Kawasaki

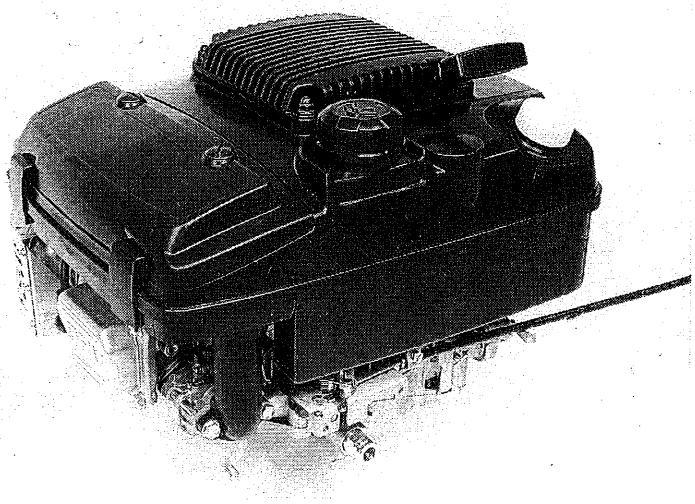
SW 621

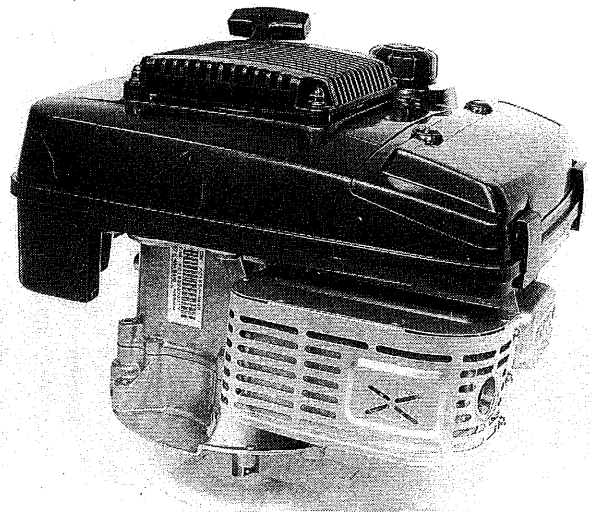
FC180V

OHV

4-stroke air-cooled gasoline engine

WORKSHOP MANUAL





FOREWORD

This manual is designed for use by trained mechanics in a properly equipped shop.
In order to perform the work efficiently and to avoid costly mistakes, read the text thoroughly, familiarize yourself with the procedures before starting work, and then do the work carefully in a clean area. Whenever special tools or equipments are specified, do not use makeshift tools or equipment. Precision measurements can only be made if the proper instruments are used, and the use of substitute tools may adversely affect safe operation.

Whenever you see these WARNING AND CAUTION symbols, heed their instructions! Always follow safe operation and maintenance practices.

⚠ WARNING : This safety alert symbol identifies important safety messages in this manual and on the equipment. When you see this symbol, read the message that follows very carefully to avoid fire, personal injury, or loss of life.

CAUTION : This identifies special instructions or procedures to avoid equipment damage or destruction.

NOTE : Indicates message or points of particular interest for more efficient and convenient operation.

The term "Replace" and some abbreviations are used as follows:

Replace = Usually means replace with a new part
MIN = Minimum
MAX = Maximum
Assy = Assembly
STD = Standard
PTO = Power take off
Approx. = Approximately (Approximate)
Carb. = Carburetor
Con-rod = Connecting rod
Cyl. = Cylinder
Dia. = Diameter

SAFETY

⚠ WARNING : Gasoline is extremely flammable and can be explosive under certain conditions. Stop the engine. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

⚠ WARNING : When servicing the engine or equipment, always stop the engine and remove the spark plug wire from the spark plug to avoid accidental starting.

⚠ WARNING : Protect your hands with gloves or a piece of thick cloth from edges and heat in servicing the product.

⚠ WARNING : Before performing any disassembly operations on the equipment with the electric starter, disconnect the negative (−) lead from the battery to avoid the possibility of accidentally cranking the engine while partially disassembled.

⚠ WARNING : Always minimize shock hazards when working on the electrical equipment. Work in a clean, dry environment with dry hands. For maximum shock hazard protection, connect the equipment ground terminal to an earth ground.

TABLE OF CONTENTS

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GENERAL INFORMATION

MECHANICAL SYSTEM

Be familiar with OPERATOR'S MANUAL before service.

Lubrication

Supply engine oil as specified even for a short test running to avoid any score in the engine, which may destroy the engine in the field use.
Use clean engine oil in the case specified as just "coat oil" in this manual.
Don't use just any oil or grease. Some oils and greases in particular should be used only in certain applications and may be harmful if used in an application for which they are not intended.
Engine wear is generally at its maximum while the engine is warming up and before all the rubbing surfaces have an adequate lubricative film. During assembly, oil or grease (whichever is more suitable) should be applied to any rubbing surface which has lost its lubricative film. Old grease and dirty oil should be cleaned off. Deteriorated grease has lost its lubricative quality and may contain abrasive foreign particles.

Fuel

Unleaded gasoline is preferably recommended because of the less deposit in the combustion chamber.
Alcohol mixed gasoline is not recommended due to bad influences of alcohol on the engine components in the fuel and combustion systems.

High Flash-point Solvent

A high flash-point solvent is recommended to reduce fire danger. A commercial solvent commonly available in North America is Stoddard solvent (generic name). Always follow manufacturer's and container's directions regarding the use of any solvent.

Dirt

Before removal and disassembly, clean the product. Any dirt entering the product, carburetor, or other parts will work as an abrasive and shorten the life of the product. For the same reason, before installing a new part, clean off any dust or metal fillings.

Liquid Gasket and Non-permanent Locking Agent

Follow manufacturer's directions for cleaning and preparing surfaces where these compounds will be used. Apply sparingly. Excessive amounts may block engine oil passages and cause serious damage. An example of a non-permanent locking agent commonly available in North America is Loctite Lock'n Seal (Blue).

Oil Seal, Grease Seal

Replace any oil or grease seals that were removed, because the removal generally damages seals.
A seal guide is required for certain oil or grease seals during installation to avoid damage to the seal lips.

Gasket, O-ring

When in doubt as to the condition of a gasket or O-ring, replace it. The mating surfaces around the gasket should be free from foreign matter and smooth to avoid leakage.

Circlip, Retaining Ring

Replace any circlips and retaining rings that were removed, because the removal weakens and deforms them. When installing circlips and retaining rings, take care to compress or expand them only enough to install them.

GENERAL INFORMATION

Force

Common sense should dictate how much force is necessary in assembly and disassembly. If a part seems especially difficult to remove or install, stop and check what may be causing the problem. Whenever tapping is necessary, tap lightly using a wooden or plastic-faced mallet. Use an impact driver for screws (particularly for the removal of screws held by a locking agent) in order to avoid damaging the heads.

Press

A part, such as a seal, installed using a press or driver should first be coated with oil on its outer or inner surface so that it will go into place smoothly.

Ball Bearing Installation

When installing a ball bearing, the bearing race which is affected by friction should be pushed by a suitable driver. This prevents severe stress on the balls and races, and prevents races and balls from being dented. Press a ball bearing until it stops at the stop in the hole or on the shaft.

Torque

The torque values given in this manual should always be adhered to. Either too little or too much torque may lead to serious damage. Use a good quality, reliable torque wrench.

Tightening Sequence

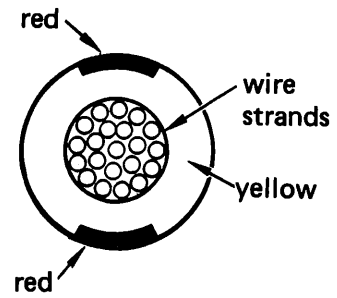
Follow the tightening sequence shown in this manual. When installing a part with several bolts, nuts or screws, they should all be started in their holes and tightened to a snug fit. Then tighten them evenly, according to the tightening sequence, to the specified torque. This is to avoid distortion of the part and/or leakage. Conversely, when loosening the bolts, nuts, or screws, loosen all of them about a quarter of a turn and then remove them.

ELECTRICAL SYSTEM

No Shock
The electrical parts should never be sharply struck, with a hammer, or dropped on a hard surface. Such a shock to the parts may damage them.

Electrical Leads
All the electrical leads are either single-color or two-color and, with only a few exceptions, must be connected to leads of the same color. On any of the two-color leads, there is greater amount of prime color and lesser amount of second color, so the two-color lead is identified first by the prime color and then the second color. For example, a yellow lead with thin red stripes is referred to as a "yellow/red" lead; it would be a "red/yellow" lead if the colors were reversed to make red the prime color.

TWO-COLOR LEAD

Lead (cross-section)	
Name of Lead Color	yellow/red

Defective Component
Never replace a defective electrical component without determining what caused the failure. If the failure was brought on by some other item or items, they too must be repaired or replaced, or the new replacement will fail again.

Connectors
Make sure all connectors in the circuit are clean and tight, and examine leads for signs of burning, fraying, etc. Poor leads and bad connections will affect electrical system operation.

Coil Resistance
Measure coil and winding resistance when the part is cold (at room temperature).

Battery
Do not disconnect the battery leads or any other electrical connections when the ignition switch is on, or while the engine is running, unless specifically noted.
Do not reverse the battery lead connections. This will burn out the diodes or other parts in the electrical systems.
Always check battery condition before blaming other parts of an electrical system. A fully charged battery is a must for performing accurate electrical system check.

Starter
Never keep the starter engaged if the starter motor will not turn over, or the current may burn out the starter motor windings.

KAWASAKI Multimeter
KAWASAKI Multimeter (P/N 395100-9803A) is recommended for the electrical system check because a meter of other type may indicate different value.

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GENERAL SPECIFICATIONS

ITEM	FC180V
Engine Type	Forced Air-cooled, Vertical Shaft, OHV, 4-Stroke Gasoline Engine
Number of Cylinder	1
Piston Displacement	182 cc (11.1 cu. in.)
Bore x Stroke	68 x 50 mm (2.68 in. x 1.97 in.)
Direction of Rotation	Counterclockwise facing the PTO Shaft
Fast Idle Speed	3200 ~ 3350 rpm cf. Note 3
Slow Idle Speed	1450 ~ 1650 rpm
ACR	Mechanical Flyweight Type
Lubricating Method	Splash
Oil Pan Capacity	0.65 L (1.37 US pt)
Fuel Tank Capacity	2.4 L (2.54 US qt.)
Carburetor	Float Type Fixed Main Jet
Choke Control	Automatic (with Throttle Control)
Air Cleaner	Semi-cyclone Type with Dual Element
Ignition	Transistorized Flywheel Magneto
Spark Plug	NGK BP5ES
Cooling Air Inlet	Recoil Starter and Rotating Screen
Governor	Mechanical Flyweight

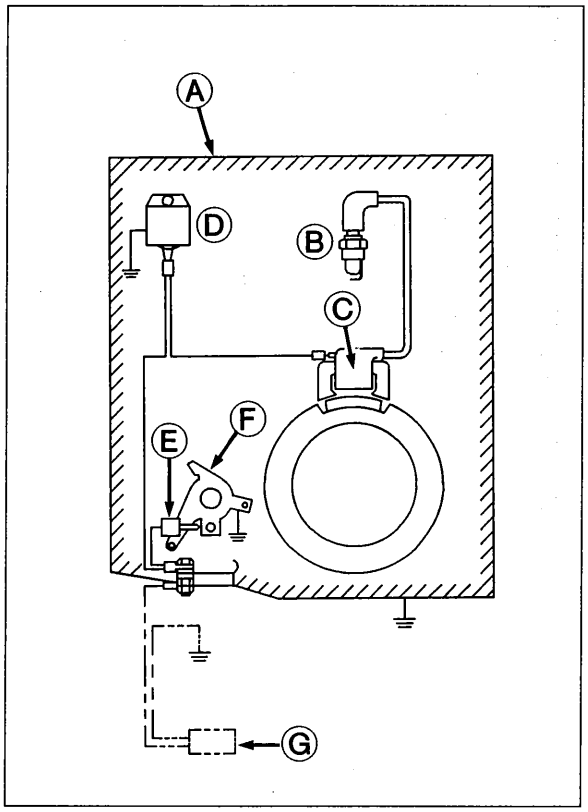
Note : 1. Specifications are subject to change without notice.
2. ACR = Automatic Compression Release.
3. Fast idle speed may vary depending on each equipment on which engine is used. Refer to the equipment specification.

WIRING DIAGRAM

RECOIL STARTER MODEL

1. Portion surrounded by hatching shows KAWASAKI procurement parts.

A: Engine
B: Spark plug
C: Ignition coil
D: Control unit
E: Stop switch
F: Control lever
G: Interlock switch



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PERIODIC MAINTENANCE

To ensure satisfactory operation over extended period of time, engine requires normal maintenance at regular intervals.
Chart below shows periodic maintenance. Suitable interval is shown as (○).

MAINTENANCE	INTERVAL				
	Daily	Every 25 hr	Every 50 hr	Every 100 hr	Every 300 hr
Check and add engine oil.	○				
Check for loose or lost nuts and screws.	○				
Check for fuel and oil leakage.	○				
Check and clean air intake screen.	○				
Clean engine switch and control panel on engine.	○				
★★ Clean air cleaner foam element.		○			
Tighten nuts and screws.		○ (first)		○	
Clean fuel filter.			○		
★ Change engine oil.			○		
★★ Clean air cleaner paper element.				○	
Clean and regap spark plug.				○	
Clean combustion chamber.				○	
Check and adjust valve clearance.				○	
Clean and lap valve seating surface.				○	
★★ Replace air cleaner paper element.					○
★★ Clean cylinder and cylinder head fins of dust and dirt.					○

★ Perform these maintenances after first 5 hours of use, then at recommended intervals.
★★ Service more frequently under dusty conditions.

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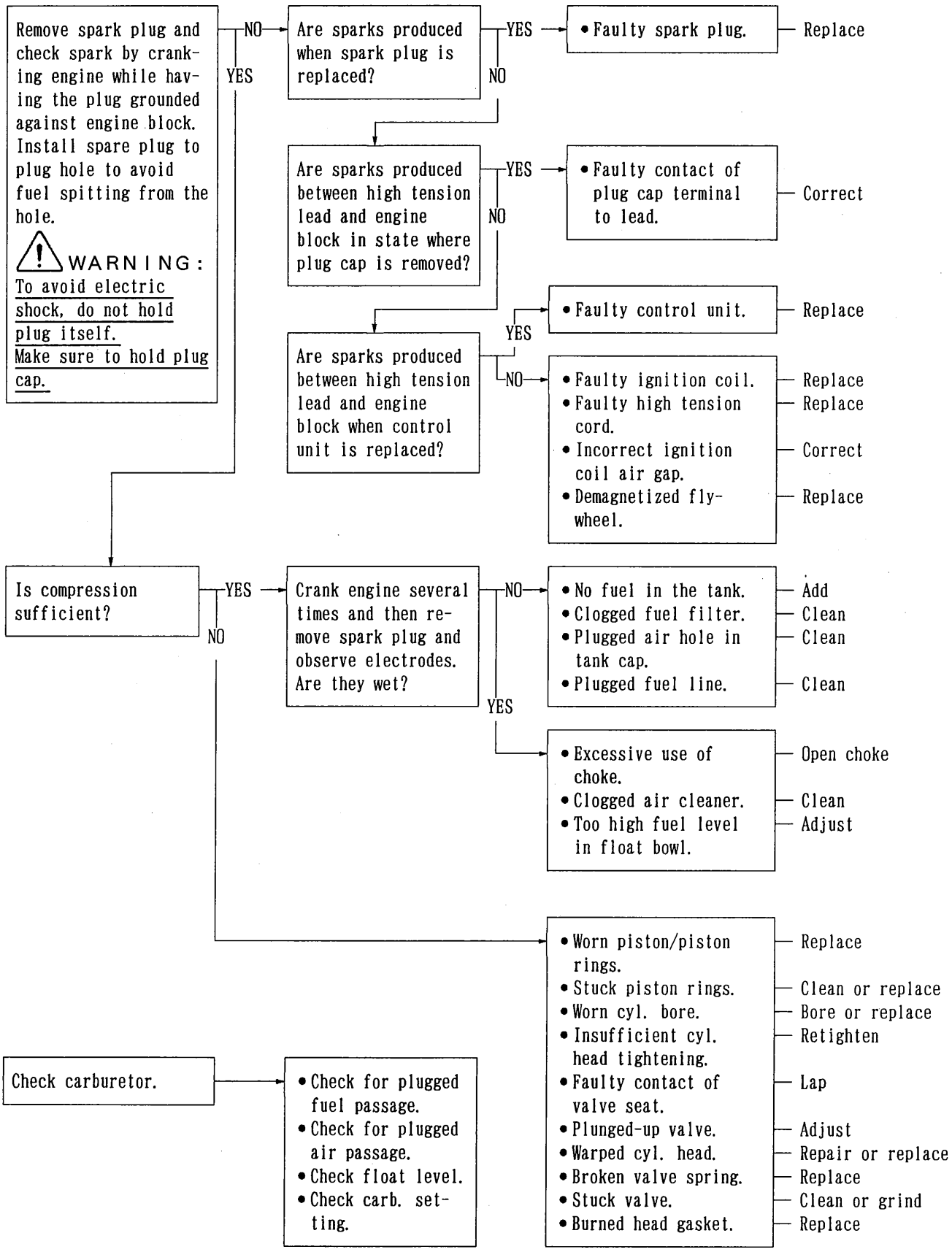
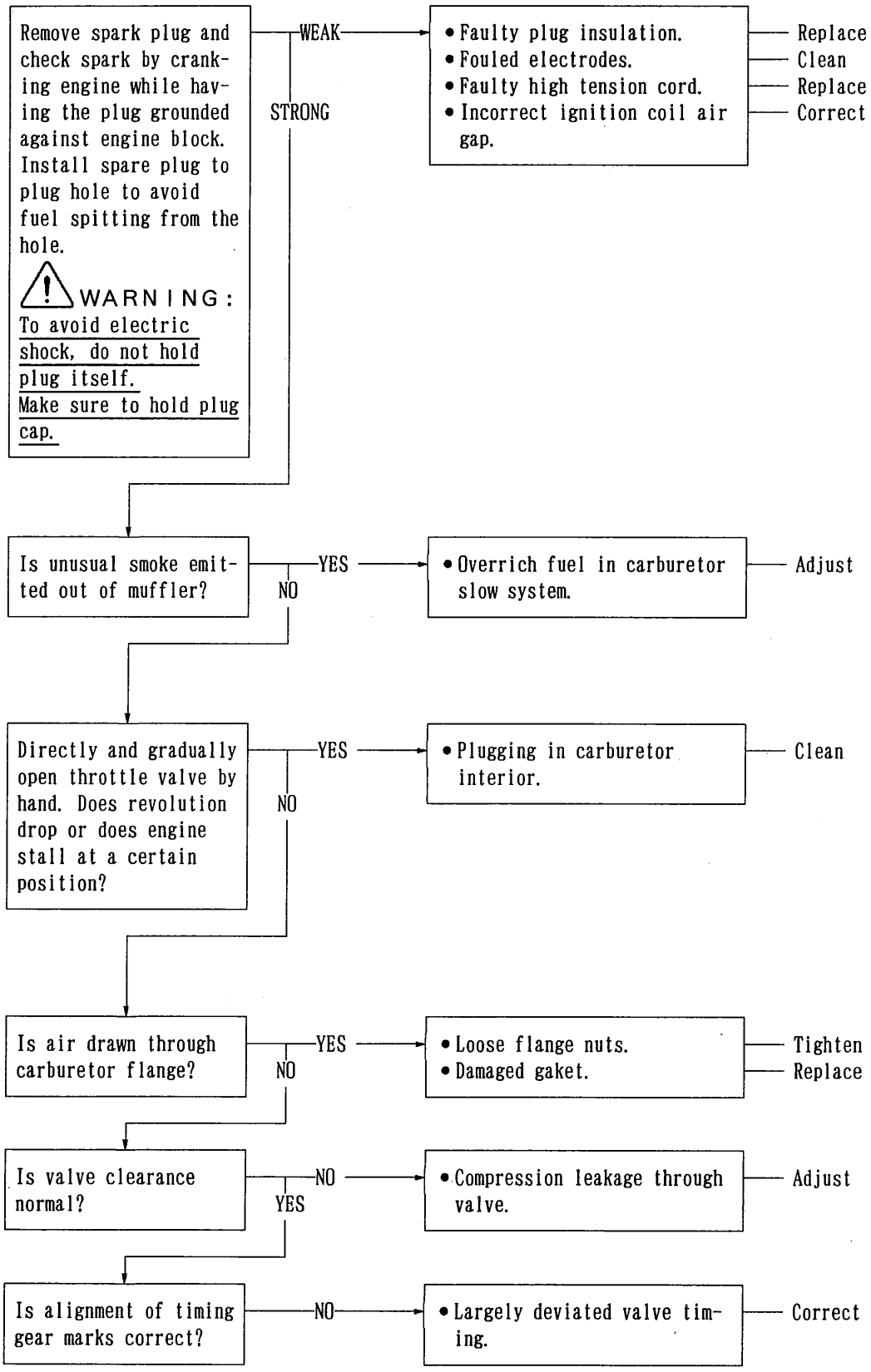
TROUBLESHOOTING

