Kohler Engine
Models K241, K301 & K321
Service Manual No. 9-77713

J I Case
A Tenneco Company
TENNECO

TABLE OF CONTENTS

OPERATING INSTRUCTIONS
- Pre-Start Check 4
- Starting Procedure 4
- Stopping Procedure 4

GENERAL
- Model Number 5
- Specification Number 5
- Serial Number 5
- General Specifications 5

SERVICE SCHEDULE 6

TROUBLESHOOTING
- Troubleshooting Guide 7

LUBRICATION 7

AIR INTAKE
- Dry Air Cleaners 8
- Precleaners 8

FUEL SYSTEMS
- Carburetor 9
- Fuel Pump 11

GOVERNOR SYSTEMS
- Operation 12
- Adjustment 12

ENGINE – GENERAL
- Cooling 14
- Engine Storage 14
- Engine Tests 14

KOHLER ACR
- Operation 16
- Timing Procedure 17

INSPECTION – DISASSEMBLY
- Inspection 18
- Repair - Replacement Methods 19
- Disassembly Procedure 20

ENGINE RECONDITIONING
- Cylinder Block 21
- Crankshaft 22
- Connecting Rod 22
- Piston and Rings 22
- Cylinder Head 23
- Ring Gear 23
- Valves (Guides and Seats) 24
- Dynamic Balance System 30

ENGINE REASSEMBLY
- Reassembly Procedure . . . . 34 - 41

SPECIFICATIONS AND WEAR TOLERANCES . 42 - 43

OPERATING INSTRUCTIONS

PRE-START CHECK LIST

OIL LEVEL: Add oil as needed to keep level in safe range between L and F marks on the dipstick.

FUEL: Fill fuel tank with clean, fresh REGULAR grade of gasoline. Use leaded or non-leaded type but make sure octane rating is at least 90. Don't mix oil with gasoline. If engine has a fuel filter, clean sediment bowl if needed.

COOLING: Check air intake screens and cooling fins--keep them clean and unrestricted.

AIR CLEANER: Make sure cleaner and intake parts are tight and properly installed to prevent unfiltered air from entering the engine.

BATTERY (ELECTRIC START): Keep battery surface clean to prevent self-discharge. Check electrolyte level. Connections must be tight and negative (-) terminal must be the ground terminal.

STARTING PROCEDURE

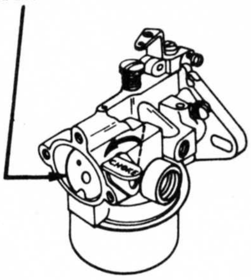
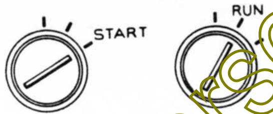
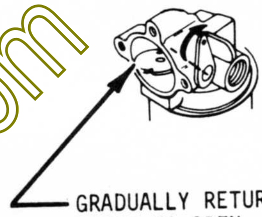
CLOSE CHOKE	KEYSTART	OPEN CHOKE
MOVE CHOKE TO CLOSED POSITION 	KEYSTART - MOVE KEY TO START POSITION, *RELEASE WHEN ENGINE STARTS (SWITCH AUTOMATICALLY RETURNS TO RUN) 	 GRADUALLY RETURN CHOKE TO OPEN POSITION AFTER ENGINE STARTS

FIGURE 1

STOPPING PROCEDURE

DISENGAGE DRIVE	TURN IGNITION OFF
EMERGENCY STOP:	If engine continues running when ignition is turned off, close choke and open throttle to stall engine--Don't pull ignition leads to stop.

GENERAL

This manual covers the Kohler single cylinder, horizontal crankshaft engine models listed in the chart below. These are 4-stroke cycle air-cooled engines. When ordering replacement parts and in any communication involving an engine, always report the MODEL, SERIAL and SPECIFICATION numbers as found on the nameplate. The significance of these numbers is explained as follows:

MODEL NUMBER

This number indicates the model series within which the engine is built. It also is a code indicating (a) the cubic inch displacement and (b) number of cylinders. The model K241 for example indicates a 24 cubic inch displacement, 1 cylinder engine. Letter suffixes following the model number indicate a specific version--the letter suffix code is as follows:

MODEL SUFFIX LETTER EXPLANATION

A – suffix indicates special oil pan.

SPECIFICATION NUMBER

The specification number indicates model variation. It is used to indicate a combination of various groups used to build an engine. It may have a suffix letter which is sometimes important in determining supersession of parts. The first two digits of the specification number is the code designating engine model--the remaining numbers are issued in numerical sequence as each new specification is released--for example 2899, 28100, 28101. The current model code designation is as follows:

SPECIFICATION NUMBER MODEL CODE EXPLANATION

Model	K241	K301	K321
CODE DESIGNATION (First 2 Digits)	46	47	60

SERIAL NUMBER

The serial number lists 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. In 1969, the letter prefix to the engine serial number was dropped. The letter prefix was the code designation for year of manufacture as shown in the chart below. The first digit in the serial number is now used as the code indicator; for example, in serial number 2127796, the 2 indicates that the engine was built in 1970--the numerical code is also shown below. Note that in 1969 some engines had the letter prefix designation while others had the numerical indicator. The code since 1965 is as follows:

SERIAL NUMBER CODE EXPLANATION

YEAR OF MANUFACTURE	LETTER PREFIX					FIRST DIGIT (NUMBER)						
	1965	1966	1967	1968	1969	1969	1970	1971	1972	1973	1974	
CODE DESIGNATION	A	B	C	D	E	1	2	3	4	5	6	ETC.

GENERAL SPECIFICATIONS

ENGINE MODEL	BORE (Nominal)	STROKE (Nominal)	DISPLACEMENT	WEIGHT (Approx.)	LUBE OIL CAPACITY	SPARK PLUG GAP	BREAKER POINT GAP
K241A	3-1/4" (82.6 mm)	2-7/8" (73.0 mm)	23.9 cu. in. (392 cm^3)	116# (52.5 kg)	1-1/2 qt. (1.4 l)	.025" (.64 mm)	.020" (.50 mm)
K301A	3-3/8" (85.7 mm)	3-1/4" (82.6 mm)	29.07 cu.in. (476 cm^3)	116# (52.5 kg)	1-1/2 qt. (1.4 l)	.025" (.64 mm)	.020" (.50 mm)
K321A	3-1/2" (88.9 mm)	3-1/4" (82.6 mm)	31.27 cu.in. (512 cm^3)	119# (54 kg)	1-1/2 qt. (1.4 l)	.025" (.64 mm)	.020" (.50 mm)

SERVICE SCHEDULE

SERVICE FUNCTION	PERFORM SERVICE AT INTERVAL INDICATED (X)				
	DAILY	25 HOURS	50 HOURS	100 HOURS	500 HOURS
LUBRICATION SYSTEM					
OIL LEVEL Check and add oil as needed.	X				
OIL CHANGE Thoroughly drain, refill with oil of proper grade and weight.		X			
AIR INTAKE SYSTEM					
DRY TYPE AIR CLEANER Clean element. (Replace element every 200 hours under normal operating condition.)			X		
IGNITION SYSTEM					
SPARK PLUG Remove plug, clean and regap. (Use new plug if needed.) Reinstall plug and tighten to 324 in. lbs. (36.6 Nm) torque.				X	
BREAKER POINTS Remove cover, check condition of point contacts, service (or replace) as necessary.				X	
IGNITION TIMING Check and retime as necessary. Set breaker point gap to .020" (.50 mm) fully open then use timing light method.					X
ELECTRICAL (CHARGING - STARTING) SYSTEMS					
MOTOR - GENERATOR Check and correct belt tension if needed. Check brushes and commutator — service as required.			X		
VOLTAGE REGULATOR Remove cover, check condition and contact point gap, Service as required.					X
ENGINE - GENERAL					
EXTERNAL SURFACES Clean air intake screen, cooling fins and block especially in oil fill area.	X				
VALVE CLEARANCE Remove cover, check clearance between valve stems and tappets (See Valve Clearance Adjustment), adjust as needed.					X
CRANKCASE BREATHER Remove components, check reed valve and gaskets, clean filter. Reinstall in proper sequence.					X
CYLINDER HEAD Remove head, scrape out carbon deposits with piece of wood. Install new gasket, reinstall head and tighten bolts in proper sequence and to specified torque value.					X

NOTE: See appropriate Service Section for specific details on performing the various service functions.

TROUBLE SHOOTING

If trouble occurs, don't overlook causes that seem too obvious to be considered such as an empty fuel tank--check for the simplest causes first. To operate, an engine must have fuel, a good ignition spark and, of course, good compression--keep this in mind when trying to pinpoint the cause of a problem. The following is offered as a guide for correcting some of the problems that are possible with a 4 stroke cycle engine.

TROUBLE SHOOTING GUIDE

PROBLEM	FUEL RELATED CAUSES			IGNITION CAUSES		OTHER CAUSES						
	NO FUEL	IMPROPER FUEL	FUEL MIX. WRONG	NO SPARK	POOR IGNITION	IMPROPER COOLING	IMPROPER LUBRICATION	POOR COMPRESSION	VALVE PROBLEMS	CARBON BUILD-UP	GOVERNOR FAULTY	ENGINE OVERLOADED
WILL NOT START	X			X				X	X			
HARD STARTING		X	X		X	X		X	X			
STOPS SUDDENLY	X			X			X		X			
LACKS POWER		X	X		X	X		X	X	X		X
OPERATES ERRATICALLY		X	X		X						X	
KNOCKS OR PINGS		X	X			X				X		X
"SKIPS" OR MISFIRES			X		X							
BACKFIRES			X		X				X			
OVERHEATS			X		X	X			X			X
IDLES POORLY			X		X							

LUBRICATION

OIL LEVEL

With the splash system, the oil level must be maintained on the "Safe" operating range at all times--this is between the F (full) and L (low) mark on the dipstick. Check the level daily and add cil as needed. DO NOT OVERFILL--oil level must no exceed F mark.

OIL TYPE

Oils meeting the requirements of the American Petroleum Institute's (API) Service classification SC are suitable for use in Kohler Air-Cooled Engines. Service SC oils are detergent type oils. Oil Viscosity (weight) is selected according to the anticipated ambient temperatures. The temperature-viscosity recommendations are:

AIR TEMPERATURE	OIL VISCOSITY	OIL TYPE
Above 30° F.(-1° C.)	**SAE 30**	**API Service SC***
30° to 0° F. (-1° C. to -18° C.)	**SAE 10W-30**	**API Service SC***
Below 0° F. (-18° C.)	**SAE 5W-20**	**API Service SC***
*SC standard recommendation--CC (MIL-2104B) and SD class oils may also be used.		

OIL CHANGE

On new engines, the oil should be changed after the first five hours of operation--there-after each 25 hours of operation under normal conditions. If extremely dusty or dirty conditions prevail, change oil more frequently. If possible, run engine just prior to changing oil--the oil will flow more freely and carry away a greater amount of contamination when it is hot. Refill with 3 pints (1.4 l) of a clean and proper type oil. (See OIL TYPE above).

RUN-IN OIL

A special "break-in" oil is used in the factory on new Kohler Engines. Each new engine is test run on this oil for a specific period of time to allow proper seating of the rings. After factory "run-in", the break-in oil is drained. Further use of break-in or non-detergent type oil is not required or recommended for new Kohler Engines. Use detergent type API Service SC.

On overhauled engines or on those having new blocks, the use of non-detergent oil is recommended only during the first 5 hours of operation. This helps seat piston rings, however, use should be discontinued after the run-in period. Use API Service SC (detergent type) oil after the initial run-in period.

Dirt induced through improperly installed, poorly serviced or inadequate air cleaner elements wears out more engines than does long hours of operation. Even a small amount of dirt will wear out a set of piston rings in a few hours. Also, a clogged element causes a richer fuel mixture which may lead to formation of harmful sludge deposits. Always cover carburetor or air horn when air cleaner is removed.

DRY AIR CLEANERS

SERVICE - REPLACEMENT: Dry type elements should be replaced after 100 to 200 hours if engine is operated under good clean air conditions--service and replace element more frequently under extremely dusty or dirty conditions. Dry elements should be cleaned after about each 50 hours of operation--remove element and tap lightly on a flat surface to remove loose surface dirt. Replace element if dirt does not drop off easily. Do not wash dry elements in any liquid or attempt to blow dirt off with air hose as this will puncture filter element. Carefully handle new element--do not use if gasket surfaces are bent or twisted. Check the following when installing new or serviced elements:

1. Back plate must be securely tightened to carburetor. Replace back plate if bent or cracked.
2. Gasket surfaces of element must be flat against back plate and cover to seal effectively.
3. Wing nut must be finger tight--don't overtighten.

PRECLEANERS: Precleaners are available for use with dry type air cleaners. The precleaner traps much of the dirt, preventing it from entering the dry element thereby extending its life. No modification is needed--the precleaner slips right over the dry element. Servicing of the precleaner is accomplished by washing it in soap and water then, after rinsing and squeezing out excess water, allowing it to air dry (whenever possible), then reinstall it over element. DO NOT oil this type precleaner.

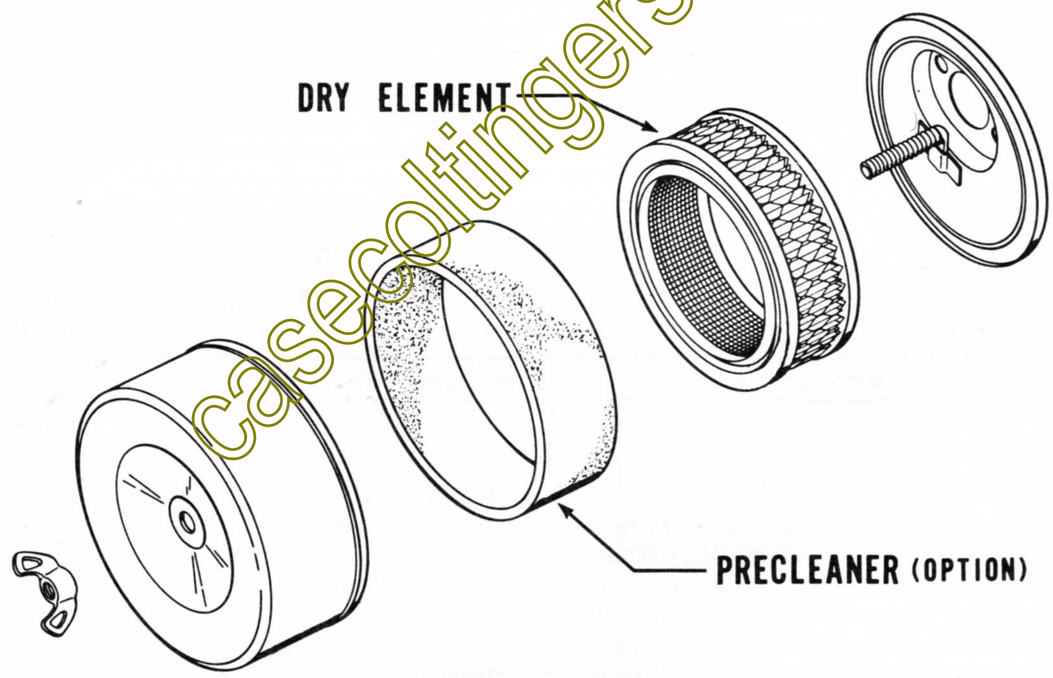


FIGURE 2 DRY TYPE AIR CLEANER WITH OPTIONAL PRECLEANER

Always use a clean, fresh REGULAR grade of gasoline. Leaded or non-leaded type gasoline may be used provided the octaine rating is 90 or higher. Use of the non-leaded type gasoline not only lowers emission of air pollutants but results in a considerable reduction of deposits in the combustion chamber. Purchase brand name fuels from popular service stations to eliminate chances of using stale gasoline as this results in formation of gum deposits which can quickly clog carburetor passages. If the engine is to be stored during an off season, drain the fuel system, run the tank dry or add a gasoline stabilizer to the tank.

IMPORTANT: Some stabilizers are not suitable for use in non-metallic tanks--check this before using.

Always use a vented fuel tank filler cap and keep the vent open to prevent stoppage or starvation of fuel.

CARBURETOR

Carburetors are adjusted in the factory and should not have to be reset. If however, one of the following conditions is noted, readjust carburetor immediately as continues operation with incorrect setting can lead to fouled spark plugs, overheating, excessive valve wear or other problems. If black exhaust smoke is noted, check the air cleaner first--an "overrich" mixture is usually caused by a poorly serviced, clogged air cleaner element, not an improperly adjusted carburetor.

If readjustment becomes necessary, stop the engine, then turn the MAIN and IDLE fuel adjusting screws all the way in until they bottom lightly--don't force them closed as this will damage the needle valves. For preliminary setting, turn MAIN fuel screw out (counterclockwise) 2 full turns and the IDLE 1-1/4 turns. For final adjustments, start engine and allow it to warm up then operate at full throttle and under load, if possible. Turn MAIN fuel in until engine slows down (lean side) then out until it slows down again from overrich setting--note positions of screw at both settings, then set it about halfway between the two. The IDLE fuel setting can then be adjusted in the same manner for smoothest idle. Rough idle is often due to the idle speed being set too low--check this also.

IDLE SPEED: Idle no-load speed on most engines is set at 1200 RPM; however, with parasitic loads such as presented by hydrastatic drives, the idle speed may have to be increased as much as 1700 RPM for best no-load idle.

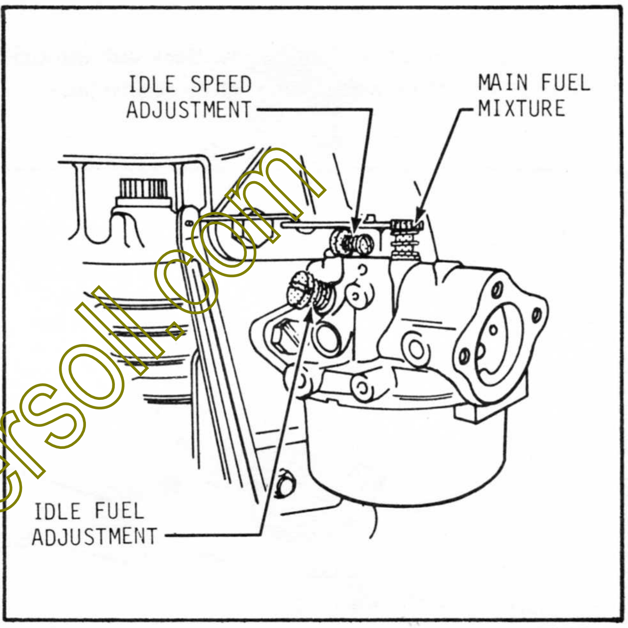


FIGURE 3 SIDE DRAFT GASOLINE CARBURETOR

CONDITION	POSSIBLE CAUSE/PROBABLE REMEDY
A. Black, sooty exhaust smoke, engine sluggish.	**A. Mixture too rich - readjust main fuel needle.**
B. Engine misses and backfires at high speed.	**B. Mixture too lean - readjust main fuel needle.**
C. Engine starts, sputters and dies under cold weather starting.	**C. Mixture too lean - turn main fuel adjustment 1/4 turn counterclockwise.**
D. Engine runs rough or stalls at idle speed.	**D. Idle speed too low or improper idle adjustment - readjust idle speed then idle fuel needle if needed.**

CARBURETOR RECONDITIONING: Service difficulties with fuel systems usually originate from improper carburetor adjustments 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 an alcohol or acetone solvent. 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.

ASSEMBLY OF CARBURETOR - SIDE DRAFT

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" (4.3 mm) plus or minus 1/32 of an inch (.8 mm) 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, new bowl nut gasket (when required) and bowl nut. Tighten securely after making sure bowl is centered on gasket.
5. Install main fuel adjustment needle. Turn in until needle seats in nozzle and back out two turns.
6. Install idle fuel adjustment needle. Back out approximately 1-1/4 turns after seating lightly against jet.

IMPORTANT: DO NOT USE FORCE ON ADJUSTMENT NEEDLES.

DISASSEMBLY OF CARBURETOR - SIDE DRAFT

1. Remove carburetor from engine.
2. Remove bowl nut, gasket and bowl. When carburetor has bowl drain, remove drain spring, spacer (when used), plug and gasket from inside of 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.

