

4. ENGINE

4-1.	Description	4-2
4-2.	Engine Services Not Requiring Engine Removal.	4-5
4-3.	Dismounting the Engine	4-6
4-4.	Engine Disassembly	4-8
4-5.	Engine Maintenance Service.	4-17
4-6.	Engine Reassembly	4-33
4-7.	Mounting the Engine.	4-46
4-8.	Engine Inspection and Adjustments	4-47
4-9.	Engine Lubrication	4-51

4-1. Description

- 1) The engine is a water-cooled, in-line 3 cylinders, 4-stroke cycle gasoline unit with its S.O.H.C. (single overhead camshaft) valve mechanism arranged for "V"-type valve configuration.

The single overhead camshaft (S.O.H.C.) is mounted over the cylinder head; it is driven from crankshaft through timing belt. Unlike conventional overhead valve (O.H.V.) engines, this engine has no pushrods. Thus, drive for valves is more direct and enables the valves to follow the crankshaft without any delay.

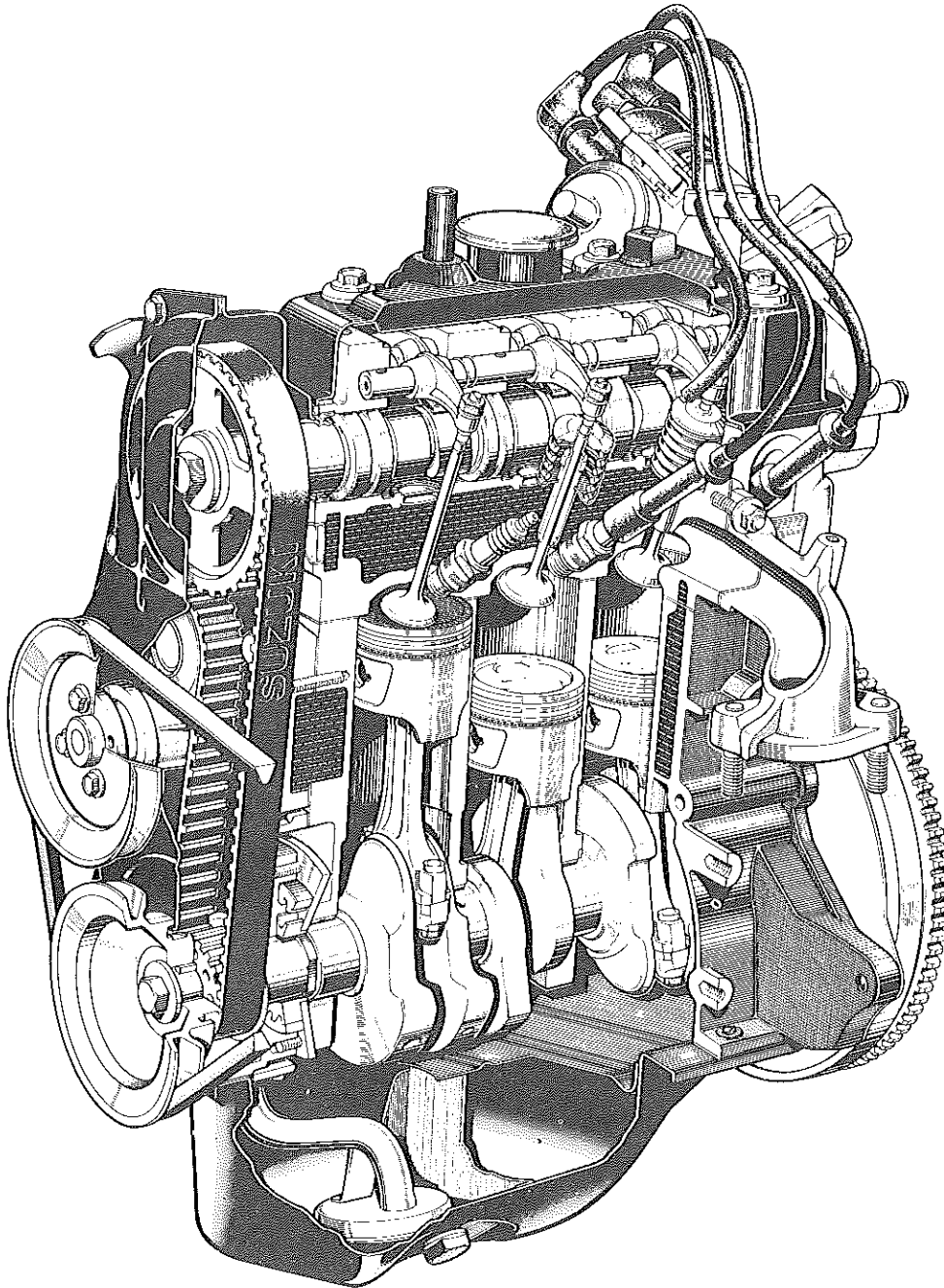


Fig. 4-1

- 2) The distinctive features of this engine may be summarized as follows:
1. Because of inlet and exhaust ports arranged for cross-flow pattern, with valves located in "V"-type configuration, both volumetric and scavenging efficiencies are very high.
 2. The combustion chamber formed between piston crown and cylinder head is of a multi-spherical type shaped to provide squish. This feature is calculated to make available greater horsepower from a lesser amount of fuel.
 3. The supports for camshaft and rocker shafts are integral with the cylinder head, so that the valve mechanism noise is markedly reduced by the structural rigidity and, moreover, that the number of valve mechanism parts is reduced, let alone a more compact size of the engine.
 4. The timing belt for driving the camshaft runs quiet and is light in weight.
 5. A high-grade cast iron is used for the material of the cylinder block. The block is shaped to present deep skirts and retain greater rigidity.
 6. The crankshaft is a one-piece forging, and is supported by four bearings for vibration-free running.
 7. Heating by hot water is employed for the inlet manifold in order to facilitate fuel carburetion and ensure the uniform distribution of the mixture. The higher combustion efficiency of this engine is largely explained by this inlet manifold feature.
 8. Smooth engine running with minimized vibration and noise is assured in contrast to comparable two-cylinder engines of 4 cycle type, because the three crankpins are 120° apart to make for balanced running and minimized speed fluctuation.

3) Blowby gas recycling system

Blowby gas passage is provided in the cylinder block to pass the blowby gases from crankcase to cylinder head. In the head cover, an oil separator removes oil particles from the gases before the gases are drawn into the air cleaner.

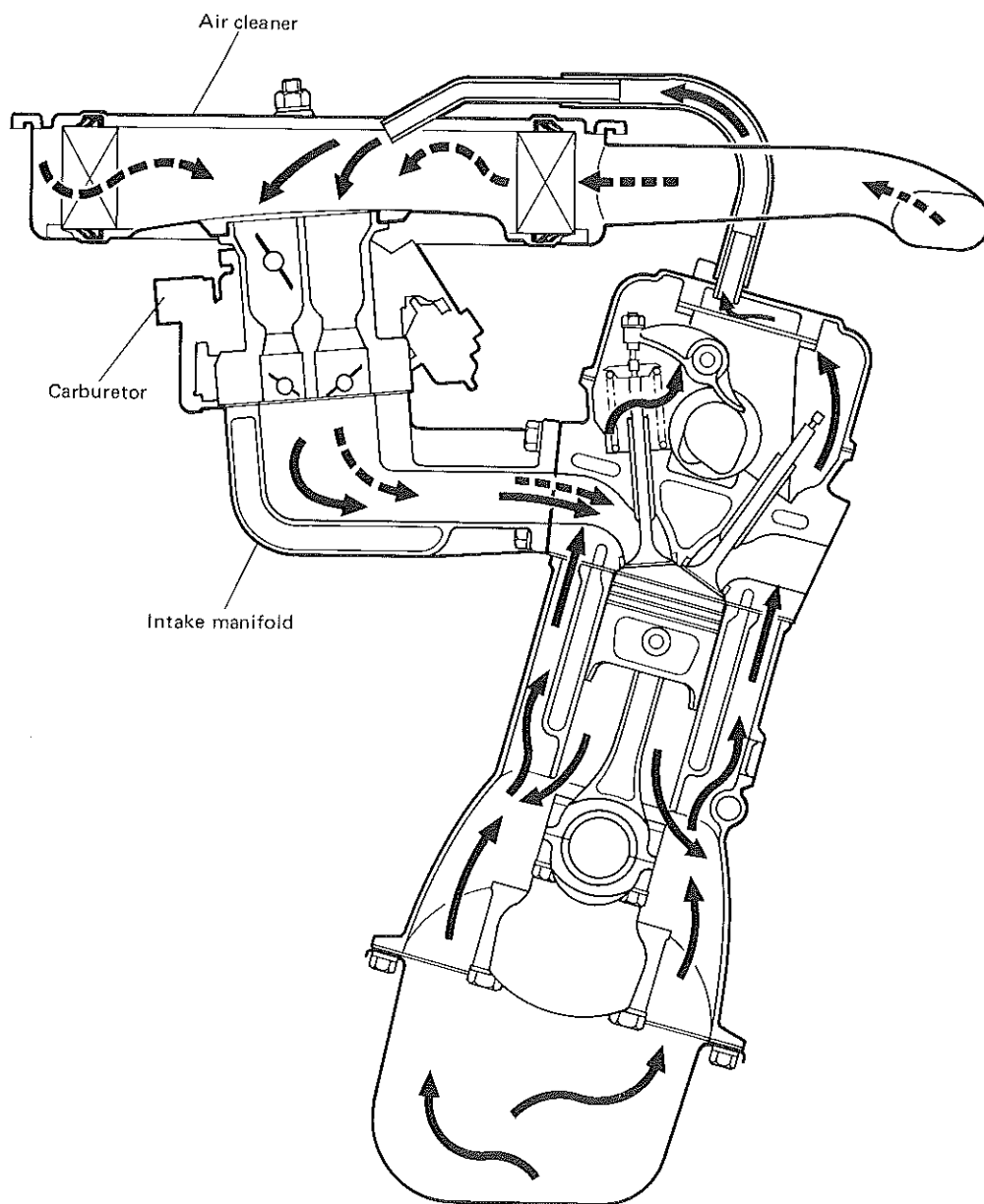


Fig. 4-2

4–2. Engine Services Not Requiring Engine Removal

The following parts or components do not require engine removal to receive services (replacement, inspection or adjustment):

Part or Component	Nature of Service
1. Spark plug	Replacement or inspection
2. Distributor	Replacement, inspection or adjustment
3. Exhaust manifold	Replacement or inspection
4. Oil filter	Replacement
5. Oil pressure unit	Replacement
6. Cylinder head cover	Replacement
7. Rocker shaft	Replacement or inspection
8. Rocker-arm	Replacement or inspection
9. Rocker-arm spring	Replacement or inspection
10. Cam shaft	Replacement or inspection
11. Cylinder head	Replacement or inspection
12. Radiator	Replacement or inspection
13. Distributor gear case	Replacement
14. Camshaft timing belt pulley	Replacement or inspection
15. Crankshaft timing belt pulley	Replacement or inspection
16. Timing belt	Replacement or inspection
17. Fuel pump	Replacement
18. Carburetor	Replacement, inspection or adjustment
19. Intake manifold	Replacement
20. Alternator	Replacement or inspection
21. Starter motor	Replacement or inspection
22. Water pump belt	Replacement, inspection or tension adjustment
23. Water pump	Replacement
24. Pulleys (crank, alternator, water pump)	Replacement
25. Timing belt cover	Replacement
26. Water hose	Replacement or inspection
27. Oil pump	Replacement or inspection

4—3. Dismounting the Engine

1. Remove the front grille and upper member.
2. Disconnect negative (—) and positive (+) cords from the battery terminals, and remove the battery.
3. Remove the battery insulator from the battery tray.
4. Disconnect the lead wire from the radiator fan thremo switch.
5. Disconnect the radiator fan lead wire at the coupler.
6. Disconnect the radiator outlet hose from the outlet pipe and drain the cooling water.
7. Disconnect the radiator inlet hose from the thermostat cap.
8. Remove the radiator and reserve tank from the body.
9. Pull off ignition coil high-tension cord from the distributor.
10. Disconnect the lead wire (brown) from distributor terminal.
11. Disconnect the lead wire (black/yellow) and positive (+) battery cord from the starter motor.
12. Disconnect the negative (—) battery cord from transmission case.
13. Disconnect the clutch cable from the clutch release lever and transmission case.
14. Disconnect the back light switch lead wire (red and yellow) at the coupler.
15. Release the transmission breather hose from its clamp.
16. Disconnect the speedometer cable from the transmission case.
17. Disconnect the coupler and lead wire (white) from the alternator terminals.
18. Remove the air cleaner case.
19. Disconnect the choke wire from the carburetor body.
20. Disconnect the accelerator wire from the carburetor body.
21. Disconnect the carburetor solenoid lead wire (black/white) at the joint part.
22. Disconnect the fuel return hose from the carburetor body.
23. Disconnect the fuel pump inlet hose from the fuel filter.
24. Disconnect the lead wire (yellow) from the water TEMP. gauge.
25. Disconnect the lead wire (yellow/black) from the oil pressure gauge.
26. Disconnect the heater outlet hose from the water inlet pipe.
27. Disconnect the heater inlet hose from the intake manifold.
28. Remove the torque rods from its brackets.
29. Lift the front end of the machine by jacking, and support it on safety stands.
30. Disconnect the exhaust center pipe from the exhaust manifold.
31. Remove the exhaust center pipe mounting bolt.
32. Disconnect the gear sift control shaft from transmission.
33. Disconnect the extension rod from the transmission.
34. Drain the transmission oil.

35. Disconnect the drive shafts (left & right) from differential side gear snap rings.

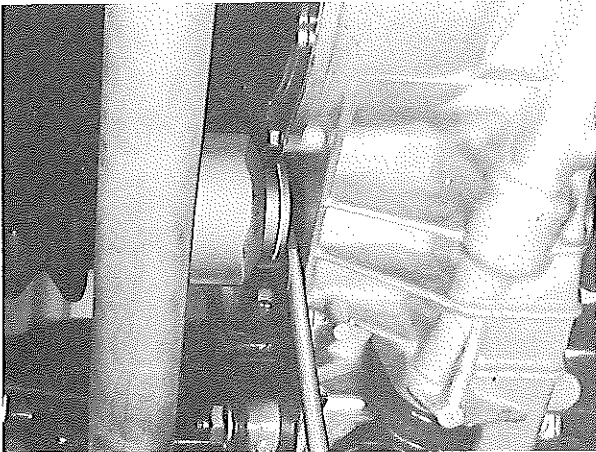


Fig. 4-3

36. Set a piece of wire across the hook on the inlet manifold and another safe place such as the exhaust manifold so that the engine can be lifted by using a chain block.

CAUTION:

Before finally lifting engine, recheck to ascertain all items are disconnected and free.