ENGINE — HARD STARTING



TROUBLESHOOTING

ENGINE – MALFUNCTIONS AT LOW SPEED



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TROUBLESHOOTING

ENGINE – ERRATICAL RUN

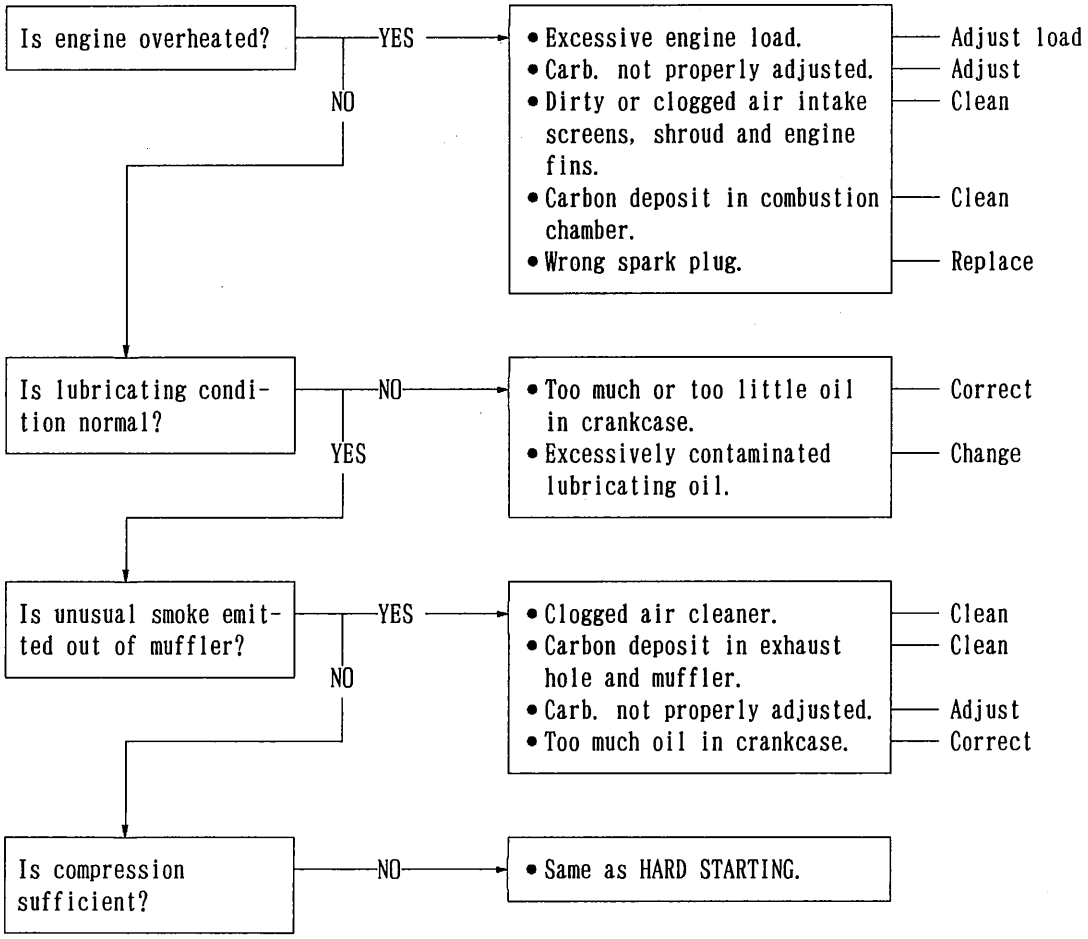
Problem in fuel system (lack of fuel)	• Entry of dust or water into fuel pipe or fuel filter.	— Clean
	• Air or vapour lock in fuel line.	— Remove.
	• Plugged air vent of fuel tank cap.	— Clean
	• Plugged air/fuel passes in carburetor.	— Clean
Problem in governor system	• Incorrect governor linkage adjustment.	— Correct
	• Faulty governor spring.	— Replace
	• Governor gear assy malfunction.	— Replace
Engine knocks	• Stale fuel.	— Change
	• Excessive carbon deposit in engine.	— Clean
	• Excessive engine load.	— Adjust
	• Engine overheating.	— See LOW POWER

ENGINE – EXCESSIVE OIL CONSUMPTION

Is compression sufficient?	YES	• Plugged oil ring groove.	— Clean
		• High oil level.	— Correct
		• Worn valve stems and valve guides.	— Replace
		• Oil leakage along governor shaft.	— Replace
		• Oil leakage from oil seal.	— Replace
		• Oil leakage from gasket.	— Replace
		• Oil leakage from drain plug.	— Retighten or replace
		• Faulty breather valve.	— Repair or replace
		• Drain-back hole in tappet chamber plugged.	— Clean
		• Incorrect oil viscosity.	— Change
	NO	• Same as HARD STARTING.	

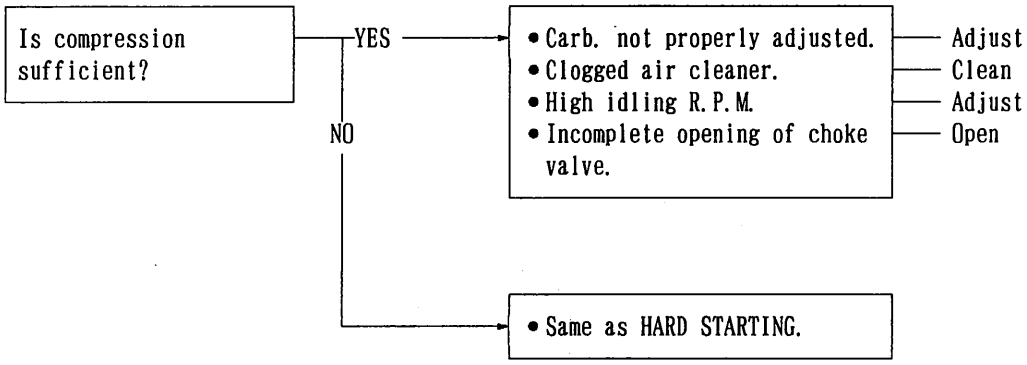
TROUBLESHOOTING

ENGINE – LOW POWER



TROUBLESHOOTING

ENGINE – EXCESSIVE FUEL CONSUMPTION



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TORQUE SPECIFICATIONS

ITEM	FC180
Con-rod bolt ★★★	12 N•m (104 in•lb)
Crankcase cover bolt	23 N•m (16.5 ft•lb)
Valve clearance adjust screw(lock screw)	7 N•m (61 in•lb)
Cylinder head bolt	23 N•m (16.5 ft•lb)
Flywheel nut	45 N•m (33 ft•lb)
Ignition coil bolt	6 N•m (52 in•lb)
Rocker arm bolt(stud)	23 N•m (16.5 ft•lb)
Recoil starter center screw	3.5 N•m (30 in•lb)
Recoil starter stud	8 N•m (69 in•lb)
Recoil starter nut ★	7 N•m (61 in•lb)
Governor arm nut	7 N•m (61 in•lb)
Muffler nut	7 N•m (61 in•lb)
Carburetor and intake pipe bolt ★	7 N•m (61 in•lb)
Engine switch screw	3 N•m (26 in•lb)
Side drain plug ★★	23 N•m (16.5 ft•lb)
PTO side crankshaft end bolt (with plane washer)	38 N•m (28 ft•lb)
Engine mounting flange bolt (M10)	28 N•m (21 ft•lb)
General bolt ④ M 5	3.5 N•m (30 in•lb)
M 6	6 N•m (52 in•lb)
M 8	15 N•m (11 ft•lb)

★ All bolts and screws especially for plastic part tightening -- Do not tighten completely at a time.

★★ When new crankcase cover is used, tighten plug to minimum specified torque and loosen it a little at first, then tighten it to specified torque to get good sealing face.
Do not over-tighten it. Crankcase cover may be damaged.

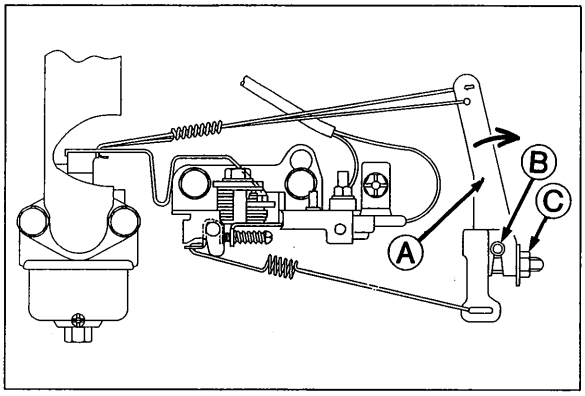
★★★ Apply an oil to the threads, seated surface.

CONTROL SYSTEM

GOVERNOR LEVER SETTING

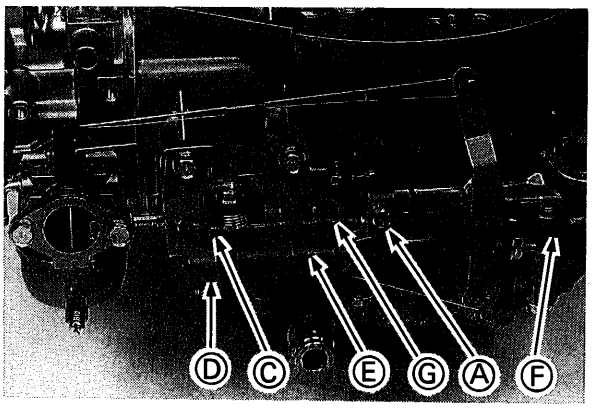
Whenever carburetor or governor lever is removed from engine and then installed again, adjust governor lever position.

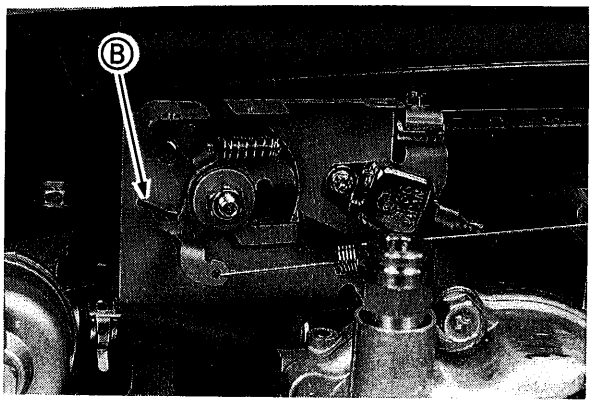
1. Install governor lever (A) on governor shaft (B) but do not tighten nut (C).
   Loosen nut (C) if it is tightened.
2. Turn governor lever (A) clockwise or place throttle lever on dash in "FAST" position to open carb. throttle valve fully.
3. Turn governor shaft (B) clockwise to end of travel.
4. Keeping governor lever position of throttle fully open, tighten nut (C).



THROTTLE CABLE INSTALLATION

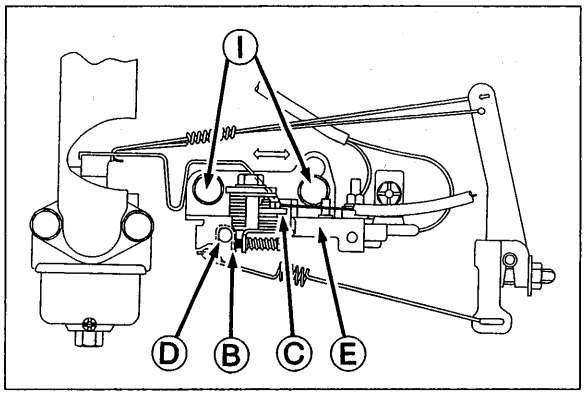
1. Link throttle cable (G) to speed control lever (C) and clamp throttle cable outer housing (F) temporalily.
2. With throttle lever on dash in "FAST" position, align tang (B) of speed control lever (C) with hole (D) of control plate (E) and insert 6 mm (0.24 in.) dia. pin or 6 mm bolt through hole.
3. Pull out throttle cable outer housing (F) to remove any slack and tighten cable clamp bolt (A).
4. Remove 6 mm pin and set throttle lever on dash in "CHOKE" position. Make sure carb. choke valve is completely closed. (See CHOKE ADJUSTMENT)





CONTROL SYSTEM

FAST IDLE SPEED ADJUSTMENT



NOTE : Air cleaner must be installed to engine before starting.

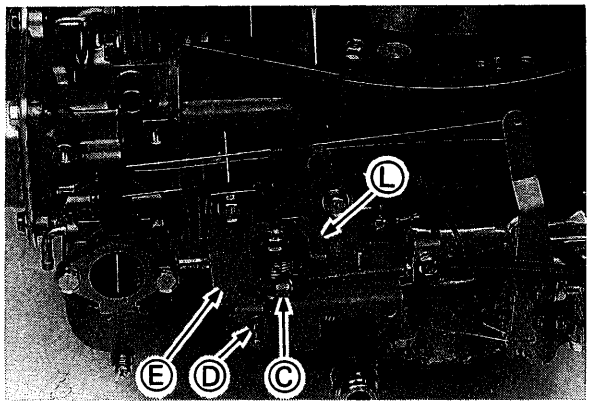
1. Start and warm up engine without load.
2. Loosen two control plate bolts (I).
3. Align tang (B) of speed control lever (C) with hole (D) of control plate (E) and insert 6 mm (0.24 in.) dia. pin or 6 mm bolt through hole.

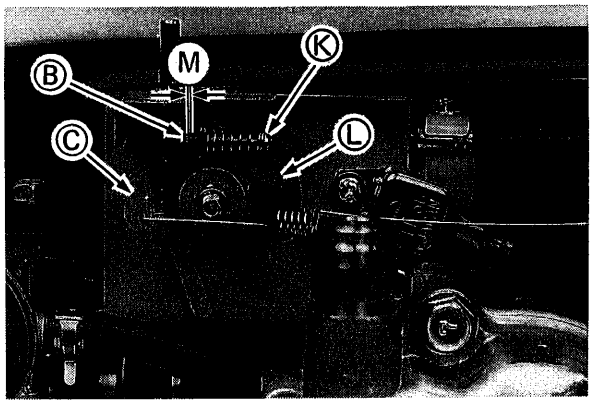
NOTE : Make sure choke valve is fully opened.

4. Adjust fast idle speed for specified rpm (see GENERAL SPECIFICATIONS) by moving control plate (E).
5. Tighten two bolts (I) securely in a manner to avoid changing specified speed.
6. Remove 6 mm pin, stop engine, and set throttle lever on dash in "CHOKE" position.
   Make sure carb. choke valve is closed completely.

CHOKE ADJUSTMENT

1. Align tang (B) of speed control lever (C) with hole (D) of control plate (E) and insert 6 mm (0.24 in.) dia. pin or 6 mm bolt through hole.
2. Turn choke setting screw (K) counter clockwise until it is clear of lever (L) and then turn choke setting screw clockwise until it clearance (M) 0.5 mm (0.02 in.) speed control lever.
3. Remove 6 mm pin and set throttle lever on dash in "CHOKE" position.
   Make sure carb. choke valve is closed completely.





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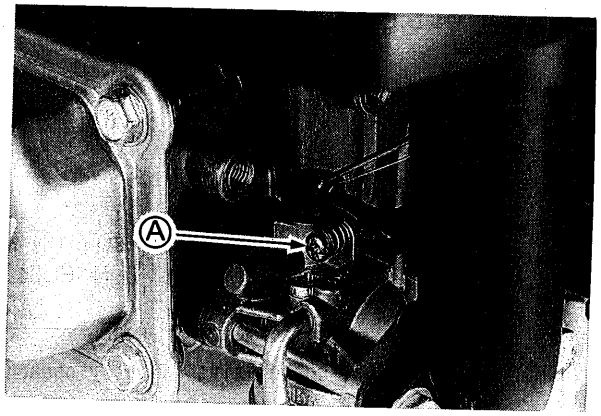
CONTROL SYSTEM

SLOW IDLE SPEED ADJUSTMENT

1. Start and warm up engine without load.
2. Move throttle lever on dash to "SLOW" position.
3. Adjust slow idle speed to specified rpm (see GENERAL SPECIFICATIONS) by moving throttle stop screw (A).



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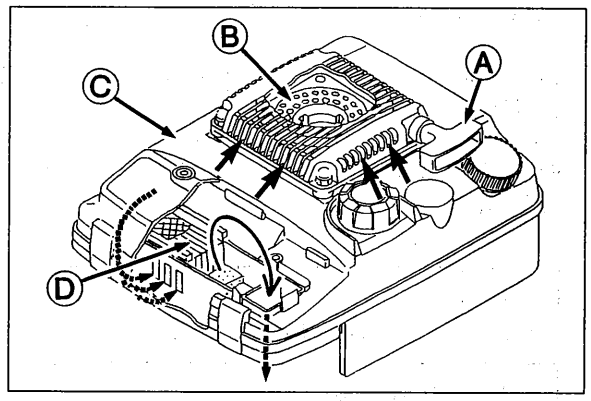
AIR CLEANER

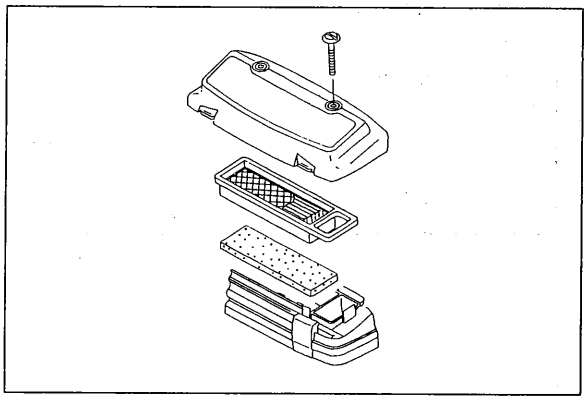
"K" KLEEN SYSTEM



Intake air is inducted through grille of recoil starter (A), rotary screen (B), fan housing (C), and air cleaner (D) to remove grass and rubbish from air.
Therefore, condition of air passages affects volume of intake air and carburetor functions.

1. Assemble related parts neatly to minimize air leakage.
2. Do not remove any parts constructing air passages when running engine.
3. Keep air passages free from grass and rubbish.

MAINTENANCE



Air cleaner maintenance is one of the most important items to keep engine performing well.
Instruct users for following cautions.

1. FOAM ELEMENT must be lightly oiled to perform as intended. Make sure to soak element in engine oil and squeeze excessive oil, after washed.
2. PAPER ELEMENT is cleaned by gentle tapping or washing in detergent and water.
   Do not use pressurized air to paper element to avoid breakage.
   Do not oil paper element.

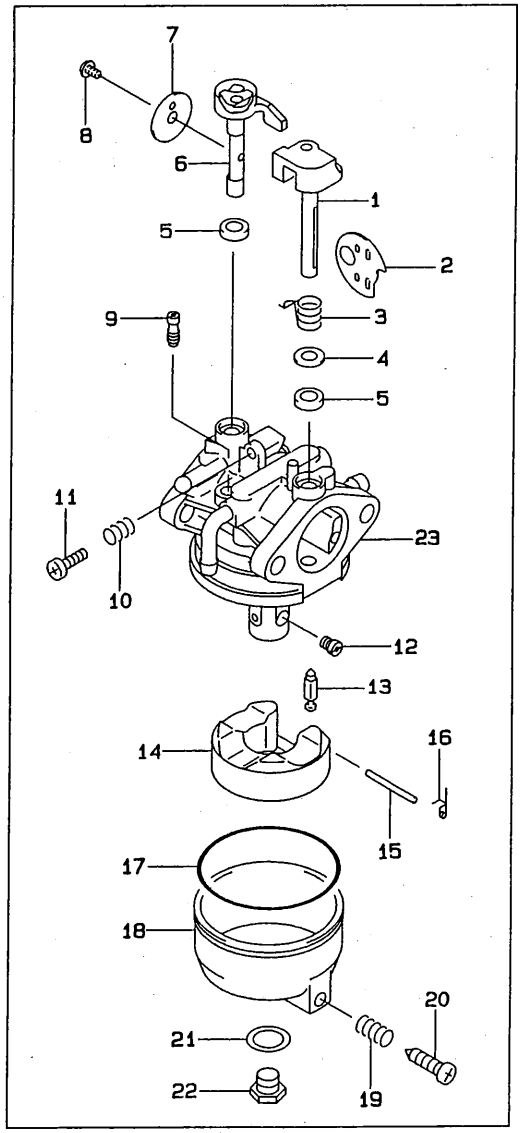
CARBURETOR

COMPONENTS

This carburetor is float type with adjustable stop screw and fixed main jet.