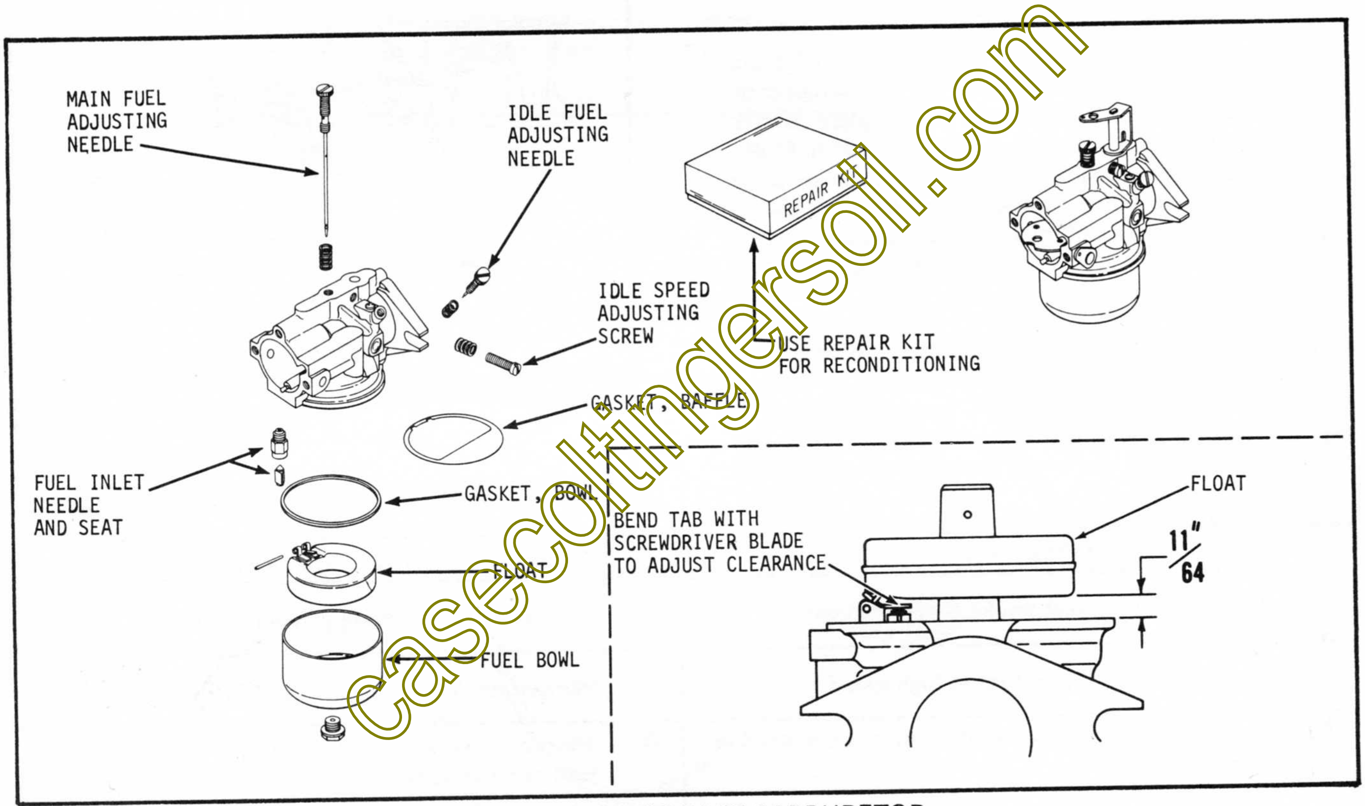


FIGURE 4 SIDE DRAFT CARBURETOR

FUEL PUMP

The mechanical fuel 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.

Repair kits are available for reconditioning fuel pumps.

RECONDITIONING PROCEDURE

1. Remove fuel lines and mounting screws holding pump to engine.

2. With a file, make an indicating mark across a point at the union of fuel pump body and cover. This is a positive marking to assure proper reassembly. Remove assembly screws and remove cover.

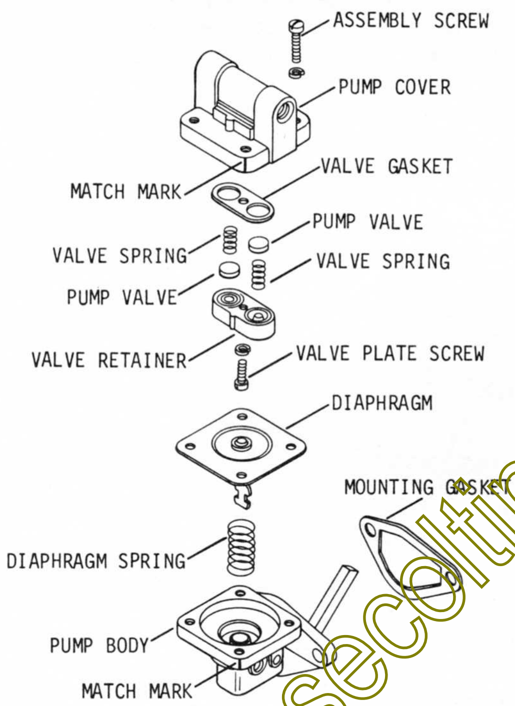


FIGURE 5 FUEL PUMP (MECHANICAL - 10 H.P.)

3. For 10 h.p.: Turn cover over and remove valve plate screw and washer. Remove valve retainer, valves, valve springs and valve gasket, noting their position. Discard valve springs, valves and valve retainer gasket.

   For 12-14 h.p. (die cast pump): Remove top cover gasket and press out valve and cage assemblies and valve gaskets.

   For all models (plastic pump): Fuel pump valve area is not serviceable.

4. Clean fuel head thoroughly with solvent and a fine wire brush.

5. For 10 h.p.: Holding pump cover with diaphragm surface up, place new valve gasket into the cavity. Now assemble the valve spring and valves into the cavity and reassemble valve retainer and lock in position by inserting and tightening fuel pump valve retainer screw.

   For 12-14 h.p. (die cast pump): Press valve gaskets and valve and cage assemblies into upper body. Align top cover gasket and top cover and secure with retainer screws and lockwashers.

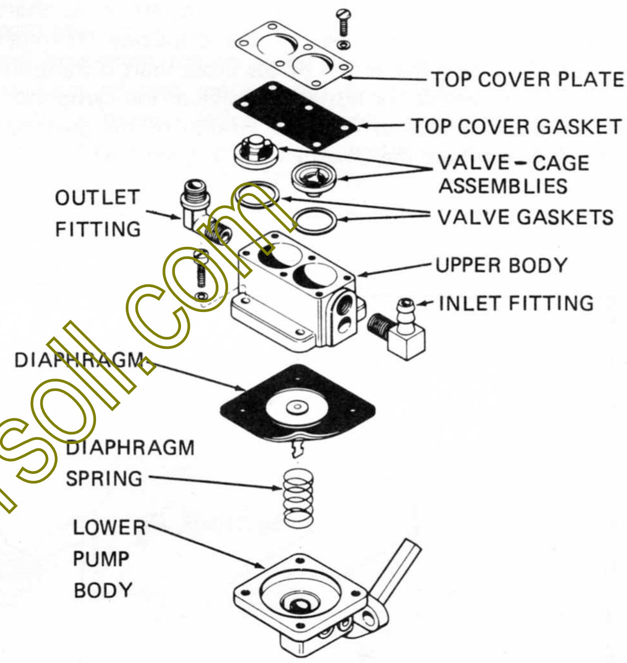


FIGURE 6 FUEL PUMP (MECHANICAL - 12 AND 14 H.P.)

6. Holding mounting bracket, press down on the diaphragm to compress spring under it, then turn bracket 90° to unhook diaphragm so it can be removed.

7. Clean mounting bracket with a solvent and a fine wire brush.

8. Replace the diaphragm operating spring, stand new spring in casting, position diaphragm and press down on diaphragm to compress spring and turn 90° to reconnect diaphragm.

9. Hold mounting bracket, then place the pump cover on it (make sure that indicating marks are in line) and insert the four screws. DO NOT TIGHTEN. With the hands on the mounting bracket only, push the pump lever to the limit of its travel and hold in this position while tightening the four screws. This is important to prevent stretching the diaphragm.

10. Mount the fuel pump on engine, using the new mounting gaskets. Connect the fuel lines.

GOVERNOR SYSTEMS

All Kohler Single Cylinder Engines are equipped with centrifugal flyweight mechanical type governors. The governor gear--flyweight mechanism is mounted within the crankcase and driven off a gear on the camshaft.

OPERATION

In 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, 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.

ADJUSTMENT

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

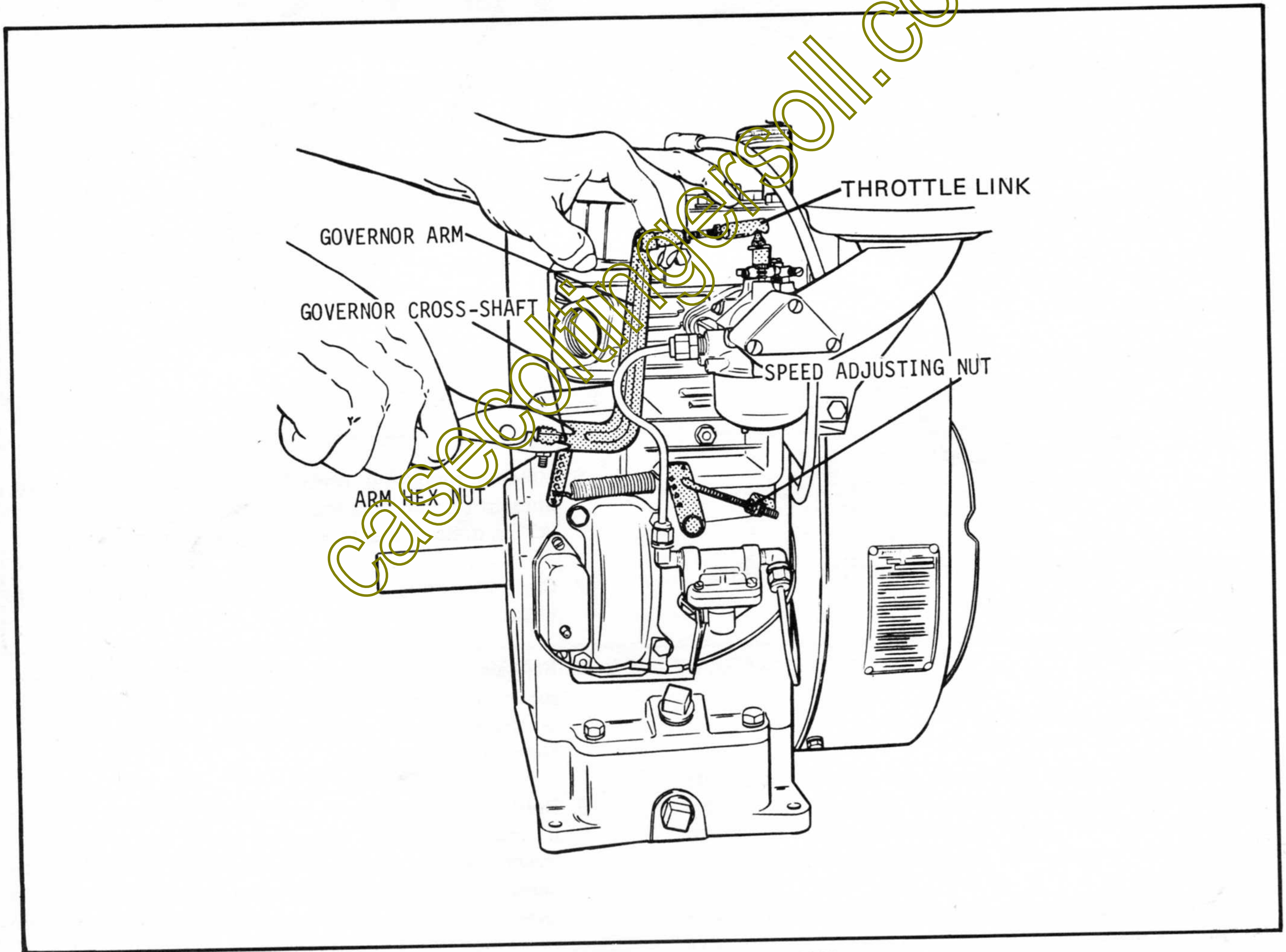


FIGURE 7 INITIAL ADJUSTMENT

THROTTLE AND GOVERNOR ADJUSTMENT

1. With the engine not running hold the throttle shaft and lever on the carburetor in the full open position (against high idle stop).

2. Loosen the governor arm retainer nut and adjust the throttle link so the governor arm is vertical when the throttle is full open.

3. Turn the governor shaft counter-clockwise as far as possible with a pair of pliers and with the governor arm in the vertical position, tighten the governor arm retainer nut.

4. Tighten generator belt to 1/4" (6.3 mm) deflection (finger tight) between the pulleys. Start the engine and check the high idle speed. Use vibration tachometer or a hand tachometer at the end of the starter - generator pulley. The RPM at the starter - generator is 2.6 times faster than engine speed. The engine high idle speed should be 3600 RPM; therefore the RPM at the starter - generator will be 2.6 x 3600 or approximately 9,360 RPM at the starter - generator pulley.

5. To adjust the high speed stop on the side of the engine, loosen the hex head screw and move the stop up or down. With the high speed stop properly set to 3600 RPM, tighten the screw.

SENSITIVITY ADJUSTMENT: Governor sensitivity can be adjusted by repositioning the governor spring in the holes on the governor arm and speed control brackets. 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 bottom on the governor arm bracket and in the second hole from top on speed control bracket. To make governor control more sensitive, increase tension on spring by moving spring into holes spaced further apart. Conversely, decreasing spring tension allows broader governor control but less sensitivity.

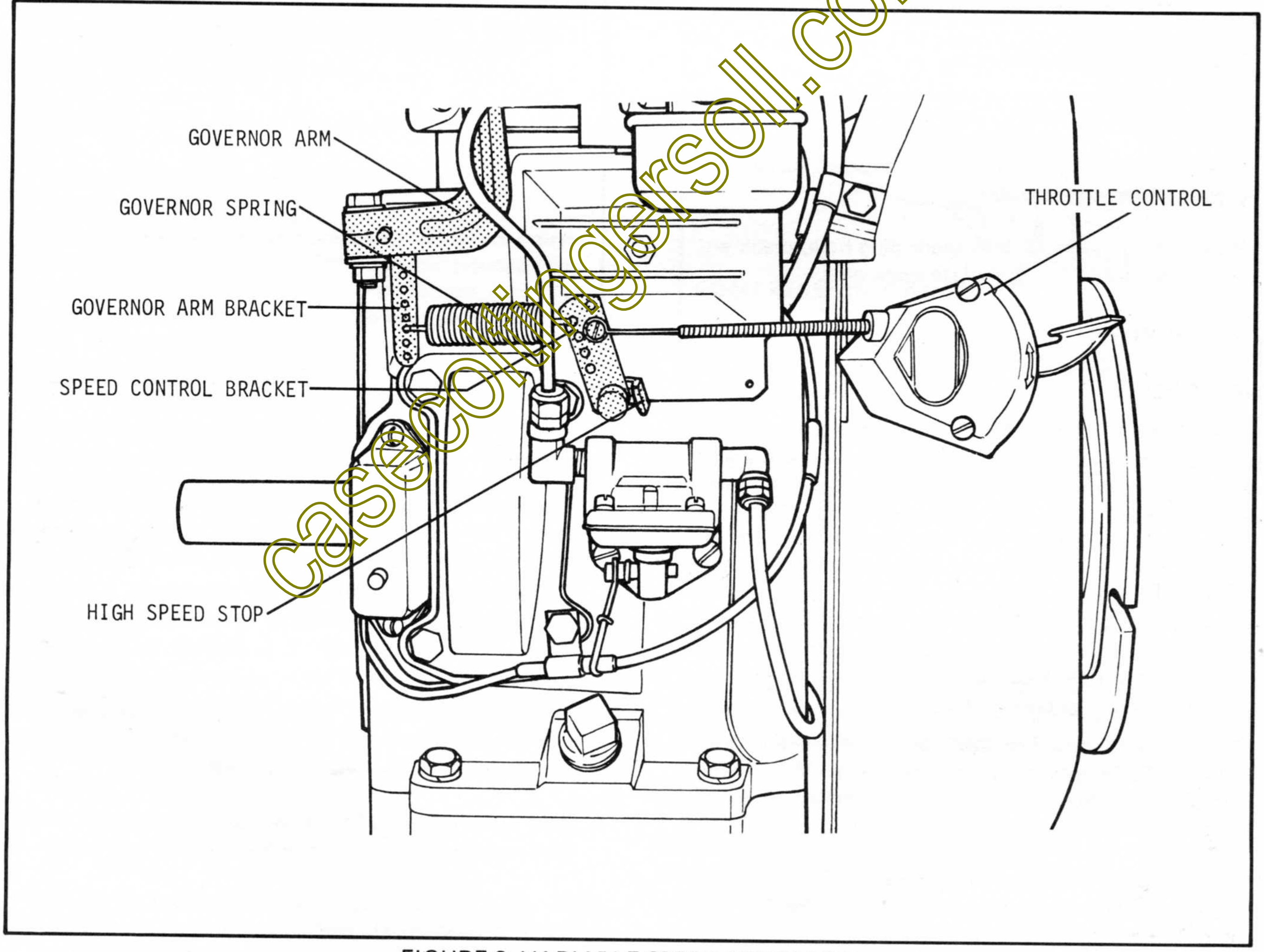


FIGURE 8 VARIABLE SPEED GOVERNOR

COOLING

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

EXTERNAL SURFACES

External surfaces must be maintained in clean condition free of any oil and dirt accumulation. This is done not only for safety and appearance but because poor cooling efficiency results from dirty external surfaces.

ENGINE STORAGE

If engine is to be out of service for a considerable length of time, the following steps are recommended:

1. Drain oil from crankcase while engine is still hot and flush with clean, light oil. Refill crankcase.
2. Drain fuel tank and carburetor.
3. Clean exterior of engine.
4. Spread a light film of oil over any exposed surfaces of engine subject to corrosion.
5. Pour tablespoon of oil into spark plug hole, crank engine slowly by hand and replace spark plug.
6. Store in dry place.

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″ (125 mm) to 10″ (254 mm) water column as read on "U" tube water manometer or 1/2 (12.7 mm) to 1″ (25.4 mm) 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 check first:

1. Clogged Crankcase Breather can cause positive pressures to build up in the crankcase. Disassemble breather assembly, thoroughly clean, then recheck pressure after re-installing.
2. Worn oil seals can cause lack of vacuum. Oil leakage is usually evident around worn oil seals. (See Oil Seal Replacement Instructions)
3. Blowby, leaky valves can also cause positive pressures. These conditions can be confirmed by making compression test on engine.

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

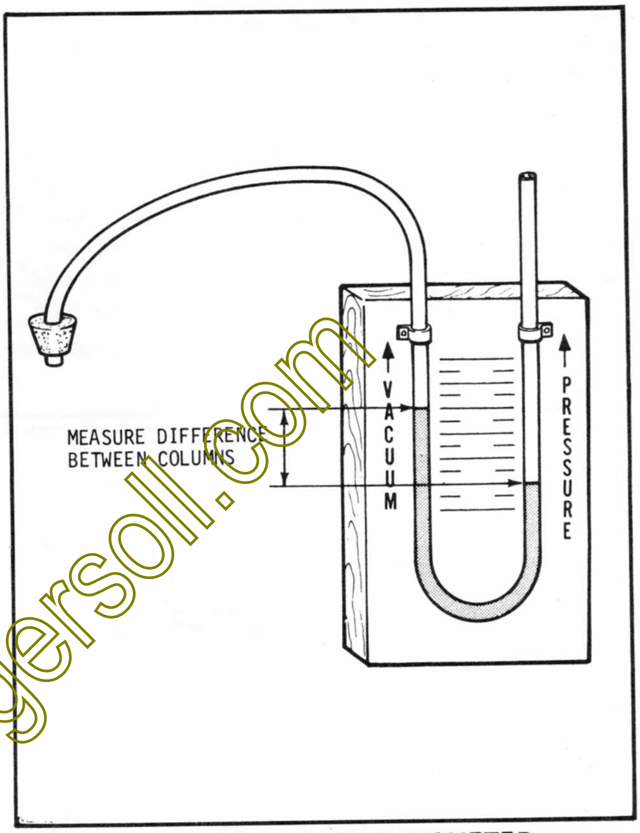


FIGURE 9 "U" TUBE MANOMETER

1. 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.
2. Measure inside, straight section of tube and mark inch increments from 0 to 12″ (0 to 300 mm in 25 mm increments.)
3. 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.
4. Pour water (colored for easier reading) into tube until level reaches the approximate halfway mark on scale.

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: The results of a compression check can be used to determine if an engine is in good operating condition or if reconditioning is needed. Low readings can indicate several conditions or a combination of the following conditions.