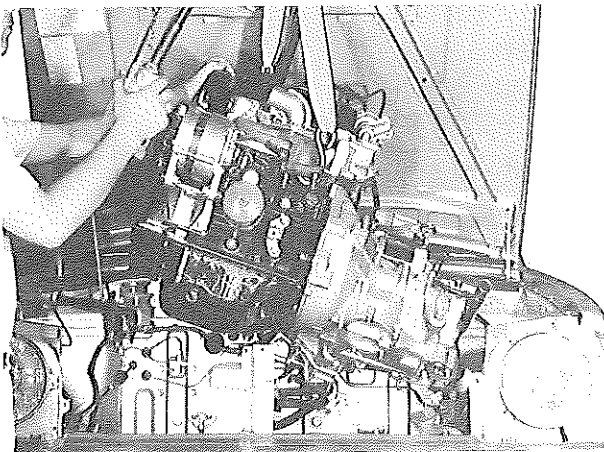


Fig. 4-3-1

37. Remove the nuts securing the engine mountings to make the engine ready for removal.
38. Lift the engine a little and pull the drive shafts (right & left) out of the spline of the differential side gear.
39. Take down the engine.

NOTE:

Throughout this MANUAL, the three cylinders of the engine are identified by numbers: No. 1, No. 2 and No. 3 as counted from crankshaft pulley side.

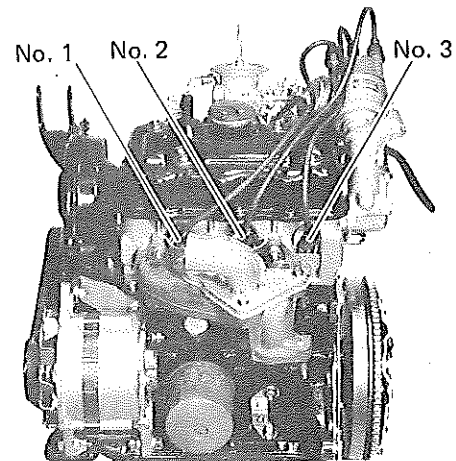


Fig. 4-4

4-4. Engine Disassembly

NOTES:

- Observe critically before starting to remove a component or part by loosening bolts, nuts and the like. What you may find before and during disassembly is valuable information necessary for successful reassembly.
- Be careful in handling aluminum-alloy parts. They are softer than steel or cast-iron parts and their finished surfaces more easily take scratch marks.
- Have trays and pans ready for setting aside the disassembled parts in an orderly manner. Place the parts in the trays and pans in such a way that they can be readily identified. Put match marks or tags on them, as necessary, so that they will go back to where they came from.

Carry out engine disassembly in the following sequence:

Remove starter motor and loosen the transmission securing bolts after removing the radiator outlet pipe.

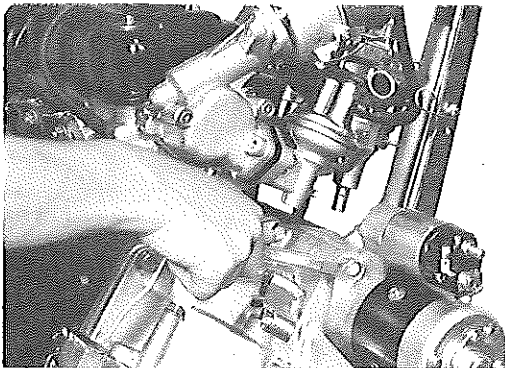


Fig. 4-5

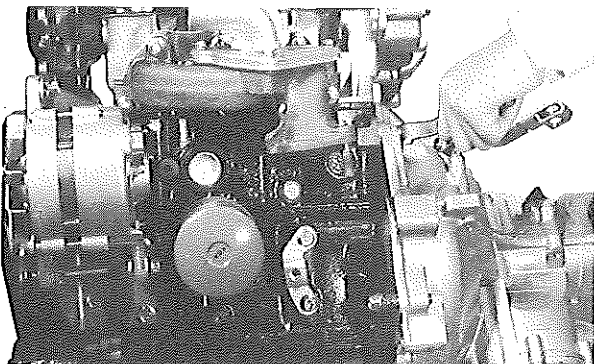


Fig. 4-5-1

Take off transmission case from cylinder block after removing clutch housing lower plate.

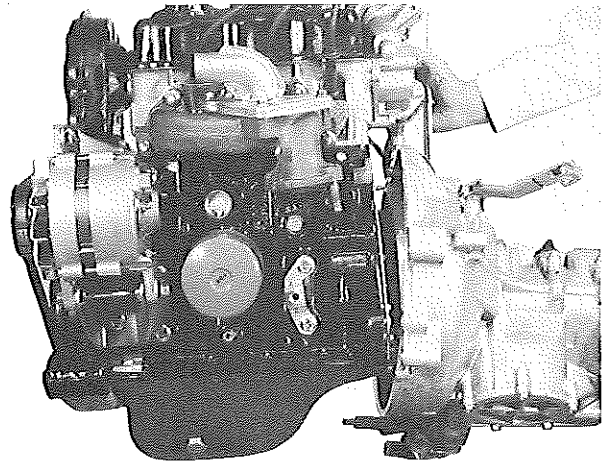


Fig. 4-6

Remove drain plug and drain out engine oil.

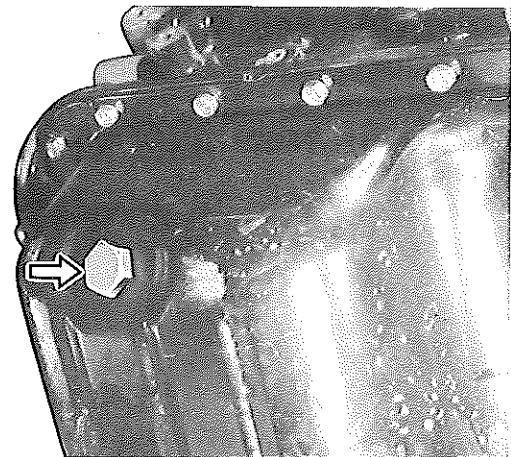


Fig. 4-7

Remove clutch cover.

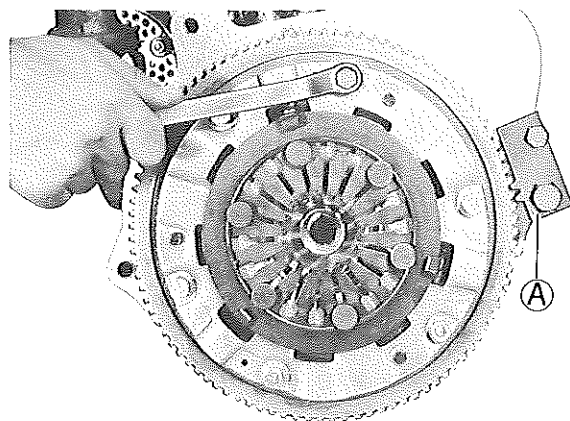


Fig. 4-8 Ⓐ Flywheel stopper (09916-97820)

Remove distributor assembly.

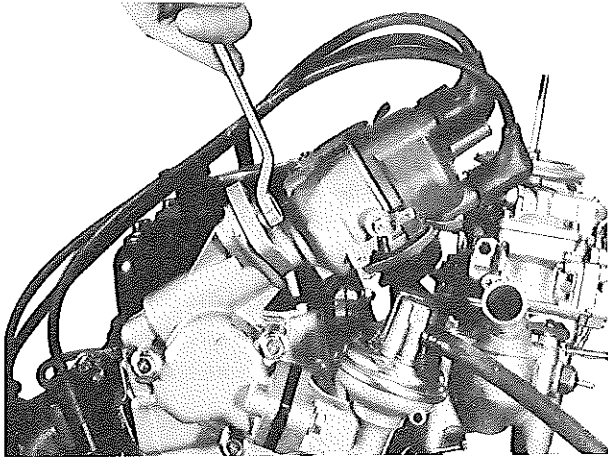


Fig. 4-9

Remove fuel pump.

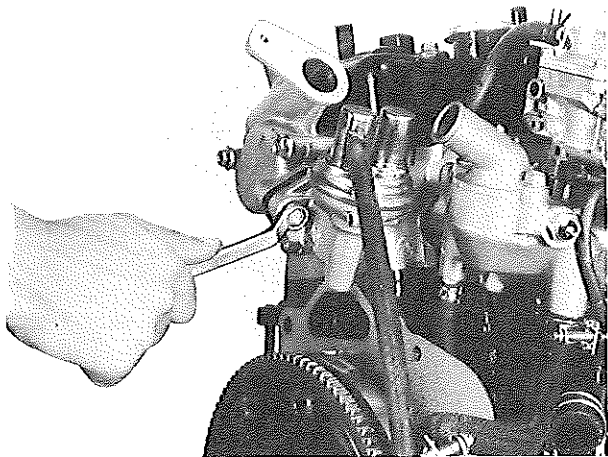


Fig. 4-10

Take down distributor case.

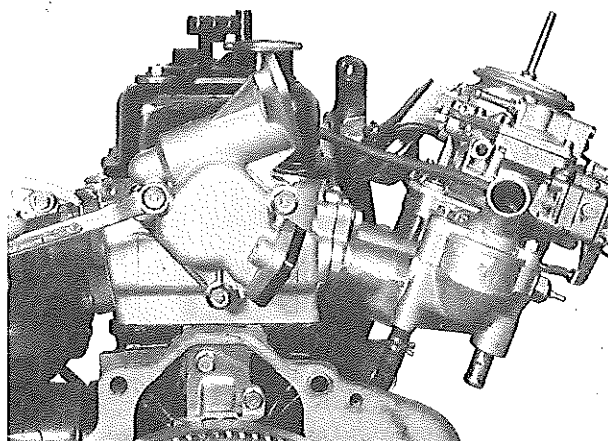


Fig. 4-11

Take down alternator.

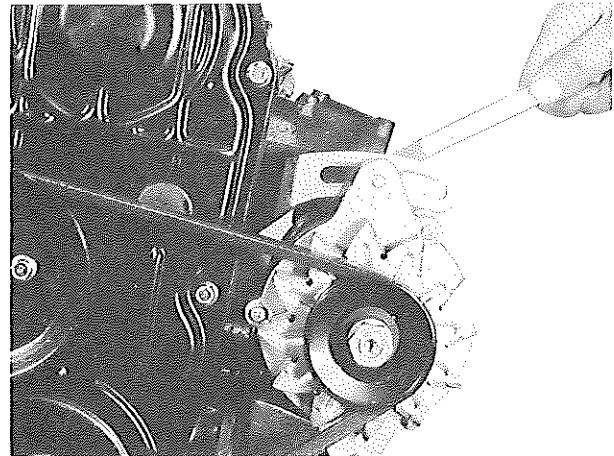


Fig. 4-12

Remove alternator mounting stay.

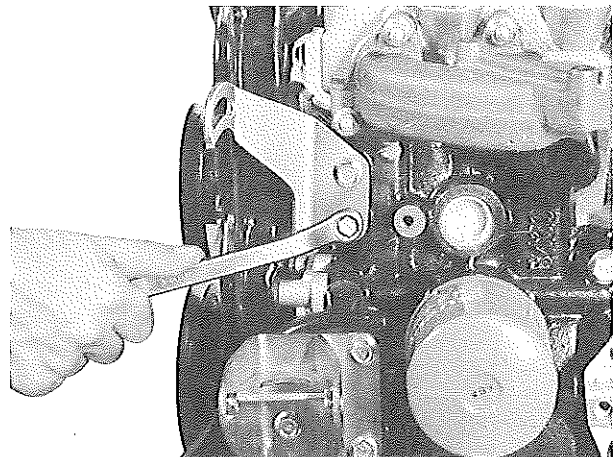


Fig. 4-13

Ease out water pump pulley.

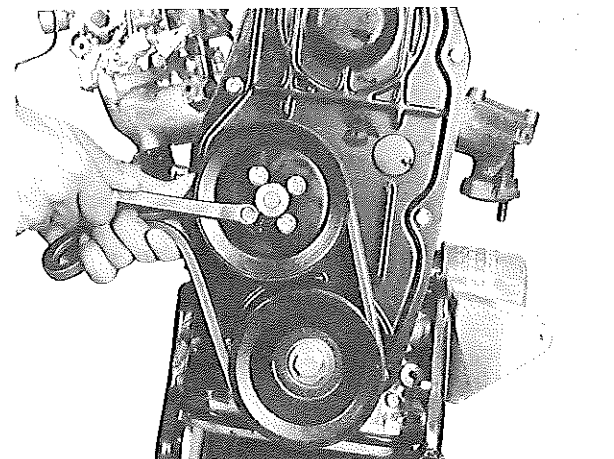


Fig. 4-14

Remove crank pulley similarly, with special tool **A** (09916-97820) hitched to flywheel so that crankshaft will not turn.

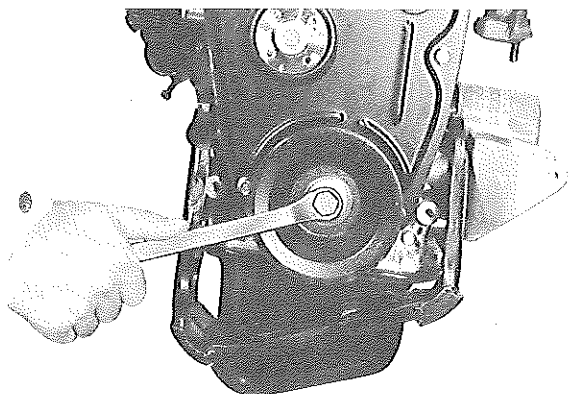


Fig. 4-15

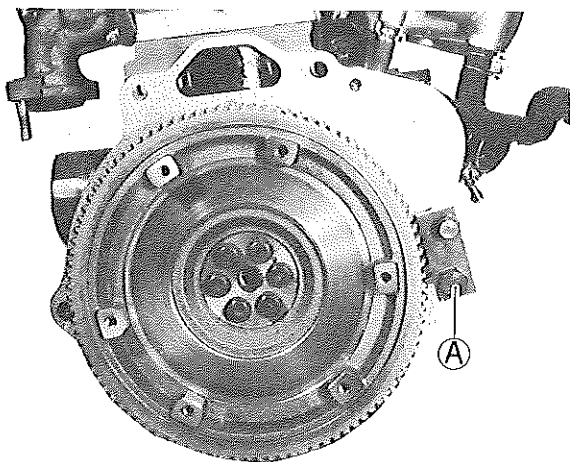


Fig. 4-16

Remove outside cover on timing belt.

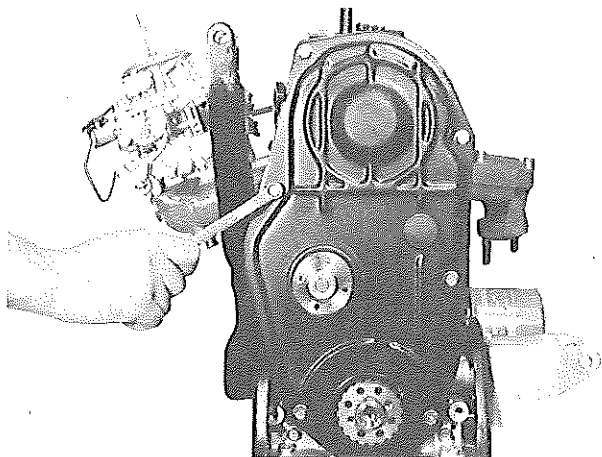


Fig. 4-17

Remove timing belt tensioner after removing a part of the tensioner spring from the tensioner bracket.

CAUTION:

Before removing the tensioner, turn over the crankshaft to bring its keyway **1** to a point between 50° and 70° on the left side of mark **2** provided on the timing belt inside cover. See Fig. 4-18. This positioning is necessary in order to prevent the piston crown from coming into contact with the valve. The valve could be damaged if this contact should occur. Never rotate camshaft or crankshaft before the cylinder head or rocker arms are removed.