NOTE : Refer to each parts catalog for detailed parts configulation.

Ref. No.	Part Name	Ref. No.	Part Name
1	Choke shaft	13	Needle jet
2	Choke valve	14	Float assy
3	Spring	15	Shaft float
4	Washer	16	Spring
5	Seal	17	Gasket
6	Throttle shaft	18	Float chamber
7	Throttle valve	19	Spring
8	Screw	20	Screw
9	Pilot jet	21	Gasket
10	Spring	22	Bolt
11	Stop screw	23	Carb body
12	Main jet		



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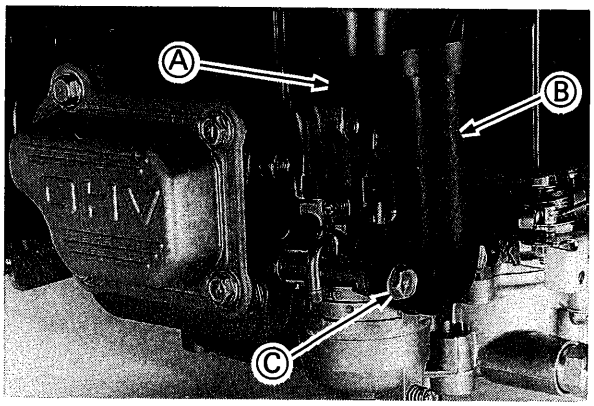
CARBURETOR

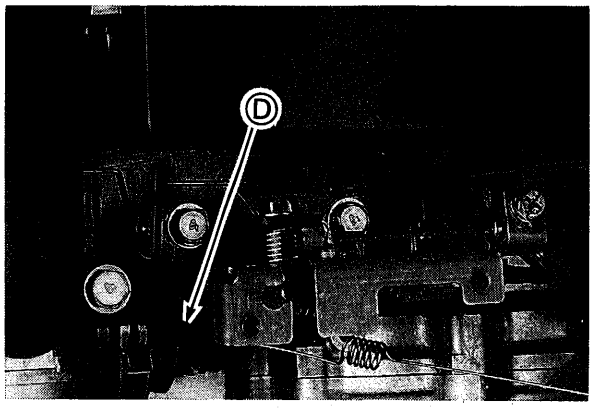
REMOVAL

⚠ WARNING : Gasoline is extremely flammable.
Avoid fires due to smoking or careless practices.

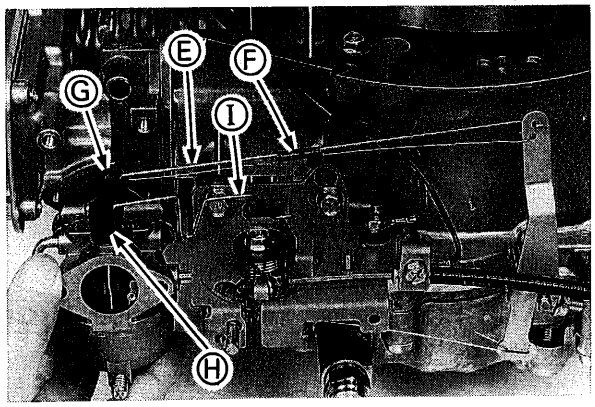
1. Shut fuel valve.
2. Drain fuel from float chamber.
3. Disconnect fuel line (D) from carburetor. Plug the fuel line opening immediately or drain fuel in the line into suitable container.
4. Disconnect breather tube (A) from intake pipe (B).
5. Remove bolts (C).



CAUTION : Do not lose collars in intake pipe bolt holes.

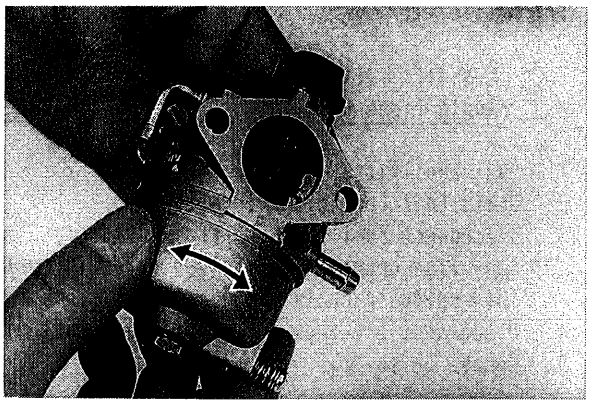


6. Unhook throttle rod (E) and rod spring (F) from throttle lever (G).
7. Unhook choke rod (I) from choke lever (H).



FLOAT CHAMBER REMOVAL

NOTE : Before removing float chamber, rotate float chamber clockwise and counterclockwise for 1/6 turns 2 or 3 times, pushing float chamber to carb. body to release sticking of float chamber and rubber gasket.



CLEANING

CAUTION : Remove main jet before removing main nozzle. Main jet will interfere with main nozzle.

CAUTION : Do not clean jet orifices and float valve seat with hard object.

⚠ WARNING : Follow instructions prepared by cleaner manufacturer when using cleaner.

1. Dip carb. components except non-metaric parts such as gasket into carb. cleaner until dirt is removed and rinse them with solvent.

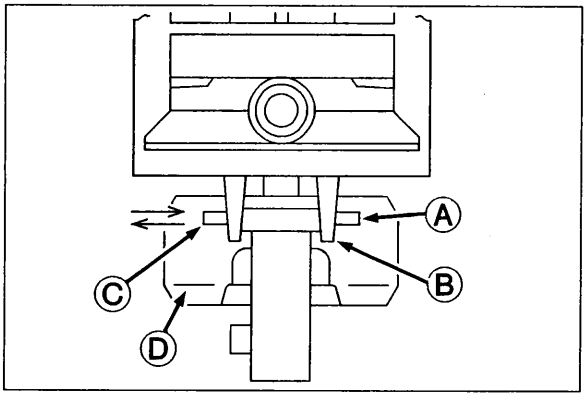
NOTE : Rinse carb. aluminum components in hot water to neutralize corrosive action of cleaner, if so instructed by the manufacturer.

2. Dry components with compressed air.
   Make sure all orifices and passages are free from dirt or foreign object.

CAUTION : Do not use rags or paper to dry components to avoid plugging orifices by lint.

CARBURETOR

FLOAT ADJUSTMENT



CAUTION : Do not strike float pin (A) to remove or install it, to avoid breakage of pin holder (B). To remove float pin, pull the transformed end (C) with pliers. To install float pin, push float pin transformed end until both coming off pin ends are at same length.

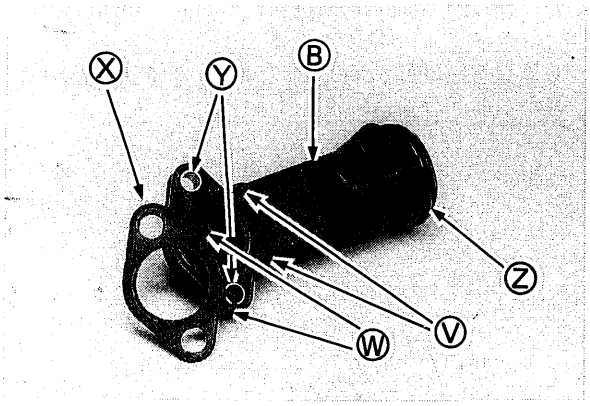
NOTE : Float (D) does not require check and adjustment.

ASSEMBLY AND INSTALLATION

CAUTIONS :

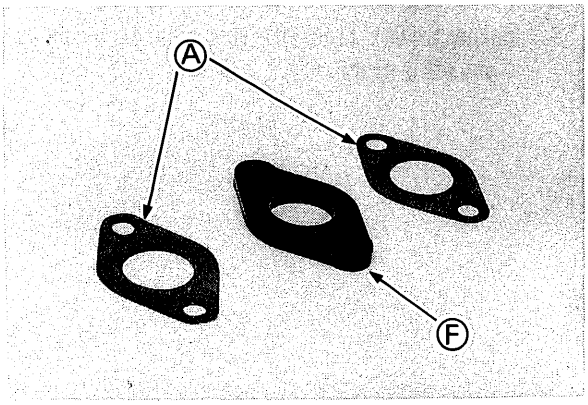
1. Do not over-tighten small carb. components. Finger-tighten stop screw.
2. Do not bend throttle and choke shafts when assembling.
3. Apply screw locking agent to screws of throttle valve or choke valve. Do not allow agent to flow into shaft bearing surfaces.
4. Make sure movement of throttle and choke valves is smooth.

1. Fit holes (W) in gasket (X) on projections (V) of intake pipe (B) flange.
2. Put O Ring (Z) and collars (Y) in place.



3. Arrange gaskets (A) and insulator (F), as shown.

   Gasket (A): Cylinder and carburetor sides.



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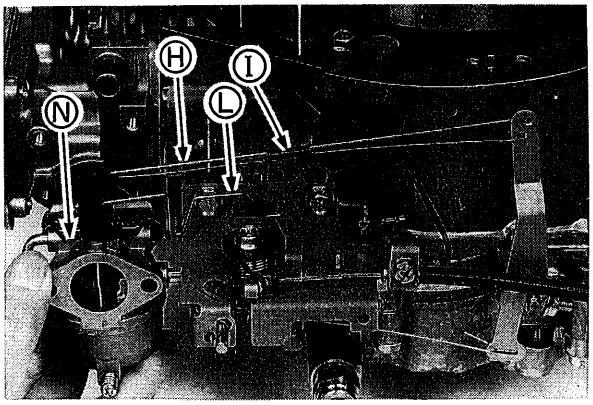
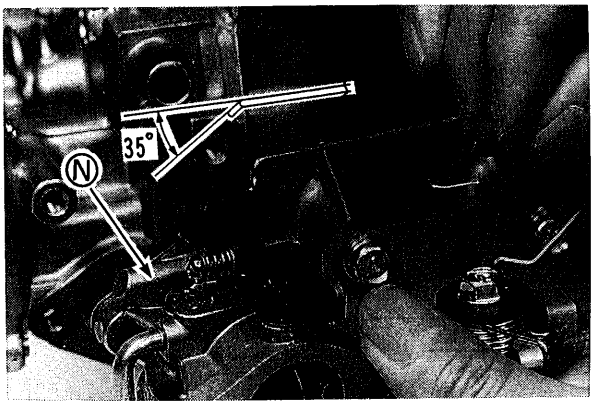
CARBURETOR

4. Hook throttle rod (H), rod spring (I) and choke rod (L) to carburetor (N).

- with the end illustrated, hook throttle rod (H) to carburetor (N).

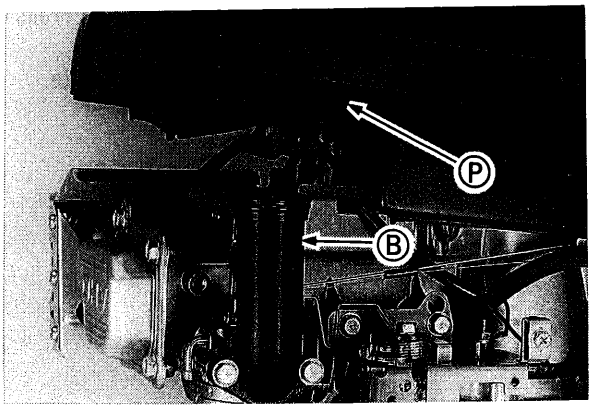


5. Set related parts through the bolts in following sequence:
   Intake pipe
   Gasket - for intake pipe
   Carburetor
   Gasket - with round hole
   Insulator
   Gasket - with round hole
6. Install the related parts on cylinder flange and tighten bolts to specified torque.
   (See TORQUE SPECIFICATIONS.)

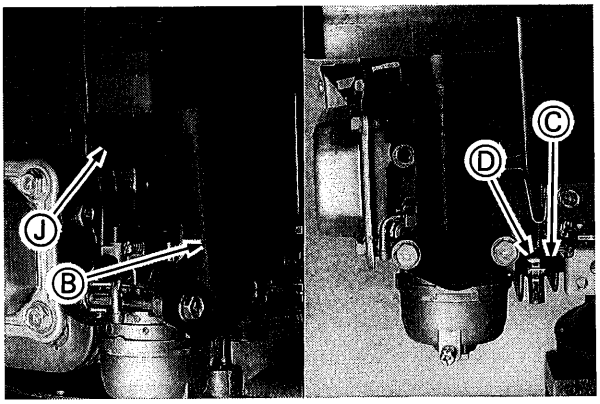


7. Intake pipe (B) to air cleaner joint (P).

CAUTION : Confirm fit in with intake pipe (B) and cleaner joint (P) firmly.

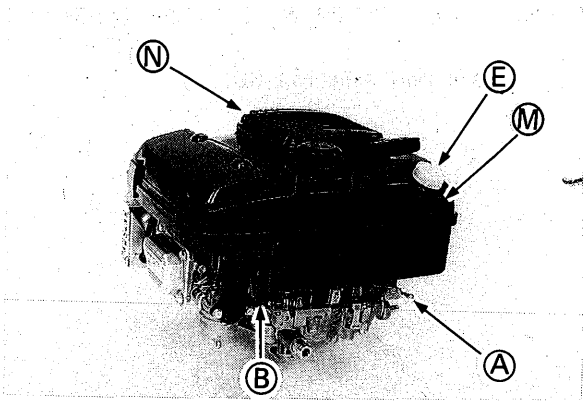


8. Connect breather tube (J) to intake pipe (B).
9. Connect fuel line (C) to carburetor and fasten the line with clamp (D).



COOLING SYSTEM

ENGINE COVER REMOVAL

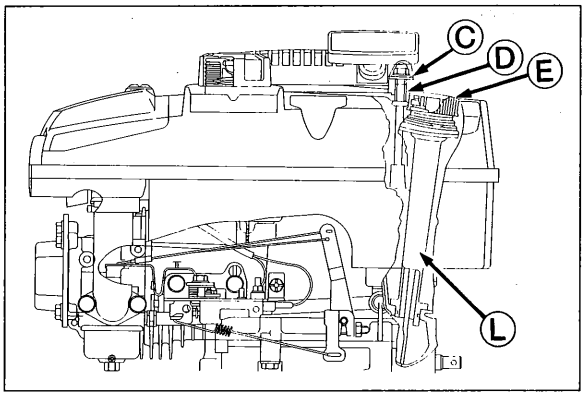


⚠ WARNING : Gasoline is extremely flammable. Avoid fires due to smoking or careless practices.

Remove engine cover integrated with fuel tank (M), together with recoil starter, air cleaner cover, and tank cap.

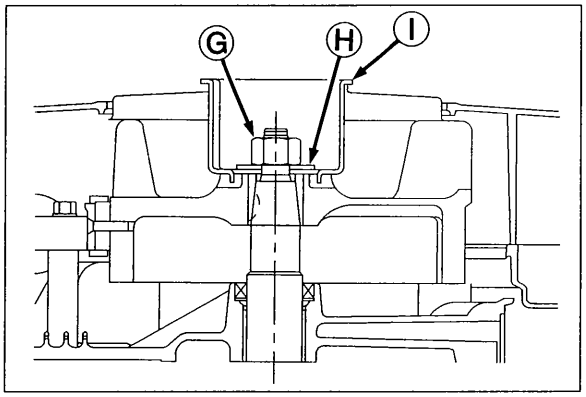
1. Shut fuel tap (A) and disconnect fuel line (B) from carburetor inlet.
2. Open fuel tap and drain fuel into suitable container.
3. Remove recoil starter (N).

CAUTION : Do not lose washers (C) and collars (D).

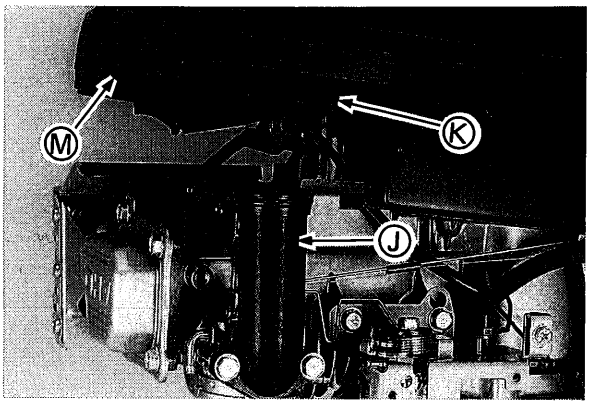


4. Remove oil filler cap (E).

⚠ WARNING : Remove plug cap from spark plug to avoid engine starting.



5. Loosen flywheel nut (G) by turning it counterclockwise. Use air impact wrench to avoid flywheel retation.
6. Remove flywheel nut (G), washer (H), and starting pulley (I).

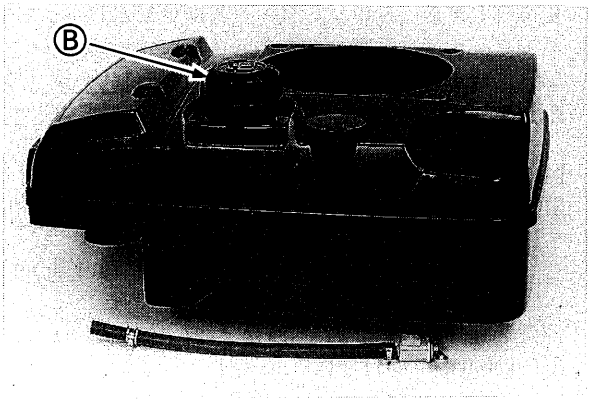


7. Slightly lifting up engine cover assy (M), disconnect intake pipe (J) from air cleaner outlet (K).
8. Remove engine cover assy (M).
9. Remove oil filler (L).

COOLING SYSTEM

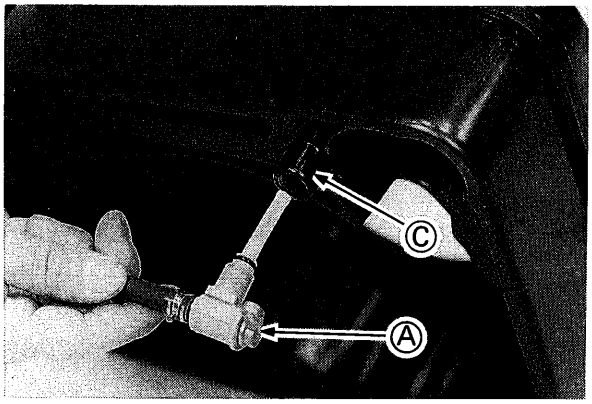
ENGINE COVER DISASSEMBLY

1. Remove fuel tank cap (B).



2. Remove fuel tap (A) from fuel tank (C).

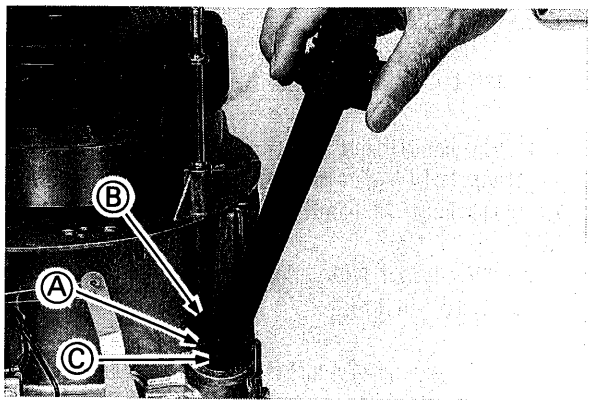
CAUTION : Do not disassemble fuel tap (A).