LOW COMPRESSION

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 valve.**
C. Piston rings worn - blowby occuring.	**C. Recondition engine.**
D. Valves leaking.	**D. Recondition engine.**

Higher than normal compression can indicate that excessive carbon deposits have built up in the combustion chamber.

A simple "feel" test can be used as a "spot check" if poor compression is suspected as the reason for hard starting and lack of power. If results of test point to poor compression--this test should be followed up with the more precise and accurate test method using a compression gauge.

METHOD 1 - SPOT CHECK (WITHOUT GAUGE)

1. Remove high tension lead from the spark plug.

2. Spin flywheel against compression - (clockwise direction) on pre-ACR engines. Piston should bounce backward with considerable force. Pull piston over Top Dead Center (TDC) - considerable resistance should be felt as piston approaches TDC. After piston reaches TDC, it should snap downward on the power stroke.

   On ACR engines, rotate flywheel backwards (counterclockwise direction) against power stroke - if little or no resistance is felt, check with compression gauge.

METHOD 2 - COMPRESSION GAUGE TEST

1. Remove spark plug and insert compression gauge in hole.

2. Engine will have to be motored to a speed of about 1000 RPM. Hold throttle and choke wide open and take several compression readings. Consistant readings of 110 to 120 psi (750-825 kPa) indicate good compression.

COMPRESSION TESTING ACR ENGINES

Since ACR engines release compression at speeds under 500 RPM, the test procedure is different than that for other pre-ACR engines. If low compression is suspected, run the engine first to warm it up, then stop the engine and install a compression gauge in the spark plug hole. Set throttle and choke wide open. Crank engine first with fully charged battery. If compression is 90-100 psi (620-680 kPa) ok.

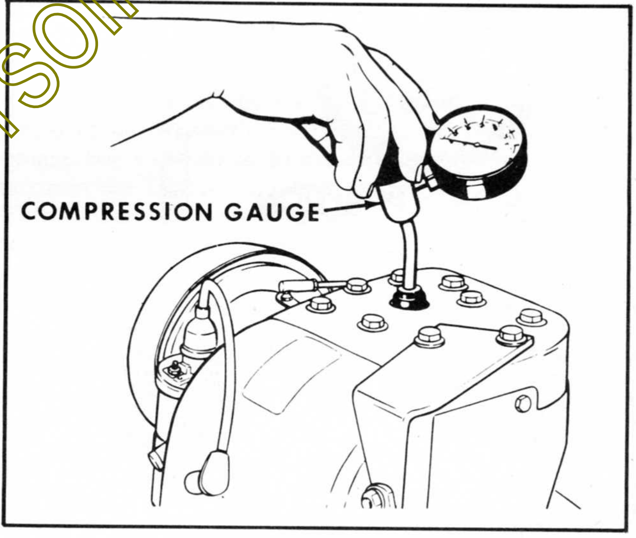


FIGURE 10 COMPRESSION TEST

If less than 90 psi (620 kPa) manually crank the engine in counterclockwise direction (opposite normal rotation) and take compression readings--note that the readings will build up after each turn. At the first pull, the reading may be as low as 30 psi (200 kPa) but after the seventh pull, it will be as high as 90-100 psi (620-680 kPa) if the engine is in good condition. If readings are considerably below 90 psi after seven or eight successive readings, this indicates poor compression.

Low compression could be attributed to a blown cylinder head gasket, loose cylinder head, leaking valves or worn piston rings. Check the head and head gasket first.

KOHLER ACR

ACR is the trademark for the Automatic Compression Release mechanism patented by Kohler Co. All Kohler 4-cycle single cylinder engines, with the exception of the Model K91, now are 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.

OPERATION

Kohler 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 11. 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.

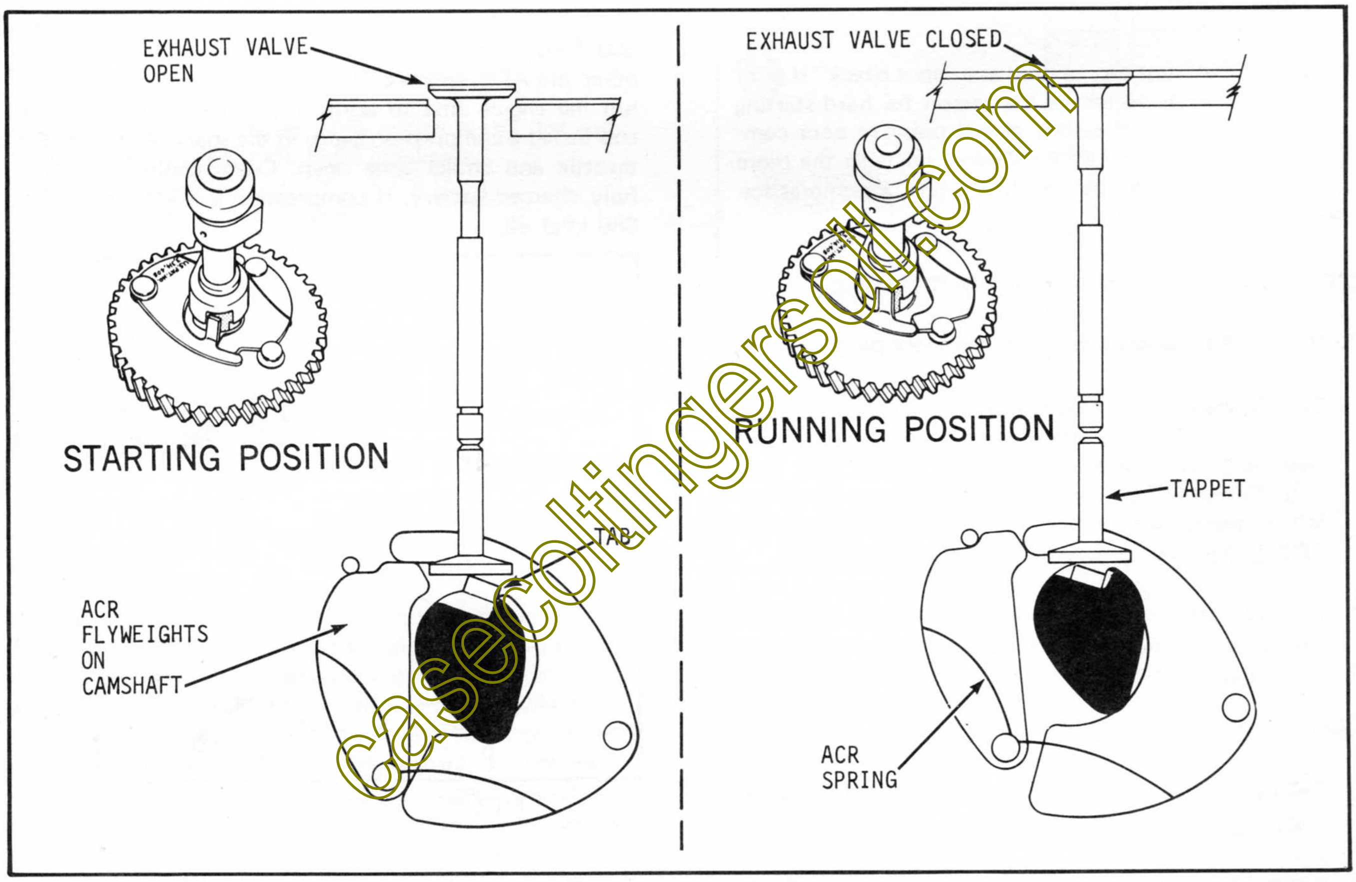


FIGURE 11 ACR OPERATION

BENEFITS

Manual starting of the higher horsepower engines would be virtually impossible at full compression. Furthermore, the size of the battery and starter for electric start engines without ACR would have to be too large to be practical for most applications in which these engines are used.

In addition to lowering the cranking effort, ACR eliminated the need for a spark retard mechanism. Spark retard is necessary on engines without ACR to prevent "kick-back"--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 thru 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 REQUIREMENTS

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 gear cover and rehook or replace--the camshaft does not have to be removed for servicing the spring. The flyweights are non-serviceable--if they become permanently stuck or excessively worn, a new camshaft is required.

ACR TIMING PROCEDURE

When the tab on the ACR flyweight is properly set, the exhaust valve will close when the piston is 40° to 36° BTDC. The tab is adjusted during manufacture of the engine but the setting could change under adverse conditions. If, for example, a sticking exhaust valve pushes the tab closer to the camshaft, not enough compression will be released resulting in hard cranking. If, on the other hand, the tab is pulled away from the shaft, too much compression will be released which could prevent starting.

To determine if the ACR is properly timed, remove the cylinder head, then install a depth gauge to measure where the piston is when the exhaust valve closes. The piston depth is stated in millimeters and inches at 36° and 40° in the chart below--note that it varies according to engine model.

DEGREES BTDC	K241		K301 - K 321	
	INCHES	MM	INCHES	MM
40°	.4136	(10.505)	.4842	(12.296)
36°	.3391	(8.611)	.3972	(10.086)

If the ACR compression is too high, the valve will close before the piston is 40° to 36° BTDC and if compression is too low, it will close after the piston is in this range. If the tab is too high, tap the exhaust valve to force the tab down or if too low, remove the cam gear cover and pry the tab up with a screwdriver blade. Adjust tab as needed until the exhaust valve closes within specified range.

IMPORTANT: Use care when adjusting the tab. The tab may break off if bent up and down too often.

If a depth gauge is not available, a timing mark can be added to the flywheel at 40° BTDC for checking ACR timing. Use a divider to do this--first measure the distance between the TDC and S marks on flywheel (which is 20° BTDC), then make mark 20°ahead of the SP mark which would be 40° BTDC. Remove the cylinder head and observe if the exhaust valve closes when the piston is 40° BTDC. Adjust tab as necessary to achieve proper setting.

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.

EXCESSIVE SLUDGE AND VARNISH FORMATION

Sludge 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 lubricating oil changes. It can also indicate operation with improper ignition timing or overrich carburetor adjustment or a poorly serviced clogged air cleaner which restricts air intake and also results in an overrich mixture.

SCORING OF THE CYLINDER WALL

Unburnt 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 pre-ignited 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 pressures under 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 blow-by, oil will be forced out of an engine at oil seals, gaskets or any other available spot.

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.

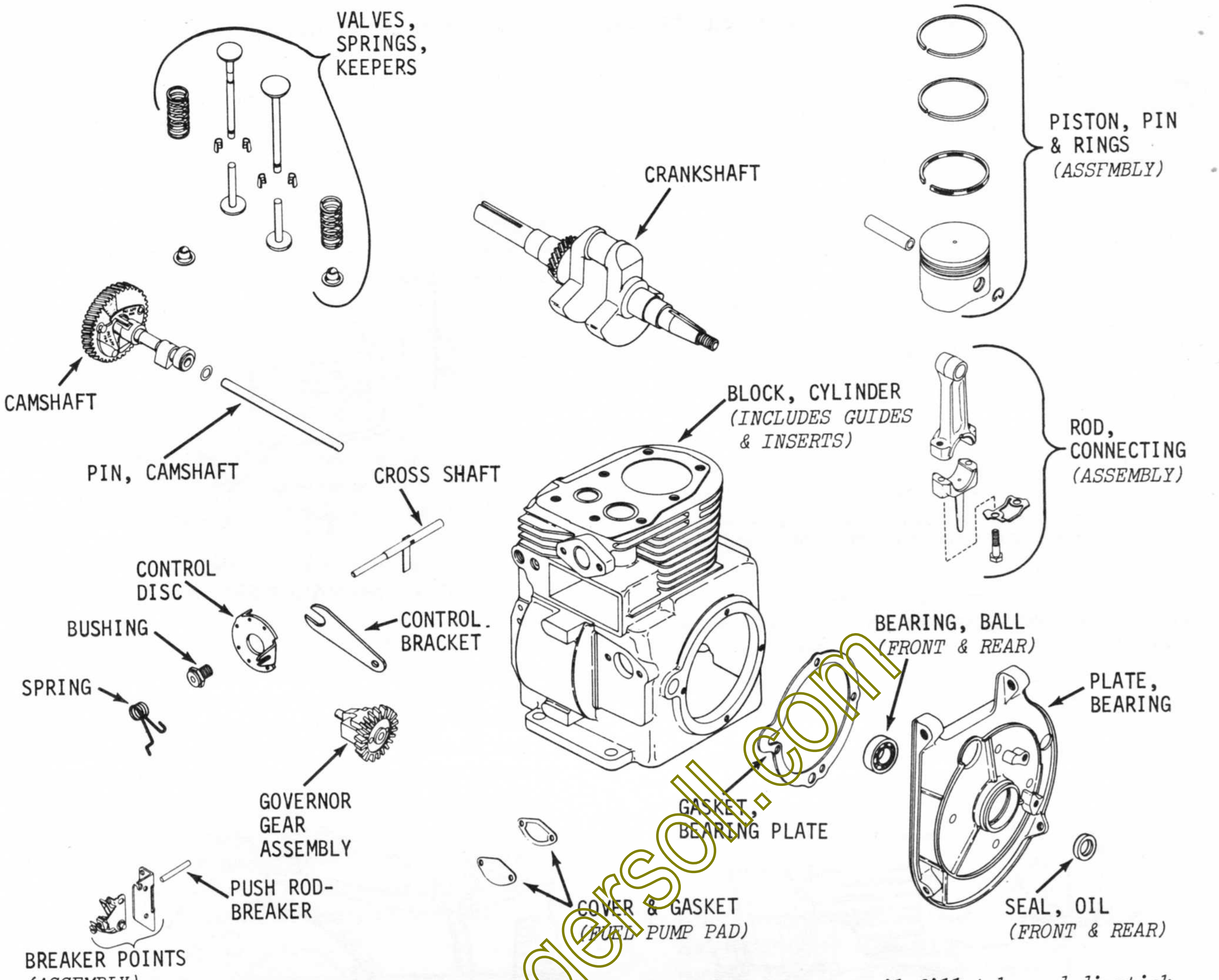
REPAIR - REPLACEMENT METHODS

There are several different methods to choose when repairing a failed single cylinder engine. If you have complete shop facilities to rebore cylinders and regrind crankshafts, you may choose to completely overhaul the engine using appropriate oversize and/or undersize replacement parts. If the bore, piston, connecting rod are damaged but the crankshaft and all other parts are in good condition, the miniblock may be the best repair method. When an engine, including crankshaft, is extensively damaged or badly worn internally, a short block could be used.

If an engine is in bad shape, both internally and externally, consider replacing it with a Universal Service Engine or a basic catalog engine if available for the engine spec involved. These repair and replacement methods are described briefly in the following.

SHORT BLOCK: Each short block includes a crankcase with all internal parts, such as, valve mechanism, camshaft, piston-rod assembly, crankshaft and bearing plate installed--all other items must either be transferred from the damaged engine or taken from stock to build the short block up to a complete unit. Parts included with each short block are shown in the accompanying illustration .

MINIBLOCK: A miniblock could be considered as a "crankless" short block since it has the same items except that the crankshaft and bearing plate assembly are omitted. Omitting these items not only reduces costs but allows the miniblock to be used in place of a short block in cases where the short block crankshaft is not suitable for the particular application. The crankcase-bearing plate assembly must be in condition to be reused on the miniblock.



NOTE: *All parts are assembled to Short Block except oil fill tube and dipstick.*

FIGURE 12 COMPONENTS OF A TYPICAL SHORT BLOCK ASSEMBLY

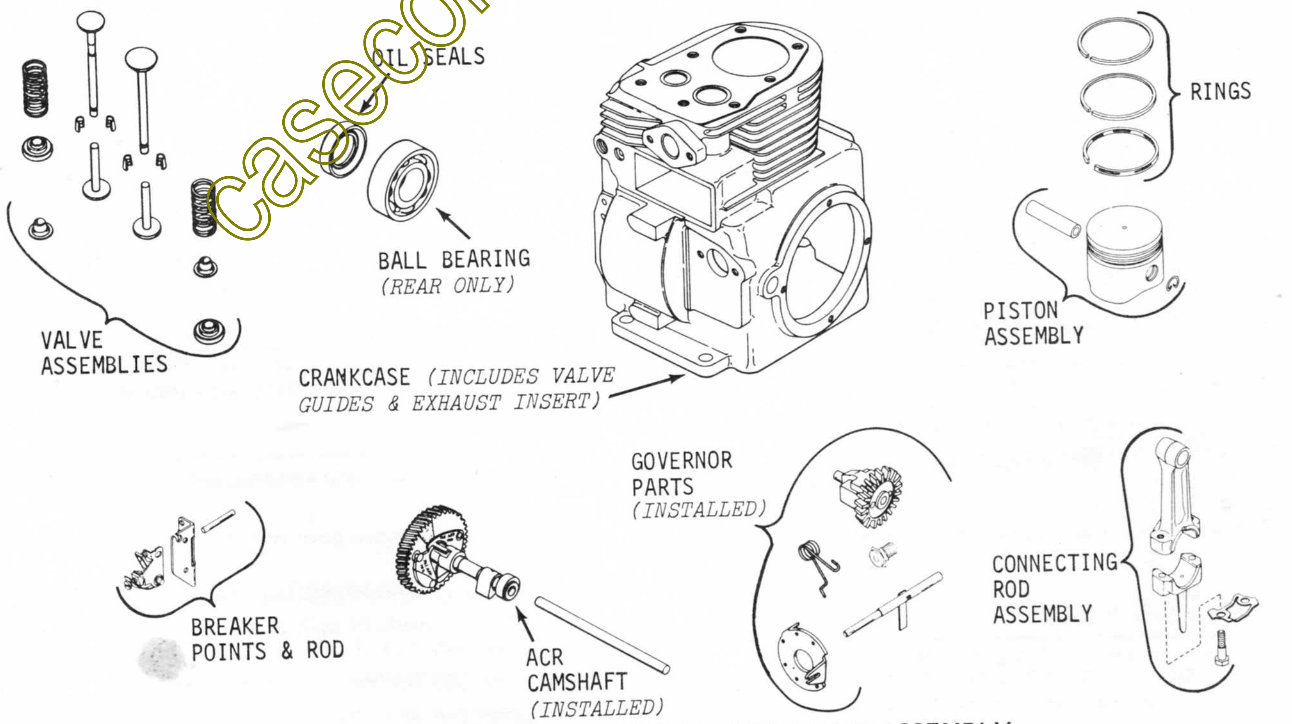


FIGURE 13 CONTENTS OF A TYPICAL MINIBLOCK ASSEMBLY

DISASSEMBLY PROCEDURE (REASSEMBLY SECTION BEGINS ON PAGE 34)

The following is intended as a guide to disassembly of the standard engine models--the sequence may have to be varied slightly to facilitate removal of special equipment or accessory items such as motor - generators, starters, etc.

1. Disconnect lead and remove spark plug.

2. Drain fuel tank, remove fuel line at carburetor.

3. Remove air cleaner from carburetor intake.

4. Remove carburetor.

5. Remove blower housing, cylinder baffle and head baffle.

6. Remove starter generator, rotating screen and starter pulley.

7. Flywheel is mounted on tapered portion of the crankshaft. Use of a puller is recommended for removing flywheel. Bumping end of crankshaft with hammer to loosen flywheel should be avoided as this can damage crankshaft.

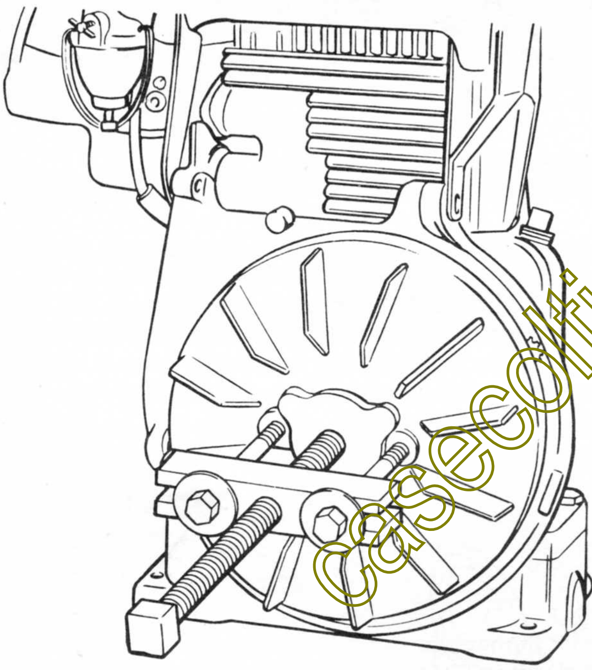


FIGURE 14 REMOVE FLYWHEEL WITH PULLER

8. Remove breaker point cover, breaker point lead, breaker assembly and push rod.

9. Remove valve cover and breather assembly.

10. Remove cylinder head.

11. Raise valve springs with a spring compressor and push valve keepers off valve stems. Remove valve spring retainers, springs and valves.