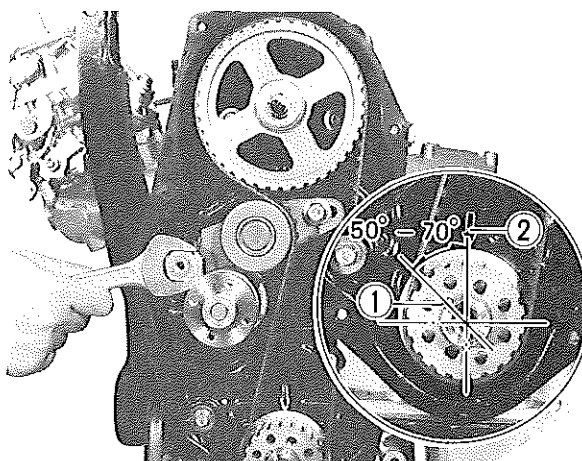


Fig. 4-18

Remove timing belt.

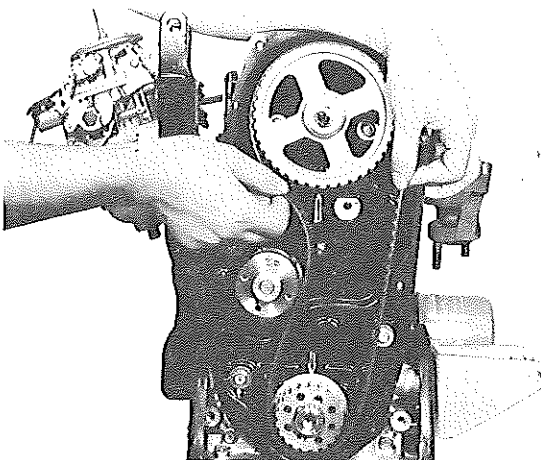


Fig. 4-19

Remove the camshaft timing belt pulley, with special tool ① (09930-40113) attached, as shown, to lock the camshaft.

CAUTION:

Do not rotate camshaft when removing the pulley.

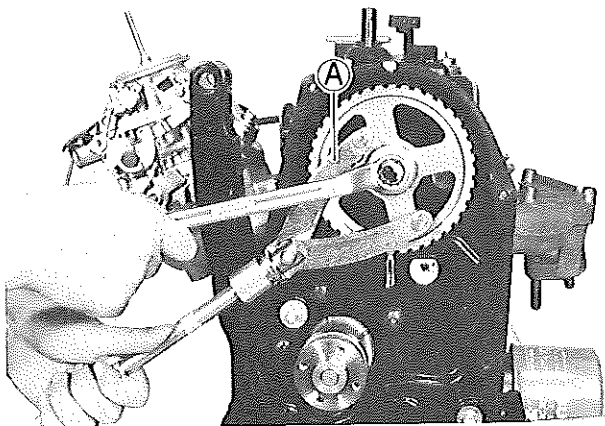


Fig. 4-20

Similarly remove the crankshaft timing belt pulley.

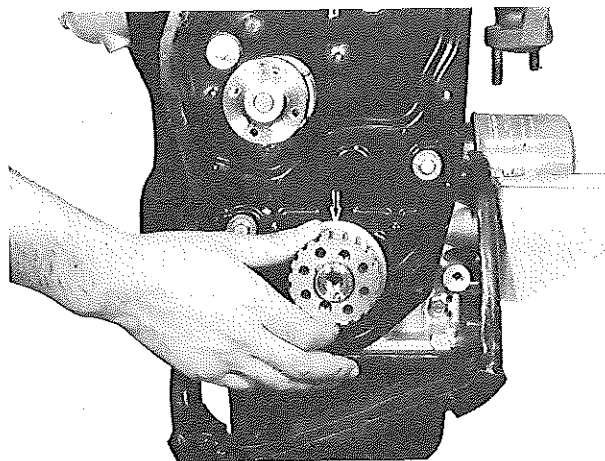


Fig. 4-21

After removing the pulley key, take out timing belt guide.

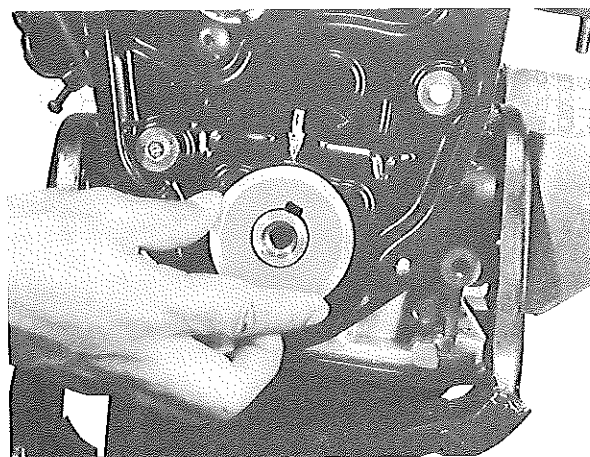


Fig. 4-22

Take down timing belt inside cover.

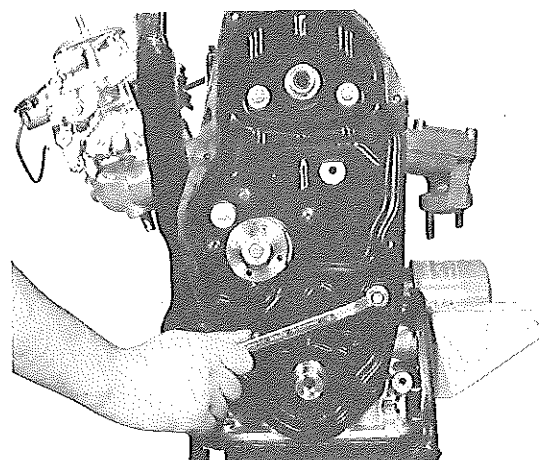


Fig. 4-23

Remove engine mounting brackets.

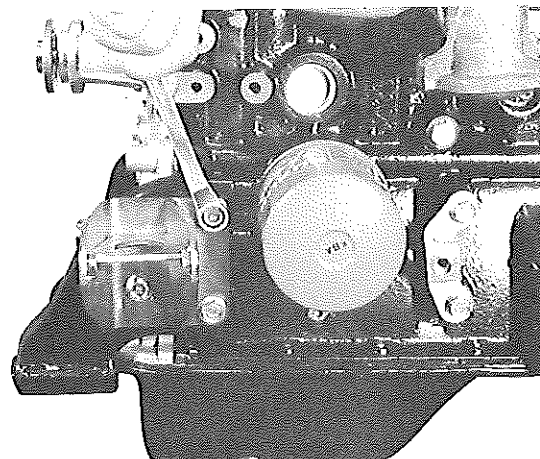


Fig. 4-24

Remove water pump case.

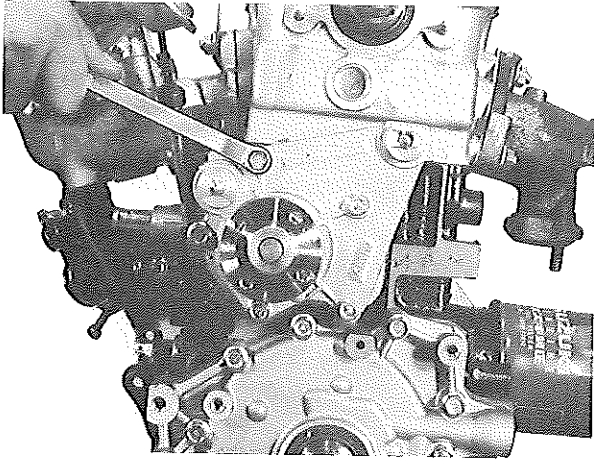


Fig. 4-25

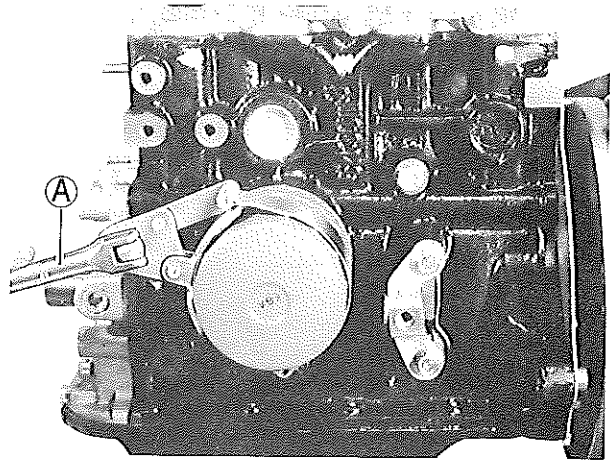


Fig. 4-27

Take off exhaust manifold and its gasket.

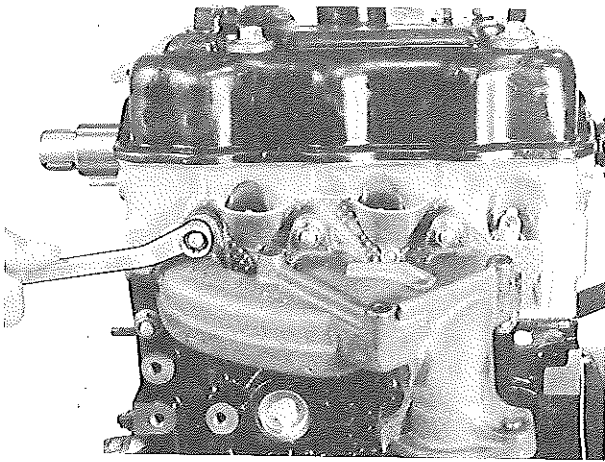


Fig. 4-26

Draw bypass hose.

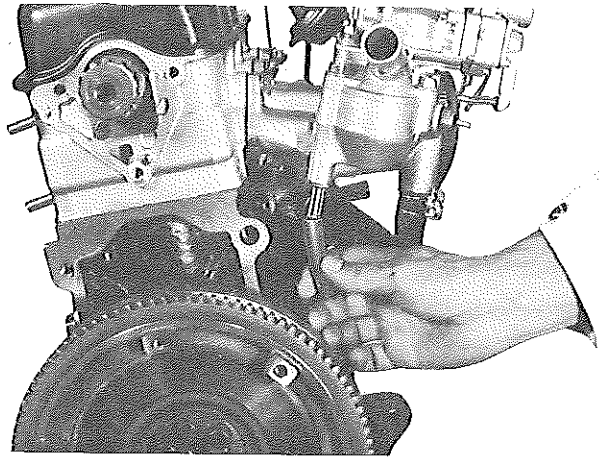


Fig. 4-28

Using special tool ① (09915-47310), remove oil filter.

NOTE:

Be careful not to spill the oil when removing the filter.

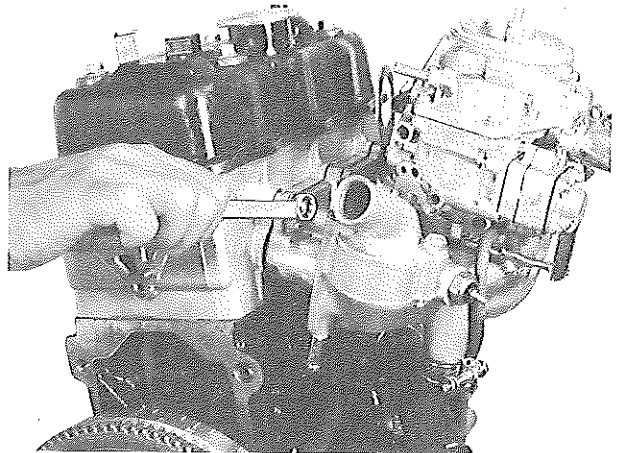


Fig. 4-29

Sever and remove water inlet pipe.

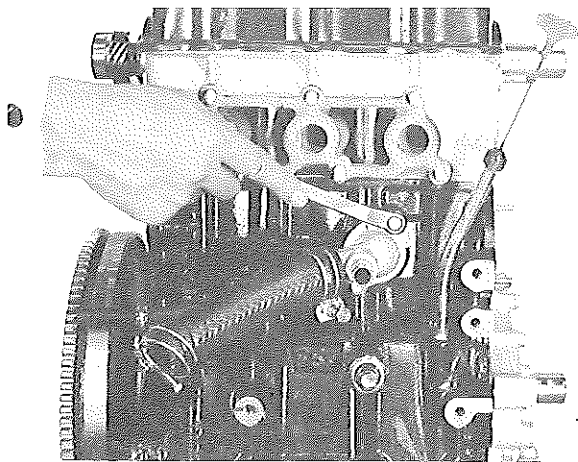


Fig. 4-30

Take off cylinder head cover.

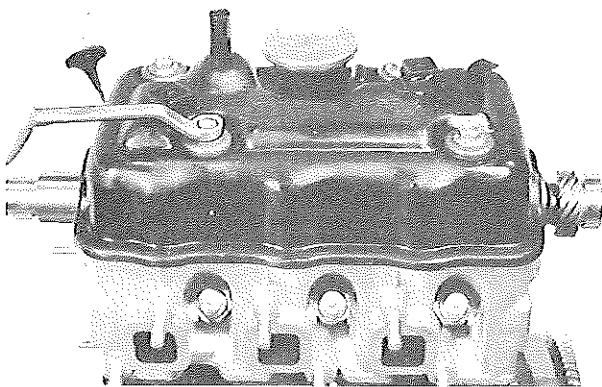


Fig. 4-31

Loosen the 6 valve adjusting screws fully.
Leave the screws in place.

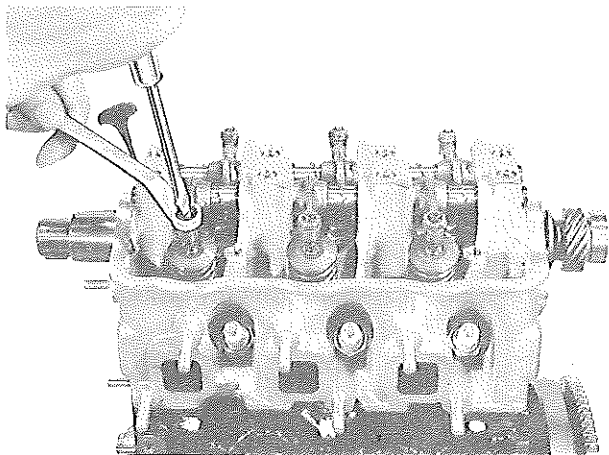


Fig. 4-32

Loosen rocker arm shaft securing screws:
there are 8 screws.

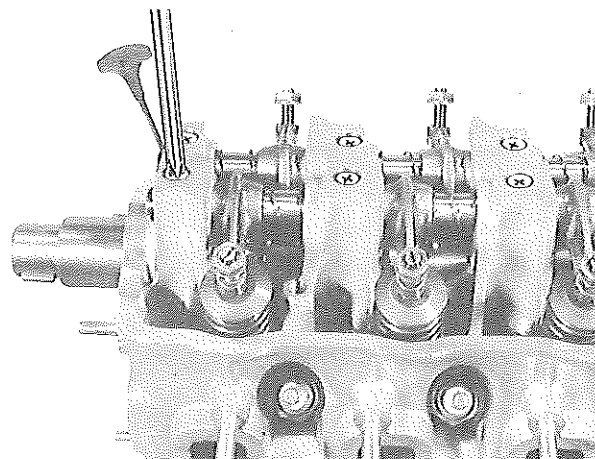


Fig. 4-33

While drawing out rocker arm shaft, separate
valve rocker arms and rocker arm springs.