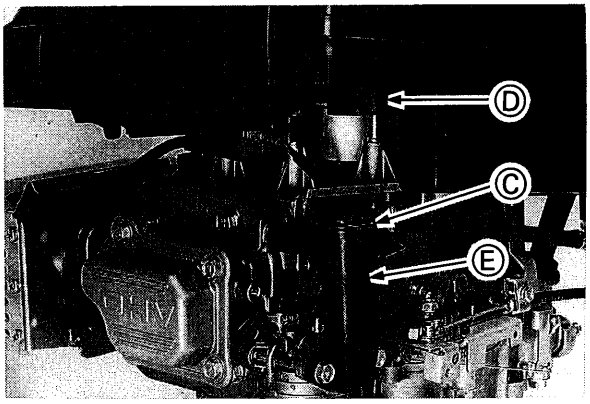


ENGINE COVER ASSEMBLY AND INSTALLATION

Assembly and installation are reverse of disassembly and removal. Note following points.

1. Apply locking agent on thread when replace stud for engine cover mounting.
2. Align notch (A) of oil filler with projection (B) of filler port.
3. Connect air cleaner outlet (D) and intake pipe (E) firmly.
4. Make sure O-ring (C) is in place.
5. Coat a light film of oil on O-ring and install oil filler.
6. Holding pulley, torque flywheel nut as specified in TORQUE SPECIFICATIONS.
7. Tighten screws in crisscross sequence and evenly to specified torque.
   Do not tighten screw completely at a time.





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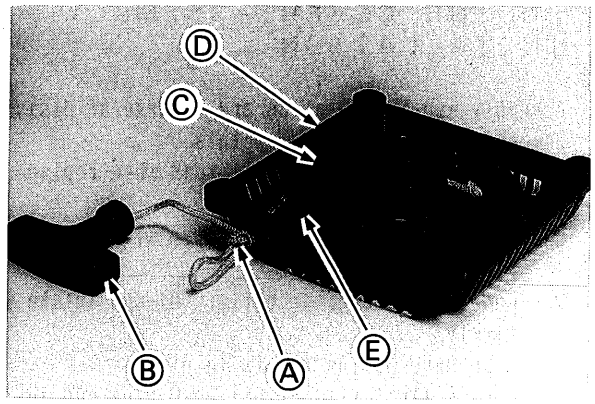
RECOIL STARTER

DISASSEMBLY



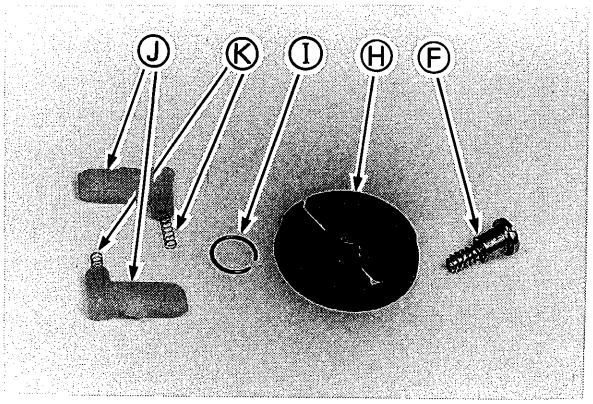
CAUTION : Do not wedge rope between reel and case.

1. Pull handle out about 250 mm (10 in).
   Then hold rope in place with locking pliers or knot (A).
2. Pull knot in handle (B) out and untie it.

⚠ WARNING : Wear gloves during disassembling to avoid injury.

3. While carefully holding reel (C) and case (D), remove locking pliers or untie knot.
4. Unwind spring tension slowly.

NOTE : As for recoil starter with extended rope, steps 1 through 4 are not necessary except when rope and/or handle are changed. Instead of the steps, unwind spring tension keeping rope in notch (E) of reel.



5. Remove screw (F).
6. Remove retainer (H) with circlip (I) carefully.
7. Before removing pawl (J), make sure position of the pawl, then remove pawl and spring (K).

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RECOIL STARTER

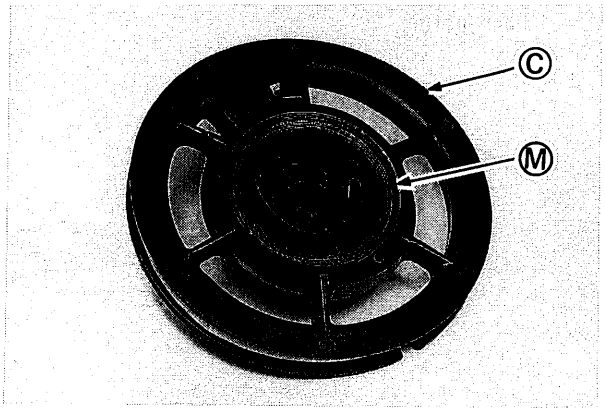
⚠ WARNING : When removing reel (C), be careful that recoil spring under the reel does not fly loose and causes injury. The spring is under great pressure.

NOTE : There should be no spring tension on reel when removing reel. If tension is felt, push reel back into place and gently "wiggle" it until reel can be easily removed.

8. Rotate reel (C) one-quarter turn clockwise from rest position where no tension can be felt. Then, slowly lift reel straight up out of case.

⚠ WARNING : Be careful that recoil spring (M) does not fly loose from reel (C) and causes injury. The spring is under great pressure.

9. If recoil spring (M) must be removed from reel (C), hold the reel with spring side downward in suitable container and tap reel to remove recoil spring.



CHECK

1. Dip metal parts in bath of high flash-point solvent, if necessary.

CAUTION : Do not clean any non-metalic parts in solvent. They may be damaged by the solvent.

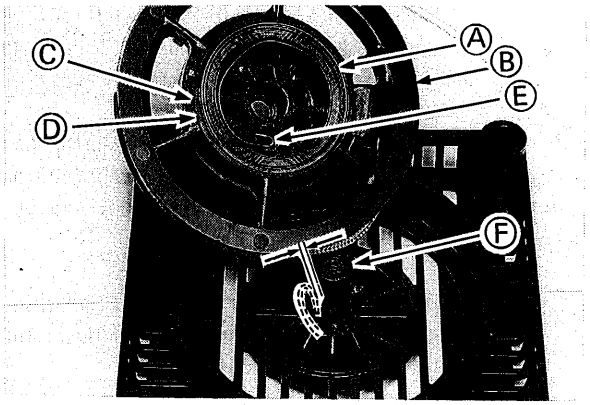
2. Check starter pawl for chips or excessive wear.
3. Check starter rope for excessive wear or fraying.
4. Check springs for break, rust, distortion, or weakened condition.

- If damage is found, replace the part.

⚠ WARNING : Do not throw away recoil spring as installed in reel. Recoil spring may fly loose from reel and cause injury.

RECOIL STARTER

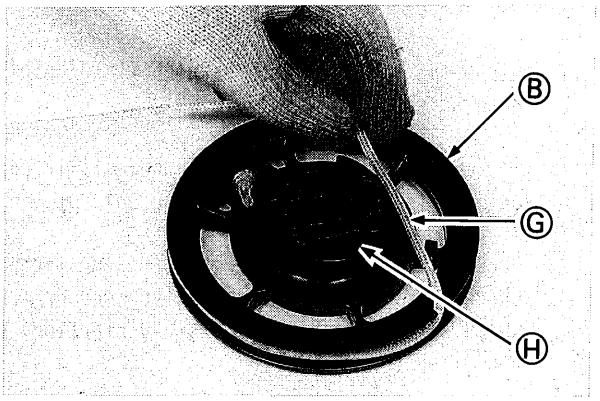
REASSEMBLY



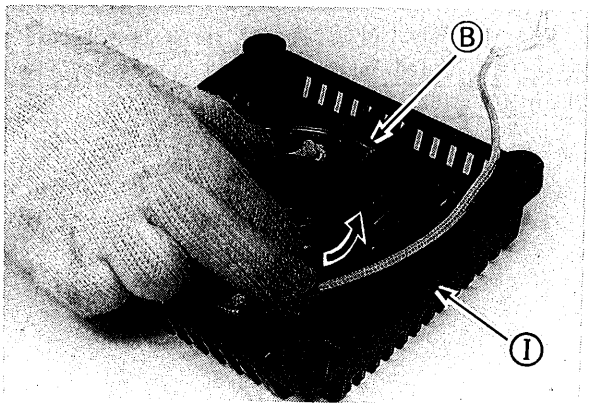
⚠ WARNING : Wear gloves during recoil spring installation to avoid injury. The recoil spring must be assembled with great pressure.

1. Coat grease for high temperature application on recoil spring (A) and sliding surfaces.
2. Set recoil spring (A) in reel (B) so that spring end (C) catches hook (D) in reel.
3. Wind recoil spring (A) into reel (B) counterclockwise.
4. Make sure that gap between spring hook (E) and outside of reel boss (F) is 2 - 4 mm (0.08 - 0.16 in.). If not, make the gap by bending spring end with long nose plier.

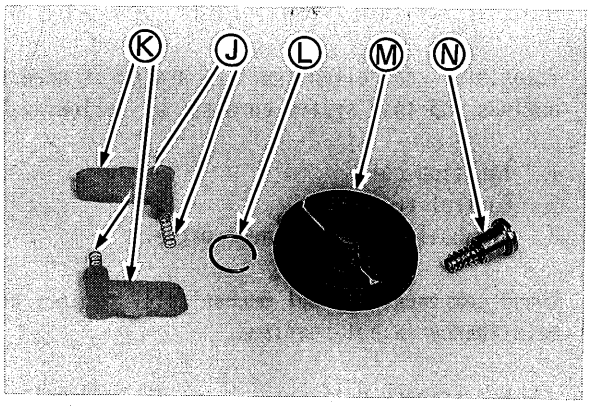
5. If rope (G) is unwound from reel (B), wind rope in reel 3.5 turns counterclockwise facing pawl groove (H).



6. Install reel (B) into case (I) and turn the reel counterclockwise until spring tension is felt.



7. Install spring (J) and pawl (K) into the respective groove.



NOTE : Do not forget to install circlip (L) to retainer (M).

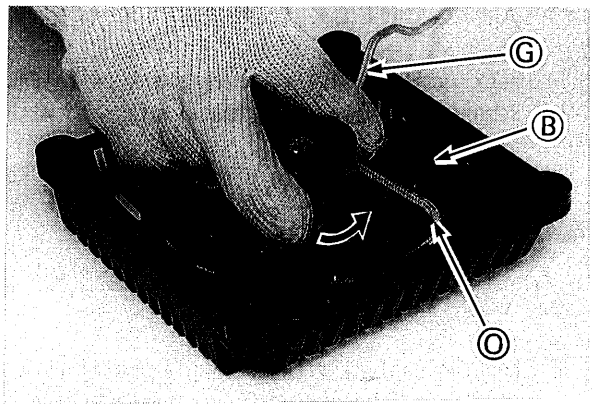
8. Install retainer (M), covering pawl with side groove.

NOTE : Apply locking agent on screw (N).

CAUTION : Do not over tighten screw (N). Over tightening may disturb movement of pawl.

9. Tighten screw (N) to specified torque. (See TORQUE SPECIFICATIONS.)

10. Keeping rope in notch (O) of reel (B), rotate reel 3 turns counterclockwise to preload recoil spring.



11. Pull rope out of case and install handle.
12. Check movement of pawl, pulling and returning rope.
13. Pull rope out to the end. If rope can not be pulled out to the end or can not be rewound when released, preloading is too much. Rotate reel (B) 1 turn clockwise, keeping rope (G) in notch (O) of reel, and then check the condition again.

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IGNITION SYSTEM

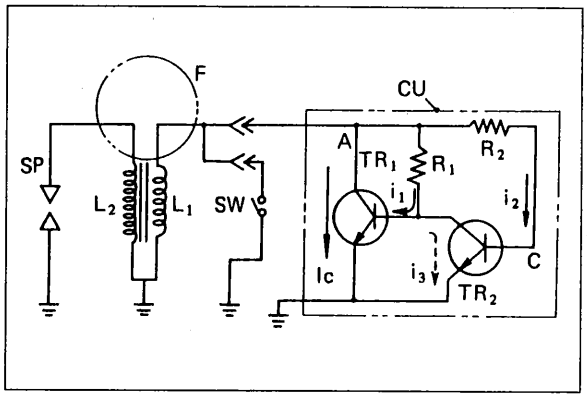
TYPE OF IGNITION SYSTEM

Transistor controlled ignition system is used for these engines and this system consists of following components.

1. Ignition coil
2. Control unit
3. Flywheel (with permanent magnet)

These components do not mechanically contact and periodic maintenance is not required.

L_1: Primary coil	TR_1: Transistor
L_2: Secondary coil	TR_2: Transistor
CU: Control unit	F : Flywheel
R_1: Control resistor	SP : Spark plug
R_2: Control resistor	SW : Engine switch



SPARK CHECK

To check ignition system, check spark as follows;

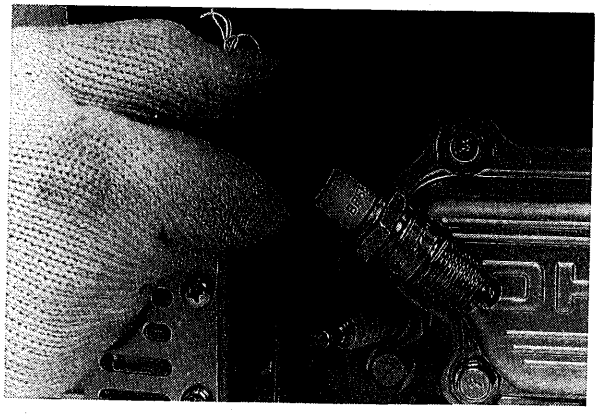
1. Remove spark plug and connect plug cap with the removed spark plug.
2. Install spare plug to plug hole to avoid fuel spitting from hole.

⚠ WARNING : To avoid electric shock, hold plug cap, but not spark plug.

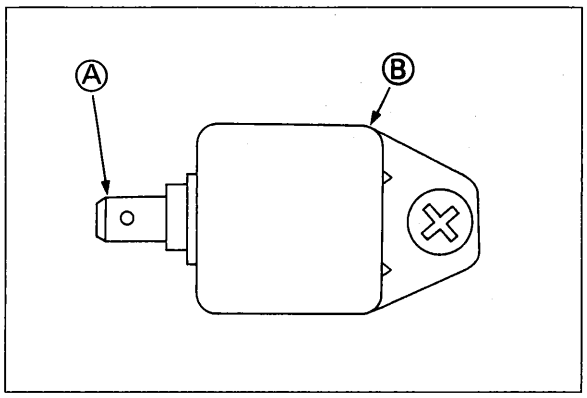
3. Keeping contact with spark plug metal part (not center electrode) and engine block, crank engine.

CAUTION : Do not clean spark plug with bead or sand cleaner.

- If no or very weak spark is observed, clean spark plug and regap it to 0.7 - 0.8 mm (0.028 - 0.031 in.) and try engine cranking again.
- If spark is not improved by cleaning, try checking again with new spark plug.
- If spark is not improved yet, check ignition system.



CONTROL UNIT CHECK



1. Set multimeter selector switch to R x 1kΩ position.
2. Check resistance between terminal (A) and case (B).

- If resistance is out of specified value, replace control unit.

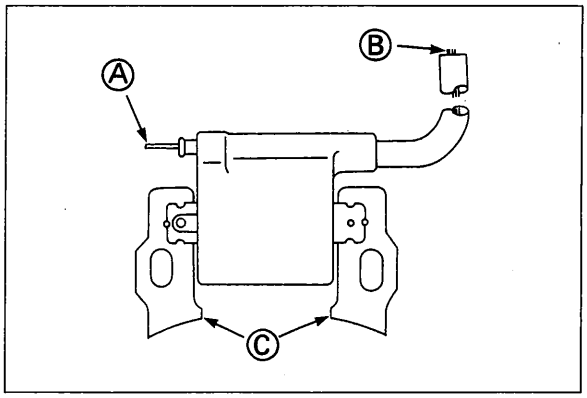
CAUTION : Do not use Megger.

CONTROL UNIT RESISTANCE (kΩ)

Meter ⊖ / Meter ⊕	Terminal (A)	Case (B)
Terminal (A)		0.2 - 0.7
Case (B)	1 - 5	

NOTE : This check may not cover every defect.

IGNITION COIL CHECK



1. Check resistance between the points as specified.
2. If resistance is out of specified value, replace ignition coil.

IGNITION COIL RESISTANCE

	Connection	Resistance
Primary coil	Primary terminal (A) and Core (C)	0.67 - 1.10Ω (R x 1Ω Range)
Secondary coil	Plug lead (B) and Core (C)	6.0 - 10.0kΩ (R x 1kΩ Range)

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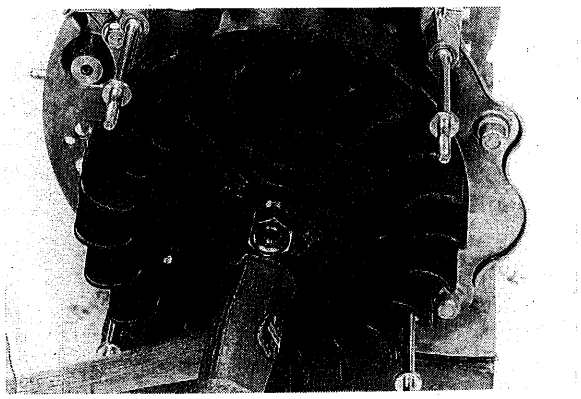
IGNITION SYSTEM

FLYWHEEL REMOVAL

1. Remove starting pulley and the engine cover assy. (See ENGINE COVER REMOVAL.)
2. To prevent the engine oil from spilling, place the engine on the bench with the flywheel up.
3. Screw on the flywheel nut so that it is just flush with the end of the crankshaft.
4. Strike the nut and shaft end with a brass or lead hammer, to loosen the flywheel from the crankshaft.



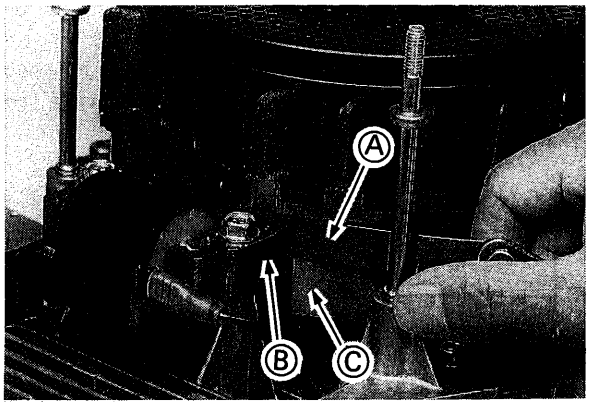
FLYWHEEL INSTALLATION

1. Before installing flywheel, remove grease and oil from taper part of crankshaft and taper hole of flywheel.
2. Make sure key is in place when installing flywheel.
3. Torque nut as specified in TORQUE SPECIFICATIONS. (See ENGINE COVER ASSEMBLY AND INSTALLATION.)

IGNITION COIL AIR-GAP ADJUSTMENT

If ignition coil is removed or replaced, adjust AIR-GAP in installing coil.

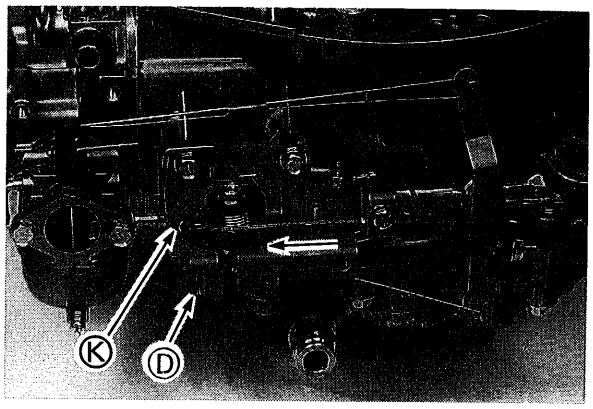
1. Insert 0.3 mm (0.012 in.) feeler gauge or solid sheet (A) between coil legs (B) and flywheel rim (C).
2. Pushing coil to flywheel, tighten coil mounting screws firmly.



THROTTLE-LEVER-LINKED ENGINE SWITCH

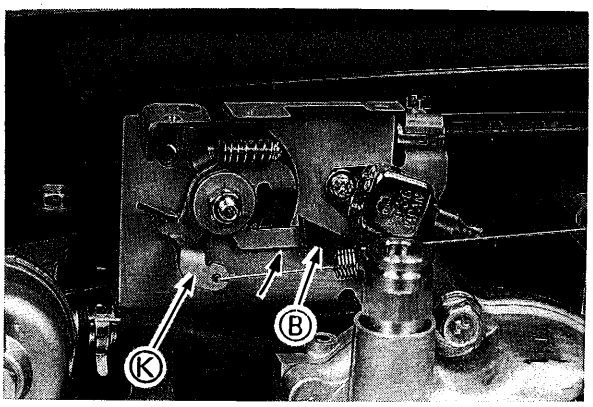
Engine switch linked with throttle lever is equipped on control pannel of engine and operated as follows:

1. When control lever (K) is positioned at slow idle, fast idle, or choke, control lever is far from engine switch tang (B).
2. When control lever (K) is moved beyond slow idle position, the lever contacts with engine switch tang (B) and grounds ignition circuit.