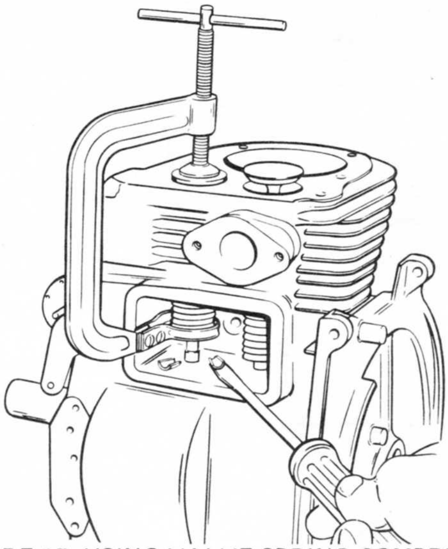


FIGURE 15 USING VALVE SPRING COMPRESSOR

12. Remove oil base and unscrew connecting rod cap. Remove piston assembly from cylinder block.

13. Remove crankshaft, oil seals and, if necessary, antifriction bearings. It may be necessary to press crankshaft out of cylinder block. Bearing plate should be removed first if this is done.

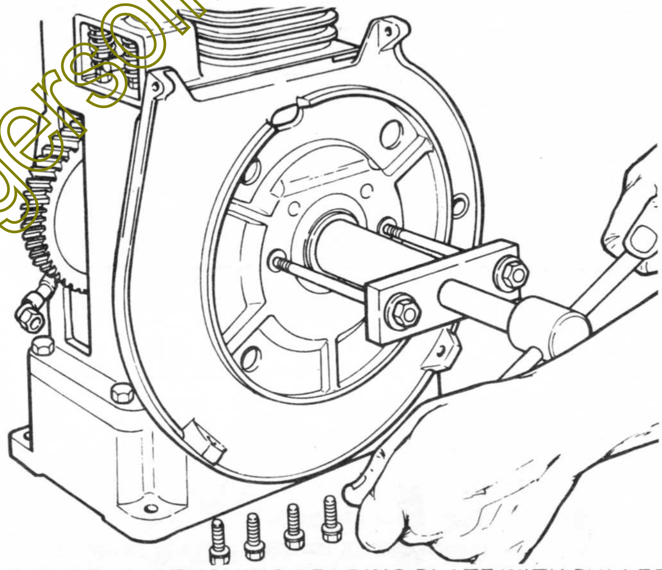


FIGURE 16 REMOVING BEARING PLATE WITH PULLER

14. Turn cylinder block upside down and, using a small punch, drive camshaft pin out from power-take-off side of engine. Pin will slide out easily after it is driven free of block.

15. Remove camshaft and valve tappets.

16. Loosen and remove governor arm from governor shaft.

17. Unscrew governor bushing nut and remove governor shaft from inside of cylinder block.

18. Loosen (do not remove) screw located to lower right of governor bushing nut until governor gear is free to slide off stub shaft.

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 grease, 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.

CYLINDER BLOCK

INSPECTION

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

2. Bearings - (Crankshaft) - 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 and are to be replaced. (See Reconditioning - Cylinder Block.) If the bearings turn easily and noiselessly and there is no evidence of scoring or grooving on the races, the bearings can be reused.

3. Cylinder bore - If badly scored, excessively worn or tapered or out of round more than .005'' (.12 mm), reboring is necessary. Use an inside micrometer to determine amount of wear (See Fits and Clearance Section). If cylinder bore is not damaged and is within tolerances, only light deglazing may be necessary.

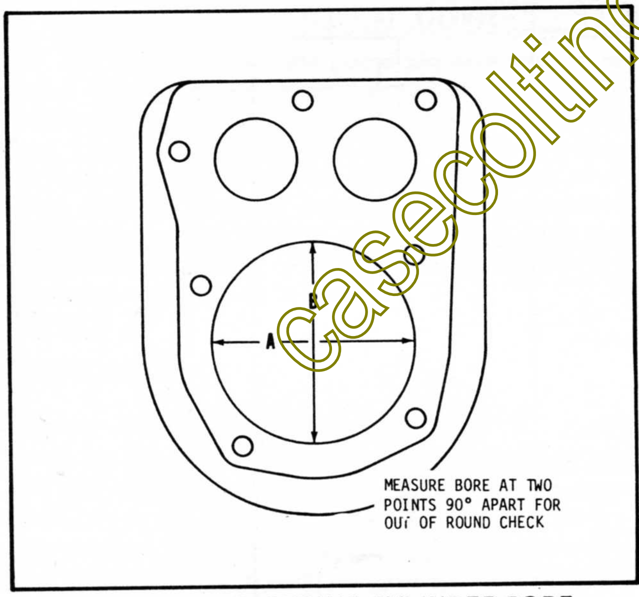


FIGURE 17 MEASURING CYLINDER BORE

RECONDITIONING - CYLINDER BLOCK

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

2. Reboring procedure - See Clearance Section for original cylinder bore size. Use an inside micrometer to measure wear then select 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 bores 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. Reboring is best accomplished at drill speed of about 600 RPM. After installing coarse stones in hone, proceed as follows:

A. Lower hone into bore and after centering, adjust so that stones are in contact with walls. Diesel fuel oil or kerosene can be applied to the stones as a cutting-cooling agent.

B. 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.

C. When bore is within .0025'' (.063 mm) of desired size, remove coarse stones and replace with burnishing stones. Continue with burnishing stones until within .0005'' (.012 mm) of desired size then use finish stones and polish to final size.

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

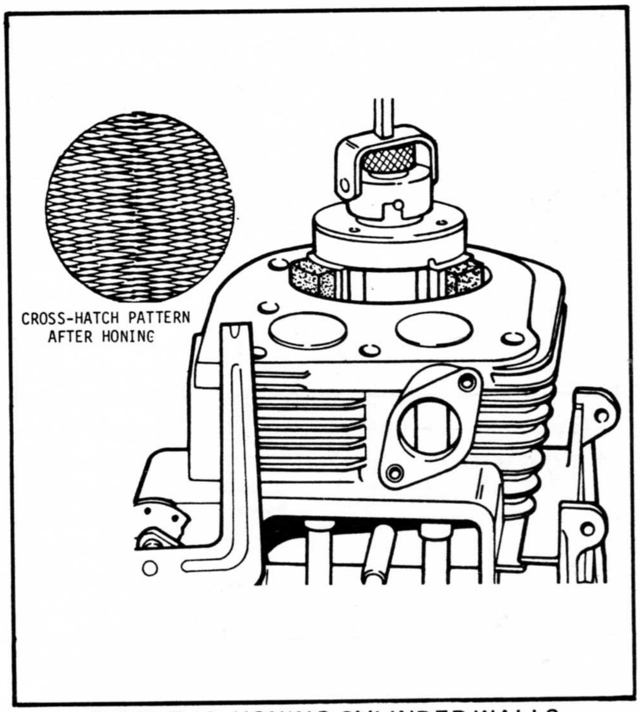


FIGURE 18 HONING CYLINDER WALLS

CRANKSHAFT

KEYWAYS--GEARS: If keyways for flywheel are badly worn or chipped, replacement of the crankshaft may be necessary. Broken or badly worn cam gear teeth will also necessitate replacement of shaft.

CRANKPIN: Inspect 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 Clearance Section, are exceeded by more than .002" (.05 mm), it will be necessary to either replace crankshaft or regrind the crankpin to .010" undersize. If wear is moderate, the .010" undersize connecting rod (big end) must then be used to achieve proper running clearance.

CONNECTING ROD

1. Check bearing area (big end) for excessive wear, score marks, running and side clearance. Replace rod and cap if worn beyond limits stated.

2. Connecting rods with bearing area .010" undersize are available for use with reground crankpin.

PISTON - PISTON RINGS

Production type and service type ring replacement sets are available in the standard size plus .010", .020" and .030" oversize sets. The production standard type set is used only when cylinder is not worn or out of round. Production oversize sets are used only when cylinder has been rebored to the corresponding oversize. Service type sets are used when cylinder is worn but within wear and out of round limits (wear limit .005" (.12 mm) oversize, out of round limit .004" (.10 mm)). Service 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. Chrome plated rings, when used, should be installed in the top groove.

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, however.

2. Remove old rings and clean up grooves.

3. Before installing new rings on piston, place each ring in turn in its running area in cylinder bore and check end clearance.

4. Rings must be installed according to markings on rings. Generally 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 position or toward skirt. 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.

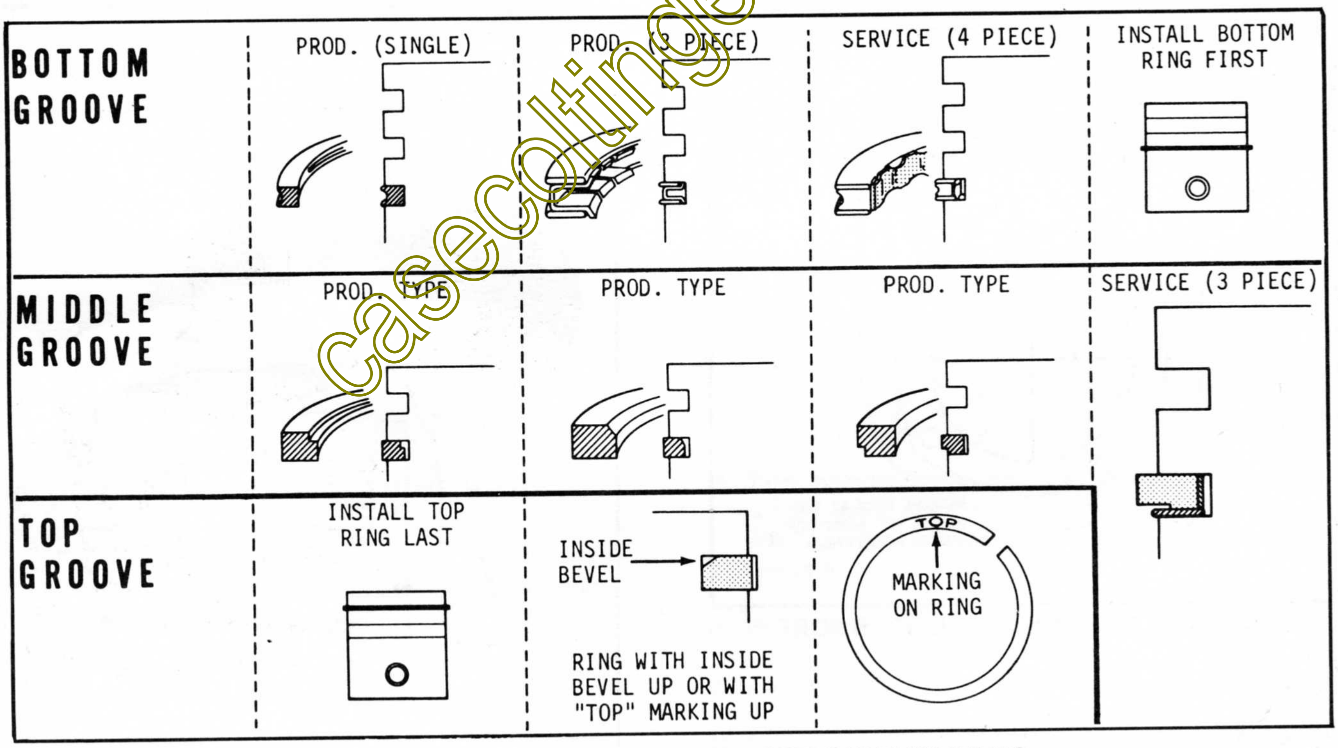


FIGURE 19 PRODUCTION TYPE AND SERVICE TYPE RINGS

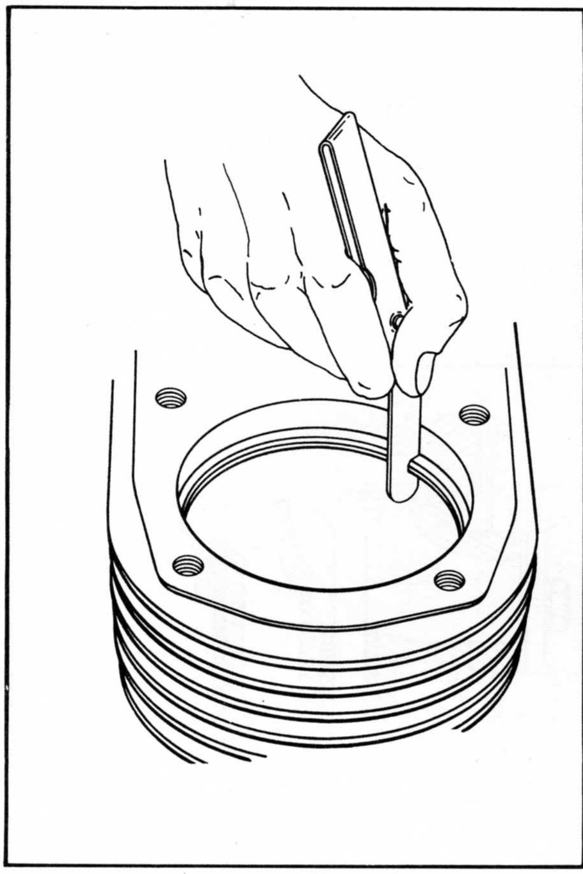


FIGURE 20 MEASURING PISTON RING END GAP

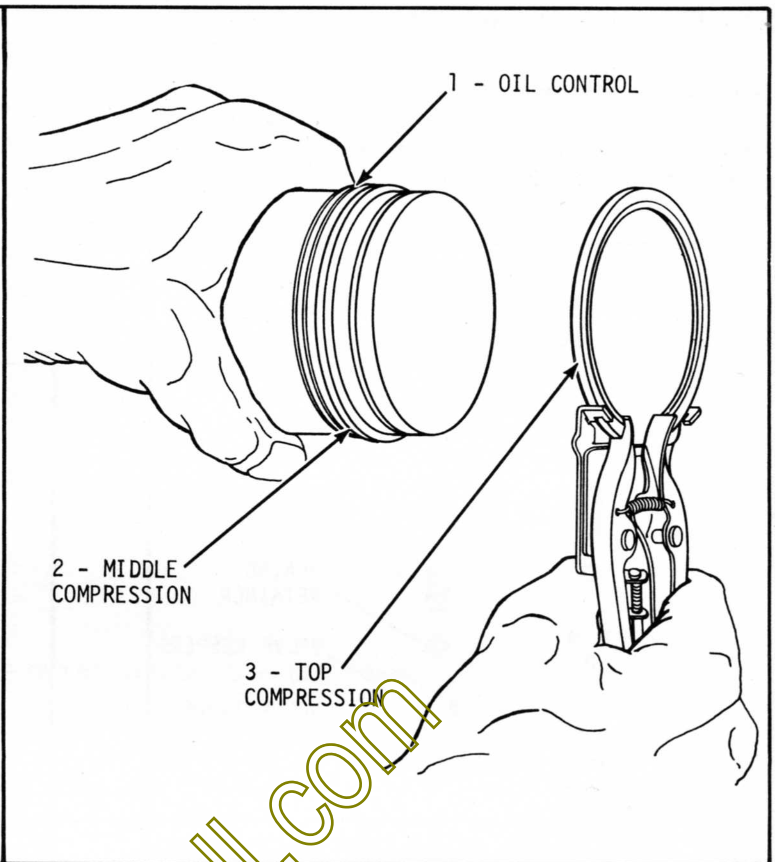


FIGURE 21 RING INSTALLATION SEQUENCE

PISTON - ROD ASSEMBLY

Normally, very little wear takes place in the piston boss-piston 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. After checking pin, rod small end and piston pin boss for proper clearances, lubricate pin then assemble piston to rod--pin is light interference to loose fit. Lock piston pin using new pin retainers--make sure retainers are fully engaged in the grooves on both sides of the piston.

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 capscrews, high temperature combustion bases can burn away portions of aluminum alloy head. If no evidence of this is found, head should be checked for flatness. A slightly warped head can be resurfaced by simply rubbing it on a piece of sandpaper positioned on a flat surface. Carefully clean carbon deposits from cylinder head if it is to be reused--use putty knife or similar blade to scrap deposits. Be careful not to nick or scratch aluminum, especially in gasket seat area.

RING GEAR (EARLY 444)

If inspection of the ring gear reveals broken, excessively worn or otherwise damaged teeth, the ring gear must be replaced. The ring gear is press fitted into a recess on the outer perimeter of the flywheel. The flywheel must be off the engine for ring gear replacement.

Several methods may be used to remove the damaged ring gear. One method is to break the gear with a cold chisel and/or a hack saw. Another way is to heat the ring gear with a torch, then drive the gear off the flywheel. If the latter method is used, the flywheel will also absorb some heat and it must be allowed to cool before the new ring gear can be installed.

The new gear must be expanded with heat before installation. This can be done by submerging the gear in hot oil or heating in oven to about 400 to 450° F (200-230° C). Position the hot gear on the flywheel, then after making sure it is not cocked, either press the gear on with an arbor press or drive it on with a soft-head hammer. As the gear cools, it will contract to form a tight press fit on the flywheel. Be sure to tighten the flywheel retaining nut to the proper torque value after reinstalling the flywheel on the engine.

VALVES - VALVE MECHANISM

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--refer to page 43 for details.

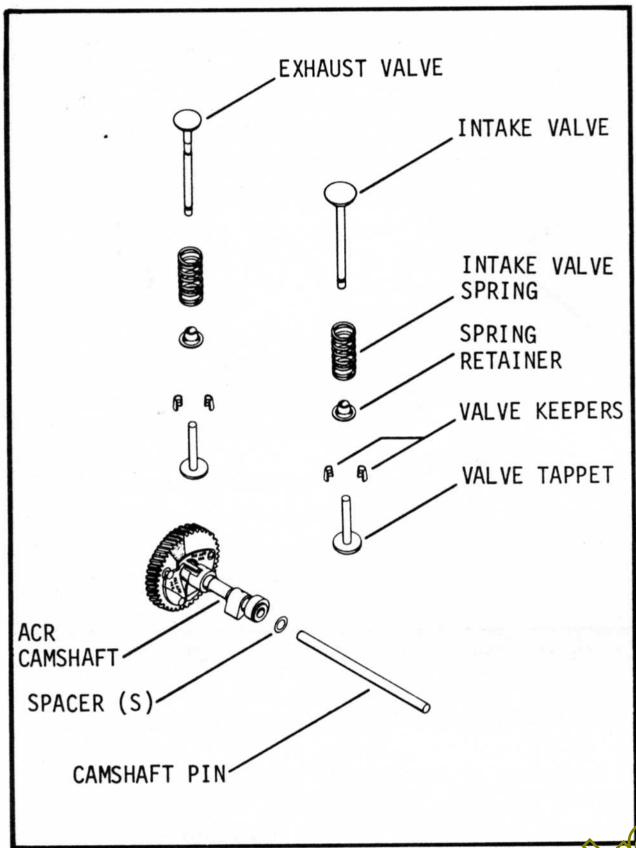


FIGURE 22 - CAMSHAFT AND VALVE MECHANISM

GUIDES: Guides must be replaced if worn sufficiently to allow valve stem-guide clearance to exceed limits stated in the Wear Tolerance Chart on page 42. To remove, press guide down into valve chamber and carefully break protruding end until guide is completely removed--be careful not to damage block when removing old guide. Use an arbor press to install new guides--press to depth specified then use a valve guide reamer and ream new guide to specified I.D.--refer to Figure 24 for valve guide details.

VALVES AND VALVE SEATS: Consult parts manual for correct valve numbers when replacing valves. Some applications require special hard faced valves for both intake and exhaust valves. Exhaust valves are always hard faced. Intake valve seats are usually machined into block although inserts are used in certain applications. Exhaust valves seat on special hardened inserts. Seating surfaces should be held as close as possible to 1/32" (.8 mm) width. Seats with more than 1/16" (1.6 mm) must be reconditioned with 45° and 15° cutters to obtain proper width. 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.

VALVE CLEARANCE: Valve clearance must be checked after resurfacing and lapping in. Install valves in guides, rotate camshaft to position where cam has no effect on tappet--hold valve firmly on seat and check clearance between valve stem and tappet (See Specification Section). If clearance is insufficient, it will be necessary to adjust the tappets.

Loosen the locking nut, turn adjusting nut in or out until proper clearance is attained then securely tighten locknut.