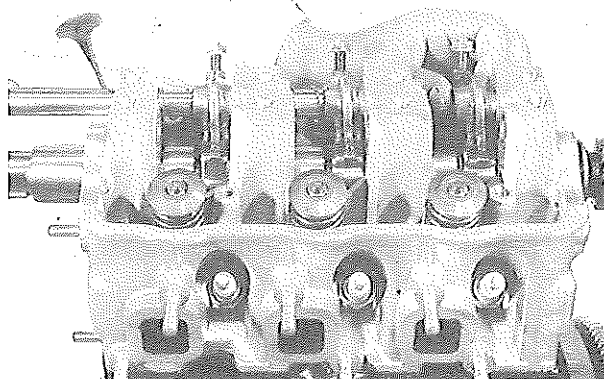


Fig. 4-34

Remove camshaft thrust plate, and draw cam-
shaft out toward distributor gear case side.

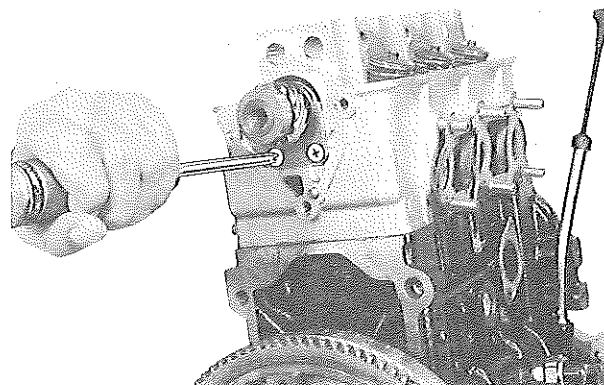


Fig. 4-35

Remove cylinder head.

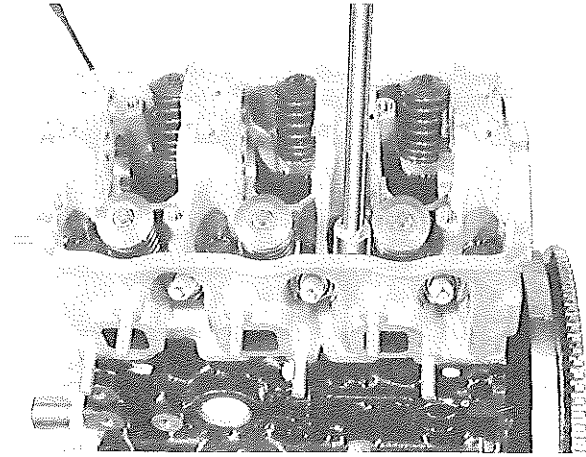


Fig. 4-36

Use valve lifter **A** (09916-14510) to compress the valve spring in order to free valve cotter pieces for removal. In this way, remove valve spring and valves.

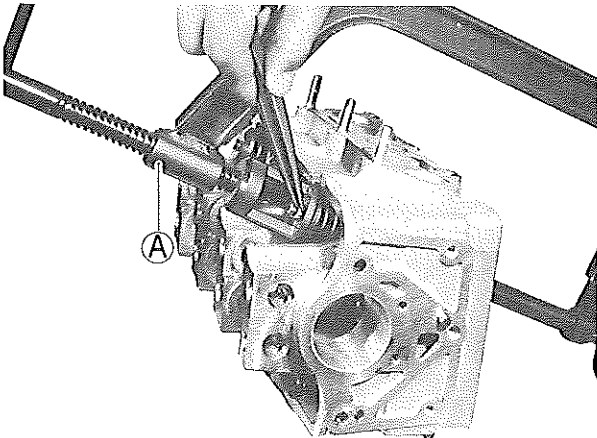


Fig. 4-37

Remove flywheel, using special tool **A** (09916-97820) as shown.

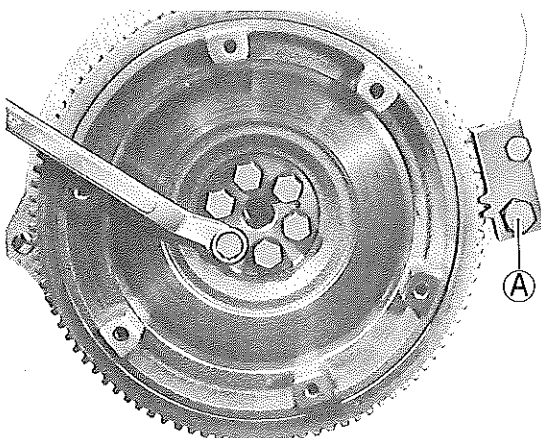


Fig. 4-38

Take down oil pan.

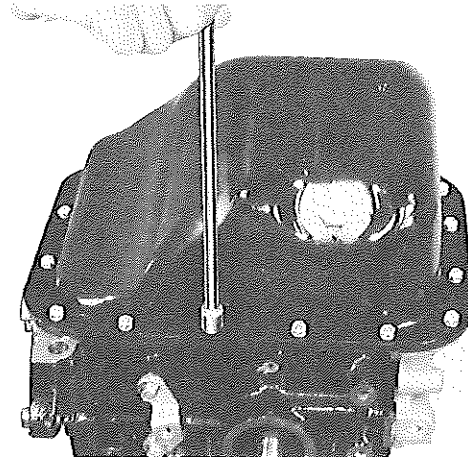


Fig. 4-39

Remove oil pump strainer.

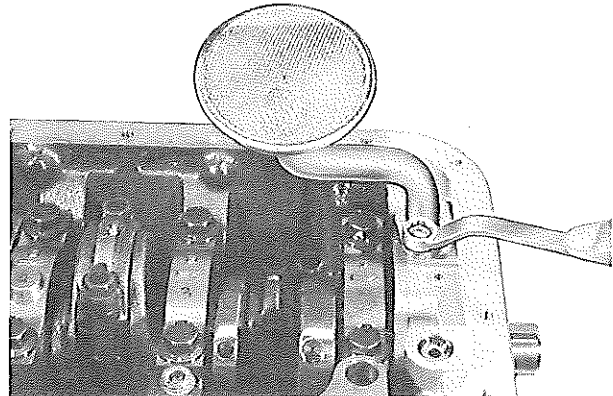


Fig. 4-40

As the first step of crankshaft removal, remove the three connecting rod caps and take out pistons, each complete with its connecting rod, from cylinder head side.

CAUTIONS:

- Before pulling the piston out, scribe the cylinder number on its crown.
- Never drive on the big end in an attempt to force the piston out. If driving is necessary to ease the big end off crankpin, run stud bolts into the big end and drive on the bolts with a mallet handle.
- Be sure to identify each bearing cap for its connecting rod by using the cylinder number. Set the cap and rod aside in combination.

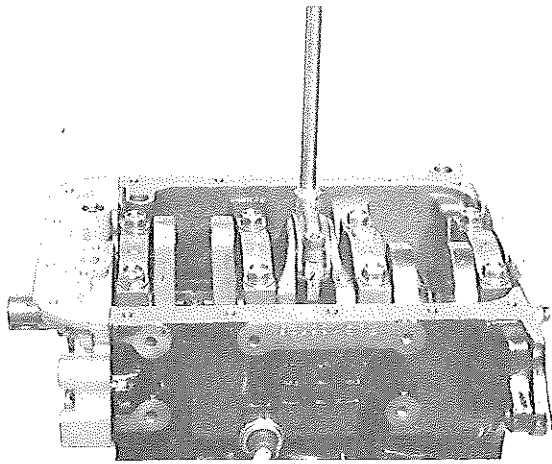


Fig. 4-41

Remove oil pump case.

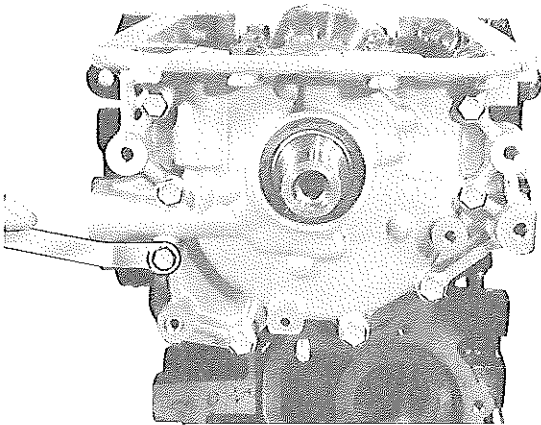


Fig. 4-42

Remove oil seal housing.

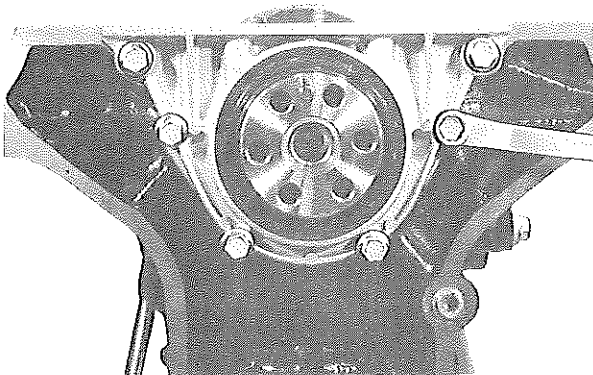


Fig. 4-43

Remove crankshaft bearing caps, and take out crankshaft.

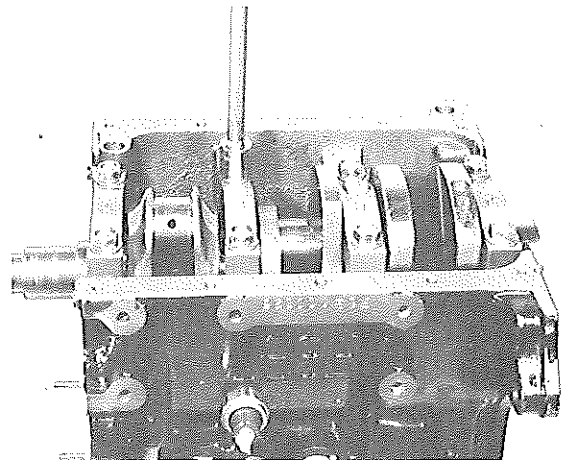


Fig. 4-44

From each piston, ease out piston pin circlips, as shown.

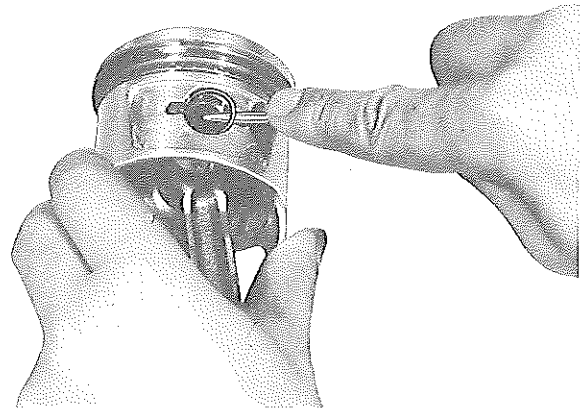


Fig. 4-45

Force piston pin out.

CAUTIONS:

- Before removing the pin, scribe the cylinder number on the connecting rod.
- Set the piston, piston pin and connecting rod, together with cap, in the tray or pan as a combination.

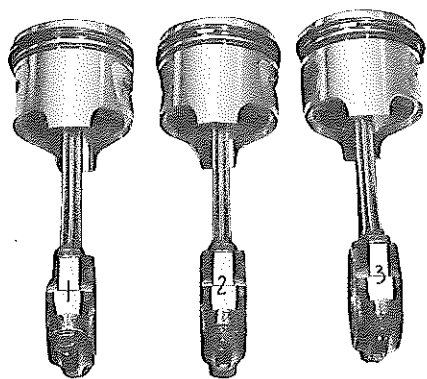


Fig. 4-46

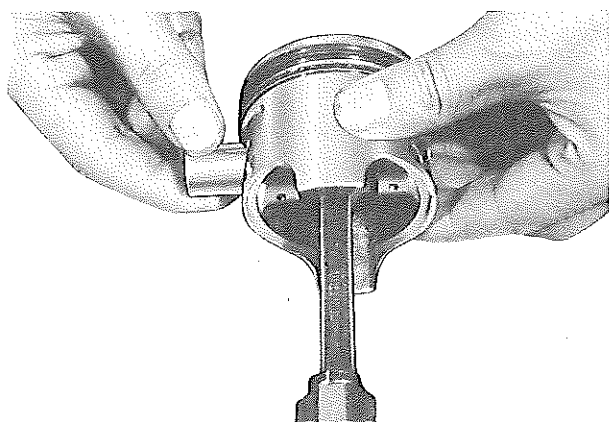


Fig. 4-47

4-5. Engine Maintenance Service

NOTES:

- During and immediately after disassembly, inspect the cylinder block and head for evidence of water leakage or damage and, after washing them clean, inspect more closely.
- Wash all disassembled parts clean, removing grease, slime, carbon and scales, before inspecting them to determine whether repair is necessary or not. Be sure to de-scale the water jackets.
- Use compressed air to clear internal oil holes and passages.
- Do not disturb the set combinations of valves, bearings and bearing caps, etc. Have the sets segregated and identified.

Cylinder head

- De-carbon the cylinder head:
Deposits of carbon will be found on its combustion chamber surfaces and exhaust ports. Remember, overheating tendency and loss of output are often due to excessive carbon accumulation. De-carbon the valves, too.

NOTE:

Do not use any sharp-edged tool to scrape off the carbon. Be careful not to scuff or nick the metal surfaces when de-carboning. This applies to valves and valve seats, too.

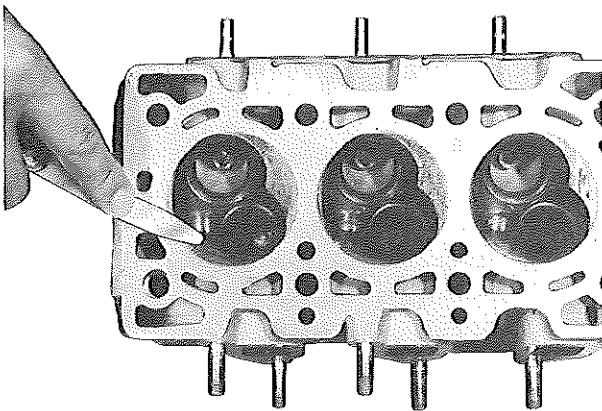


Fig. 4-48

- Flatness of gasketed surface:

Using a straightedge and thickness gauge, check the flatness at a total of 6 locations. If the limit, stated below, is exceeded, correct the gasketed surface with a surface plate and sandpaper of about #400: place the sandpaper on and over the surface plate, and rub the gasketed surface against the sandpaper to grind off high spots. Should this fail to reduce the thickness gauge readings to within the limit, replace the cylinder head.

Leakage of combustion gases from this gasketed joint is often due to a warped gasketed surface; such leakage results in reduced power output and hence a higher cost of fuel per kilometer.