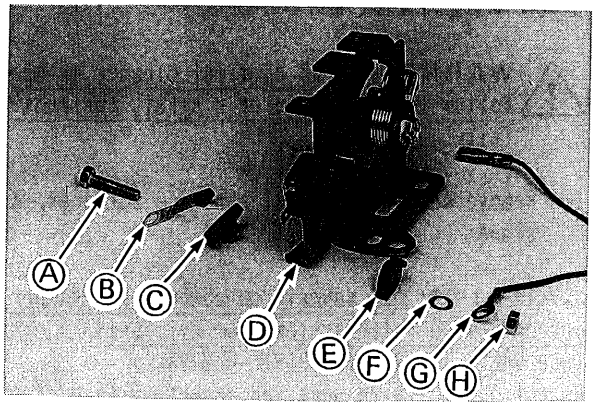


CAUTION : Check and clean engine switch tang area to keep good contact.

3. Engine switch installation is as shown.



A: Bolt
B: Switch tang
C: Insulator
D: Control plate
E: Cover
F: Washer
G: Control unit terminal
H: Nut



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CYLINDER HEAD

COMPRESSION CHECK

1. Remove spark plug and set compression gauge to plug hole.
2. Crank engine with recoil starter several times and check highest reading.

- If highest reading is less than 441 kPa (63 psi), check engine in accordance with TROUBLE SHOOTING.

REMOVAL

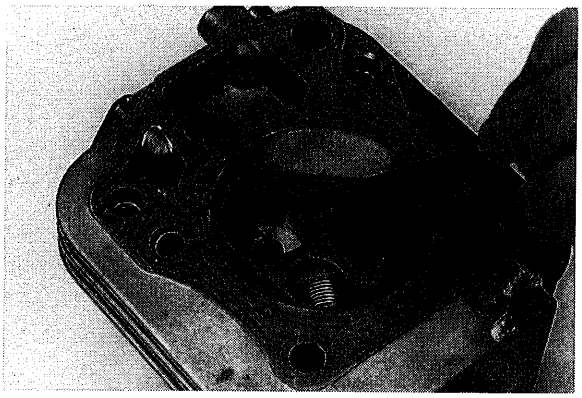
1. Disconnect plug cap from spark plug.
2. Remove rocker cover.
3. Remove cyl. head.
4. If push rods are removed, mark push rods so they are placed in their original positions in re-installing.

MAINTENANCE

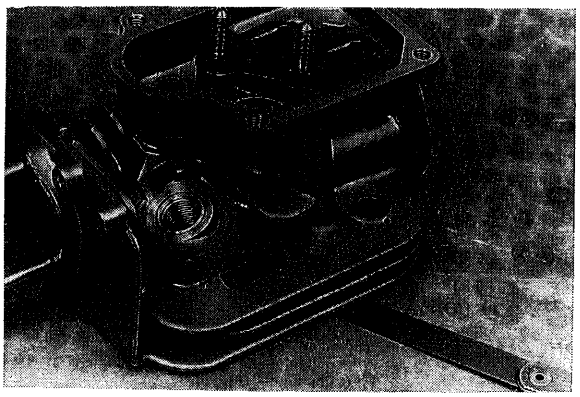
⚠ WARNING : If chemical cleaner is used, always follow the manufacturer's safety instructions carefully.

1. Remove coating material stuck on surfaces, with oil stone.

CAUTION : If deposit on combustion chamber is removed, remove valve system from cyl. head. (See VALVE AND RELATED PARTS REMOVAL.) Do not damage valve seat and gasket surface of cyl. head in deposit cleaning.

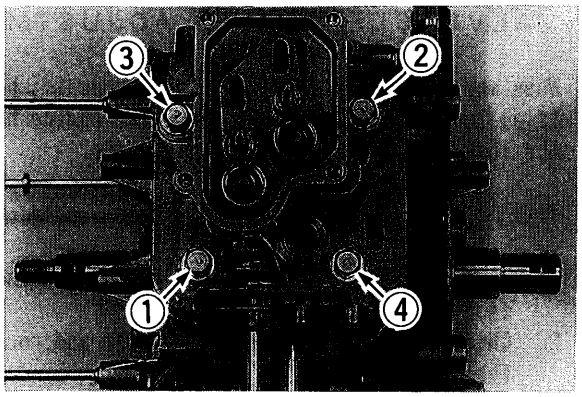


2. Remove deposit from cyl. head.
3. Check flatness of head gasket surface on surface plate with feeler gauge.



- If cyl. head is warped more than 0.07 mm (0.003 in.), replace it.

INSTALLATION



CAUTION : Gasket is coated with special sealant. Do not damage surface of gasket during installation. If surface coating is damaged, replace gasket.

1. Rotate crankshaft until piston comes up at highest position in compression stroke.
2. Install push rods in their respective position in cylinder.
3. Place head gasket and cyl. head assy on cyl. block.
4. Make sure both spherical ends of push rods are in place on rocker arms and tappets.

CAUTION : Do not tighten one screw completely while others are loose. It may cause warped cyl. head.

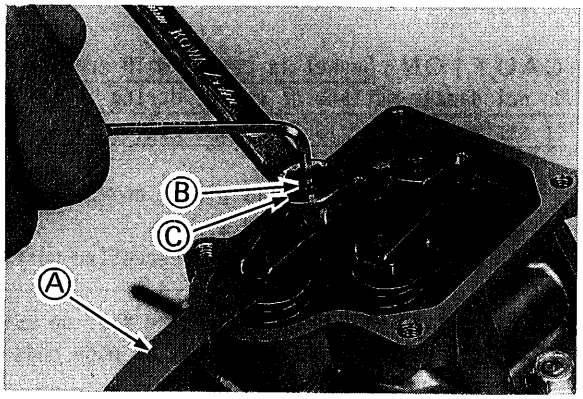
5. Tighten screws down evenly by hand and then torque them in sequence as specified.
   (See TORQUE SPECIFICATIONS.)

VALVE CLEARANCE ADJUSTMENT

When any part related to valve clearance is changed or modified for defect correction, or after engine has been used for long period, adjust valve clearance.

NOTE : Do adjustment while engine is cold.

1. Turn crankshaft until piston comes up at highest position in compression stroke.
2. Check clearance between valve stem and rocker arm with feeler gauge (A).



- If clearance is out of value specified below, adjust clearance as follows:

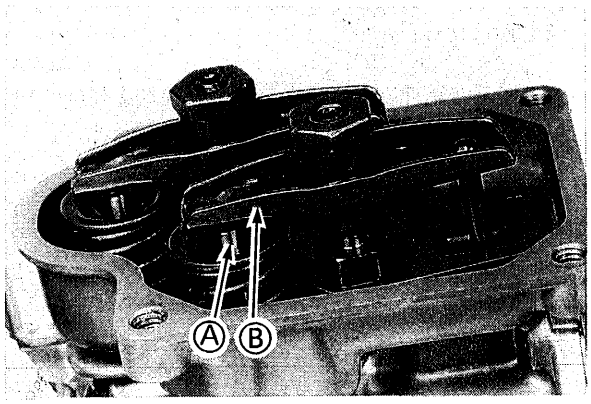
(1) Make sure both spherical ends of push rod are in place on rocker arm and tappet.
(2) Loosen lock screw (B) and turn rocker arm pivot (C) in or out until valve clearance becomes 0.12 mm (0.005 in.), and then tighten lock screw to specified torque. - for both valves. (See TORQUE SPECIFICATIONS.)

CAUTION : Do not turn lock screw (B) counterclockwise to enlarge valve clearance. If necessary to do so, follow step (2).

AUTOMATIC COMPRESSION RELEASE (ACR) CHECK

ACR is device to release compression during engine start, for easy cranking.

1. Remove rocker cover.
2. Remove spark plug to ease hand cranking.
3. Make sure valve clearance is as specified. (See VALVE CLEARANCE ADJUSTMENT.)
4. Rotate crankshaft slowly in usual direction observing movement of intake valve (A) and rocker arm (B).



- If intake valve does not open more than 0.50 mm (0.02 in.) briefly just after exhaust valve closes, ACR mechanism on camshaft is faulty. (See CAMSHAFT VISUAL CHECK.)

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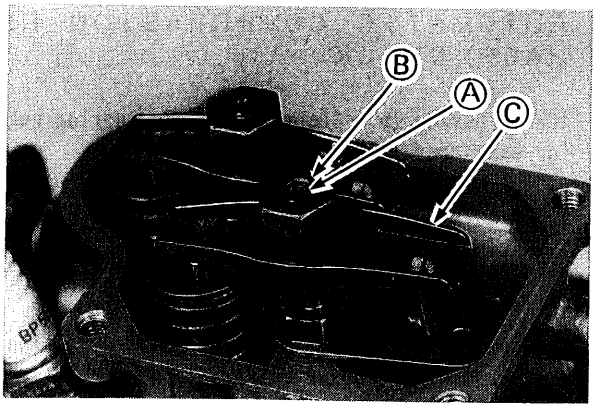
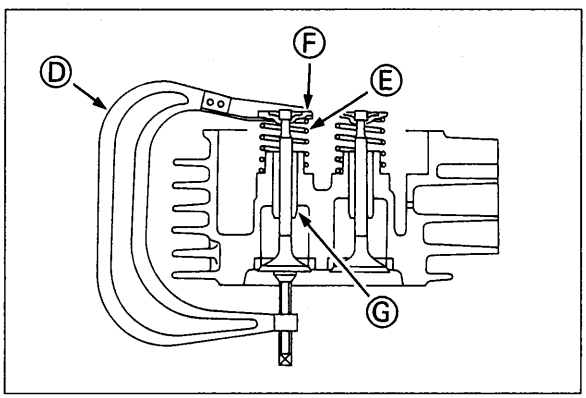
VALVE

VALVE AND RELATED PARTS REMOVAL



NOTE : Mark push rods so they are placed in their original positions in re-installing.

1. Remove push rods.
2. Unscrew lock screw (A) and pivots (B), and then remove rocker arms (C).



3. Place screw head of valve spring compressor (D) on the valve head and slip jaw of compressor between spring (E) and retainer (F).
4. Compress spring and remove retainer (F) with needle nose pliers.
5. Remove compressor and valve spring.

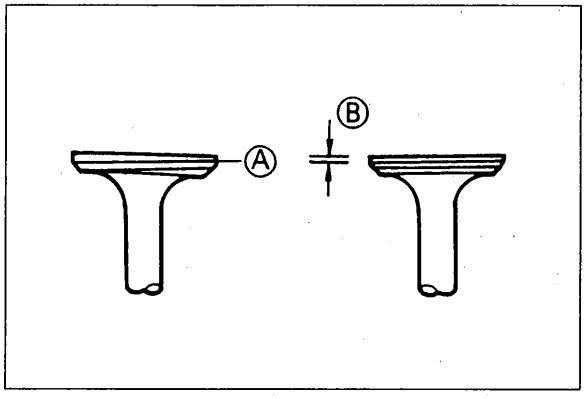
NOTE : Before pulling valve out of guide (G), remove all burrs from valve stem, and oil to stem to avoid damaging valve guide.

ROCKER ARM STUD INSTALLATION

When re-installing or replacing rocker arm stud, apply locking agent on thread and tighten to specified torque. (See TORQUE SPECIFICATIONS.)

VALVE

CHECK AND MAINTENANCE



1. Check valve head for excessive deposit and gas leakage.
2. Remove carbon from valve head with wire brush.
3. Check valve head for warped face (A), dent on face and margine (B) of less than 0.5 mm (0.020 in.).

- If valve head has above defect, replace valve.

NOTE : Excessive deposit is caused by leaded gasoline, and deposit triggers gas leakage causing valve defects. Therefore unleaded gasoline is recommended.

4. Check valve stem for sticking, gummy deposit, discoloration at area covered by valve guide, and excessive corrosion.
5. Remove carbon from valve stem as well as head.

- If valve stem is worn excessively or does not move smoothly in guide, replace valve.

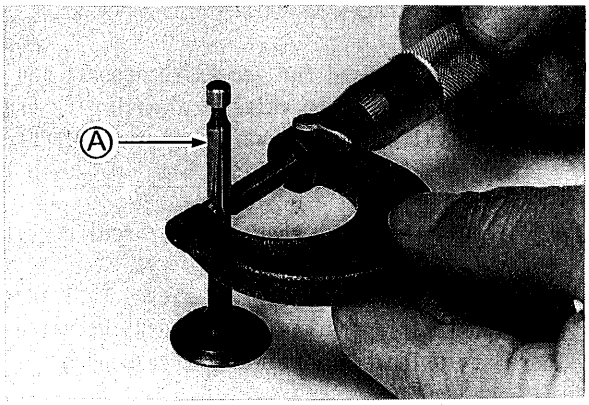
NOTE : Sticking and discoloration are caused by over heating of engine, or gas leakage from valve face. Therefore such causes must be corrected as well as valve maintenance. Gummy deposit is caused by old or stale gasoline. Clean fuel system and use fresh gasoline. Remove gasoline from fuel system before long storage.

VALVE

SERVICE LIMIT

1. Check diameter of valve stem (A) in area covered by valve guide at several points with micrometer.

- If diameter is less than MIN, replace valve.

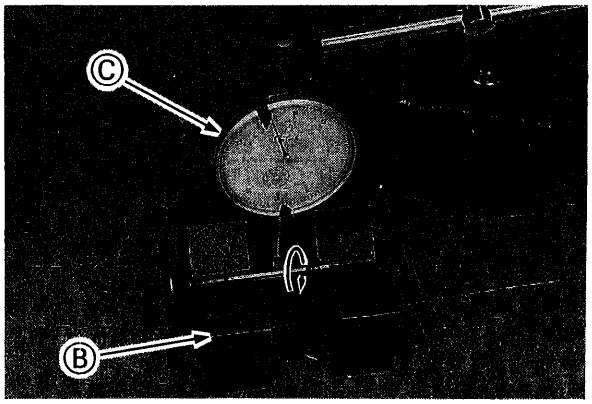


VALVE STEM DIA. MIN

Intake	5.435 mm (0.2139 in.)
Exhaust	5.420 mm (0.2133 in.)

2. Check bend of valve stem at center part with V blocks (B) and dial indicator (C).

- If bend (dial gauge reading) of valve stem is more than 0.03 mm (0.0012 in.), replace valve.

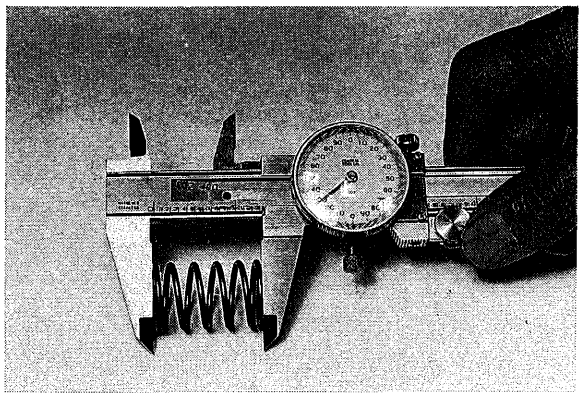


CAUTION : Do not try to grind or recondition valve face. If valve face is worn or damaged, replace it.

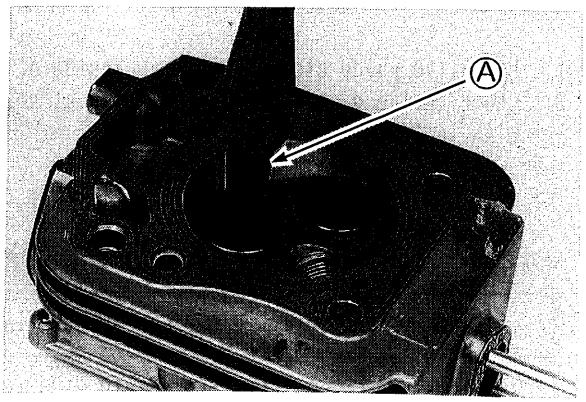
VALVE SPRING SERVICE LIMIT

1. Check valve spring for any damage and replace it if necessary.
2. Check free length of valve spring with vernier calipers.

- If length is less than 31.5 mm (1.240 in.), replace spring. - for both springs



LAPPING



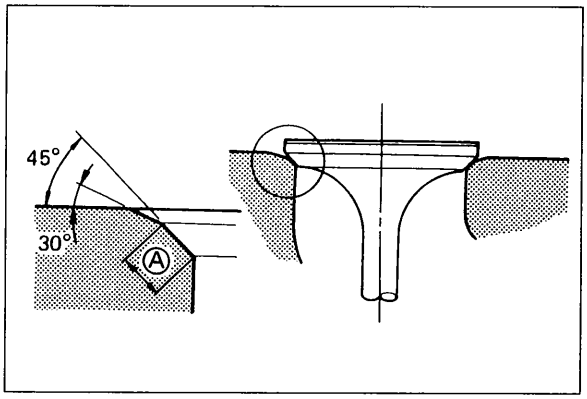
If valve does not contact all way around with seat, lap valve into seat.

1. Coat fine lapping compound sparingly on valve face.
2. Rotate valve in circular motion with valve lapper (A).

NOTE : Lapping mark should appear on or near center of valve face.

3. Check valve every 8 to 10 strokes and continue lapping until uniform ring appears on valve seat all way around.
4. After lapping, wash parts in solvent to remove compound. Dry parts thoroughly.

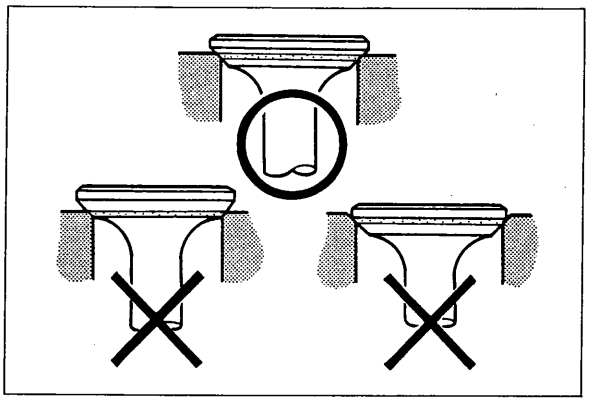
VALVE SEAT RECONDITIONING



Pitted or worn valve seat can be refaced.

1. Reface valve seat with 45° cutter, removing only enough material to make smooth and concentric seat.
2. Use 30° cutter to narrow seat width to 0.50 - 0.90 mm (0.020 - 0.035 in.).

   A : Seat width



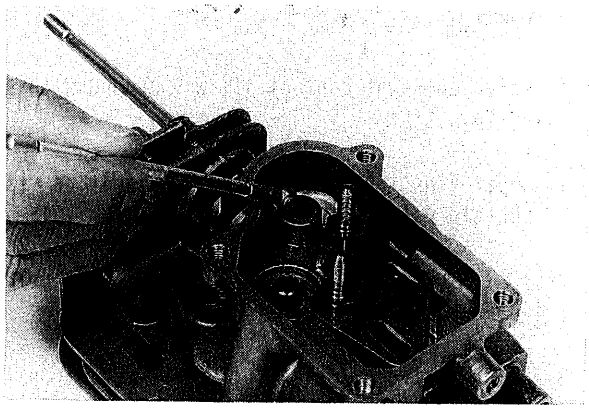
3. Make a light pass with 45° cutter to remove any burr at edge of seat.
4. Coat marker and check contact of valve face and seat. Contact should be at center part of valve face as shown and all way around.
5. Lap valve into seat. (See LAPPING.)

VALVE

VALVE GUIDE SERVICE LIMIT

1. Use valve guide cleaner to clean inside of valve guides.
2. Check inside diameter of valve guide at several points with inside micrometer.

- If diameter is more than MAX, replace cyl. head.