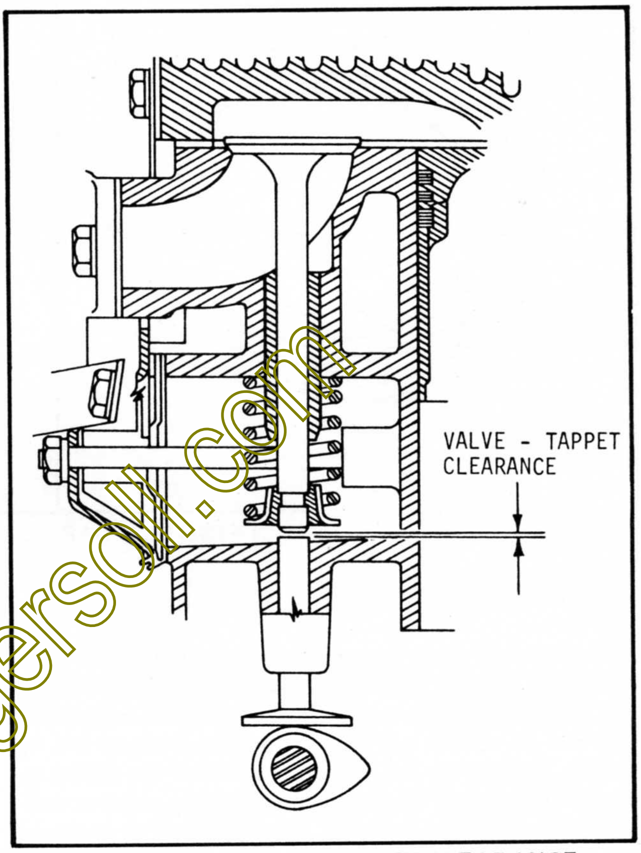


FIGURE 23 VALVE - TAPPET CLEARANCE

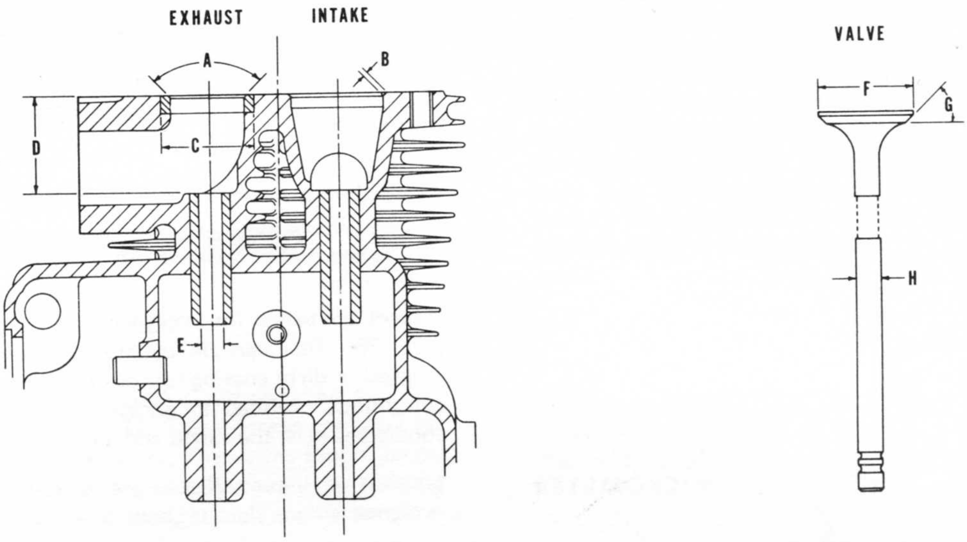


FIGURE 24 VALVE DETAIL DRAWING — LOCATION

DIMENSION	K241, K301, K321	
	INTAKE	EXHAUST
A SEAT ANGLE	89°	89°
B SEAT WIDTH	.037/.045″ (.94/1.14 mm)	.037/.045″ (.94/1.14 mm)
C INSERT O. D.	----------	1.2535/1.2545″ (31.839/31.864 mm)
D GUIDE DEPTH	1.586″ (40.28 mm)	1.497″ (38.02 mm)
E GUIDE I. D.	.312/.313″ (7.92/7.95 mm)	.312/.313″ (7.92/7.95 mm)
F VALVE HEAD DIAMETER	1.370/1.380″ (34.80/35.05 mm)	1.120/1.130″* (28.44/28.70 mm)
G VALVE FACE ANGLE	45°	45°
H VALVE STEM DIAMETER	.3105/.3110″ (7.887/7.899 mm)	.3084/.3091″ (7.833/7.851 mm)

*2.125″ (53.98 mm) on all K321 engines with spec suffix "D" and later.

INSPECTION OF THE VALVES, GUIDES AND SPRINGS

Valve springs should be checked for flat squared ends, broken or cracked coils and correct spring pressure. Use a Valve Spring Tension Tester. Refer to "Specification" Section.

Valve guides can be checked for wear by using a bore gauge and micrometer, Figure 25.

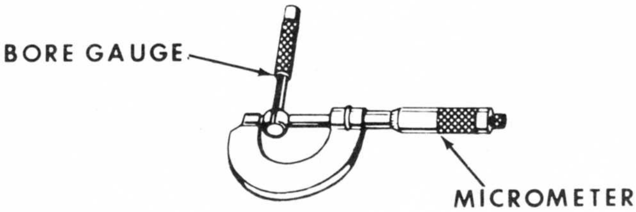


FIGURE 25

The valve guide should be checked at the top, middle and bottom of the bore for wear, Figure 26.

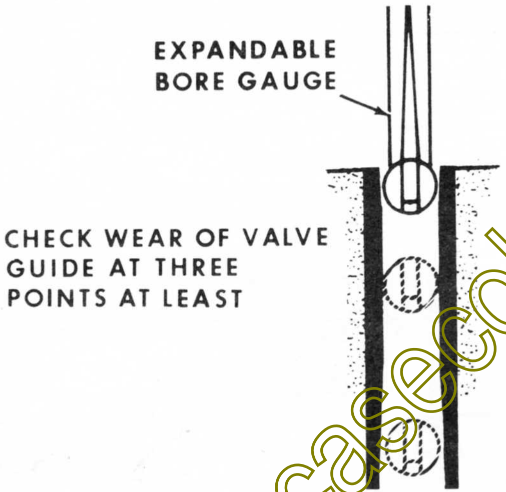


FIGURE 26

The inside diameter wear limits of the valve guide should not exceed the Specification given in the "Specification" Section, at any point along the bore of the guide. Replace guide if it does. Check the new valve guides after installation to make sure that the bore is not less than the inside diameter given in the "Specification" Section. Using an Arbor equal to the inside diameter of the valve guide will keep the guide from collapsing when pressed in place.

Clean the valves with a power driven fine wire brush being very careful not to scratch the valve stems. Reference is made to the different parts of the valve, Figure 27.

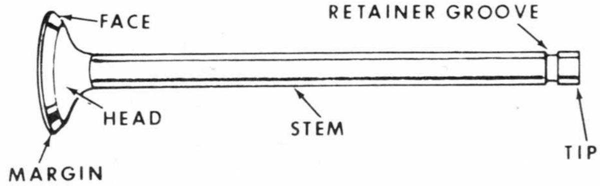


FIGURE 27

Inspect the valves for excessive wear or necked stems, Figure 28. This can be caused by lack of lubrication, plugged or dirty cooling fins or operating the engine under continuous overload at excessive engine RPM. If these conditions exist the valves and guides should be replaced.

FIGURE 28

Inspect the valves for deep grooves in the face, Figure 29. This can be caused by abrasives entering the engine through the intake system or not servicing the air cleaner regularly. A leaking breather gasket can also cause this condition. If grinding the valve face will not correct this condition, replace the valves.

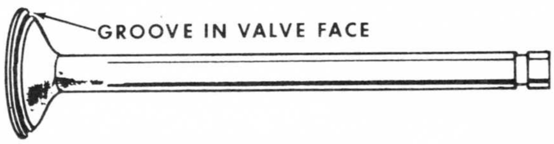


FIGURE 29

Inspect the valve face and stem for rust or pitting, Figure 30. Rust or pitting can usually be removed by grinding the valve face. If rust or pitting on the valve stem exist the valve should be replaced. These conditions can be caused by using poor quality engine oil or fuel that doesn't meet the specification given in the Operator's Manual. Rust could be caused by improper storing of the engine.

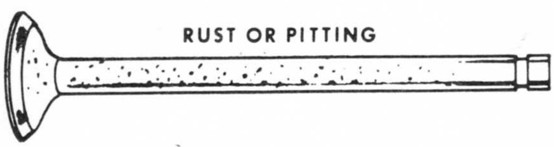


FIGURE 30

Heavy carbon or varnish deposits on the valve, Figure 31, should be removed before valves are ground. This condition is usually caused by worn piston rings and bore which allow too much oil to reach the combustion chamber. This condition could also be caused by worn valve guides. These conditions should be corrected or the same trouble with the valves will happen again.

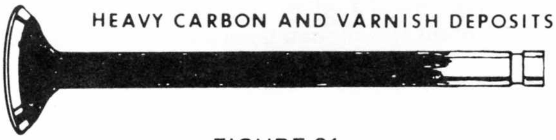


FIGURE 31

Inspect the valve head for dishing and the valve face for deep burned spots, Figure 32. These conditions can't be corrected by grinding the valves. The valves should be replaced. These conditions are usually caused by running the engine under excessive load, at high engine temperatures.

FIGURE 32

Valves with worn lock grooves or the stem is worn or dished beyond the chamfer must be replaced, Figure 33.

FIGURE 33

The checking of the valve stem diameter can best be done with a good accurate micrometer, Figure 34.

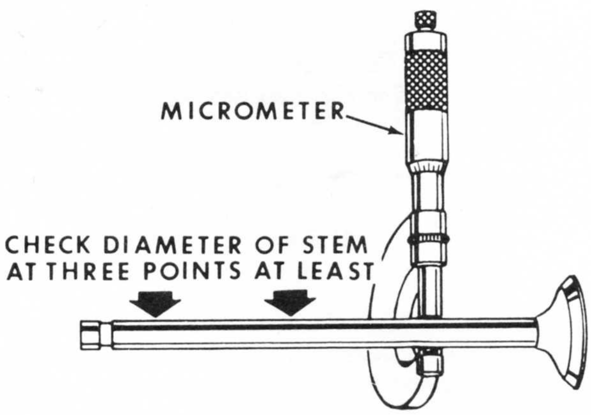


FIGURE 34

The valve stem should not vary more than the wear limits given in the "Specification" Section at any point on the valve stem. If this condition exists, the valves must be replaced.

The checking of the valve face runout should be done after valves have been ground. A Vee block type holder with a dial indicator, Figure 35, should be used to check the valve face runout. The valve face should not vary more than the specification given in the "Specification" Section. The valve stem runout can also be checked with this Vee block and dial indicator.

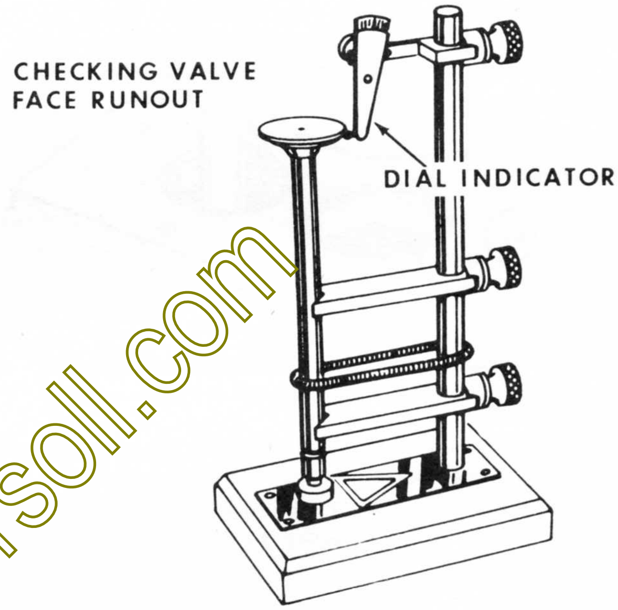


FIGURE 35

IMPORTANT: Small amounts of very fine pitting, Figure 36, may be found on the surfaces of the valve faces and seats after the valves are cleaned.

FIGURE 36

These are normal and will not affect engine performance. This fine pitting is caused by a normal oxidation process and can happen on any engine during the run-in-period. It is not necessary to grind valves or seats if this fine pitting is found as the pitting will generally reoccur after the engine is run for a few hours.

REFACING INTAKE AND EXHAUST VALVES

Before refacing the valves they should be wire brushed, cleaned and inspected. Refer to the "Specification" Section for the correct valve face grinding angle. Set the refacing machine protractor at this angle. Be sure the chuck of the machine is clean before installing valve. Dress the grinding wheel before starting to reface each valve. Take only light cuts as the valve is refaced and the last cut must be very fine so the valve face will have a polished finish.

IMPORTANT: Replace any valve that after grinding has a thin edge or margin, Figure 37. If the margin on the ground valve is less than the margin on a new valve, replace the valve.

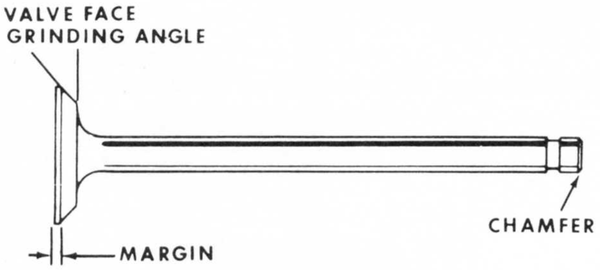


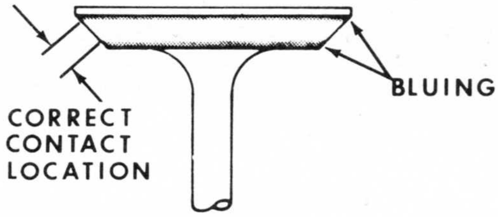
FIGURE 37

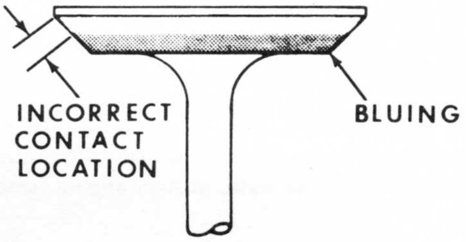
The tip end of the valve should be checked for roughness or wear. Usually this can be removed with some very light cuts against the side of the grinding wheel and will square up the end. Never grind the chamfer off the valve stem end. Any excessive grinding should not be done to the stem end. Replace the valve.

Before installing new valves a fine finish grinding should be done to each new valve. Check the valve face and valve stem runout before installing.

The valve face and seat contact location should be checked. Place valve bluing (Prussion Blue) on the face of the valve. Install the valve in the head and rotate the valve on its seat. Remove the valve and inspect the contact area on the valve face.

The bluing will have been removed from the valve face evenly at the top edge of the contact area, Figure 38. This is due to the fact that the valve face and seat are ground with 1^{o} INTERFERENCE ANGLE. Refer to "Specification" Section.





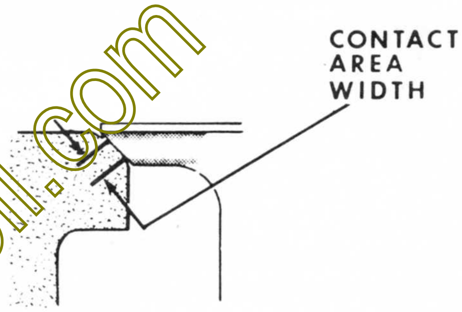


FIGURE 38

When the top edge of the contact area is too high or low on the valve face, the seat contact area must be moved. This is done by using the narrowing stones (Refer to Page 29). The contact area width should never exceed the dimension given in the Specification Section.

IMPORTANT: DO NOT USE BLUING TO CHECK VALVE SEAT AND VALVE FACE RUN-OUT. The valve face could be contacting the seat at only a few points, but the bluing would still be rubbed off by the high points and make it appear as though you had solid contact all around. The only thing bluing will indicate is the location on the valve face where the seat is contacting--no more!

GRINDING SEATS

Always use a precision type power seat grinder similar to the one shown in Figure 39. The valve seats cannot be ground with manual operated equipment. The intake valve seat is part of the block and for this reason only a finishing stone should be used to grind the seat. Take very light cuts with the grinding stones so just enough metal is removed to end up with a good smooth seat finish.

FIGURE 39

Refer to "Specification" Section for the proper specifications of the intake, exhaust seats and valve guides, Figure 40. From the specifications the proper grinding stones and pilot can be chosen.

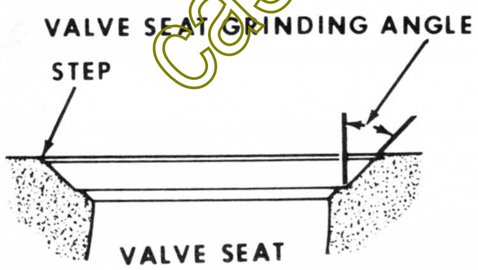


FIGURE 40

When using the grinding stones the seat grinding angle of the stone should be dressed on a stone dresser frequently so the seat angle will not vary when grinding the seats.

INSPECTION

The valve seat runout should be checked after finish grinding with a dial indicator and seat grinding pilot, Figure 41. After checking the runout, turn the pilot 1/4 turn and check runout again. The width of the valve seat contact area must be checked. Refer "Specification" Section for dimension of seat width contact area.

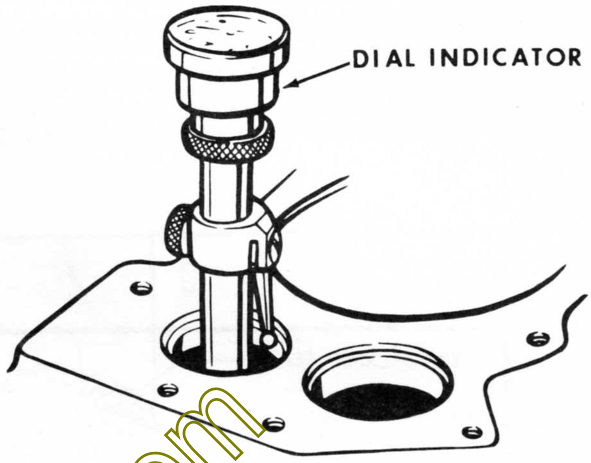


FIGURE 41

The valve seat contact area width should never vary from this dimension. The valve seat contact area width and location can be changed slightly by using narrowing stones, Figure 42.

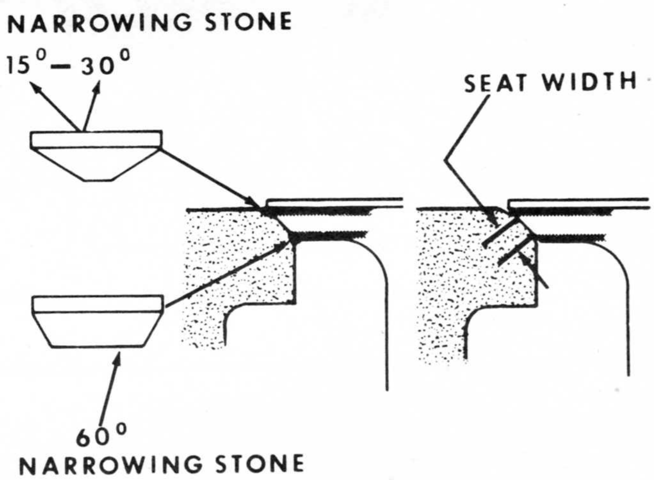


FIGURE 42

When the step above the seat, Figure 42, has been reduced by the grinding operation, installing a new valve will help to restore the compression that would normally be lost by excessive grinding of the seat and valves. Excessive grinding of the valves and seats moves the valves further into the block thereby reducing the compression ratio.

USED ON 14 H.P. ENGINES PRIOR TO ISOLATION MOUNTS

The Kohler Dynamic Balance System is used on 14 H.P. engines prior to isolation mounts and will maintain engine vibration at an absolute minimum.

On conventional single cylinder engines, counterbalancing is by necessity a compromise. The counterweights are designed to balance only about 1/2 of the inertial force created by the reciprocating weights as piston, piston pin, etc. The reason for this force varies from 0 value when the piston is midway in the cylinder to maximum force when the piston reaches TDC and BDC. If the counterweights were designed to exactly balance the maximum force, they would in effect create an unbalance each time the counterweights rotate to 90° and 180° positions when the inertial force drops to zero. By designing the counterweights to split the force, vibration is kept within acceptable limits for most applications.