Limit on flatness	0.05 mm (0.002 in.)
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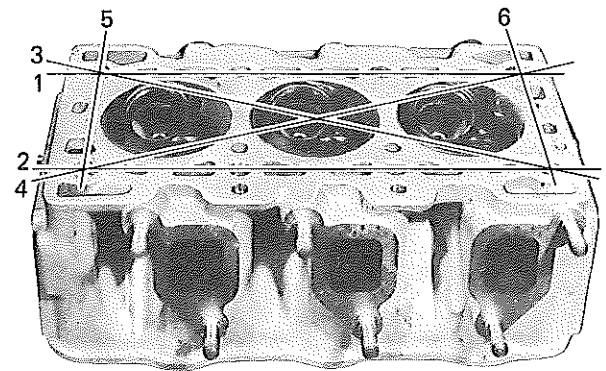


Fig. 4-49

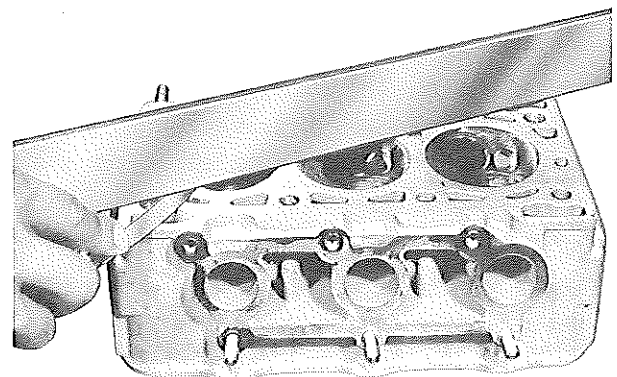


Fig. 4-50

● Flatness of manifold seating faces:

Check the seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or the cylinder head replaced.

Limit on flatness	0.10 mm(0.004 in.)
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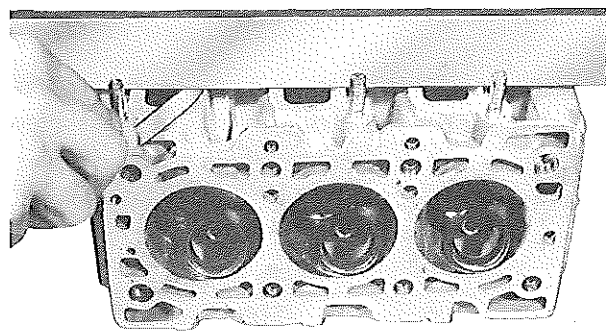


Fig. 4-51 Checking exhaust manifold seating face for flatness.

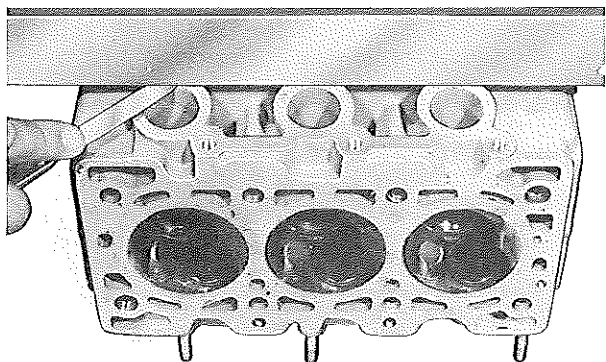


Fig. 4-52 Checking inlet manifold seating face for flatness.

Rocker-arm shaft and rocker arms

● Wear:

Check these parts for wear and, as necessary, replace them. The extent of wear is determined on the basis of two readings, one on rocker arm I.D. and the other on shaft diameter.

NOTE:

Use a micrometer on rocker-arm shaft and a bore gauge rocker arm. The difference between the two readings is the arm-to-shaft clearance on which a limit is specified. If the limit is exceeded, replace shaft or arm, or both.

Item		Standard	Limit
Rocker arm I.D.		14.985 - 15.005 mm (0.590 - 0.591 in.)	—
Rocker-arm shaft dia.		14.965 - 14.980 mm (0.589 - 0.590 in.)	—
Arm-to-shaft clearance	Inlet	0.005 - 0.040 mm (0.0002 - 0.0016 in.)	0.07 mm (0.0027 in.)
	Exhaust	0.005 - 0.040 mm (0.0002 - 0.0016 in.)	0.07 mm (0.0027 in.)

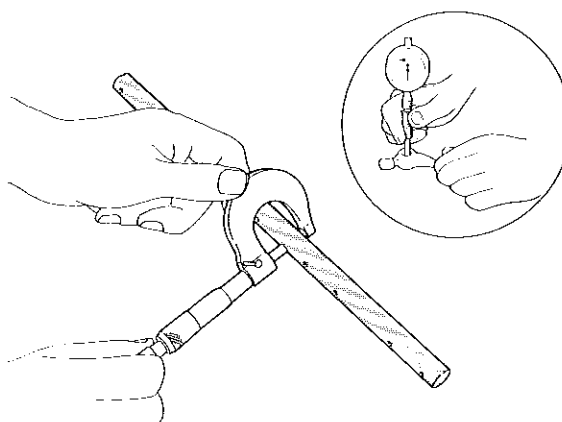


Fig. 4-53

● Rocker-arm shaft deflection:

Using "V" blocks and a dial gauge as shown in Fig. 4-54, check the shaft for straightness in terms of deflection. If the limit is exceeded, correct it by cold-working with a wooden mallet or replace it.

Deflection limit	0.06 mm (0.0023 in.)
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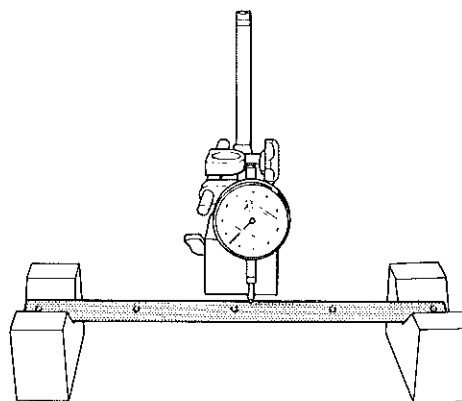


Fig. 4-54

- If the tip ① of adjusting screw ② is badly worn, replace the screw. The arm must be replaced if its cam-riding face ③ is badly worn.

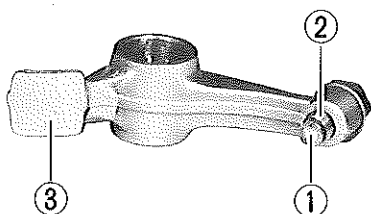


Fig. 4-55

- Visually examine each rocker-arm spring for evidence of breakage or weakening. Be sure to replace springs found in bad condition.

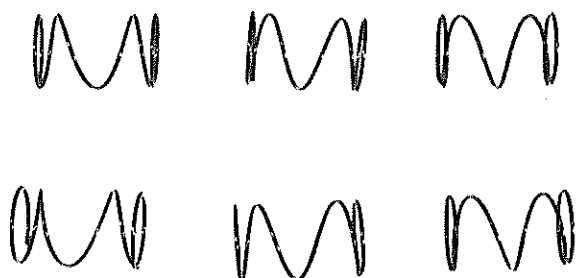


Fig. 4-56

Valve guides

- Using a micrometer and bore gauge, take diameter readings on valve stems and guides to determine the stem clearance in the guide. Be sure to take a reading at more than one place along the length of each stem and guide, as shown in Fig. 4-57.

Item		Standard	Limit
Valve stem diameter	Inlet	6.965 - 6.980 mm (0.2742 - 0.2748 in.)	—
	Exhaust	6.955 - 6.970 mm (0.2738 - 0.2744 in.)	—
Valve guide I.D.	Inlet	7.000 - 7.015 mm (0.2755 - 0.2761 in.)	—
	Exhaust	7.000 - 7.015 mm (0.2755 - 0.2761 in.)	—
Stem-to-guide clearance	Inlet	0.020 - 0.050 mm (0.0008 - 0.0019 in.)	0.07 mm (0.0027 in.)
	Exhaust	0.030 - 0.060 mm (0.0012 - 0.0023 in.)	0.09 mm (0.0035 in.)

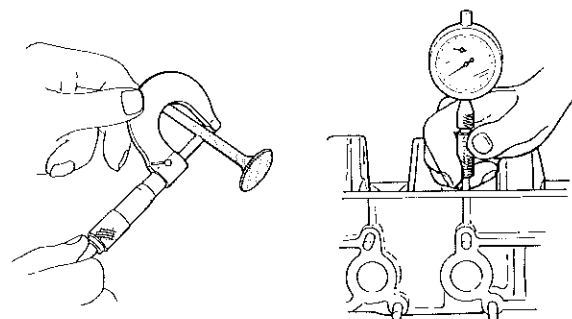


Fig. 4-57

If the bore gauge like the one shown in Fig. 4-57 is not available, check the end deflection of the valve stem in place with a dial gauge rigged as shown in Fig. 4-58. Move the stem end in the directions ④ ⑤ and determine whether replacement is necessary or not, by referring to these limiting values:

Valve stem end deflection	Inlet	0.12 mm (0.0047 in.)
	Exhaust	0.16 mm (0.0063 in.)

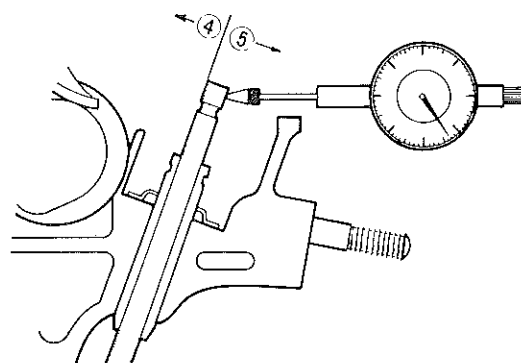


Fig. 4-58

● Valve guide replacement:

Valve guides are shrink-fitted. The method of removal and installation is as follows:

- 1) Using the guide remover (A) (09916-44510), drive the valve guide out to remove it from the top side of cylinder head. After driving the guide out, ream the guide hole with a 12 mm (0.472 in.) reamer (Special tool 09916-37310) to remove burrs, making sure that the hole diameter after reaming comes within this range:

Valve guide hole diameter	Inlet	12.030 - 12.048 mm (0.4736 - 0.4743 in.)
	Exhaust	

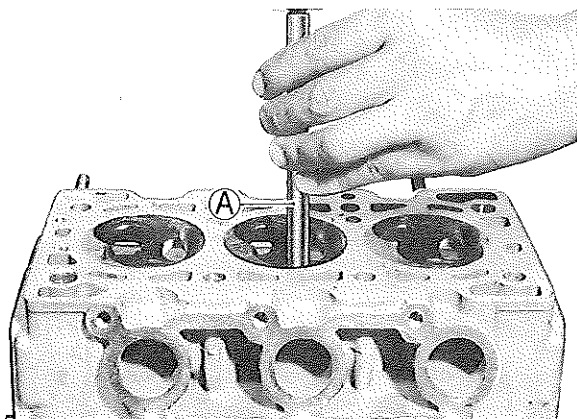


Fig. 4-59

- 2) Heat the cylinder head uniformly to anywhere between 80° C and 100° C (176° F-212° F) so that the head will not distort, and drive the oversize guide into the hole with the valve guide installer set (B) (09916-57310 and 09916-57320). See Fig. 4-60. Be sure to carry out this step speedily so that all guides will go into the cylinder head in steady temperature state.

Valve guide oversize	0.03 mm (0.0012 in.)
Valve guide protrusion (1)	16.5 mm (0.649 in.)

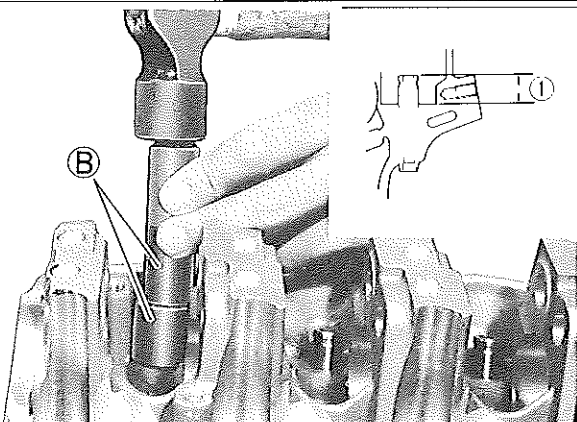


Fig. 4-60

NOTE:

Valve guide length differs between INLET and EXHAUST. It is 52.5 mm (2.067 in.) for INLET but 54.5 mm (2.145 in.) for EXHAUST.

- 3) Check all valve guides in place for I.D. and, if the I.D. reading compared with the stem diameter reading indicates too small a radial clearance, ream the guide I.D. with the reamer (C) (09916-34520), as shown in Fig. 4-61.

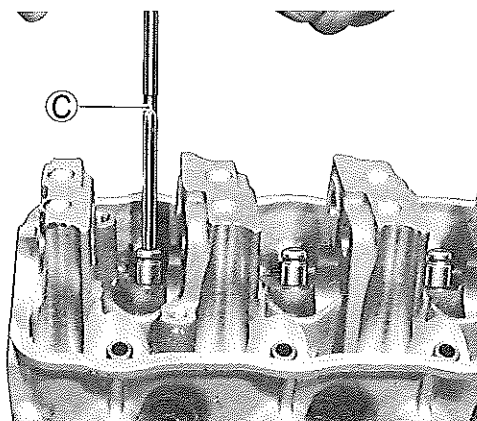


Fig. 4-61

Valves

- Inspect each valve for wear, burn or distortion at its face and stem and, as necessary, replace it.
- Measure the thickness (2) of valve head. If the limit given to this thickness is exceeded, the valve must be replaced.

Valve head thickness (2)

Standard	Limit	
	Inlet	Exhaust
0.8 - 1.2 mm (0.031 - 0.047 in.)	0.6 mm (0.0236 in.)	0.7 mm (0.0275 in.)

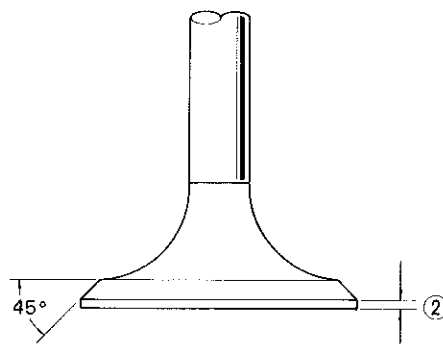


Fig. 4-62

- Check the end face of each valve stem for wear. This face meets the rocker arm intermittently in operation, and might become concaved or otherwise irregular. As necessary, smoothen the end face with an oil stone and, if this grinding removes the end stock by as much as 0.5 mm (0.0196 in.) (as measured from the original face), replace the valve.

Limit on stock allowance of valve stem end face	0.5 mm (0.0196 in.)
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Replacement valves have their stems machined to the following diameter ranges.

Standard valve stem diameter	Inlet	6.965 - 6.980 mm (0.2742 - 0.2748 in.)
	Exhaust	6.955 - 6.970 mm (0.2738 - 0.2744 in.)

- Check each valve for radial runout with a dial gauge and "V" block, as shown in Fig. 4-63. The object of this check is to determine whether the valve stem is true and square relative to the head.

Limit on valve head radial runout	0.03 mm (0.0012 in.)
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If the limit is exceeded, do not attempt to correct the stem; replace the valve, instead.