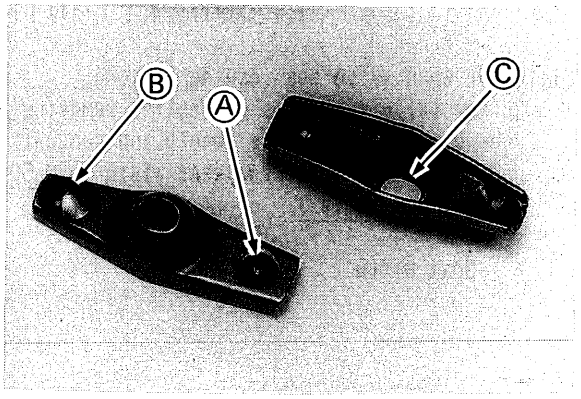
VALVE GUIDE INSIDE DIA. MAX

Intake	5.550 mm (0.2185 in.)
Exhaust	5.560 mm (0.2189 in.)

ROCKER ARM SERVICE LIMIT

1. Check rocker arm for pitted or worn contact surfaces (A - with push rod), (B - with valve stem), and (C - with pivot).

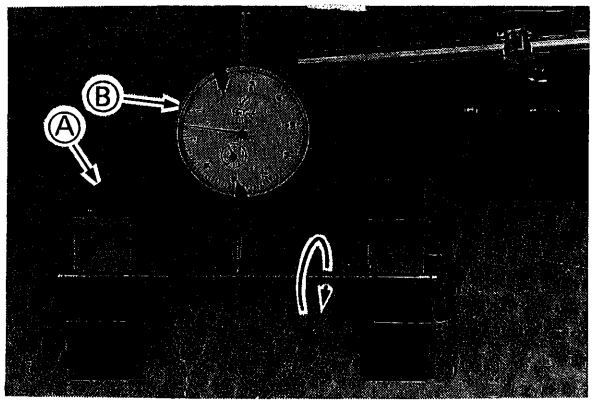
- If necessary, replace rocker arm.



PUSH ROD SERVICE LIMIT

1. Check bend of push rod at center part with V blocks (A) and dial indicator (B).

- If bend (dial gauge reading) is more than 0.6 mm (0.024 in.), replace push rod.



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CRANKCASE COVER

REMOVAL

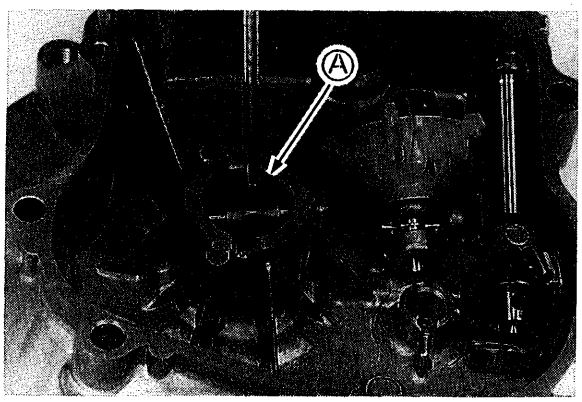
⚠ WARNING : Be careful not to burn yourself by hot oil.

1. Drain engine oil to suitable container.
2. Remove rust and burr from edge of PTO shaft step.
3. Loosen screws, and tap parts near dowel alternately with soft mallet.

SERVICE LIMIT

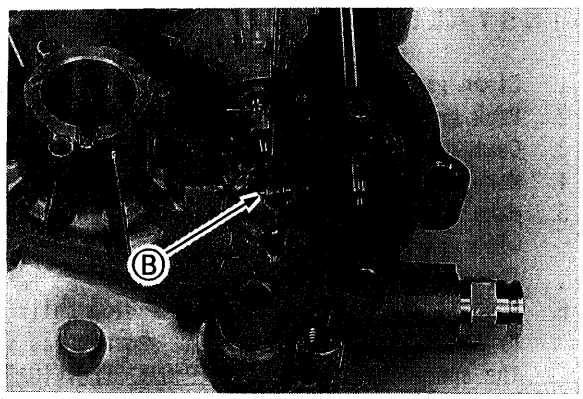
1. Check inside diameter of PTO bearing (A) at several points with inside micrometer.

- If diameter is more than 28.100 mm (1.1063 in.), replace crank case cover.



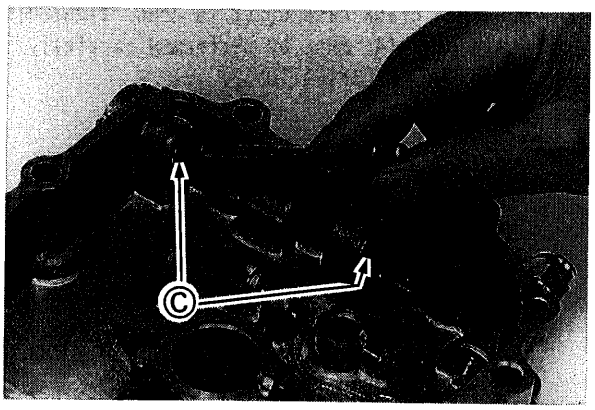
2. Check inside diameter of camshaft bearing (B) at several points with inside micrometer.

- If diameter is more than 12.050 mm (0.4744 in.), replace crank case cover.



3. Check inside diameter of auxiliary shaft bearing (C) at several points with inside micrometer.

- If diameter is more than 12.050 mm (0.4744 in.), replace crank case cover.



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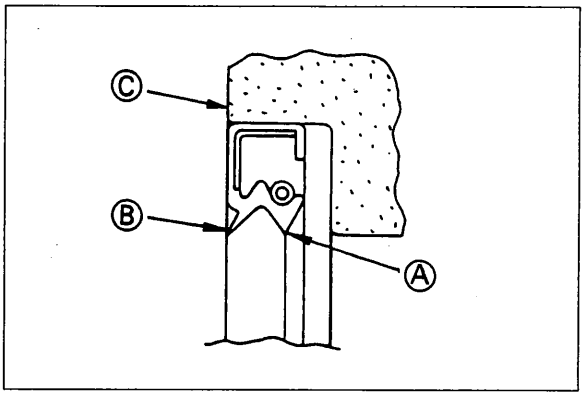
CRANKCASE COVER

OIL SEAL REPLACEMENT

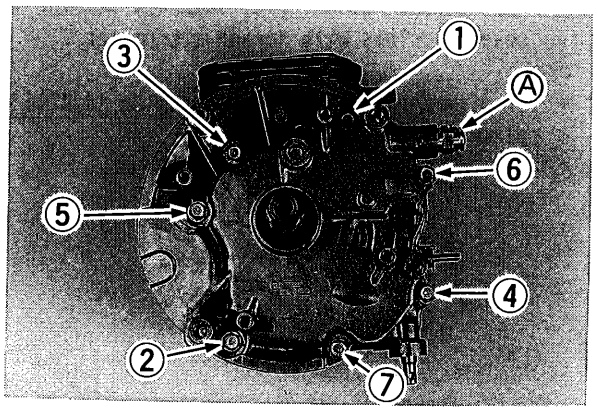
If oil leakage through oil seal is observed or seal lip is damaged, replace oil seal.

1. Remove oil seal by tapping it out with screw driver or punch.
2. Placing spring held seal lip (A) inside, push oil seal into housing until seal outside surface becomes flush with housing end (C).
3. Before final assembly, pack some amount of grease for high temperature application into space between seal lip (A) and dust lip (B).



INSTALLATION

1. Clean gasket surface and place new gasket on crank case.
2. Pack grease into oil seal. (See OIL SEAL REPLACEMENT.)
3. Coat a light film of oil on bearings.
4. Make sure governor weights are closed.
5. Make sure governor gear is properly aligned to mesh with cam gear when installing crank case cover. Do not force cover into position.
6. Install crank case cover and tighten bolts down evenly by hand. Tighten bolts in the sequence as shown and to the specified torque. (See TORQUE SPECIFICATIONS.)
   Do not tighten one bolt completely before the others. It may cause warped crank case cover.
7. When new crank case cover is used, tightening of side drain plug (A) must be performed carefully. (See NOTE in TORQUE SPECIFICATIONS.)



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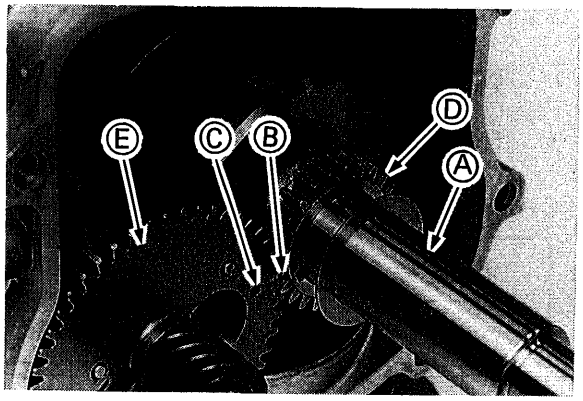
CAMSHAFT

REMOVAL

1. Place cyl. block upside down on bench.
2. Rotate crankshaft (A) until timing marks (B, C) on crankshaft gear (D) and camshaft gear (E) align, to avoid interference between tappets and camshaft in removal.
3. Remove tappets, and mark them so they can be placed in their original position in re-installing.



VISUAL CHECK

1. Check cam gear for worn or broken teeth.

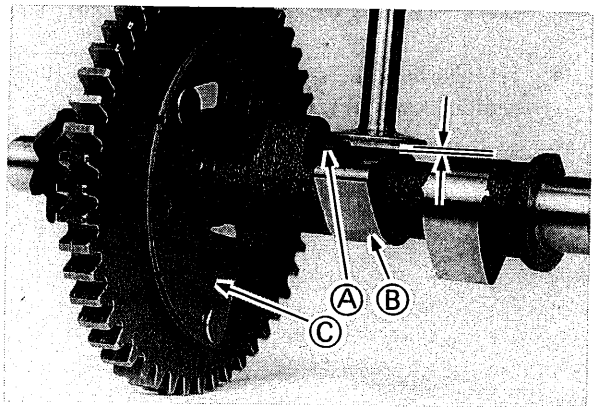
- If excessively worn or broken teeth are observed, replace camshaft.

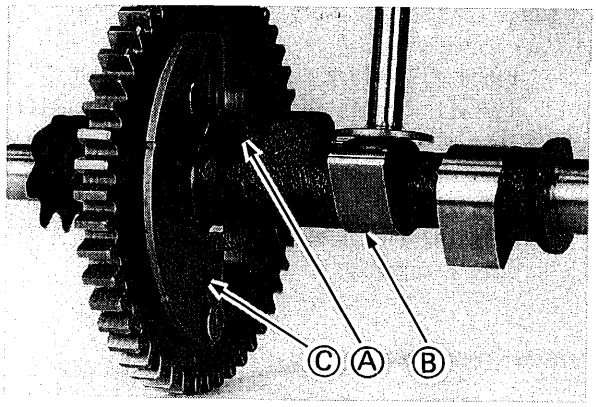
2. Check movement and damage of ACR mechanism on camshaft.

- If outer surface of tab (A) is not placed above cam heel (B) when weight (C) is closed, replace ACR mechanism.

- If outer surface of tab (A) does not lower below cam heel (B) when weight (C) is pulled toward outside by finger, replace ACR mechanism.

- If parts of mechanism are worn, replace ACR mechanism.





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CAMSHAFT

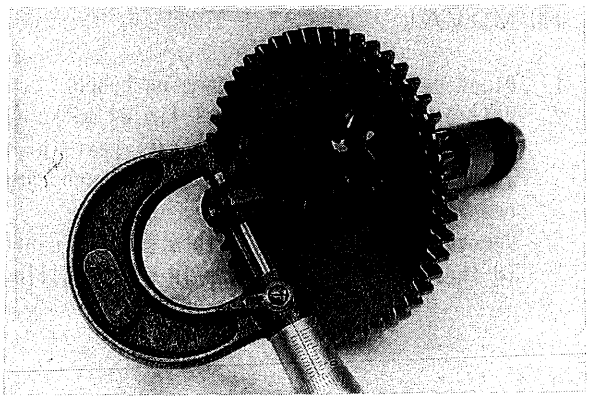
SERVICE LIMIT

1. Check bearing journal diameter with micrometer.

- If diameter is less than MIN, replace camshaft.

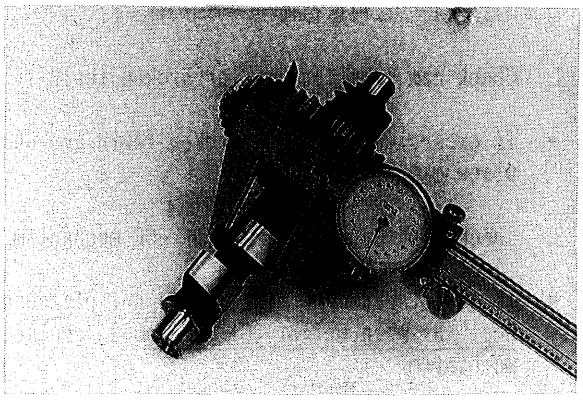
CAMSHAFT DIA. MIN

PTO side	11.937mm (0.4701 in.)
Flywheel side	13.920mm (0.5480 in.)



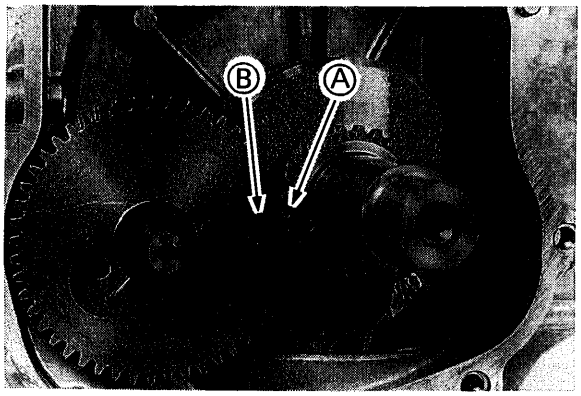
2. Check cam lobe height with vernier calipers.

- If lobe height is less than 22.80 mm (0.898 in.), replace camshaft.



INSTALLATION

1. Place cyl. block upside down on bench.
2. Install tappets in their respective positions and push them all the way into guide to avoid interference with camshaft in assembling.
3. Rotate crankshaft until piston is at highest position.
4. Aligning timing marks (A) and (B), install camshaft into crank case.

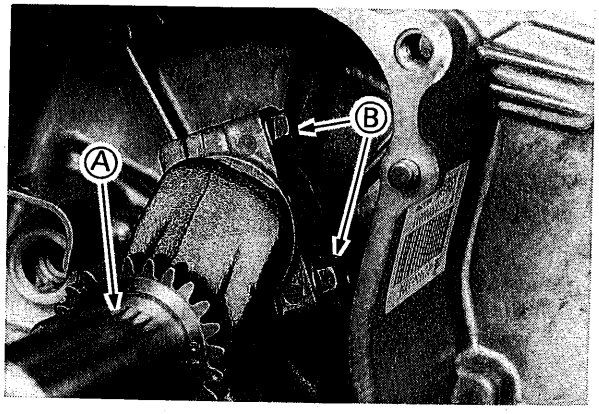


PISTON & CON-ROD

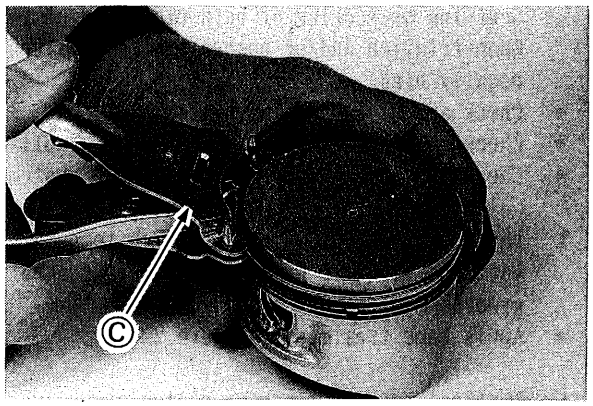
REMOVAL

CAUTION : Remove any carbon or ridge at top of cyl. bore to avoid piston ring breakage in removing.

1. Rotate crankshaft (A) to expose con-rod bolts (B).
2. Loosen con-rod bolts and remove con-rod cap.
3. Push piston and con-rod out through top of cylinder.
4. Remove piston from con-rod.



5. Remove piston rings from piston with ring expander (C).



PISTON AND PISTON RING VISUAL CHECK

Appearance of piston and piston rings shows condition of engine in running. If excessive damage is observed, replace piston and/or piston rings and remove cause of such damage.

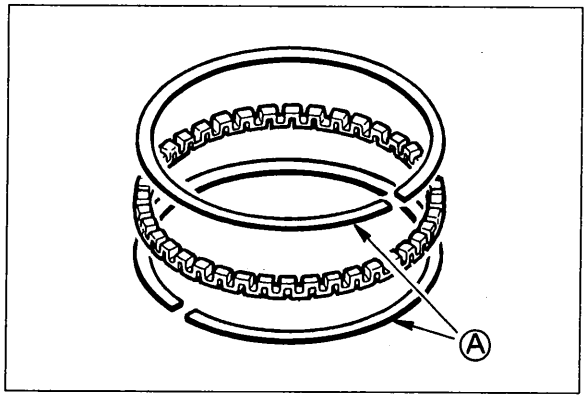
1. Rings of wrong size or rings having improper end gap will not fit to shape of cylinder. This causes high oil consumption and excessive blowby.
- Check ring end gap and arrange end gap as shown in PISTON RING INSTALLATION.

2. Scuffing or scoring of both rings and piston occurs when friction and/or combustion temperature are unusually high.
- Check and clean cooling system.
- Check and correct quality and level of oil.
- Check and adjust fuel and combustion systems.

3. Engine running at abnormally high temperature may cause varnish, lacquer, or carbon deposit formed in piston ring grooves making rings stick.
- Apply same treatment as above 2.

4. Vertical scratches across piston rings are due to abrasive in engine. Abrasive may be airborne, may have been left in engine during overhaul, or may be loose lead and carbon deposit.
- Check air cleaner and clean or replace damaged one.
- Check any air intake through abnormal route.
- Clean engine inside and change oil.

5. Scratches across oil side rails (A) are due to abrasive in engine oil, and other rings will also be worn in this condition causing high oil consumption, increased deposit in combustion chamber, and ring sticking.
- Clean engine inside and change oil.



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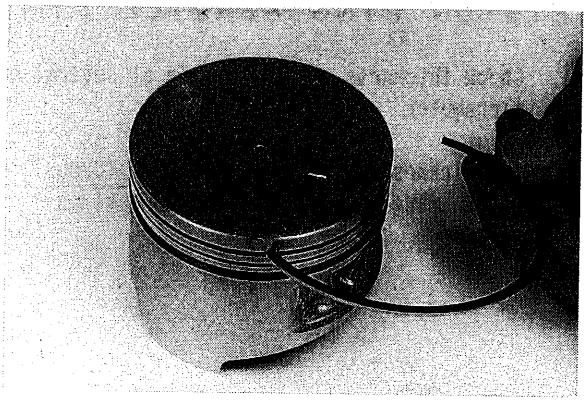
PISTON & CON-ROD

PISTON CLEANING

CAUTION : Do not use caustic cleaning solution or wire brush to clean piston.

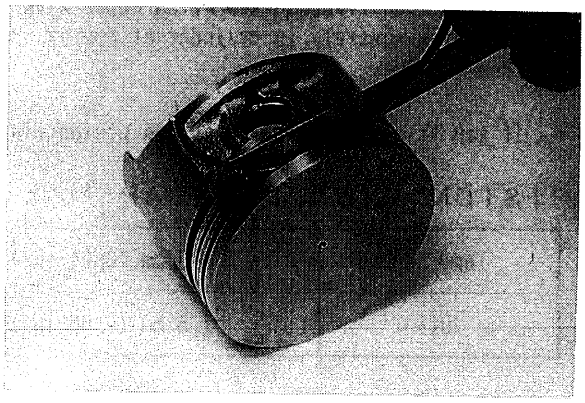
1. Remove all deposits from piston.
2. Clean carbon from piston ring grooves with ring groove cleaner. If cleaning tool is not available, use old piston ring breaking into suitable size.
3. Make sure oil return passages in ring groove are open.



PISTON SERVICE LIMIT

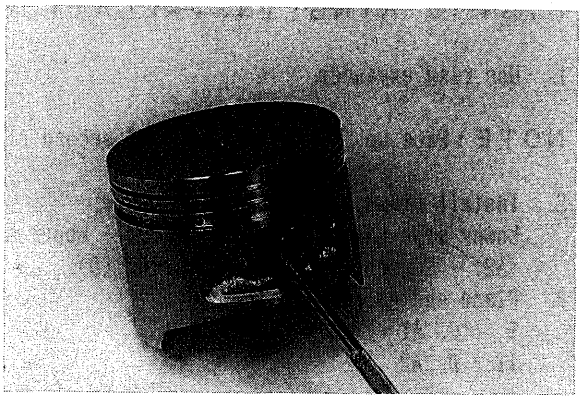
1. Check clearance between ring groove and ring using new ring and feeler gauge.