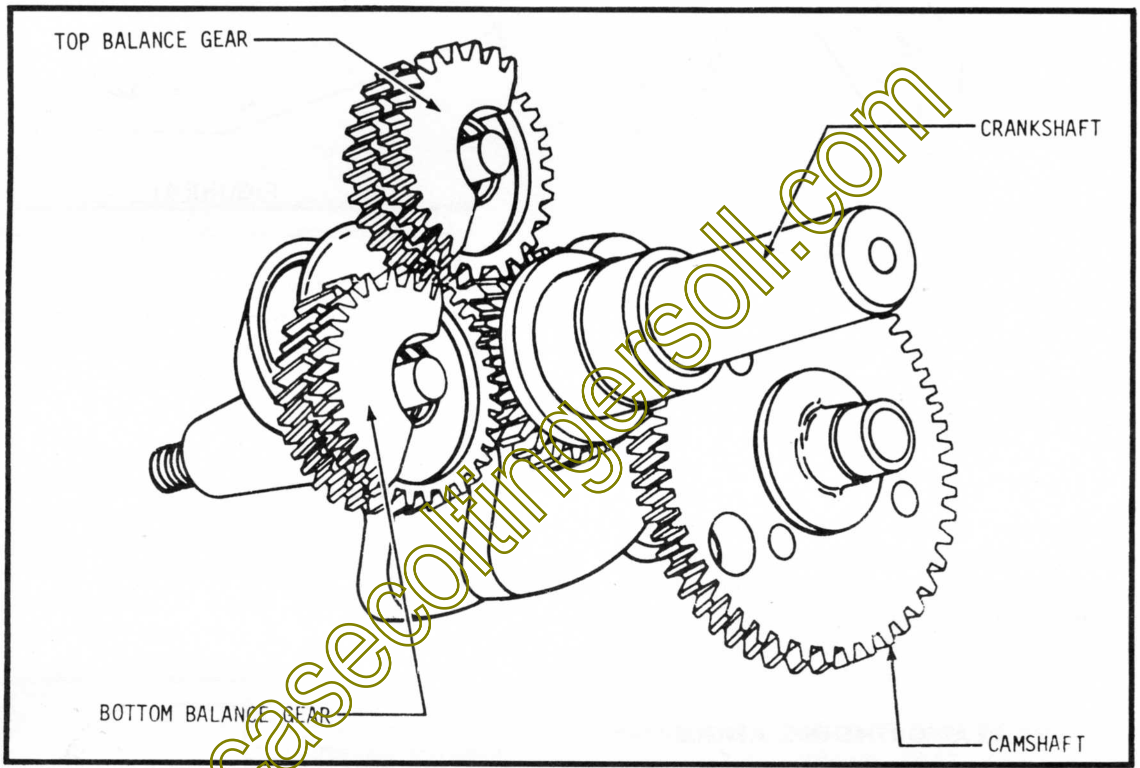


FIGURE 43

OPERATION

The balance gears function to oppose then add to the force exerted by the counterweights to effectively reduce vibration. As shown in Figure 44A, the reciprocating weights are exerting maximum force (indicated large arrow) in the vertical direction shown while the counterweights exert force (indicated small arrow) in the opposite direction. In this position, the balance gears each add force to the force of the counterweights thus providing a closer balance between the opposite forces.

This same balancing effect is evident when the piston reaches BDC as shown in Figure 44B, however, in this case the direction of the two forces is toward each other.

When the piston is midway in the cylinder as shown in Figure 44C, no inertial force is exerted but the counterweights now present a force in a horizontal direction. In this case, the force of the balance gears is exerted in opposite direction to counteract the force of the counterweights. When the crankshaft has rotated another 180^{o} and the piston is again midway in the cylinder, the force of the balance gears is directed inward while that of the counterweights is outward which also provides a balancing effect. Both horizontal and vertical forces are thus reduced resulting in smoother operation with less vibration.

Engines featuring Dynamic Balance Systems have crankshaft, crankcase and other differences which prohibit field conversion.

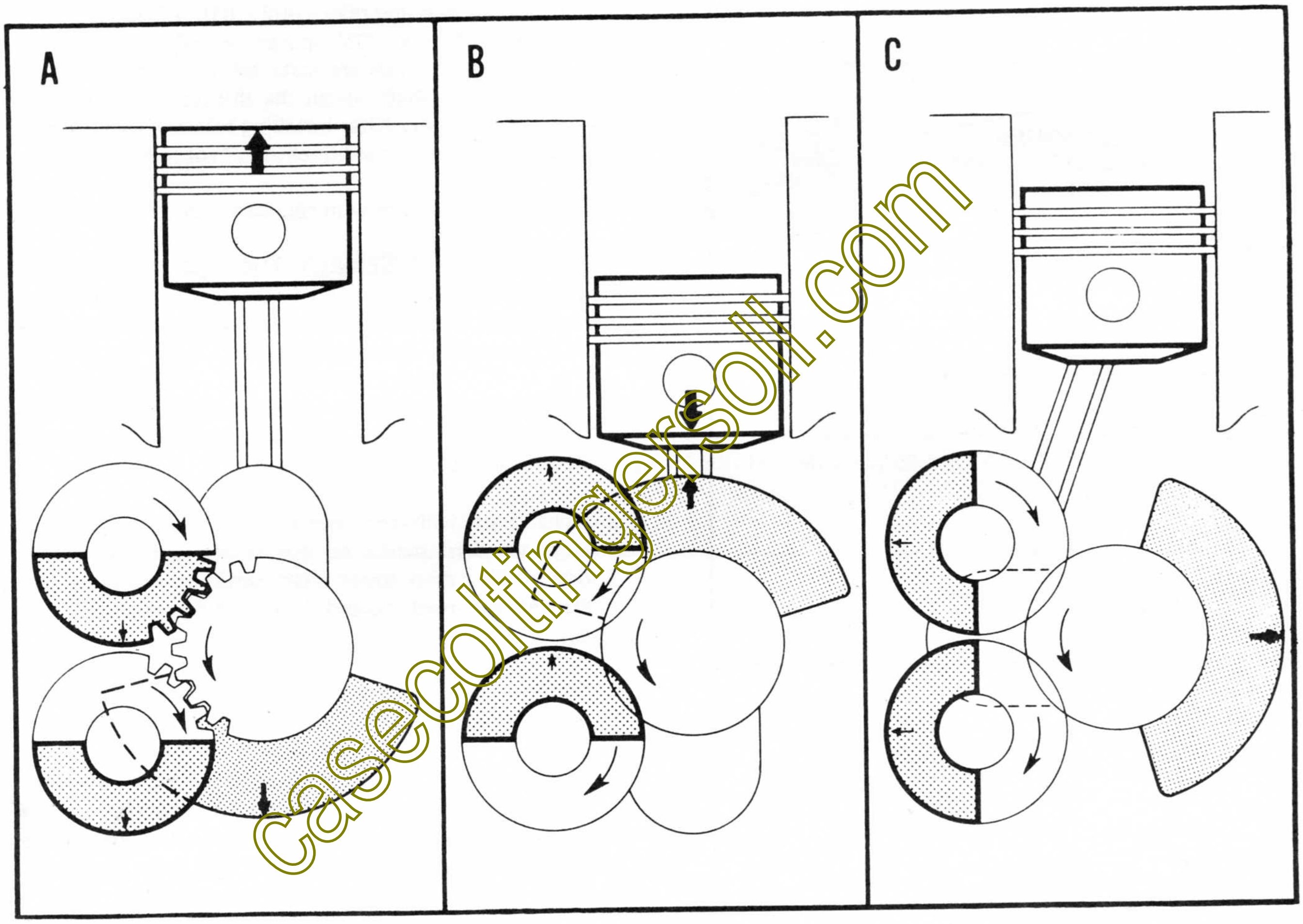


FIGURE 44

DYNAMIC BALANCE SYSTEM

Dynamic Balance is found in early model K321 engines. This system consists of two balance gears which run on needle bearings. The gear-bearing units are assembled to two stub shafts which are press fitted into special bosses in the crankcase. Snap ring retainers hold the gears and spacer washers are used to control end play. The gears are driven off the crankgear in the direction opposite to rotation on the crankshaft.

When working on Dynamic Balance models, care must be exercised to make sure that the proper end play is attained and that the gears are properly timed to the engine. Use the following procedure to install and time Dynamic Balance components.

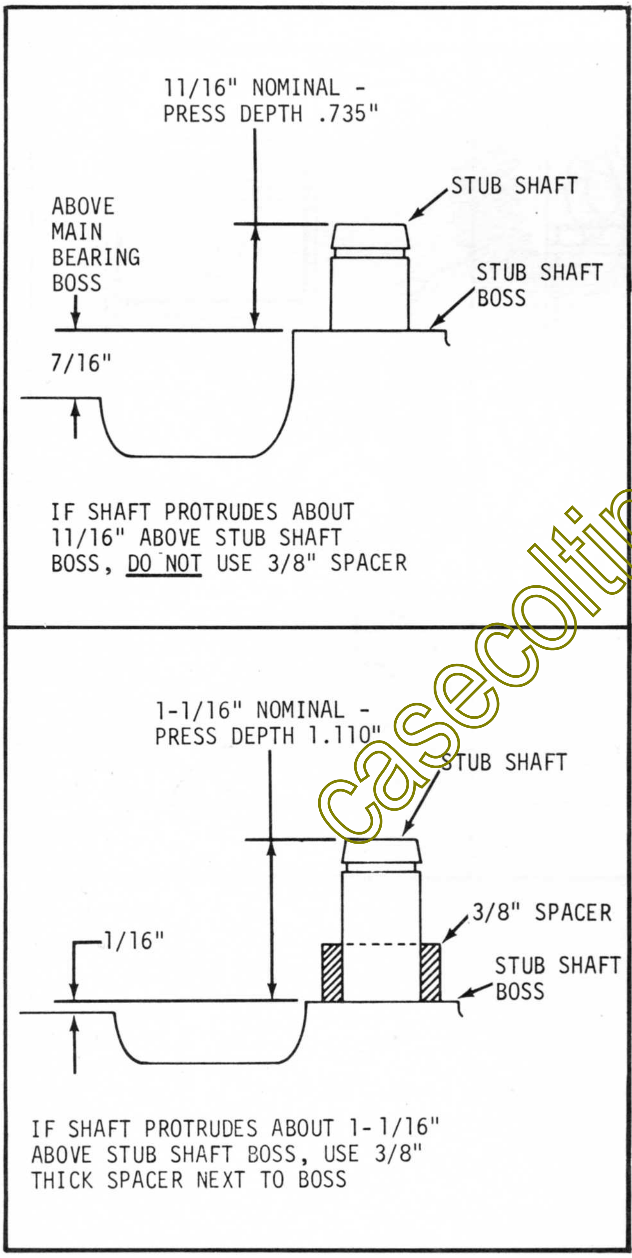


FIGURE 45 STUB SHAFT DEPTH - BOSS HEIGHT VARIATION

STUB SHAFT INSTALLATION: If stub shaft is worn or damaged, press the old shaft out and install new shaft. Shaft must protrude a specific distance above the stub shaft boss. If the stub shaft boss is about 7/16" (11 mm) above the main bearing boss, press the shaft in until it is .735" (18.67 mm) above the stub shaft boss. On blocks where the stub shaft boss is only about 1/16" (1.6 mm) above the main bearing boss, press shaft in until it is 1.110" (28.19 mm) above the stub shaft boss--a 3/8" (9.5 mm) spacer must be used with the shaft which protrudes 1.110 (28.19 mm).

BALANCE GEAR: Slip one .010" spacer on stub shaft 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") (.05 - .25 mm) 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 and adjust (add or subtract .005" spacers) if needed.

NOTE: Install retainer with rounded edge facing spacers.

TIMING - WITH ASSEMBLY TOOL: Kohler Assembly tool Y-357 simplifies procedure for timing balance gears to crankshaft. Retiming is necessary whenever the crankshaft is reinstalled. Refer to Figure 46.

1. Turn both balance gears so that primary timing marks line up with teeth on tool, then insert tool in mesh with gears.
2. Hold gears with tool butted against gasket surface, align standard marks on crankshaft with bearing oil drain hole, then lower shaft until crankgear is just started into mesh (about 1/16") (1.6 mm) in balance gears.
3. Remove tool, align crankshaft-camshaft timing marks then press crankshaft all the way into crankcase.
4. As a final check, turn crankshaft to see if standard timing mark on crankshaft lines up with secondary timing mark on the bottom balance gear--if these marks cannot be lined up, timing is off and must be corrected.

TIMING WITHOUT TOOL: 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" (1.6 mm) 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 .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. Use one .005" spacer and one .020" spacer (largest next to retainer) to obtain proper end play of .002 to .020" (.05 - .25 mm). Install snap ring retainer then recheck and adjust end play as needed.

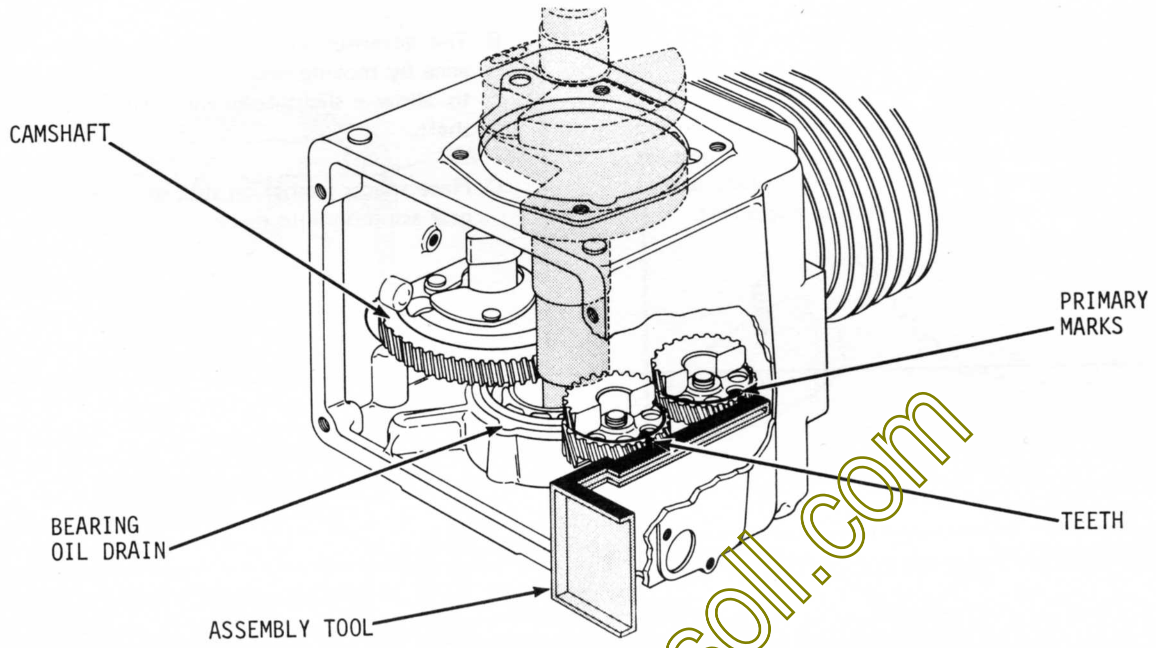


FIGURE 46 TIMING BALANCE GEARS WITH TIMING ASSEMBLY TOOL

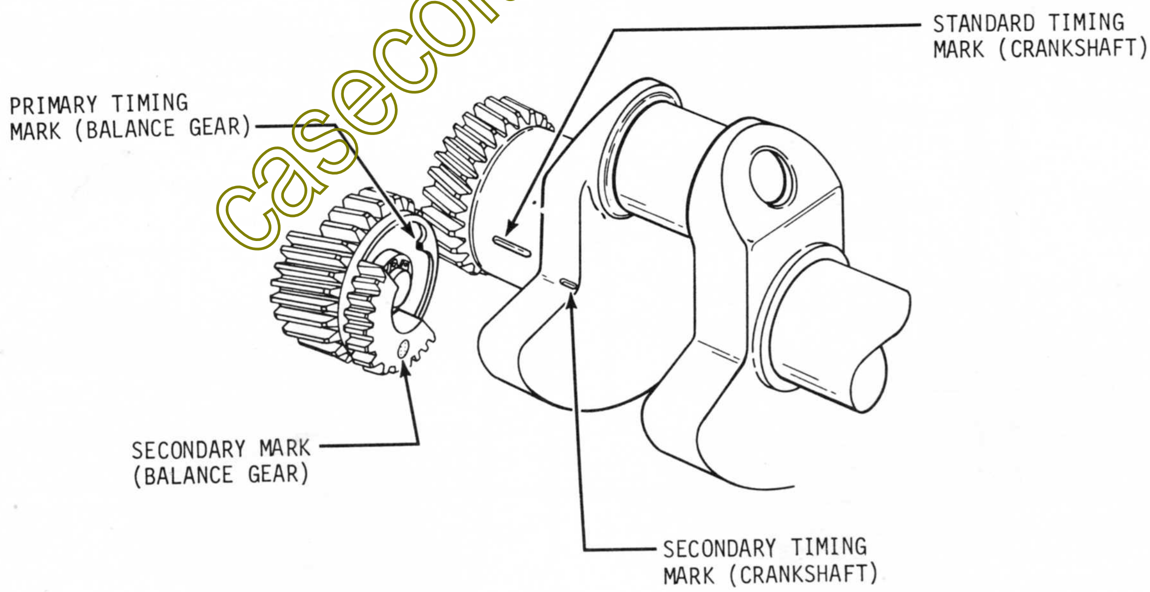


FIGURE 47 TIMING MARKS ON BALANCE GEARS AND CRANKSHAFT

1. REAR MAIN BEARING

A. Install rear main bearing by pressing it into cylinder block with shielded side facing toward inside of block--if using unshielded type bearing, either side can face inside.

2. GOVERNOR SHAFT

A. Most engines have a cross shaft with an extension riveted in place to line up with governor gear. A needle bearing or bushing on later models is provided in block to hold cross shaft in alignment.

3. GOVERNOR GEAR

A. Place cylinder block on its side. Slide governor shaft into place from inside of block. Place speed control disc on governor bushing nut and thread bushing nut into block, clamping throttle bracket into place.

B. The governor shaft can be adjusted for end clearance by moving needle bearing in block. Set bearing to allow a slight back-and-forth movement of the shaft.

C. Place spacer washer on stub shaft and slide governor gear assembly into place.

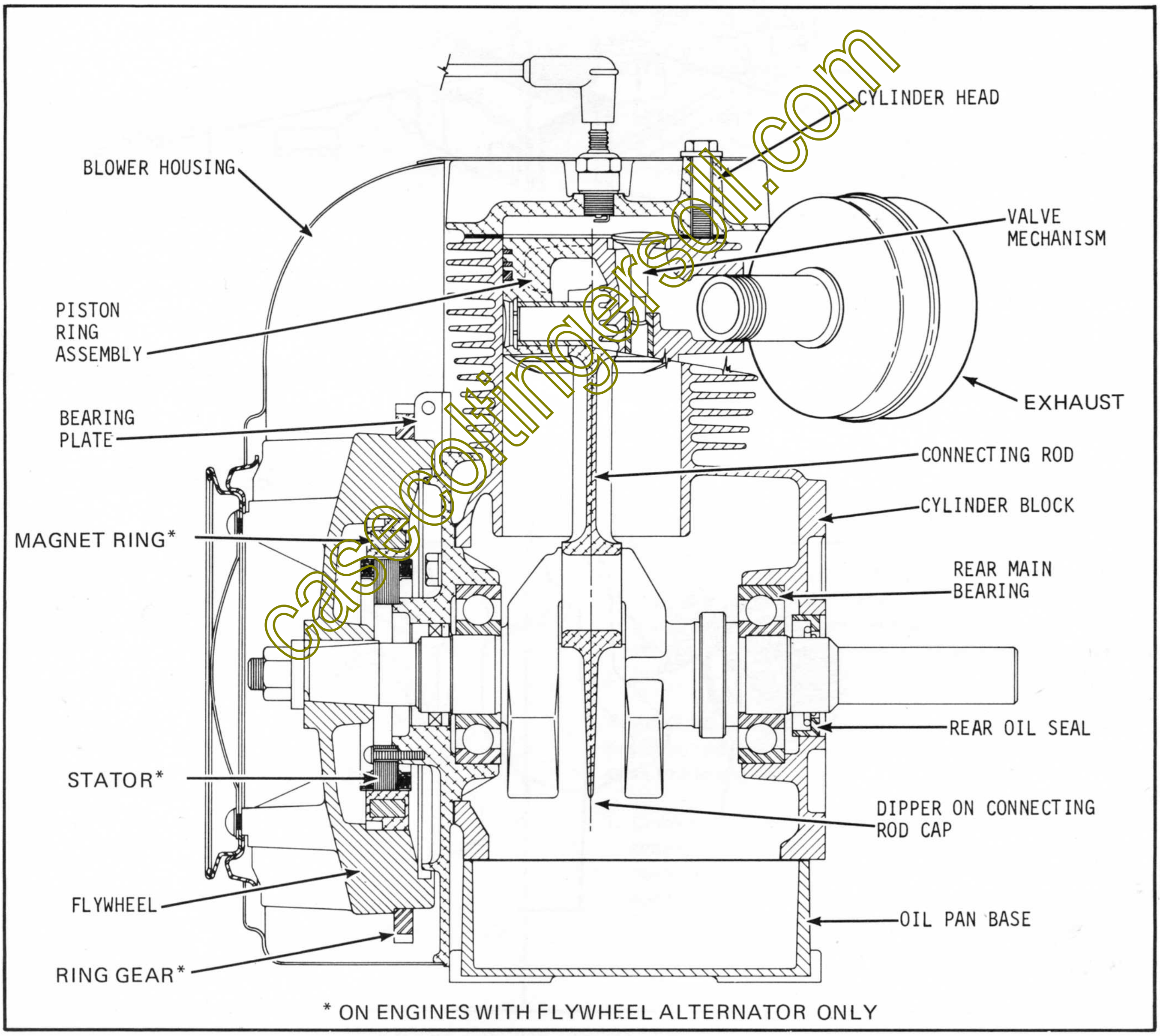


FIGURE 48 CUTAWAY VIEW OF A TYPICAL SINGLE CYLINDER ENGINE (K241 SHOWN)

D. Tighten holding screw from outside of cylinder block. Screw prevents governor gear from sliding off stub shaft during assembly.