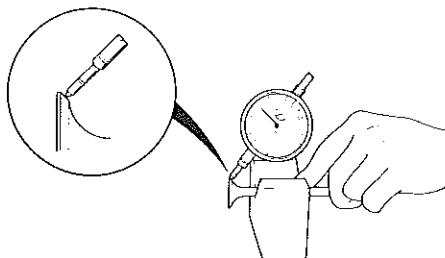


Fig. 4-63

Valve seats

CAUTION:

The valves to be checked and serviced for seating width and contact pattern must be those found satisfactory in regard to stem clearance in the guide and also the requirements stated in the preceding part titled VALVES.

- Seating contact width:

Produce a contact pattern on each valve in the usual manner, namely, by giving a uniform coat of Red-lead paste to the valve seat and by rotatingly tapping the seat with the valve head. The valve lapper (the tool used in valve lapping) must be used.

The pattern produced on the seating face of the valve must be a continuous ring without any break, and the width \textcircled{W} of the pattern must be within the stated range.

Standard seating width \textcircled{W} revealed by contact pattern on valve face	Intake	1.3 - 1.5 mm (0.0512 - 0.0590 in.)
	Exhaust	

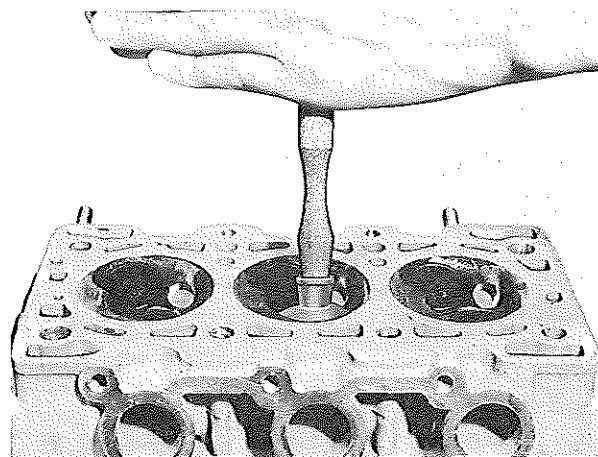


Fig. 4-64

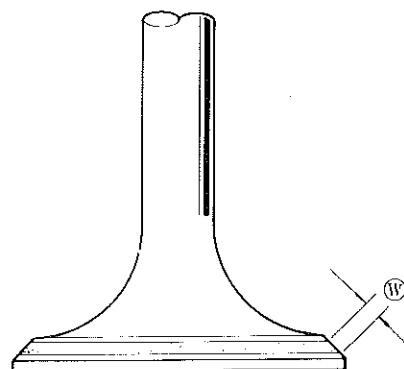


Fig. 4-65

● Valve seat repair:

A valve seat not producing a uniform contact with its valve or showing a width W of the seating contact that is off the specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

1) EXHAUST VALVE SEAT: Use a valve seat cutter to make three cuts in the order illustrated in Fig. 4-67. Three cutters must be used: the first for making the 15° angle, the second for making the 75° angle and the last for making the 45° seat angle. The third cut ③ must be made to produce the desired seat width W .

Seat width W for exhaust valve seat	1.3 - 1.5 mm (0.0512 - 0.0590 in.)
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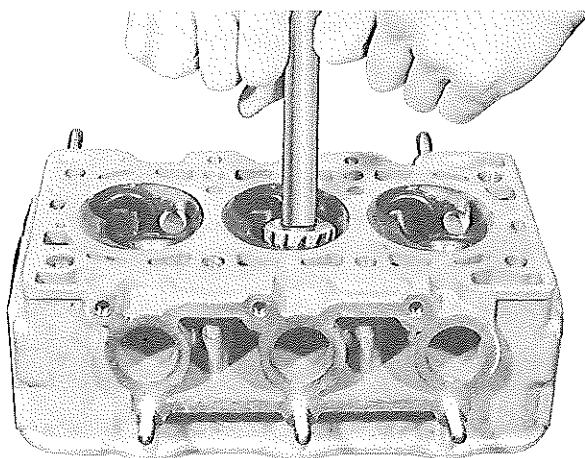


Fig. 4-66 Valve seat cutting

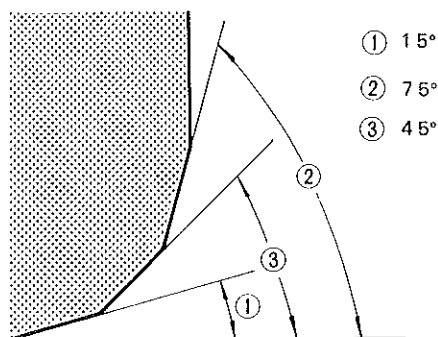


Fig. 4-67 Valve seat angles for exhaust valve seat

2) INLET VALVE SEAT: The cutting sequence is the same as for exhaust valve seats but the second angle differs, as will be noted in Fig. 4-68.

Seat width W for inlet valve seat	1.3 - 1.5 mm (0.0512 - 0.0590 in.)
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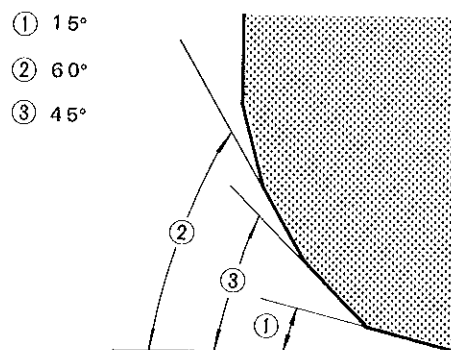


Fig. 4-68 Valve seat angles for inlet valve seat

3) VALVE LAPPING: Lap the valve on the seat in two steps, first with a coarsesize lapping compound applied to the face and the second with a fine-size compound, each time using a valve lapper according to the usual lapping method.



Fig. 4-69 Applying lapping compound to valve face

NOTES:

- After lapping, wipe the compound off the valve face and seat, and produce a contact pattern with a red-lead paste. Check to be sure that the contact is centered widthwise on the valve seat and that there is no break in the contact pattern ring.
- Be sure to check and, as necessary, adjust the valve clearance after re-installing the cylinder head and valve mechanism.

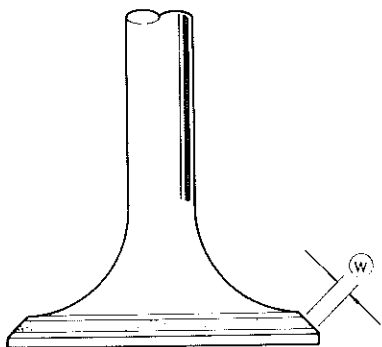


Fig. 4-70 Contact pattern (W) uniform in width

Valve springs

- Referring to the criterion data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can be the cause of chatter, not to mention the possibility of reducing the power output due to gas leakage caused by decreased seating pressure.

Item	Standard	Limit
Valve spring free length	47.7 mm (1.8779 in.)	46.5 mm (1.8307 in.)
Valve spring preload	26 - 30 kg for 40 mm (57.3 - 66.1 lb/ 1.57 in.)	24 kg for 40 mm (52.9 lb/ 1.57 in.)

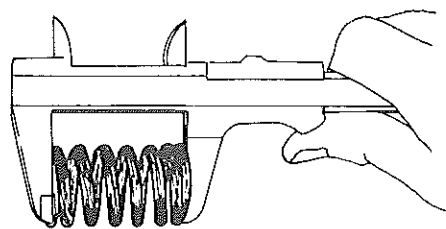


Fig. 4-71 Measuring free length of spring

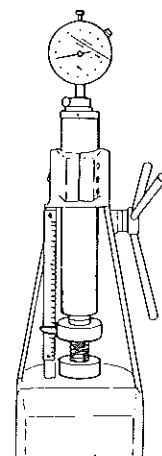


Fig. 4-72 Checking the spring for preload

- Spring squareness:
Use a square and surface plate to check each spring for squareness in terms of the clearance ①, Fig. 4-73, between the end of valve spring and the square. Valve springs found to exhibit a larger clearance than the limit must be replaced.

Valve spring squareness ①	2.0 mm (0.079 in.)
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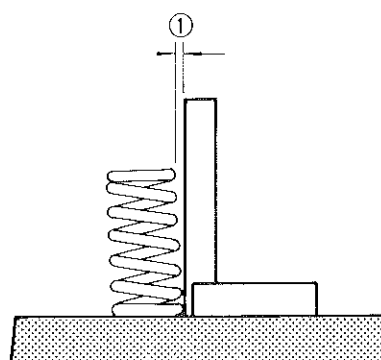


Fig. 4-73

Camshaft

A noisy engine or an engine producing not enough power is frequently due to its camshaft excessively worn or bent or bowed. The wear could occur on its cams and journals.

● Camshaft deflection:

Hold the camshaft between two center points, as shown in Fig. 4-74, with a dial gauge rigged up to measure its deflection. Replace the camshaft if the amount of deflection so measured exceeds the limit.

Camshaft deflection limit	0.10 mm (0.0039 in.)
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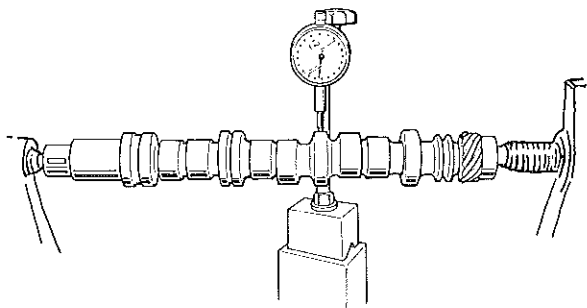


Fig. 4-74

● Cam wear:

Measure the height \oplus of each cam. If any of the micrometer readings taken is down to or less than the limit, replace the camshaft.

Cam height \oplus	Standard	Limit
Inlet cam	36.152 mm (1.4233 in.)	36.100 mm (1.4212 in.)
Exhaust cam	36.152 mm (1.4233 in.)	36.100 mm (1.4212 in.)
Pump drive cam	33.300 mm (1.3110 in.)	33.000 mm (1.2992 in.)

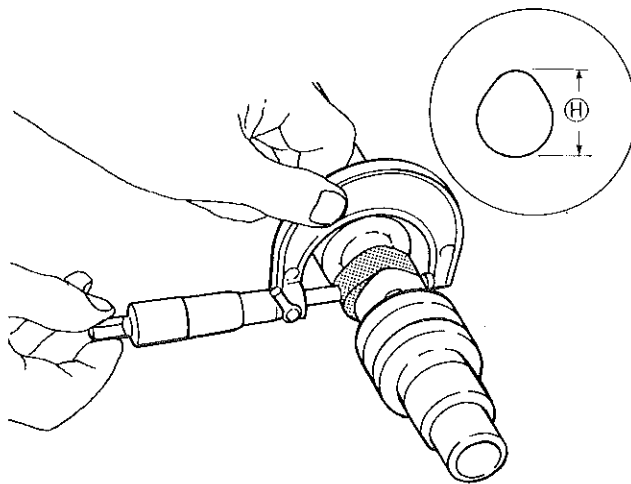


Fig. 4-75

● Thrust clearance:

Using a thickness gauge, measure this clearance as shown in Fig. 4-76, at the thrust plate. If the limit is exceeded, replace thrust plate or camshaft.

Item	Standard	Limit
Thrust clearance	0.050 - 0.150 mm (0.0020 - 0.0059 in.)	0.300 mm (0.0118 in.)

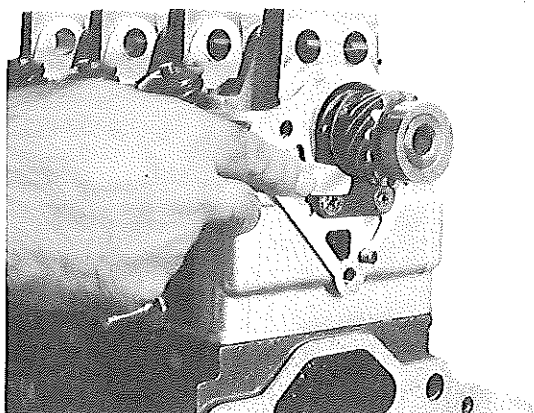


Fig. 4-76

- **Journal wear:**

Measure the journal diameter in two directions at four places to obtain four readings on each journal; and check the journal bores with a cylinder gauge, as shown in Fig. 4-78, producing four readings on each. From these readings, compute the radial clearance (camshaft journal clearance). If the service limit is exceeded by any of the computed radial clearances, replace the camshaft and, as necessary, cylinder head, too.

Item	Standard	Limit
Journal clearance	0.050 - 0.091 mm (0.0020 - 0.0036 in.)	0.15 mm (0.0059 in.)

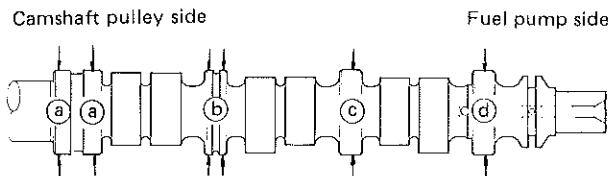


Fig. 4-77

	Camshaft journal dia.	Journal bore dia.
(a)	43.425 - 43.450 mm (1.7096 - 1.7106 in)	43.500 - 43.516 mm (1.7126 - 1.7132 in)
(b)	43.625 - 43.650 mm (1.7175 - 1.7185 in)	43.700 - 43.716 mm (1.7205 - 1.7210 in)
(c)	43.825 - 43.850 mm (1.7254 - 1.7264 in)	43.900 - 43.916 mm (1.7283 - 1.7289 in)
(d)	44.025 - 44.050 mm (1.7332 - 1.7342 in)	44.100 - 44.116 mm (1.7362 - 1.7368 in)

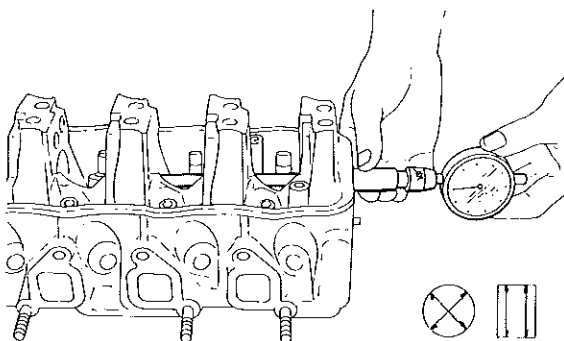


Fig. 4-78

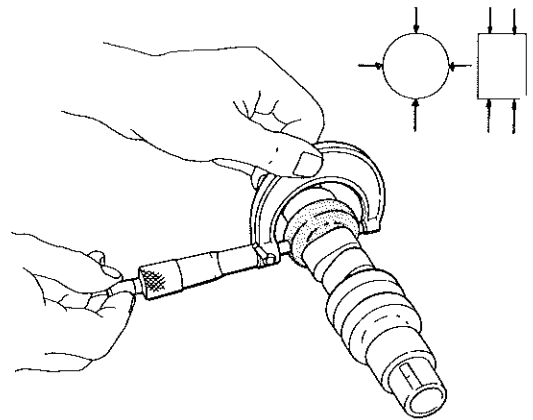


Fig. 4-79

Cylinder block

- **Flatness of gasketed surface:**

By the same method that is prescribed for checking the flatness of the gasketed surface of the cylinder head, check the top face of the cylinder block for flatness and, if the flatness is found to exceed the limit, machine the face with a surface grinder.