- If clearance is more than 0.10 mm (0.004 in.), replace piston. - for top and second rings



2. Check inside diameter of piston pin hole at several points with inside micrometer.

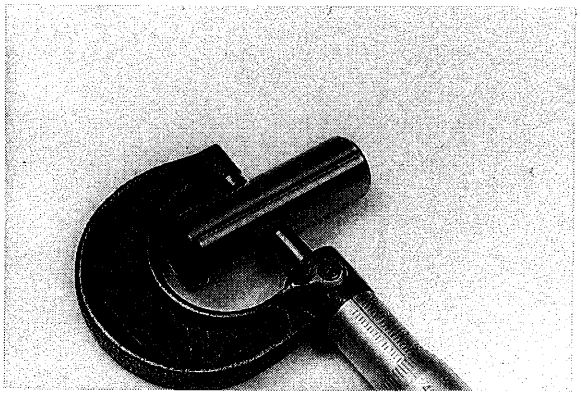
- If diameter is more than 16.050 mm (0.6319 in.), replace piston.



PISTON PIN SERVICE LIMIT

1. Check outside diameter of piston pin at several points with micrometer.

- If piston pin diameter is less than 15.975 mm (0.6289 in.), replace piston pin.



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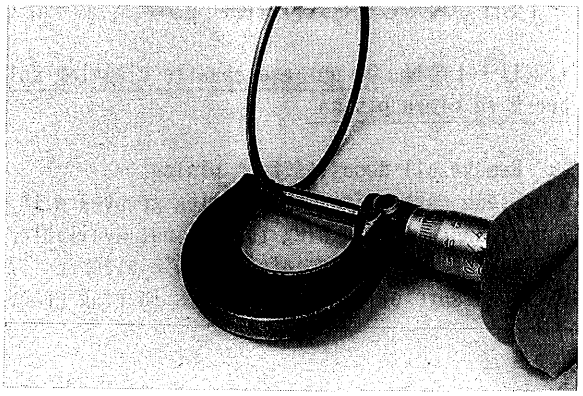
PISTON & CON-ROD

PISTON RING SERVICE LIMIT

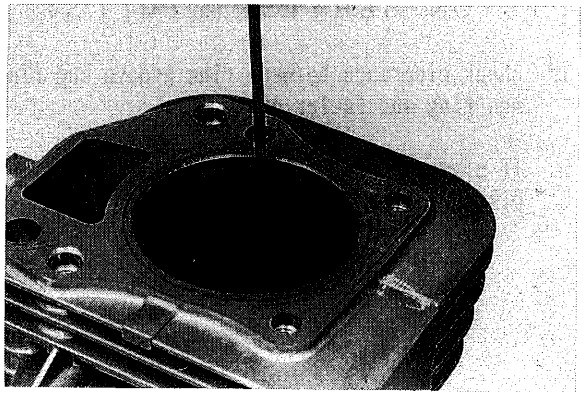
1. Check thickness of piston ring at several points with micrometer.

- If thickness is less than 1.40 mm (0.0551 in.), replace piston ring. - for top and second rings



2. Check piston ring end gap with feeler gauge, installing each ring squarely in cylinder at approx. 25 mm (1 in.) from top.

- If gap is more than MAX, replace piston ring.



PISTON RING END GAP MAX

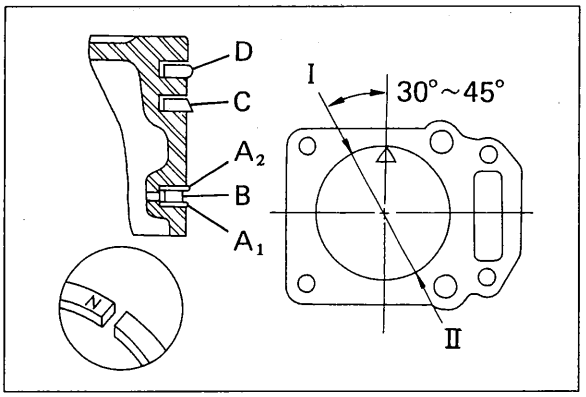
Top • Second	1.0 mm (0.04 in.)
Oil	1.5 mm (0.06 in.)

PISTON RING INSTALLATION

1. Use ring expander.

NOTE : Face up "N" mark on top and second rings.

2. Install rings in following sequence;
   Lower side rail (A1) - Spacer (B) - Upper side rail (A2) - Second ring (C) - Top ring (D).
3. Place end gaps as follows;
   I : C, A1
   II : D, A2



CON-ROD VISUAL CHECK

Check con-rod especially big end for wearing, scratching, scoring, and/or discoloring.

1. Abnormal wearing and scratching are caused by foreign particle(s) in oil.
- Clean engine inside and change oil.
- Check air cleaner, and clean or replace damaged one.
- If con-rod and/or crankshaft are used again, remove ridges on their surface carefully.

2. Scoring and discoloring are symptom of poor lubricating and/or over heating.
- If crankpin surface is damaged by melted con-rod metal, replace con-rod and crankshaft.
- Check and clean cooling system.
- Check quality of oil and maintenance method with user.

CAUTION : Check re-used components carefully when re-assembling engine which had con-rod big end seizure.
Never start engine without oil even for short test run.

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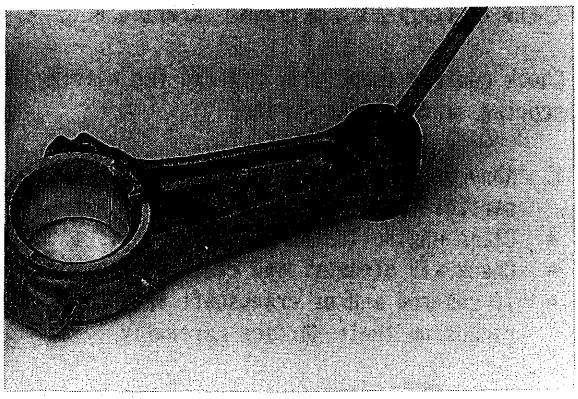
PISTON & CON-ROD

CON-ROD SERVICE LIMIT

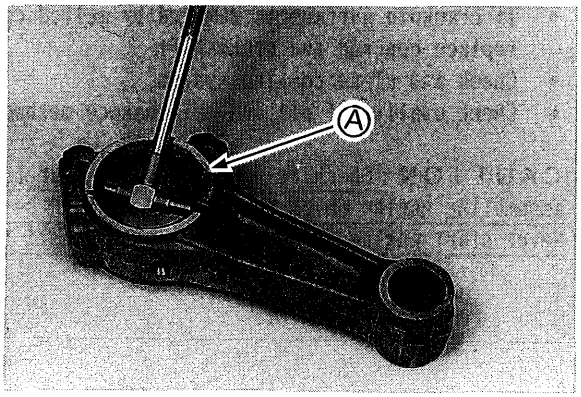
1. Check inner diameter of small end at several points with inside micrometer.

- If inside diameter is more than 16.050 mm (0.6319 in.), replace con-rod.



2. Assemble con-rod big end aligning pilot grooves (A), and tighten con-rod bolts as specified in TORQUE SPECIFICATIONS.
3. Check inner diameter of big end at several points with inside micrometer.

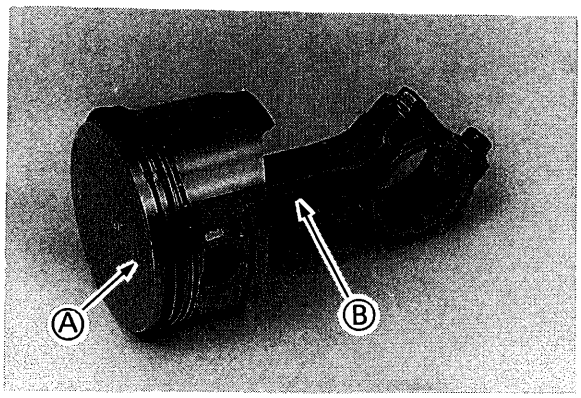
- If inside diameter is more than 29.070 mm (1.1445 in.), replace con-rod.



PISTON AND CON-ROD ASSEMBLY

1. Aligning mark "Δ" (A) on piston head with "MADE IN JAPAN" (B) on con-rod, assemble piston over con-rod.
2. Coat a light film of oil on piston pin and insert pin through piston and con-rod.
3. Install retaining rings in each grooves firmly.

CAUTION : Do not re-use retaining ring removed. Removal may deform or weaken the ring allowing it to come out during operation causing damage to cly. wall.



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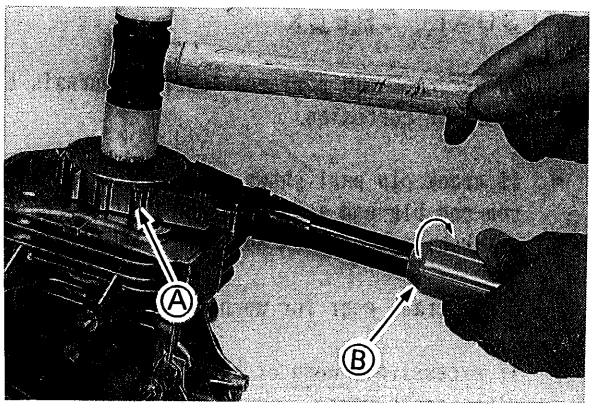
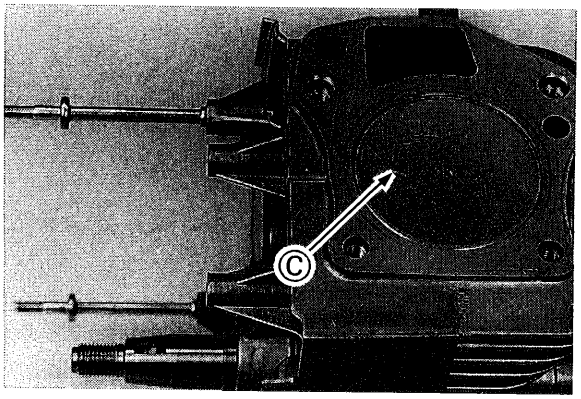
PISTON & CON-ROD

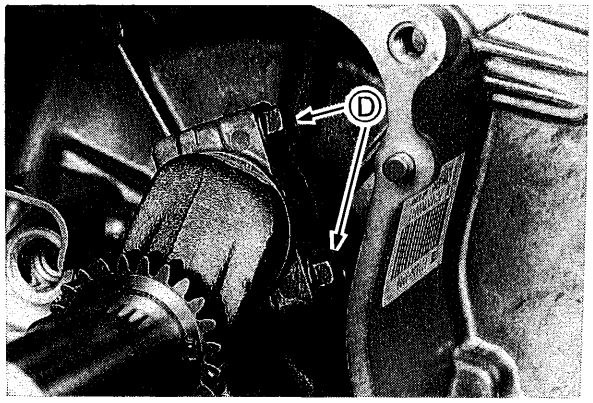
PISTON/CON-ROD ASSY INSTALLATION



1. Coat a light film of oil on cyl. bore.
2. Aligning mark "Δ" (C) on piston head toward flywheel side, install piston/conrod assy into cylinder.
3. Set ring compressor (A) over piston, flushing with piston top, toward top of piston.
4. Tighten compressor by turning compressor grip (B) clockwise.



5. Leading big end of con-rod to crank pin, push piston down further.
6. Rotate crankshaft with crank pin in lowest position.
7. Coat a light film of oil on crank pin, con-rod big end, cap, and con-rod bolts.



8. Aligning pilot groove, install cap to big end and tighten cap bolts (D) as specified in TORQUE SPECIFICATIONS.
9. Make sure con-rod moves sideways lightly on crank pin.

CAUTION : Con-rod bolt tightening is one of the most important items in assembling. Always use torque wrench.

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CRANKSHAFT

VISUAL CHECK

1. Check crank pin part and bearing journals for score, wear, or corrosion.

- If crank pin part shows any damage, carefully check con-rod big end and repair or replace con-rod and/or crankshaft. (See CON-ROD VISUAL CHECK.)

2. Check crank gear for worn or broken teeth.

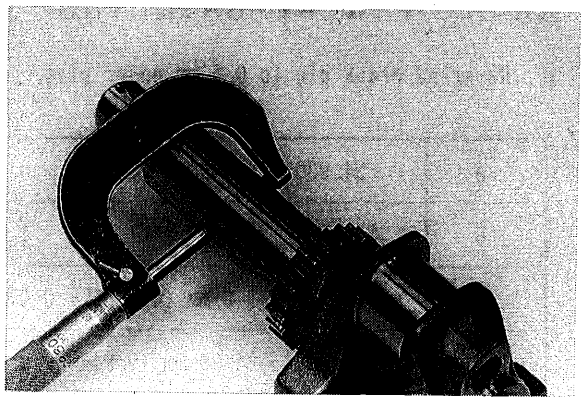
- If excessively worn or broken teeth are observed, replace crank gear.

CRANKSHAFT

SERVICE LIMIT

1. Check outside diameter of both main bearing journals at several points with micrometer.

- If diameter is less than MIN, replace crankshaft.

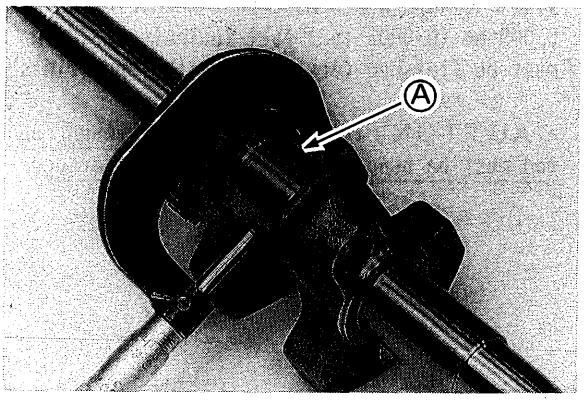


CRANKSHAFT DIA. MIN

PTO side	27.920mm (1.0992 in.)
Flywheel side	24.920mm (0.9811 in.)

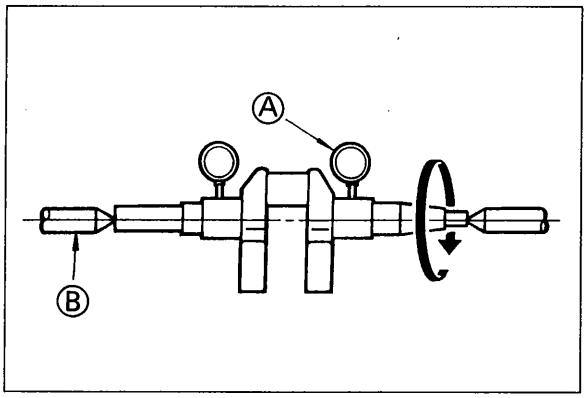
2. Check outside diameter of crank pin (A) at several points with micrometer.

- If outside diameter is less than 28.920 mm (1.1386 in.), replace crankshaft.



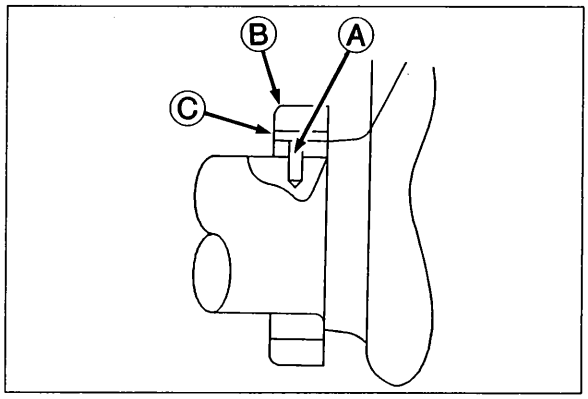
3. Check run out of crankshaft at both bearing journals with dial indicator (A), setting crankshaft to alignment jig (B).

- If total reading of run out is more than 0.20 mm (0.008 in.), replace crankshaft.



INSTALLATION

1. Install pin (A) as shown.
2. Install crank gear (B) as timing mark facing outside.
3. Make sure end of pin is not projecting from crank gear surface (C).
4. Coat a film of oil on bearing surfaces of crankshaft.
5. Tape key way at taper of crankshaft to avoid cutting of oil seal lips.
6. Pack some amount of grease for high temperature application into oil seal.

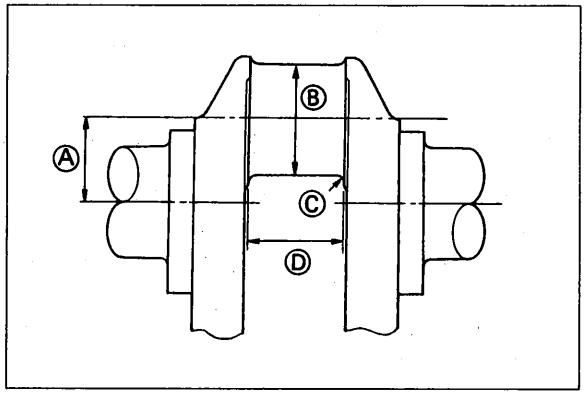


CRANKSHAFT

CRANK PIN RE-GRINDING

1. Re-grind crank pin to 0.5 mm under size.

A	24.900 - 25.00 mm (0.9803 - 0.9843 in.)
B	28.467 - 28.480 mm (1.1207 - 1.1213 in.)
C	1.5 - 1.9 mm (0.0591 - 0.0748 in.)
D	24.00 - 24.20 mm (0.9449 - 0.9528 in.)



NOTE : Crank pin must be concentric and parallel within 0.005 mm (0.0002 in.) full indicator reading, and surface must be finished very smooth with super finishing stone.

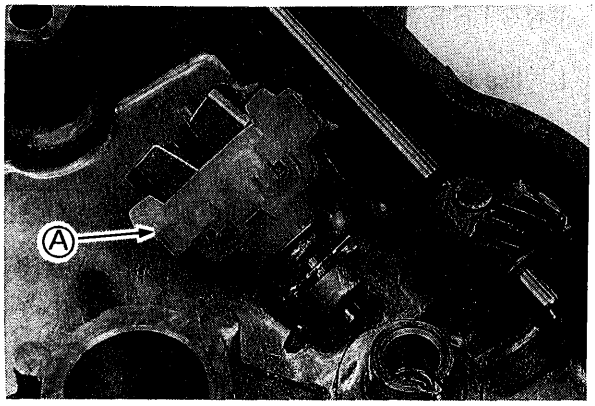
CAUTION : If crank pin is re-ground, under-size con-rod must be used to keep specified clearance.

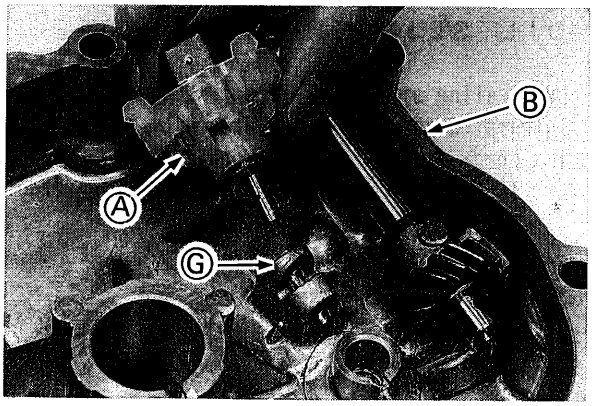
GOVERNOR GEAR CHECK AND REMOVAL

1. Check governor gear assy for wear and damage, as installed in crank case cover.

CAUTION : Do not remove governor gear assy from crankcase cover except to replace. If once removed, it cannot be re-used.

2. If governor gear assy (A) must be replaced, pull it out of crank case cover (B).



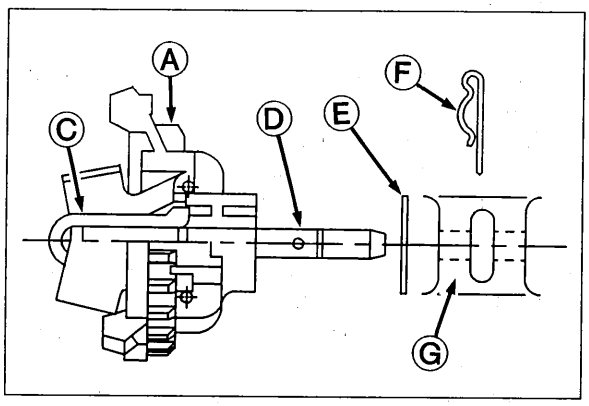


GOVERNOR GEAR INSTALLATION

1. Place sleeve (C) into governor gear assy (A).

NOTE : The sleeve can not be installed after the governor gear assembly is in place in the crankcase cover.