E. Rotate governor gear assembly to be sure holding screw does not contact weight section of gear.

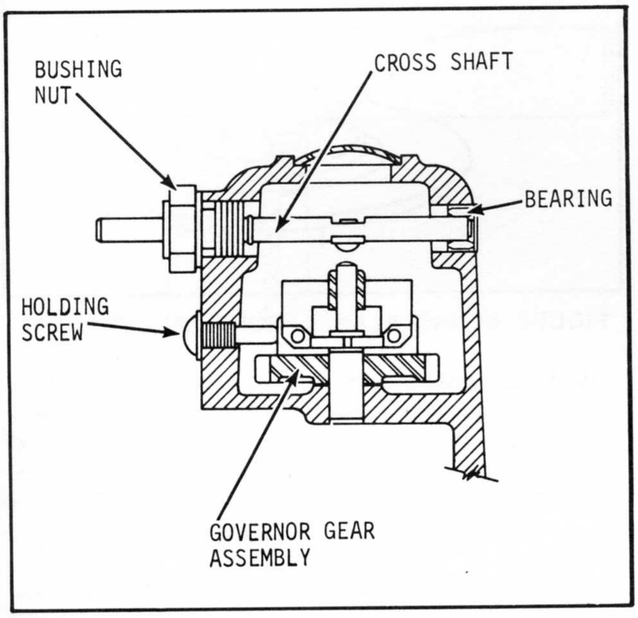


FIGURE 49 CUTAWAY VIEW - INTERNAL GOVERNOR

4. CAMSHAFT INSTALLATION

A. Turn cylinder block upside down.

B. Tappets must be installed before camshaft is placed. Lubricate and insert tappets in valve guides. Intake and exhaust tappets are interchangeable on K241, K301 and K321.

C. Position camshaft inside block.

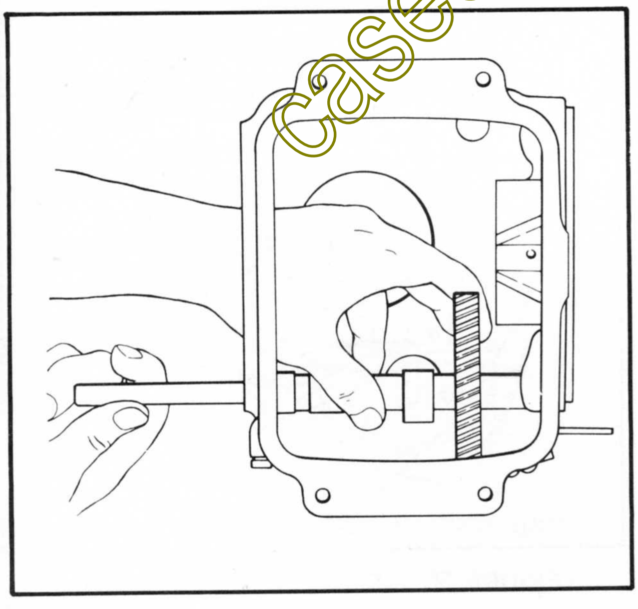


FIGURE 50 INSTALLING CAMSHAFT PIN

NOTE: On pre-ACR models with the automatic spark advance camshaft, spread actuators and insert cam--align timing marks on cam and on gear as shown in Figure 51.

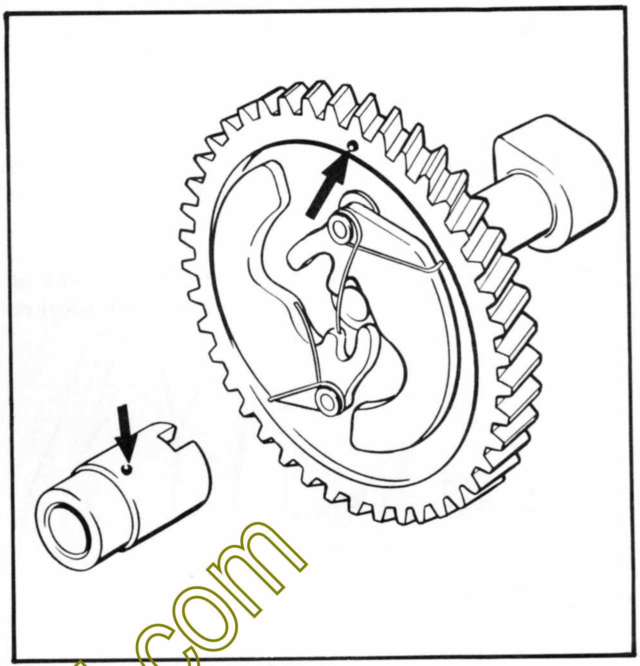


FIGURE 51 TIMING MARKS (PRE-ACR CAMSHAFT)

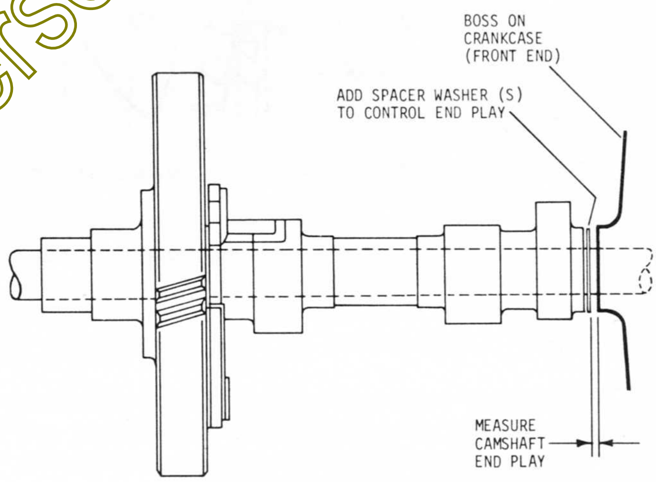


FIGURE 52 CAMSHAFT END PLAY ADJUSTMENT

D. Lubricate rod then insert into block (bearing plate side). Before pushing rod 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 rod just starts into bore at P. T. O. end of block. Check end play with feeler gauge--if within tolerance, press rod into final position or remove rod and add (or subtract) .005 and .010" washers as necessary to attain proper end play (See Fits and Clearance Section).

E. While rod is a tight press fit at engine P. T. O. end of block, a light to loose fit is necessary at the bearing plate end. New bearing plate gaskets have notches to allow any oil that may leak past to drain back into block. If gasket is not notched, apply gasket sealer around end of rod (outside block) to seal when bearing plate and gaskets are installed.

5. CRANKSHAFT INSTALLATION

A. Place block on base of arbor press and carefully insert proper end of crankshaft through inner race of ball bearing.

B. Turn crankshaft and camshaft until timing mark on shoulder of crankshaft lines up with mark (dot) on cam gear as shown in Figure 53.

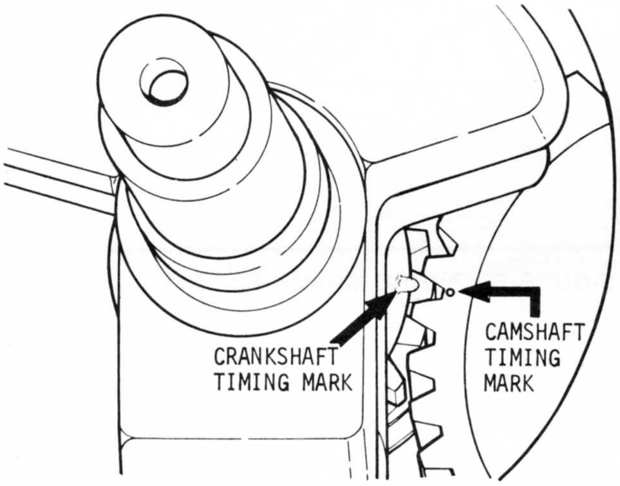


FIGURE 53 TIMING CAMSHAFT TO CRANKSHAFT

C. When marks are aligned, press crankshaft into bearing. After shoulder bottoms against inner race, recheck timing marks to make sure they are still aligned.

D. Crankshaft end play is controlled by the thickness of gaskets used between the bearing plate and block. End play must be checked after bearing plate is installed--directions stated in Step 6.

6. BEARING PLATE

A. 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.

B. 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.

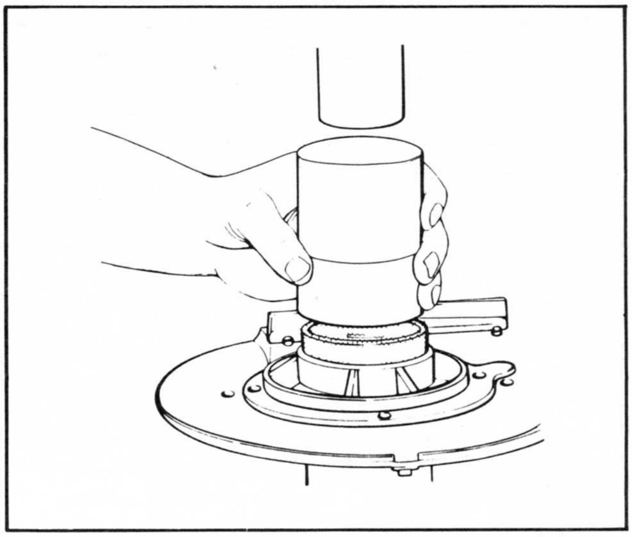


FIGURE 54 INSTALLING FRONT BALL BEARING

C. Install gaskets with thicker gasket next to block, place bearing plate on crankshaft and carefully press plate onto shaft and into position on block. Install retaining capscrews and lock washers and secure bearing plate to block. Draw screws up evenly to avoid distortion of bearing plate.

D. Crankshaft end play is measured (with feeler gauge) between inner race of rear bearing (P. T. O. end) and shoulder on crankshaft. If end play is not within tolerance as stated in Clearance Section, remove bearing plate and add or subtract gaskets to achieve proper clearance.

NOTE: Crankshaft end play is especially critical on gear reduction engines.

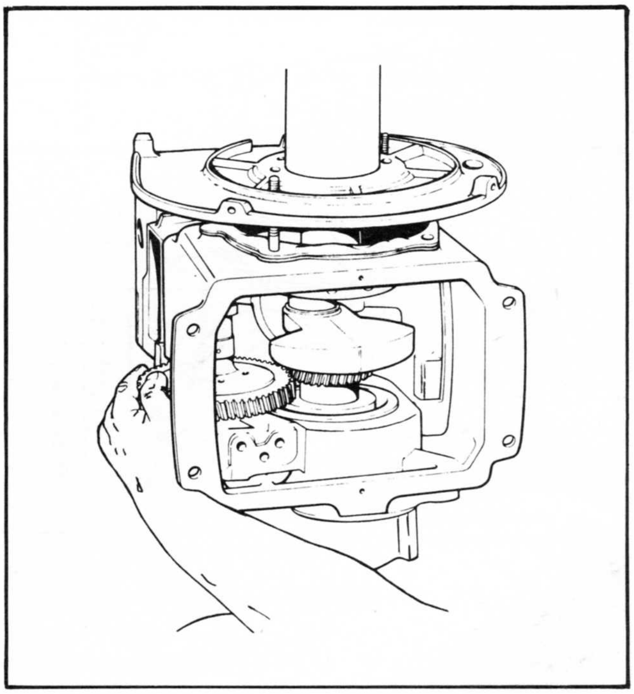


FIGURE 55 INSTALLING CRANKSHAFT - BEARING PLATE

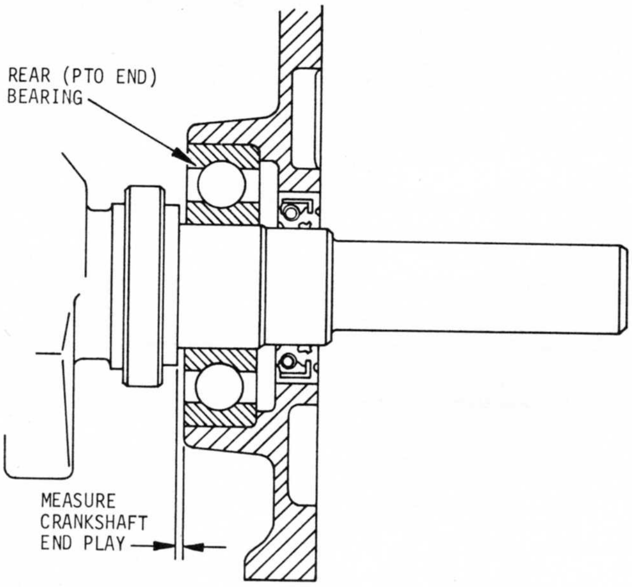


FIGURE 56 CRANKSHAFT END PLAY

7. PISTON AND ROD ASSEMBLY

A. Lubricate 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 22).

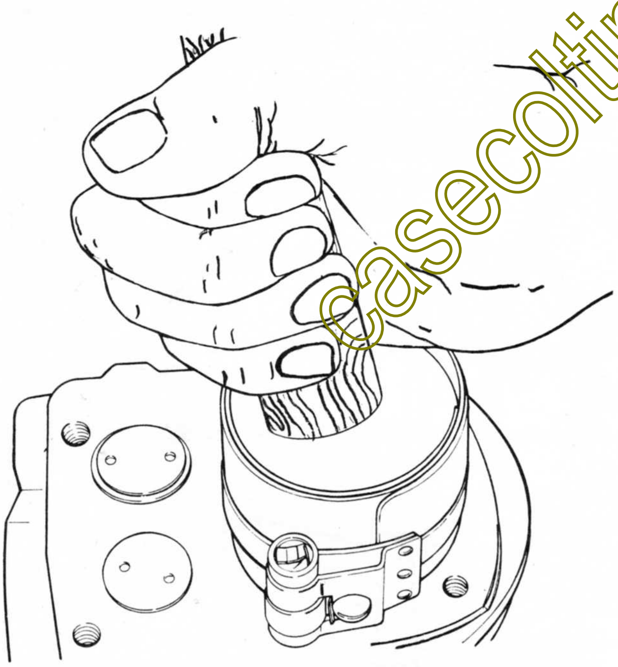


FIGURE 57 INSTALL PISTON USING RING COMPRESSOR

B. 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 marking is toward flywheel side of engine. Use a ring compressor to prevent ring breakage during installation. Gently push piston into bore with hammer handle--do not pound.

IMPORTANT: Position crankshaft to prevent rod from striking crankpin.

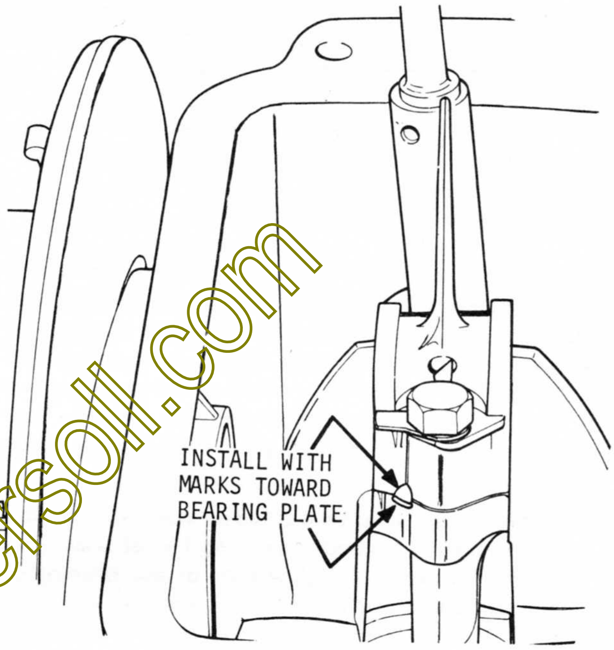


FIGURE 58 ALIGN MATCHING MARKS ON ROD AND CAP

8. ATTACHING ROD TO CRANKSHAFT

A. After piston assembly is installed, place block on end then lubricate connecting rod big end, crankpin and threads on connecting rod capscrews.

B. It is important that marks on connecting rod and cap line up and face flywheel end of engine. (See Figure 58). Move crankpin into position to allow installation of cap.

C. Rod cap, lock tabs or lock washers and capscrews are then attached to connecting rod. Use a torque wrench to tighten capscrews to proper torque value as stated in Clearance Section.

D. If locking tabs are used, bend tabs to lock capscrews.

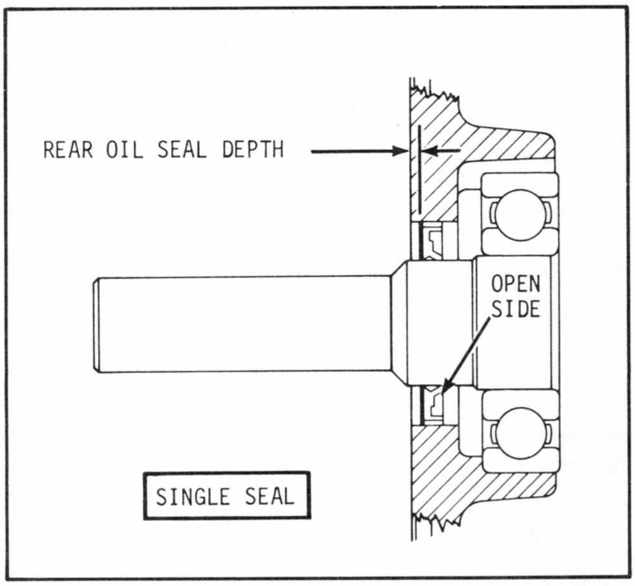


FIGURE 59 REAR OIL SEAL INSTALLATION

9. INSTALLATION OF OIL SEALS

When installing new oil seals, apply a liberal amount of light grease such as lubriplate on the seal lip area. Use seal driver and seal sleeve of appropriate size and install carefully to prevent the seal lip from rolling and creasing. Press against outer edges of seal--press squarely into position to a depth of 1/8 inch (3 mm). Rear oil seal installation details are shown in the above figure.

A. Apply grease to lip then guide oil seals into position on crankshaft without damaging lips of seals. Any foreign matter or knifelike edge or any bending of seal may cause damage and an oil leak can result.

B. After oil seals are started on shaft, place block on its side. The oil seals may now be driven squarely into bearing plate and cylinder block.