Limit on flatness	0.05 mm(0.0020 in.)
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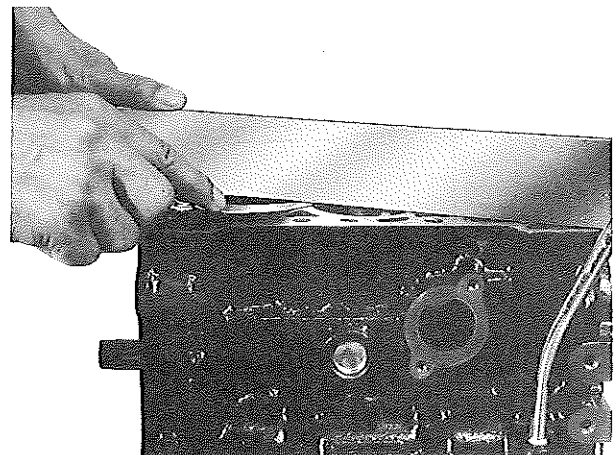


Fig. 4-80

- **Cylinder bore:**

Using a cylinder bore gauge, measure the diameter of each bore in two directions, longitudinal and transverse, at three places, top, middle and bottom, as indicated in Fig. 4-81, to obtain a total of 6 readings. On the basis of these readings taken on each bore, determine whether the maximum difference in diameter between any two bores exceeds the limit. If the limit, stated below, is exceeded or if the

bore wall is badly scored or burned, re-bore all cylinders to the next oversize and use oversize pistons in engine reassembly.

Piston oversize	0.25 mm (0.0098 in.)
	0.50 mm (0.0196 in.)

CAUTION:

If any one of the three cylinders has to be re-bored, re-bore the three to the same next oversize. This is necessary for the sake of uniformity and balance.

When replacing the pistons or installing oversize pistons, be sure that the piston-to-cylinder clearance comes within the stated range:

Wear limit on bore	0.05 mm (0.0020 in.)
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Piston-to-cylinder clearance	0.045 ~ 0.055 mm (0.0018 ~ 0.0022 in.)
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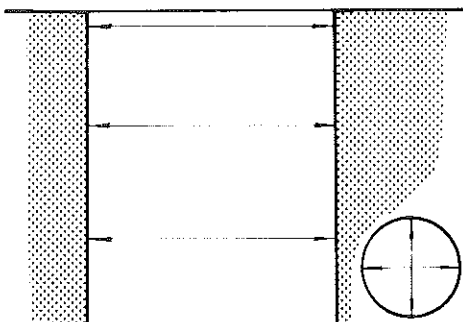


Fig. 4-81

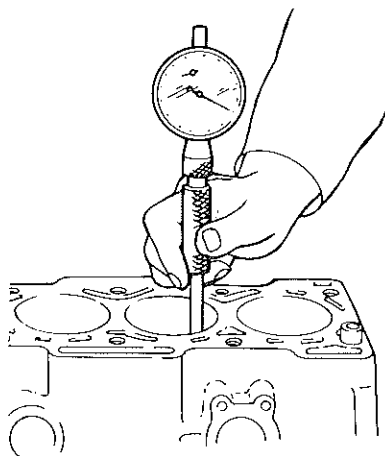


Fig. 4-82

Piston and piston rings

● **Piston diameter:**

Piston-to-cylinder clearance, mentioned above, is equal to the bore diameter minus the piston diameter, which is to be measured by measuring at the level of the piston in the direction transverse to piston pin axis, as shown in Fig. 4-83. This level \oplus from the skirt end is 30 mm (1.18 in.) high.

Piston diameter	Standard	68.450 - 68.475 mm (2.6949 - 2.6959 in.)
	Oversize: 0.25 mm (0.0098 in.)	68.700 - 68.725 mm (2.7047 - 2.7057 in.)
	0.50 mm (0.0196 in.)	68.950 - 68.975 mm (2.7146 - 2.7155 in.)

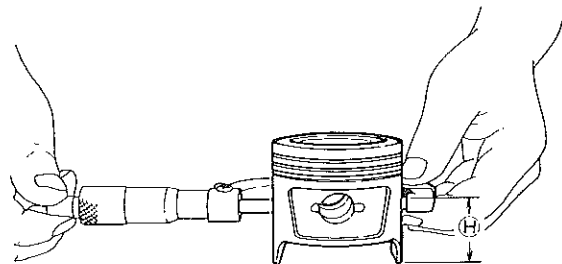


Fig. 4-83

- Inspect the outer surface of each cylinder for evidence of burn and for scratch or groove marks. Minor flaws can be removed by grinding with fine-grain sandpaper.
- De-carbon the piston crown and ring grooves, using a soft-metal scraping tool.

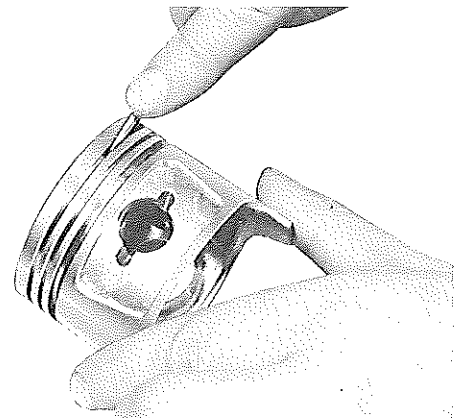


Fig. 4-84

● Ring clearance in the groove:

Using a thickness gauge, check each piston ring in its groove for side clearance and, if the limit stated below is exceeded, measure the groove width and ring width to determine whether the piston or the ring or both have to be replaced.

Item		Standard	Limit
Ring clearance in the groove	Top ring	0.03 - 0.07 mm (0.0012 - 0.0027 in.)	0.12 mm (0.0047 in.)
	2nd ring	0.02 - 0.06 mm (0.0008 - 0.0023 in.)	0.10 mm (0.0039 in.)

Piston ring thickness	Top ring	1.47 - 1.49 mm (0.0578 - 0.0586 in.)
	2nd ring	1.47 - 1.49 mm (0.0578 - 0.0586 in.)
	Oil ring	0.45 mm (0.0177 in.)
Ring groove width	Top ring	1.52 - 1.54 mm (0.0598 - 0.0606 in.)
	2nd ring	1.51 - 1.53 mm (0.0594 - 0.0602 in.)
	Oil ring	2.81 - 2.83 mm (0.1106 - 0.1114 in.)

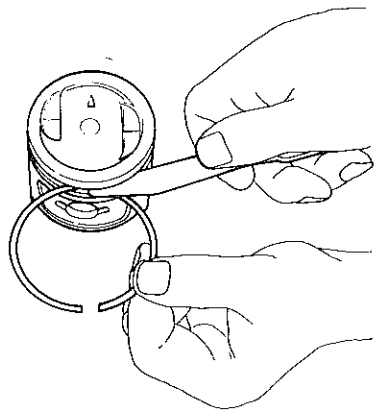


Fig. 4-85

● Piston ring end gap:

To measure the end gap, insert the piston ring into the cylinder bore, locating it at the lowest part of the bore and holding it true and square; then use a thickness gauge to measure the gap. If the gap measured exceeds the limit, replace the ring.

Item		Standard	Limit
Piston ring end gap	Top ring	0.15 - 0.35 mm (0.0059 - 0.0137 in.)	0.7 mm (0.0275 in.)
	2nd ring	0.10 - 0.30 mm (0.0039 - 0.0118 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.30 - 0.90 mm (0.0118 - 0.0354 in.)	1.8 mm (0.0708 in.)

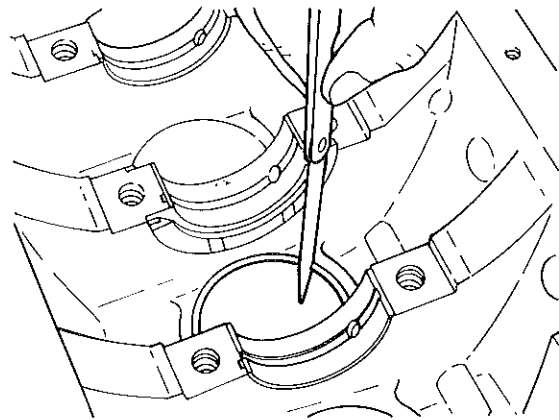


Fig. 4-86

Connecting rods

● Big-end thrust clearance:

Check the big end of each connecting rod for thrust clearance, with the rod fitted and connected to its crank pin in the normal manner. If the clearance measured is found to exceed the limit, the connecting rod or the crankshaft, whichever is responsible for the excessive clearance, must be replaced.

Item	Standard	Limit
Big-end thrust clearance	0.10 - 0.20 mm (0.0039 - 0.0078 in.)	0.30 mm (0.0118 in.)
① Width of big end	21.95 - 22.00 mm (0.864 - 0.866 in.)	
② Width of crank pin	22.10 - 22.15 mm (0.870 - 0.872 in.)	

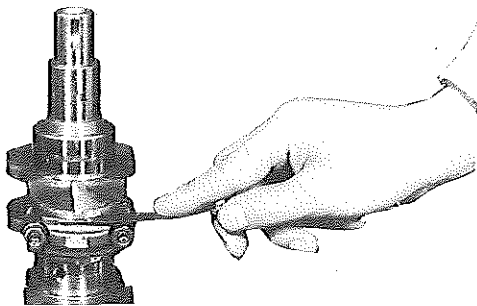
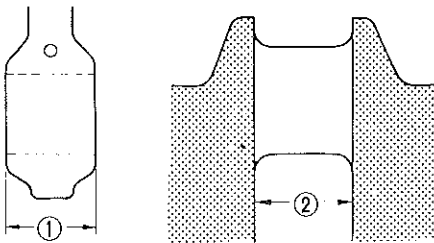


Fig. 4-87

● Connecting rod alignment:

Mount the connecting rod on the aligner to check it for bow and twist and, if the limit is exceeded, replace it.

Limit on bow	0.05 mm (0.0020 in.)
Limit on twist	0.10 mm (0.0039 in.)

- Inspect the small end of each connecting rod for wear and evidence of crack or any other damage, paying particular attention to the condition of its bush. Check the piston pin clearance in the small end. Replace the connecting rod if its small end is badly worn or damaged or if the clearance checked exceeds the limit.

Item	Standard	Limit
Pin clearance in small end	0.003 - 0.016 mm (0.0001 - 0.0006 in.)	0.05 mm (0.0020 in.)

Small-end I.D.	16.003 - 16.011 mm (0.6300 - 0.6303 in.)
Piston pin dia.	15.995 - 16.000 mm (0.6297 - 0.6299 in.)

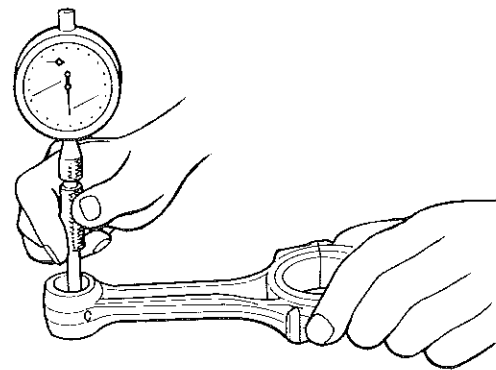


Fig. 4-88

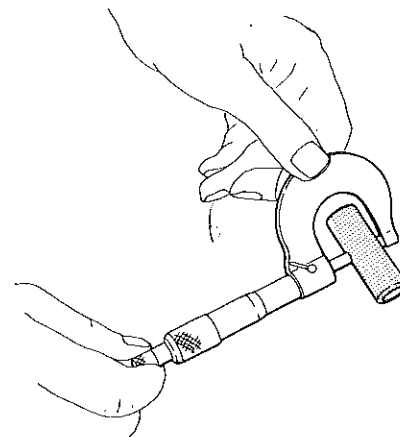


Fig. 4-89

Connecting-rod big end bearings

- Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Bearings found in defective condition through this inspection must be replaced.

CAUTION:

Bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining. The remedy is to replace them.

- Crankpin-to-bearing clearance:
Check this clearance by using fuse stock or, preferably, PLASTIGAGE. Here's how to use PLASTIGAGE:
1) Prepare, by cutting, a length of PLASTIGAGE roughly equal to bearing width and place it axially on crankpin, avoiding the oil hole.
2) Make up the big end in the normal manner, with bearing shells in place and by tightening the cap to the specification.

NOTE:

Never rotate crankshaft or turn connecting rod when a piece of PLASTIGAGE is in the radial clearance.

Bearing cap tightening torque	28 - 32 N.m 2.80 - 3.20 kg-m (20.5 - 23.0 lb-ft)
-------------------------------	--

NOTE:

When fitting bearing cap to crankpin, be sure to discriminate between its two ends, right and left.

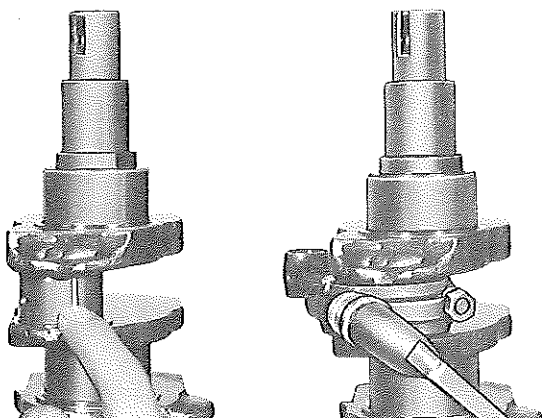


Fig. 4-90

- 3) Remove the cap, and measure the width of flattened PLASTIGAGE piece with the PLASTIGAGE envelope scale. This measurement must be taken at the widest part.

Item	Standard	Limit
Crankpin-to-bearing clearance	0.020 - 0.040 mm (0.0008 - 0.0016 in.)	0.080 mm (0.0031 in.)

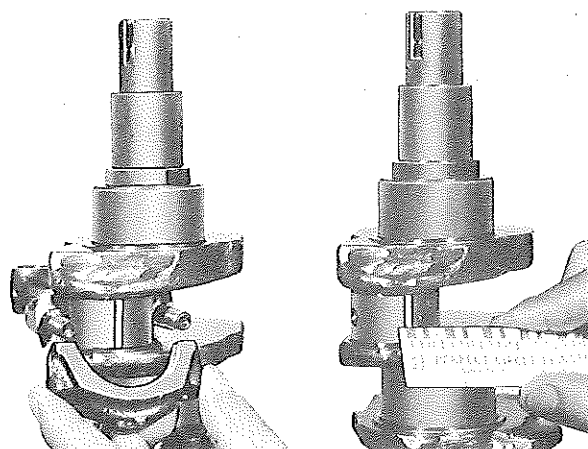


Fig. 4-91

- 4) If the limit, indicated above, is exceeded, re-grind the crankpin to the undersize and use the undersize bearing, both of which are stated below:

Bearing size	Crankpin diameter
Standard	37.985 - 38.000 mm (1.4954 - 1.4960 in.)
0.25 mm (0.0098 in.) undersize	37.735 - 37.750 mm (1.4856 - 1.4862 in.)
0.50 mm (0.0196 in.) undersize	37.485 - 37.500 mm (1.4760 - 1.4763 in.)

Where undersize bearings are used, the clearance specification is slightly lenient:

Radial clearance for undersize bearing	0.020 - 0.070 mm (0.0008 - 0.0027 in.)
--	---

Crankshaft

● Deflection:

Check the crankshaft for deflection, as shown in Fig. 4-92, and if the dial gauge reading exceeds the limit, repair or replace the crankshaft.

