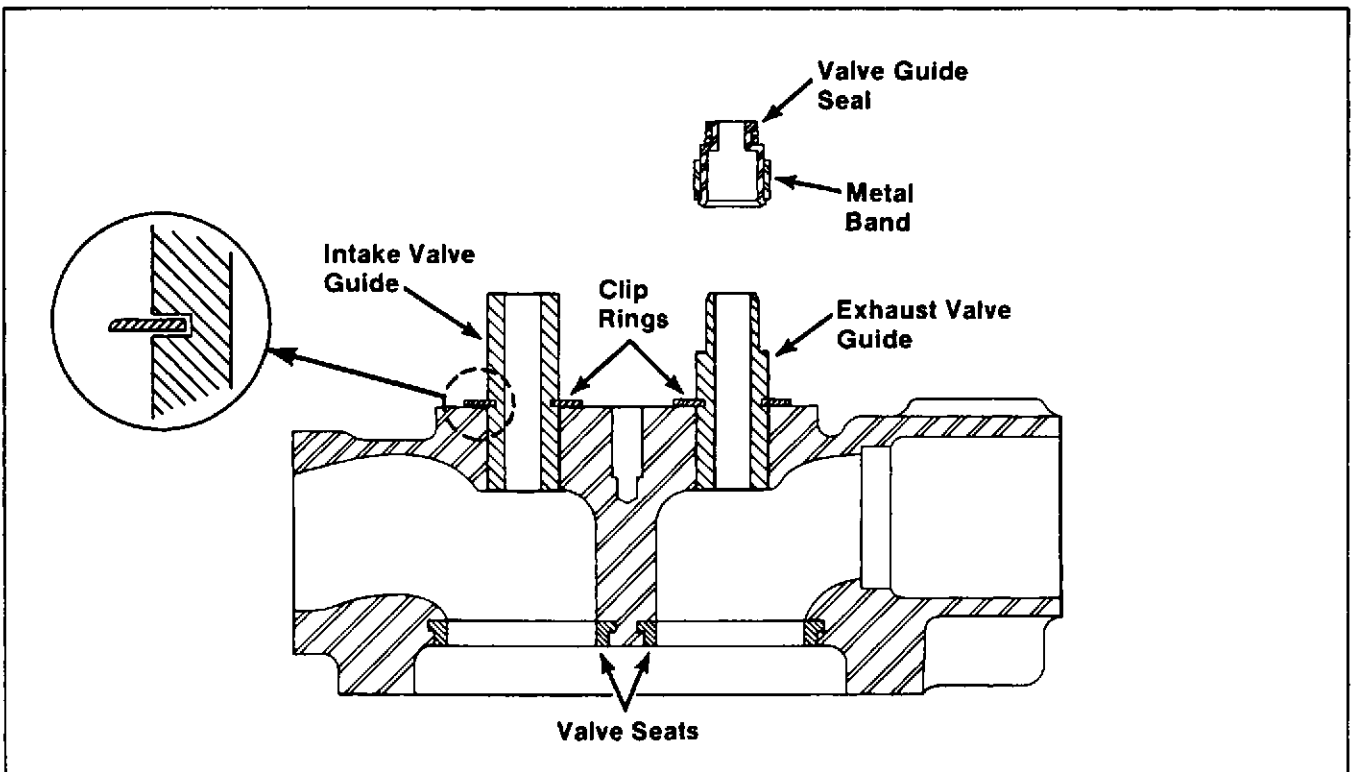


FIGURE 3

NO.	154
MODEL	K361
SUBJECT	ROCKER ARM HOUSING GASKET
ISSUE DATE	10/82
REVISION DATE	

K361 ROCKER ARM HOUSING GASKET

A new rocker arm housing gasket has been designed for the K361 overhead valve engine. This gasket will prevent oil leakage between the rocker arm housing and the cylinder head. Kohler part No. 45 041 14 has been assigned to the new gasket which replaces old gaskets 45 041 08 and 45 041 13. Refer to Parts Bulletin No. 126 for disposition of stock.

Use the following procedure to install the new gasket.

1. Disconnect the battery negative (-) lead.
2. Remove head baffle, rocker arm housing cover, rocker arm housing, and housing gasket from engine.
3. Inspect cooling fins and clean out any dirt or debris which may have accumulated between fins.
4. Check the cylinder head bolt torque values. Lubricate threads with oil and sequentially torque to 30-35 ft. lbs. Refer to the K361 Service Manual (TP-1288) for torque sequence.
5. Clean the gasket surfaces of the rocker arm housing and cylinder head. Place new gasket over the valve springs on cylinder head. Install gasket with the red silicone bead facing up and away from cylinder head.
6. Secure the rocker arm housing to cylinder head with the capscrews.

NOTE: Two different sized capscrews may be used to secure the rocker arm housing to the cylinder head. Certain specifications use (3) 1/4-20x1" capscrews; others may use (2) 1/4-20x1" and (1) 5/16-18x1-1/4" capscrews.

Torque the 1/4-20x1 capscrews to 70 in. lbs. Torque the 5/16-18x1-1/4 capscrews to 150 in. lbs. Lubricate the threads with oil before installing.

7. Check valve clearance between end of rocker arm and valve stem using a feeler gauge. Both intake and exhaust valve clearances should measure 0.005" (cold)—adjust if necessary. Refer to K361 Service Manual (TP-1288) for specific valve clearance adjustment procedure.
8. Secure rocker arm housing cover and head baffle to engine. Reconnect the battery negative (-) lead.

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