10. OIL PAN BASE

A. Use pilot studs to align cylinder block, gasket and oil base.

B. A new gasket must be used to prevent oil leakage.

C. Assemble oil base to block with four bolts.

D. Torque pan bolts to standard torque.

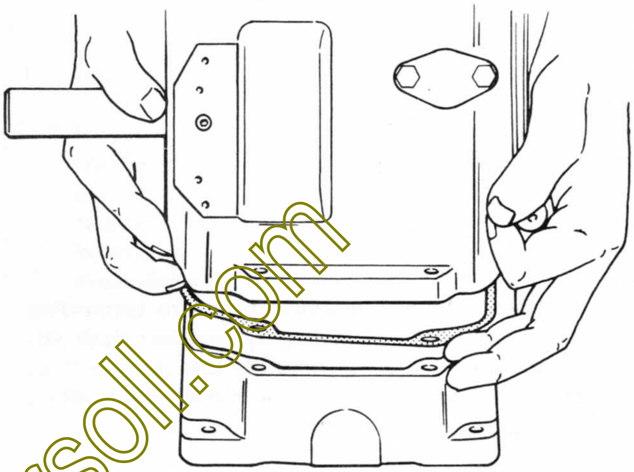


FIGURE 60 INSTALL OIL PAN GASKET

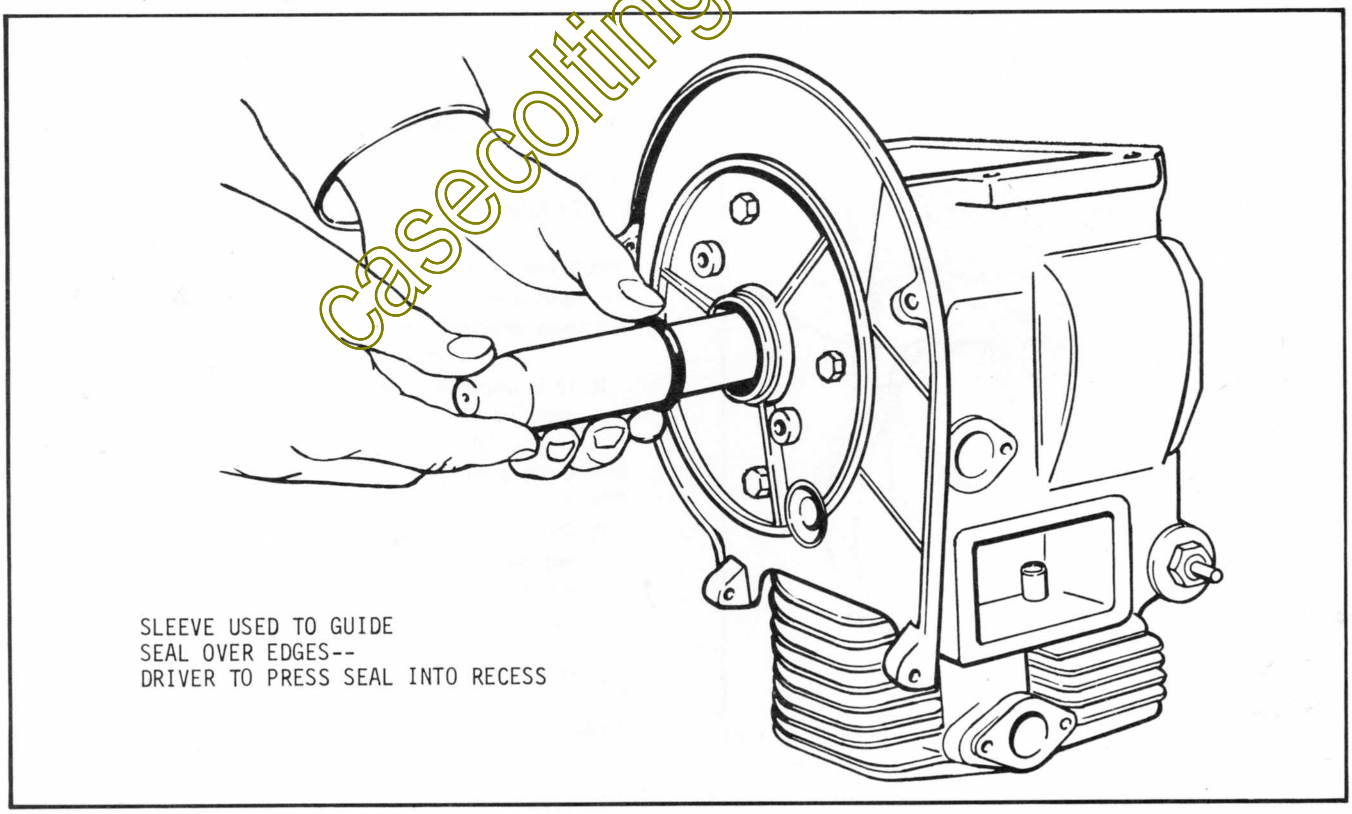


FIGURE 61 USE SEAL DRIVER AND SLEEVE TO INSTALL FRONT OIL SEAL

11. VALVE MECHANISM

A. Valves, valve seats and ports should be thoroughly cleaned. Valves should be ground and lapped-in to obtain a good valve seat. Keep valve seat from 1/32" to 1/16" (.8-1.6 mm) in width.

B. Valve clearance should be checked cold. On K241, K301, K321 adjust tappets to correct clearance.

C. After correct clearance is obtained, remove valves and install valve springs and retainers and rotators if used. Lubricate stems then replace valves, compress springs and place locking keys in grooves of valve stems.

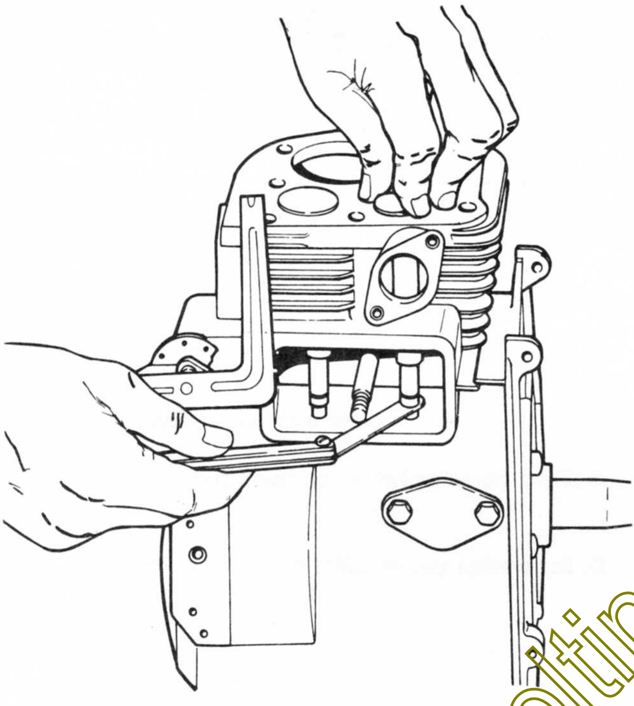


FIGURE 62 CHECK VALVE CLEARANCE BEFORE ASSEMBLY

12. CYLINDER HEAD

A. Always use a new gasket when head has been removed for service work.

B. Check cylinder head on face plate to be sure gasket surfaces make good contact at all points.

C. It is important that head capscrews be lubricated then tightened evenly and in sequence until proper torque is reached.

D. Install new spark plug and tighten to specified torque. Spark plug gap should be .025" (.64 mm).

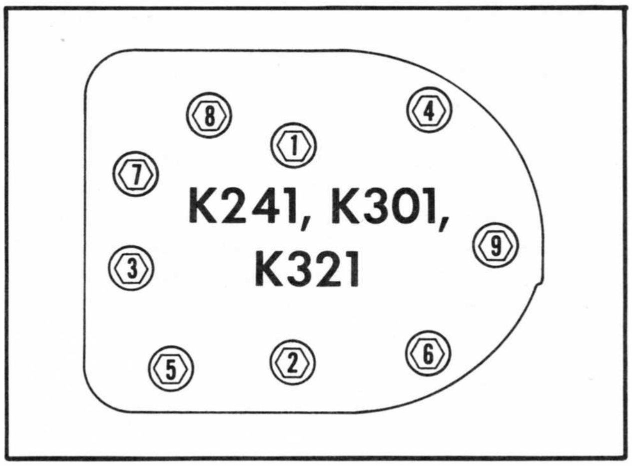


FIGURE 63 CYLINDER HEAD TIGHTING SEQUENCE

13. BREATHER ASSEMBLY

A. Reed type breathers are used to maintain slight vacuum in crankcase. All parts must be clean and in good condition. Use new gaskets, reed and filter for reconditioned engine.

B. The accompanying illustration shows the correct order of assembly. Make sure reed valve is installed properly and that oil drain hole on breather plate is down.

C. Cover must be securely tightened to prevent oil leakage.

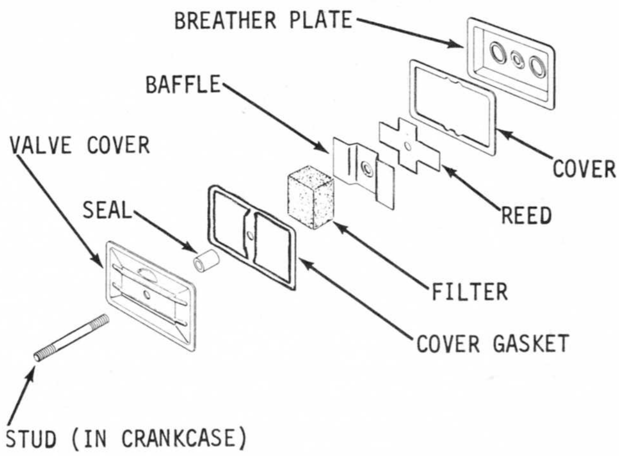


FIGURE 64 BREATHER PARTS SEQUENCE

14. FLYWHEEL

A. Place wave washer on crankshaft and place flywheel in position.

Improper procedures for removal and reinstallation 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. As a safety reminder, some important do's and don'ts are presented in the following:

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.

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 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 position key properly in keyway and carefully guide key slot in flywheel hub over the key while installing to avoid pushing the key inward.

DO use a flywheel puller to remove the flywheel rather than bumping the end of the crankshaft.

DO make sure the flywheel hub and taper of the crankshaft are clean, dry and completely free of any lubricant before installing flywheel.

DO use a torque wrench and tighten the flywheel retaining nut to the torque valve specified for the engine model involved. Torque valves are restated here to further emphasize this.

Torque flywheel retaining nut to 60-70 lb. ft. (81-94 Nm)

DO make a thorough visual inspection of the flywheel and crankshaft before installation to make sure they are in good condition and free of cracks.

B. The rotating screen is fastened to starter pulley with screws and spacers.

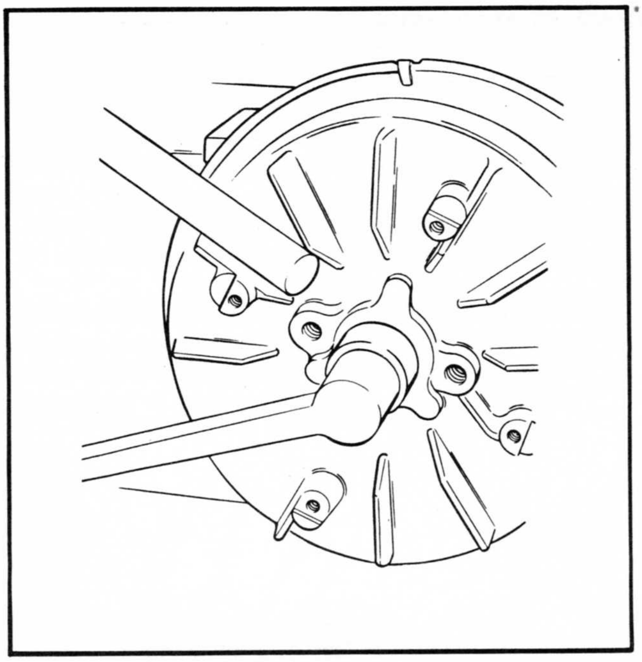


FIGURE 65 TIGHTEN FLYWHEEL TO TORQUE SPECIFIED

15. BREAKER POINTS

A. Install push rod.

B. Fasten breaker in place with two screws.

C. Place cover gasket in position and attach coil lead.

D. Set breaker gap at .020 (.51 mm) full open.

E. Time engine with automotive timing light before installing breaker point cover. Be sure breaker lead grommet is in place.

16. CARBURETOR

A. Insert a new gasket and assemble carburetor to intake port with two screws.

B. Refer to Service Section on carburetor adjustment procedure.

17. GOVERNOR ARM AND LINKAGE

A. Insert carburetor linkage in throttle arm.

B. Connect governor arm to carburetor linkage and slide governor arm onto governor shaft.

C. Before tightening clamp bolt, turn shaft counterclockwise as far as possible with a pair of pliers, pull arm as far as possible to left (away from carburetor), tighten nut and check for freedom of movement. Refer to governor section for adjustments.

18. BLOWER HOUSING

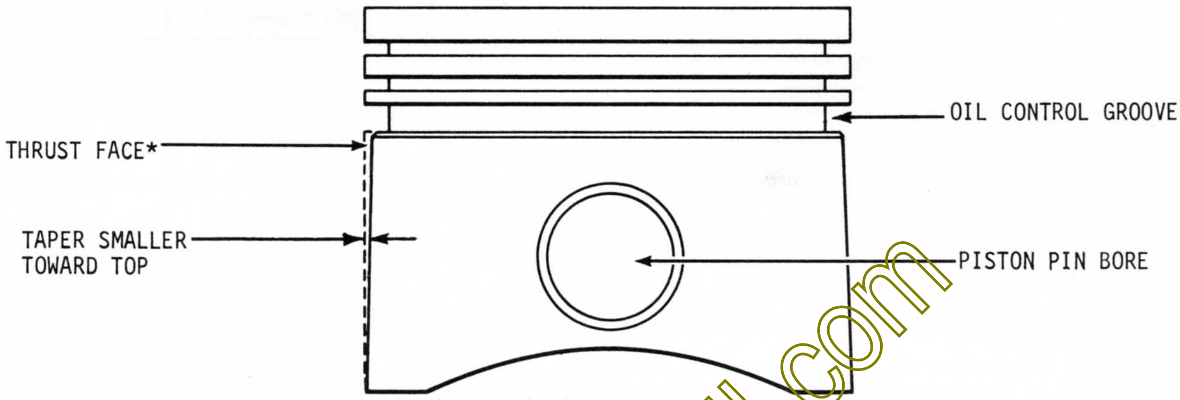
A. The engine is now ready for (1) head baffle, (2) cylinder baffle, and (3) blower housing--assembled in sequence stated. These parts are fastened to engine by cap screws which attach to cylinder head and bearing plate.

IMPORTANT: Shorter screws go into lower portion of blower housing.

RUN-IN PROCEDURES (RECONDITIONED ENGINES)

After an engine has been reconditioned and reassembled, it must be "run-in" on non-detergent oil and under load for a period of about 5 hours. This should be sufficient time to seat the piston rings.

After the initial run-in period, drain the non-detergent type oil and refill with detergent type API Service SC oil of proper weight. (See Page 7) Do not continue using non-detergent oil after the first 5 hours of operation.



**Measure wear at thrust face & at right angle to pin bore.*

FIGURE 66 PISTON WEAR MEASUREMENT DETAILS

SPECIFICATION		K241	K301	K321
GENERAL	Compression Ratio	6.2 to 1	6.6 to 1	7.0 to 1
	Crankcase Vacuum/Water	5-10″ (125-254 mm)	5-10″ (125-254 mm)	5-10″ (125-254 mm)
DISPLACEMENT		23.9″^{3} (391.65 cm^{3})	29.07″^{3} (476.37 cm^{3})	31.27″^{3} (528.46 cm^{3})
HORSEPOWER	Max. RPM	10.0 (7.46 kw)	12.0 (8.95 kw)	14.0″ (10.44 kw)
CYLINDER BORE	New Diameter	3.251″ (82.57 mm)	3.375″ (85.73 mm)	3.500″ (88.90 mm)
	Max Wear Diameter	3.2545″ (82.66 mm)	3.3785″ (85.81 mm)	3.503″ (88.98 mm)
	Maximum Taper	.0015″ (.04 mm)	.0015″ (.04 mm)	.0015″ (.04 mm)
	Max. Out of Round	.005″ (.13 mm)	.005″ (.13 mm)	.005″ (.13 mm)
CRANKSHAFT	End Play - Free	.003/.020″ (.08/.51 mm)	.003/.020″ (.08/.51 mm)	.003/.020″ (.08/.51 mm)
CRANKPIN	New Diameter	1.500″ (38.10 mm)	1.500″ (38.10 mm)	1.500″ (38.10 mm)
	Max. Out of Round	.0005″ (.01 mm)	.0005″ (.01 mm)	.0005″ (.01 mm)
	Maximum Taper	.001″ (.025 mm)	.001″ (.025 mm)	.001″ (.025 mm)
CAMSHAFT	Run Clearance on Pin	.001/.0035″ (.025/.09 mm)	.001/.0035″ (.025/.09 mm)	.001/.0035″ (.025/.09 mm)
	End Play	.005/.010″ (.13/.25 mm)	.005/.010″ (.13/.25 mm)	.005/.010″ (.13/.25 mm)
CONNECTING ROD	Big End Max. Dia.	1.5025″ (38.16 mm)	1.5025″ (38.16 mm)	1.5025″ (38.16 mm)
	Rod-Crankpin Max. Clearance	.0035″ (.09 mm)	.0035″ (.09 mm)	.0035″ (.09 mm)
	Small (Pin) End New Dia.	.85975″ (21.84 mm)	.87585″ (22.25 mm)	.87585″ (22.25 mm)
	Rod To Pin Clearance	.0003/.0008″ (.01/.02 mm)	.0003/.0008″ (.01/.02 mm)	.0003/.0008″ (.01/.02 mm)
	Rod To Pin Side Clearance	.007/.016″ (.18/.40 mm)	.007/.016″ (.18/.40 mm)	.007/.016″ (.18/.40 mm)
PISTON Note: See Figure 66, Page 41	Thrust Face Max. Wear Dia.*	3.2445″ (82.41 mm)	3.3625″ (85.41 mm)	3.4945″ (88.76 mm)
	Thrust Face Bore Clearance*	.0075/.0085″ (.19/.22 mm)	.0065/.0095″ (.16/.24 mm)	.007/.010″ (.18/.25 mm)
	Ring-Max. Side Clearance	.006″ (.15 mm)	.006″ (.15 mm)	.006″ (.15 mm)
	Ring End Gap In New Bore	.010/.020″ (.25/.51 mm)	.010/.020″ (.25/.51 mm)	.010/.020″ (.25/.51 mm)
	Ring End Gap In Used Bore	.027″ (.68 mm)	.030″ (.76 mm)	.030″ (.76 mm)

*Measured just below oil ring and at right angles to piston pin

SPECIFICATION		K241	K301	K321
PISTON (cont.)	Piston Pin Fit In Piston	Push Fit	Push Fit	Push Fit
	Piston Stroke	2.875" (73.03 mm)	3.250" (82.55 mm)	3.250" (82.55 mm)
VALVE INTAKE†	Valve Tappet Cold-Clearance	.008/.010" (.20/.25 mm)	.008/.010" (.20/.25 mm)	.008/.010" (.20/.25 mm)
	Valve Lift Zero Lash	.324" (8.230 mm)	.324" (8.230 mm)	.324" (8.230 mm)
	Stem to Guide Max. Wear Clearance	.0045" (.114 mm)	.0045" (.114 mm)	.0045" (.114 mm)
	Face Angle	45°	45°	45°
	Seat Angle	89°	89°	89°
VALVE EXHAST†	Valve Tappet Cold Clearance	.017/.020" (.43/.51 mm)	.017/.020" (.43/.51 mm)	.017/.020" (.43/.51 mm)
	Valve Lift Zero Lash	.324" (8.230 mm)	.324" (8.230 mm)	.324" (8.230 mm)
	Stem to Guide Max. Wear Clearance	.0065" (.16 mm)**	.0065" (.16 mm)**	.0065" (.16 mm)**
	Face Angle	45°	45°	45°
	Seat Angle	89°	89°	89°
VALVE GUIDES	Ream To	.312/.313" (7.92/7.95 mm)	.312/.313" (7.92/7.95 mm)	.312/.313" (7.92/7.95 mm)
TAPPET	Clearance in Guide	.0008/.0023" (.02/.06 mm)	.0008/.0023" (.02/.06 mm)	.0008/.0023" (.02/.06 mm)
IGNITION	Spark Plug Gap	.025" (.63 mm)	.025" (.63 mm)	.025" (.63 mm)
	Breaker Point Gap	.020" (.51 mm)	.020" (.51 mm)	.020" (.51 mm)
	Trigger Air Gap	N/A	N/A	.005/.010" (.13/.25 mm)
	Spark Timing °BTDC	20°	20°	20°
TORQUE VALUES	Spark Plug	18-22 lb-ft (24-29 Nm)	18-22 lb-ft (24-29 Nm)	18-22 lb-ft (24-29 Nm)
	Cylinder Head	25-30 lb-ft (34-40 Nm)	25-30 lb-ft (34-40 Nm)	25-30 lb-ft (34-40 Nm)
	Connecting Rod	300 lb-in (33.8 Nm)	300 lb-in (33.8 Nm)	300 lb-in (33.8 Nm)
	Flywheel Nut	60-70 lb-ft (81-94 Nm)	60-70 lb-ft (81-94 Nm)	60-70 lb-ft (81-94 Nm)

**Measure at top of guide with valve closed

† See page 25 for additional specifications.

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