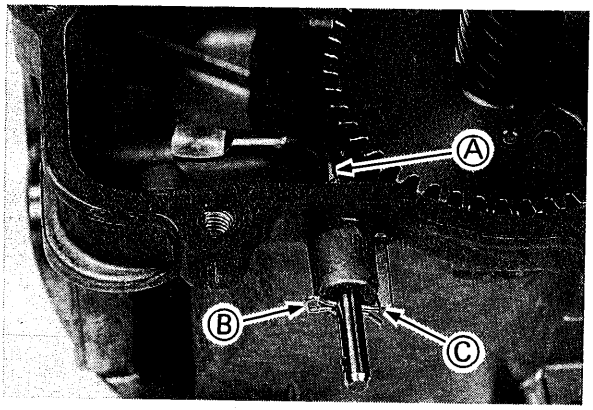
2. Install governor gear assembly (A) in the crankcase cover by fitting shaft (D) through thrust washer (E) and boss (G). Be sure to install locking pin (F) in the hole in shaft (D).
3. Check free rotation of governor assy after installation.



GOVERNOR SHAFT INSTALLATION

1. Install governor shaft (A) into crank case and set locking pin (B) to governor shaft positioning as shown.

NOTE : Be careful for position of locking pin end and projection (C) which is stopper of governor shaft (A).



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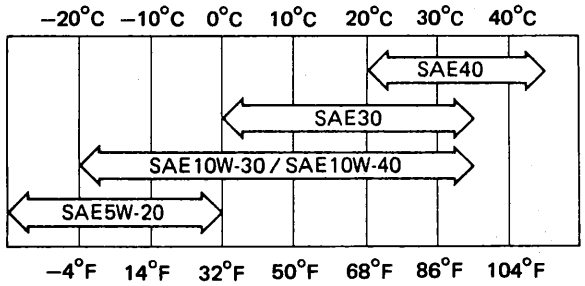
LUBRICATING SYSTEM

ENGINE OIL

1. Use high quality detergent engine oil classified "API Service SF, SE, or SD" or equivalent.

NOTE : Detergent engine oil delays formation of gum and varnish. Do not add any additives to detergent oil.

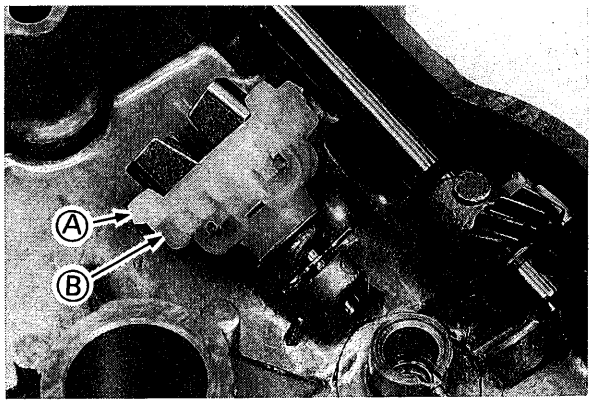
2. Select oil viscosity depending on expected environmental temperature as shown.



OIL SLINGER CHECK

Lubricating system is oil splash type which has oil slinger integrated governor gear, driven by timing gear.

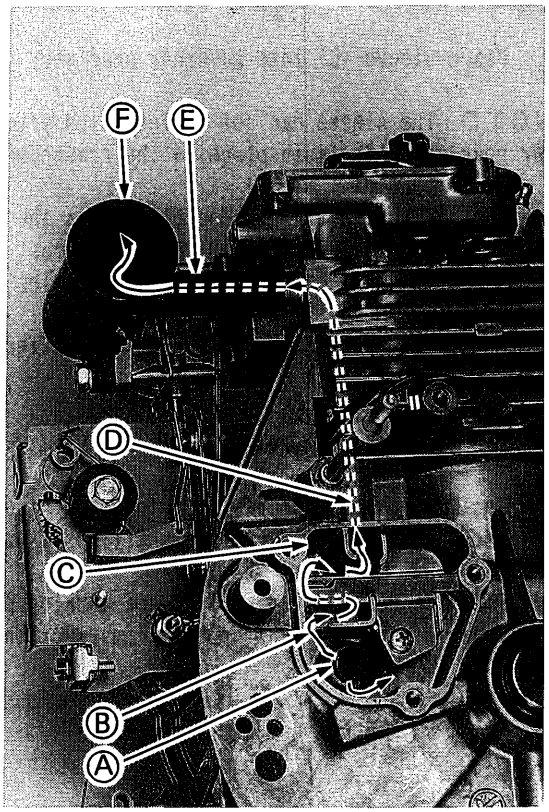
1. Check slinger (A) for worn or broken teeth.
2. If slinger is damaged, replace the governor gear assy (B)



BREATHER SYSTEM

Function of breather is to keep vacuum in crank case avoiding oil being forced out of engine.
Reed valve controls direction of air flow caused by piston movement so that air flow from inside to outside can pass reed valve but not from outside to inside.

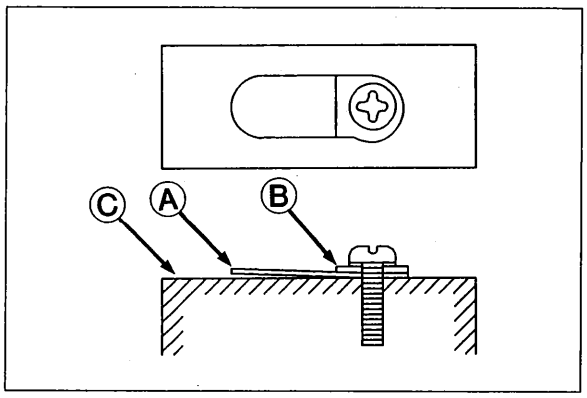
Oil laden air in crank case passes through reed valve (A) and expands in valve chamber (B).
The air passes through second chamber (C) and expands in breather chamber (D).
Then air passes through maze in breather chamber (D) and is vented to intake pipe (F), through tube (E).



BREATHER REED VALVE CHECK

1. Check valve and valve seat for any damage such as crack or wear.
2. Install reed valve (A) and back plate (B) on inspection tool (C), and check gap between reed valve (A) and tool surface (C) with feeler gauge.

- If gap is more than 0.2 mm (0.008 in.), turn over valve or replace valve.



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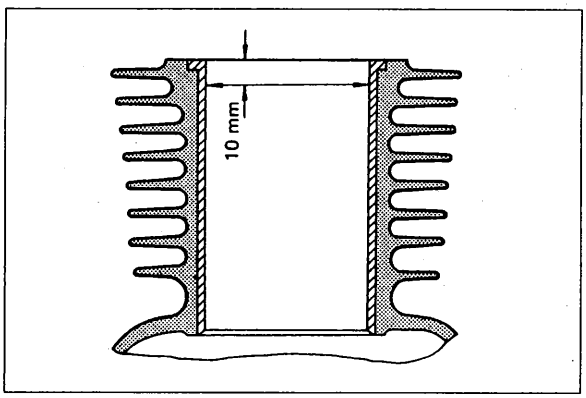
CYLINDER/CRANKCASE

CYLINDER SERVICE LIMIT



1. Visually check cyl. block for scored bore, broken fin, or other damages.

- If unrepairable damage is observed, replace cyl. block.

2. Check inside diameter at 10 mm (0.4 in.) from top in directions of parallel and right angle to crankshaft, with inside micrometer.

- If inside diameter and/or out of round are more than MAX, resize cyl. bore or replace cyl. block.

CYL. BORE INSIDE DIA. MAX

68.060 mm (2.6795 in.)

CYL. BORE OUT OF ROUND MAX

0.060 mm (0.0024 in.)

CYLINDER BORE RE-SIZING

Oversize piston and piston rings for standard plus 0.25 mm (0.01 in.), 0.50 mm (0.02 in.), and 0.75 mm (0.03 in.) are available. Select suitable size depending on condition of cyl. bore to be re-sized.

1. Bore cylinder finely to size as shown on right table before honing.

   O.S. : Over Size
   B.S. : Boring Size

O.S.	B.S.
0.25 mm	68.210 - 68.230 mm (2.6854 - 2.6862 in.)
0.50 mm	68.460 - 68.480 mm (2.6953 - 2.6961 in.)
0.75 mm	68.710 - 68.730 mm (2.7051 - 2.7059 in.)

2. Hone cylinder to final size as shown on right table following procedure shown below.

O. S.	F. S.
0. 25 mm	68. 230 - 68. 250 mm (2. 6862 - 2. 6870 in.)
0. 50 mm	68. 480 - 68. 500 mm (2. 6961 - 2. 6969 in.)
0. 75 mm	68. 730 - 68. 750 mm (2. 7059 - 2. 7067 in.)

CAUTION : Allow for a shrinkage (from the final size) of 0. 006 to 0. 008 mm (0. 0002 to 0. 0003 in.) which will occur when the cylinder cools down.

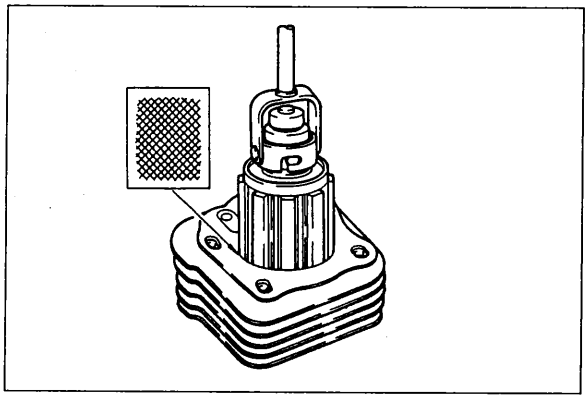
F. S. : Final Size

NOTE : Use honing stone recommended by hone manufacturer.

(1) Align centers of cyl. bore and drill press carefully and set cyl. block on drill press table.
(2) Install hone to drive shaft and set stopper of drill press so that hone can only extend 20-25 mm (3/4-1 in.) from top to bottom of cyl. bore.
(3) Adjust honing stone to contact snugly against cyl. wall at narrowest point.
DO NOT FORCE.
(4) Rotate hone by hand. If it cannot be rotated, adjust hone until it can be rotated by hand.
(5) Set drill press rpm to 200 - 250.
(6) Coat honing oil on cyl. bore.

CAUTION : Do not use solvent or gasoline.

(7) Drive drill press and move hone up and down in cyl. bore about 20 cycles/minute.



WARNING : Stop drill press when checking or measuring cyl. bore.

(8) Measure inside diameter in suitable periods with inside micrometer, and check finishing pattern which should be 40 to 60 degrees crosshatch.
(9) Clean cyl. block thoroughly with soap and warm water for "white glove inspection".

CAUTION : Thoroughly wash honing grit from cylinder. Grit is extremely abrasive to engine components.

(10) Dry cyl. block and coat engine oil to cyl. bore.

BUSHING CHECK

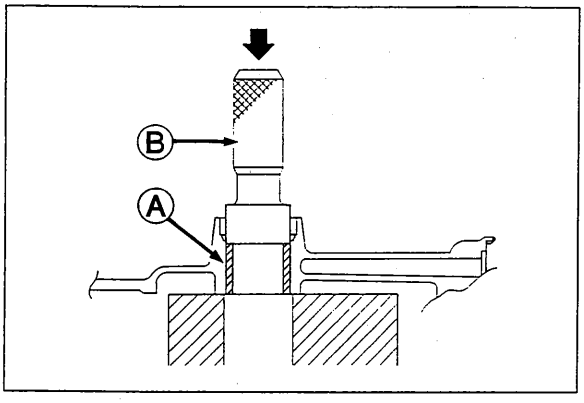
CAUTION : Do not remove bushing from housing except replacing.

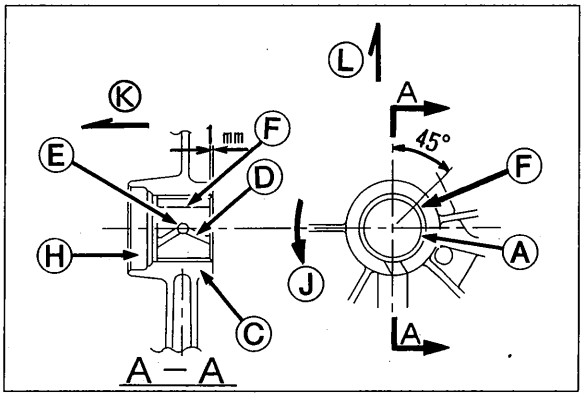
1. Clean bushing with high flash point solvent.

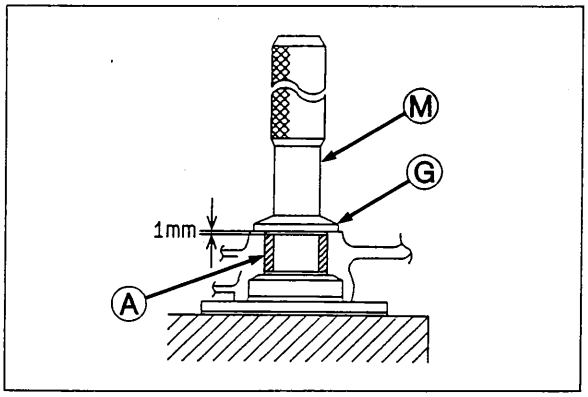
BUSHING REPLACEMENT

1. Remove oil seal preceding bushing replacement.
- Do not re-use removed oil seal.
2. Push out bushing with bushing tool (B).
3. Clean bushing (A) housing with high flash point solvent and dry it.
4. Coat a light film of oil on outside of bushing (A) and entrance of bushing housing (C).
5. Align bushing oil groove (D) and seam (F) as shown.
   H :Oil seal housing
   J :Shaft rotating direction
   K :Flywheel side
   A-A :Viewed from A→ A→
   L :Cylinder direction
6. Aligning oil hole (E) with housing oil passage, install new bushing (A) into crank case with bushing tool (M) until bushing end goes 1 mm (0.039 in.) below housing end (G)

NOTE : Finishing of bushing inside dia. is not required.







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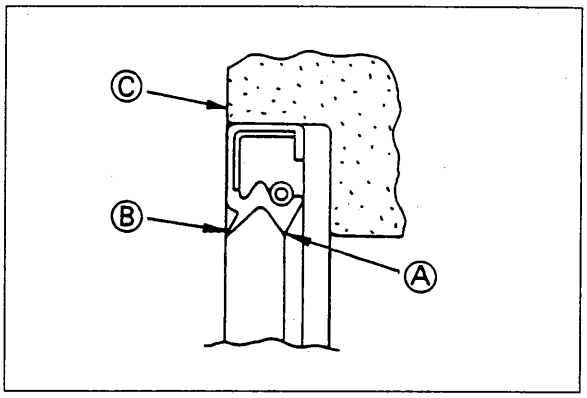
CYLINDER/CRANKCASE

OIL SEAL REPLACEMENT

If oil leakage through oil seal is observed or seal lip is damaged, replace oil seal.

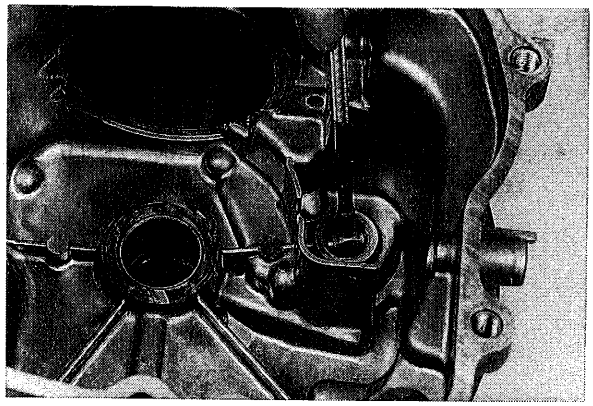
1. Remove oil seal by tapping it out with screw driver or punch.
2. Placing spring held seal lip (A) inside, push oil seal into housing until seal outside surface becomes flush with housing end (C).
3. Before final assembly, pack some amount of grease for high temperature application into space between seal lip (A) and dust lip (B).



CAMSHAFT BEARING SERVICE LIMIT

1. Check inside diameter of camshaft bearing in crank case at several points with inside micrometer.

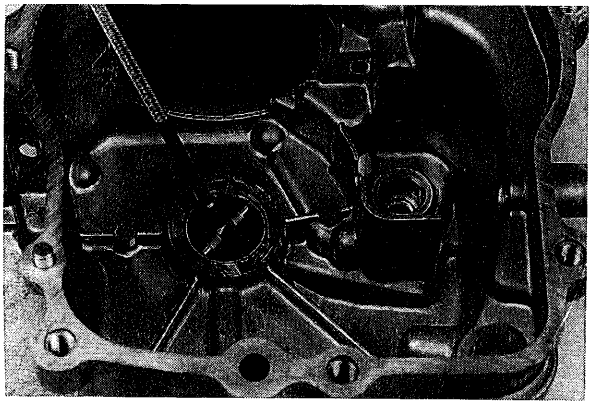
- If inside diameter is more than 14.070 mm (0.5539 in.), replace cylinder/crank case.



CRANKSHAFT BEARING SERVICE LIMIT

1. Check inside diameter of crankshaft bearing in crank case at several points with inside micrometer.

- If inside diameter is more than 25.098 mm (0.9881 in.), replace cylinder/crank case.



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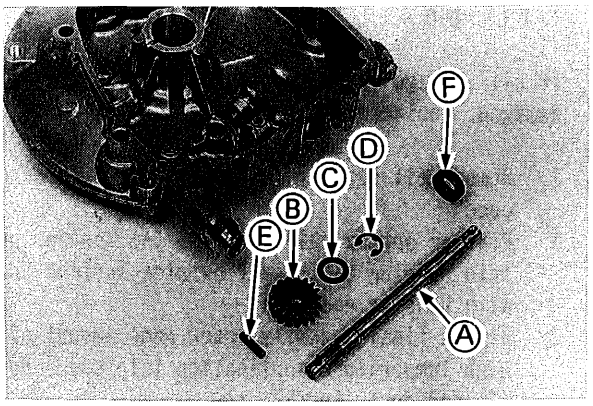
AUXILIARY SHAFT

VISUAL CHECK

1. Check helical gear (B) and shaft (A) for worn or broken teeth.

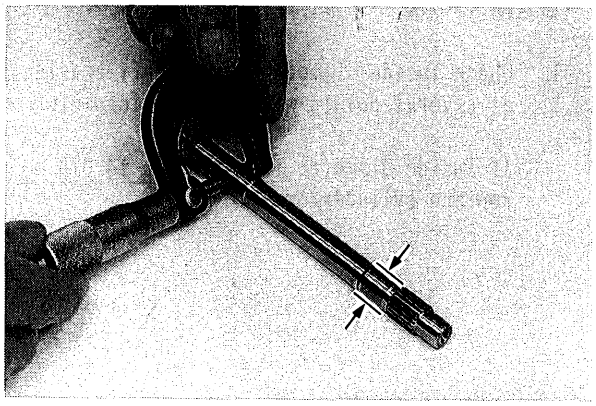
- If (excessively) worn shaft or broken teeth are observed, replace helical gear and shaft.



SERVICE LIMIT

1. Check outside diameter of both bearing journals at several points with micrometer.

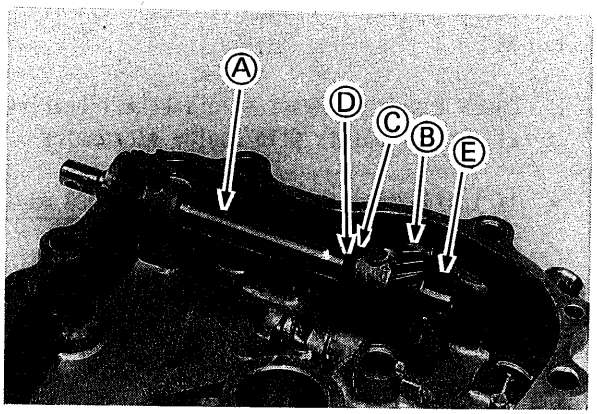
- If outside diameter is less than 11.937 mm (0.4701 in.) replace shaft. - for both journals.



INSTALLATION

Aligning shaft in a group, install shaft in their respective position.

(A) Shaft
(B) Helical gear
(C) Washer
(D) Ring (E type)
(E) Spring pin
(F) Oil seal



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