Limit on crankshaft deflection	0.06 mm (0.0023 in.)
--------------------------------	-------------------------

NOTE:

Measure the deflection at the center journal.
Rotate the crankshaft slowly.

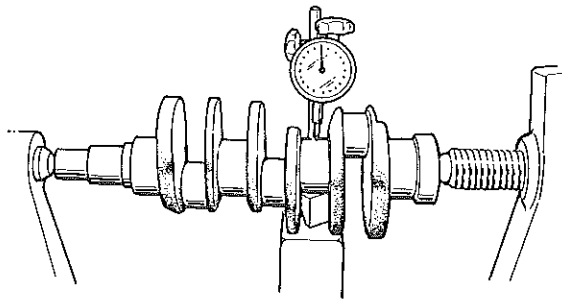


Fig. 4-92

● Crankshaft thrust play:

Measure this play with crankshaft set in the cylinder block in the normal manner, that is, with the thrust bearing fitted and the bearing caps installed. Use a dial gauge to read the displacement in axial (thrust) direction of the crankshaft. If the limit is exceeded, replace the existing thrust bearing by the oversize one.

Item	Standard	Limit
Crankshaft thrust play	0.13 - 0.28 mm (0.0051 - 0.0110 in.)	0.35 mm (0.0138 in.)

Thickness of crankshaft thrust bearing	Standard	2.500 mm (0.0984 in.)
	Oversize 0.125 mm (0.0049 in.)	2.563 mm (0.1009 in.)
	Oversize 0.250 mm (0.0098 in.)	2.625 mm (0.1033 in.)

Tightening torque for cap bolts	43 ~ 48 N.m 4.3 ~ 4.8 kg-m (31.5 ~ 34.5 lb-ft)
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Tightening torque for the bolts securing the bearing caps is specified.

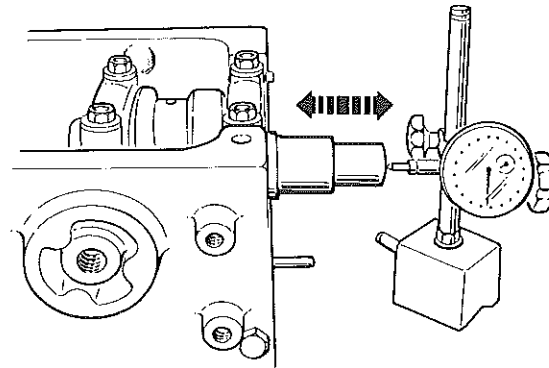


Fig. 4-93

● Out-of-round and taper (uneven wear):

An unevenly worn crankshaft journal or crankpin shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is to be determined from micrometer readings taken as shown in Fig. 4-94.

If any of the journals or crankpins is badly damaged or if the amount of uneven wear in the sense explained above exceeds the limit, repair (by re-grinding) or replace the crankshaft.

Limit on uneven wear	0.01 mm (0.0004 in.)
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NOTE:

Where journal or crankpin re-grinding is necessary, finish the diameter to the size necessary for the undersize bearing. (Refer to page 4-31)

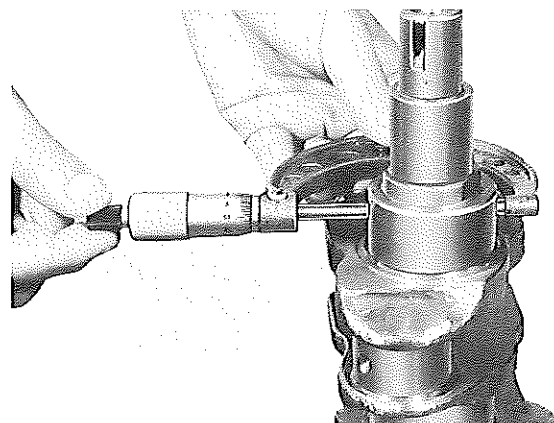


Fig. 4-94

Crankshaft journal bearings

- Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Defective shells must be replaced.

CAUTION:

As in the case of connecting-rod bearings, the journal bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining.

- Journal-to-bearing clearance:

Check this clearance by using fuse stock or, preferably, PLASTIGAGE. The following method is based on the use of PLASTIGAGE:

- 1) Cut the PLASTIGAGE stock to the required length (equal to the width of the bearing), and place it axially on the journal, avoiding the oil hole.
- 2) Mount the crankshaft in the usual manner, tightening the bearing caps to the specified torque value. (It is assumed that a PLASTIGAGE piece is pinched at each journal.)
Do not rotate the crankshaft when PLASTIGAGE is in.

Tightening torque
for cap bolts

43 ~ 48 N.m
4.3 ~ 4.8 kg-m
(31.5 ~ 34.5 lb-ft)

CAUTION:

Each of the four bearing caps has an arrow marked on it. Be sure to position each cap with its arrow pointing to crankshaft pulley side and to match it (by the cylinder number) to its journal. Remember, the three cylinders are numbered, 1, 2 and 3, as counted from crankshaft pulley side. See Fig. 4-95.

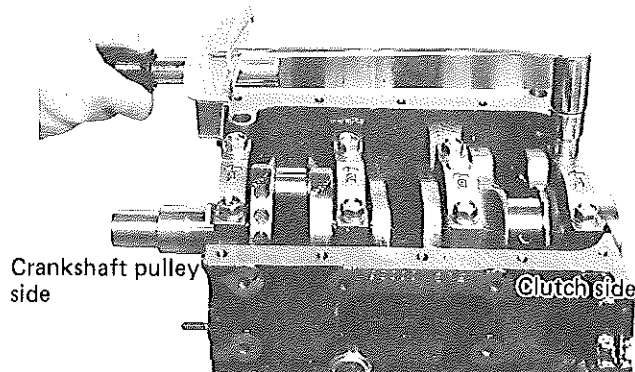


Fig. 4-95

- 3) Remove the caps and take out the PLASTIGAGE pieces, which are now flattened. By referring to the envelop scale, measure the width of the widest part of the piece, and determine whether the radial clearance checked (obtained from the PLASTIGAGE piece) is within the limit.

Item	Standard	Limit
Journal-to-bearing clearance	0.020 - 0.040 mm (0.0008 - 0.0016 in.)	0.08 mm (0.0032 in.)

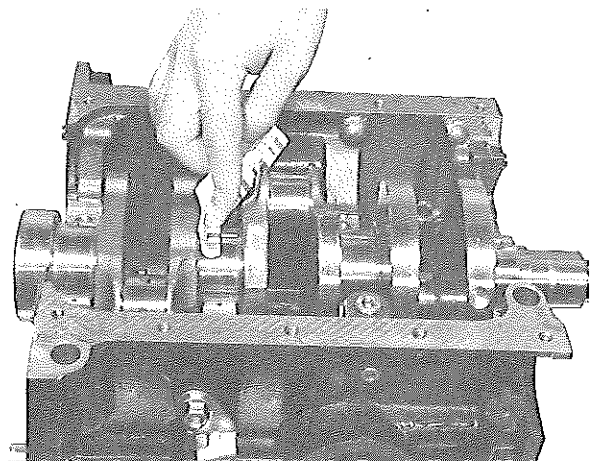


Fig. 4-96

- 4) If the limit is exceeded, re-grind the journals to the undersize and use the undersize bearing.

Bearing size	Journal diameter
Standard	49.985 - 50.000 mm (1.9679 - 1.9685 in.)
0.25-mm undersize (0.0098 in)	49.735 - 49.750 mm (1.9580 - 1.9586 in.)
0.50 mm undersize (0.0196 in)	49.485 - 49.500 mm (1.9482 - 1.9488 in.)

Radial clearance for undersize bearing	0.020 - 0.070 mm (0.0008 - 0.0027 in.)
--	---

Flywheel

- Inspect the friction surface-the surface in contact with clutch disc-for wear and damage. Most of surface flaws, if any, can be removed by simple machining. A badly damaged flywheel must be replaced.
- Face runout:
Check the flywheel for face runout with a dial gauge, as shown in Fig. 4-97. Be sure that the runout is within the limit.

Limit on runout	0.2 mm (0.0078 in.)
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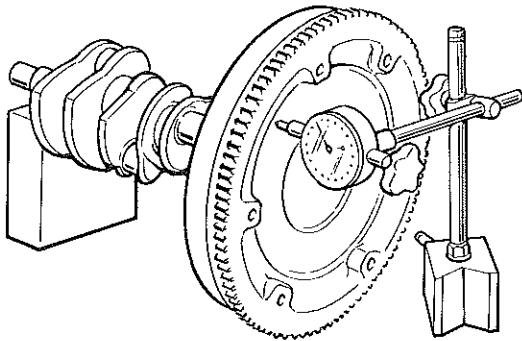


Fig. 4-97

- Ring gear tooth wear:
Inspect the teeth for wear and for evidence of crack, chipping or any other damage. Replace the ring gear if its teeth are found in bad condition.

Oil seals

Carefully inspect the oil seals removed in disassembly, examining the lip portion ① of each oil seal for wear and damage. Use of new oil seals in reassembly is recommended.

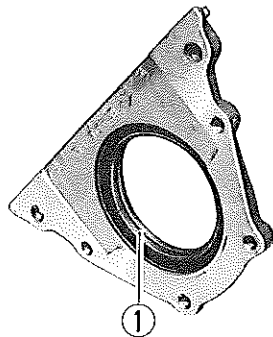


Fig. 4-98

Timing belt and timing pulleys

Inspect the belt and pulleys for wear, cracks and signs of failure. Replace them as necessary.

CAUTION:

- Do not bend the belt. Keep away oil and water from the belt. The belt must be kept clean.
- The pulleys and belt tensioner, too, must be kept clean and free of oil and water.

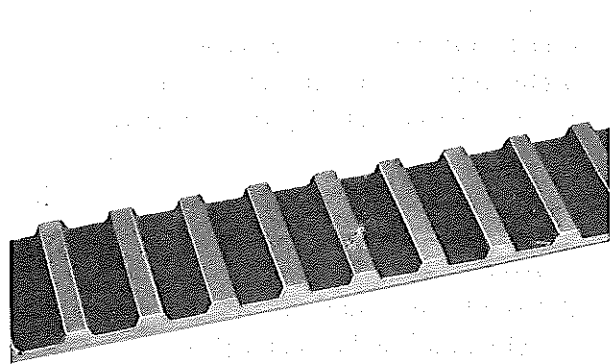


Fig. 4-99

4-6. Engine Reassembly

NOTE:

- All parts to be used in reassembly must be perfectly clean.
- Oil the sliding and rubbing surfaces of engine parts just before using them in reassembly. Use engine oil (Refer to page 1-14).
- Have the liquid packing ready for use. SUZUKI BOND No.4 is specified for the liquid. Use it wherever its use is specified in order to ensure leak-free (oil and water) workmanship of reassembly.
- There are many running clearances. During the course of engine reassembly, be sure to check these clearances, one after another, as they form.
- Gaskets, "O" rings and similar sealing members must be in perfect condition. For these members, use replacement parts in stock.
- Tightening torque is specified for important fasteners-bolts and nuts in the main of the engine and other components. Use torque wrenches and constantly refer to the specified values given in the text of this manual. The list immediately following is such specifications.
- Do not disregard the match marks provided on parts. Some of them are those given at the time of disassembly.
- There are many sets of parts. Crankshaft bearings, connecting rods, pistons, etc., are in combination sets. Do not disturb the combinations and try to see that each part goes back to where it came from.

Tightening torque data

This is a list-up of important tightening jobs identified by parts to be secured:

What to tighten	N.m	Kg-m	lb-ft
Crankshaft bearing cap bolt	43 - 48	4.3 - 4.8	31.5 - 34.5
Connecting-rod bearing nut	28 - 32	2.8 - 3.2	20.5 - 23.0
Crankshaft pulley bolt	50 - 60	5.0 - 6.0	36.5 - 43.0
Flywheel bolt	40 - 45	4.0 - 4.5	29.0 - 32.5
Cylinder head bolt	55 - 60	5.5 - 6.0	40.0 - 43.0
Spark plug	20 - 30	2.0 - 3.0	14.5 - 21.5
Camshaft pulley bolt	50 - 60	5.0 - 6.0	36.5 - 43.0
Valve adjusting nut	15 - 20	1.5 - 2.0	11.0 - 14.0

What to tighten	N.m	kg-m	lb-ft
Oil drain plug	20 - 25	2.0 - 2.5	14.5 - 18.0
Oil pan securing bolt	4 - 5	0.4 - 0.5	3.0 - 3.5
Oil filter	10 - 15	1.0 - 1.5	7.5 - 10.5
Oil filter stand	20 - 25	2.0 - 2.5	14.5 - 18.0
Oil pressure unit	12 - 15	1.2 - 1.5	9.0 - 10.5
Timing belt cover bolt	3 - 4	0.3 - 0.4	2.5
Cylinder head cover bolt	4 - 5	0.4 - 0.5	3.0 - 3.5
Rocker arm shaft screw	9 - 12	0.9 - 1.2	7.0 - 8.5
Camshaft thrust plate screw	9 - 12	0.9 - 1.2	7.0 - 8.5

Engine reassembly is the reverse of engine disassembly as far as sequence is concerned, but there are many reassembling steps that involve measures necessary for restoring the engine as close to the factory-assembled condition as possible. Only those steps will be dealt with.

Crankshaft

Be sure to oil crankshaft journal bearings as shown.

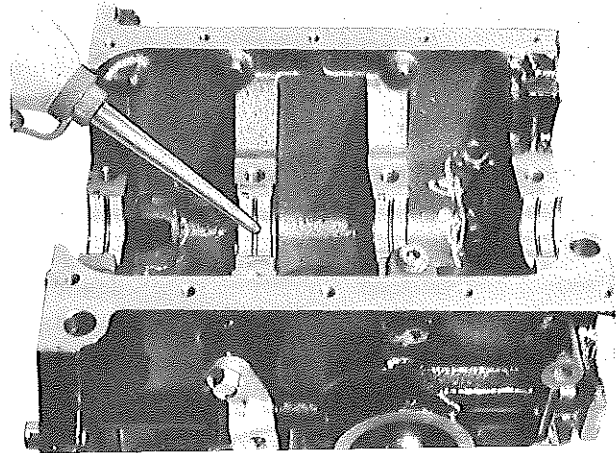


Fig. 4-100

Thrust bearings for the crankshaft are an item prone to escape the serviceman's attention: be careful not to leave them out. These bearings go into place with their oil groove side facing the crank web.

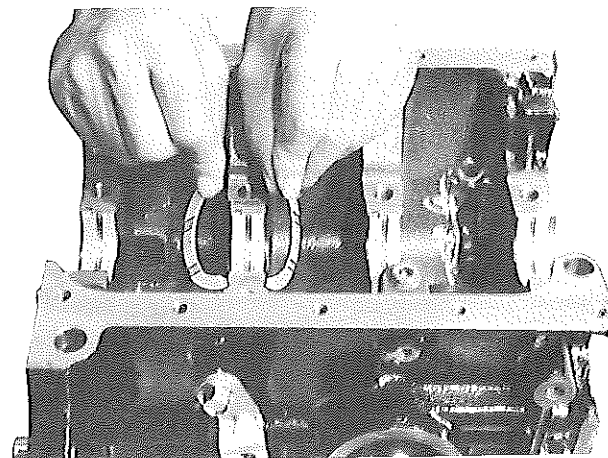


Fig. 4-101

Be sure to oil crankshaft journals as shown.

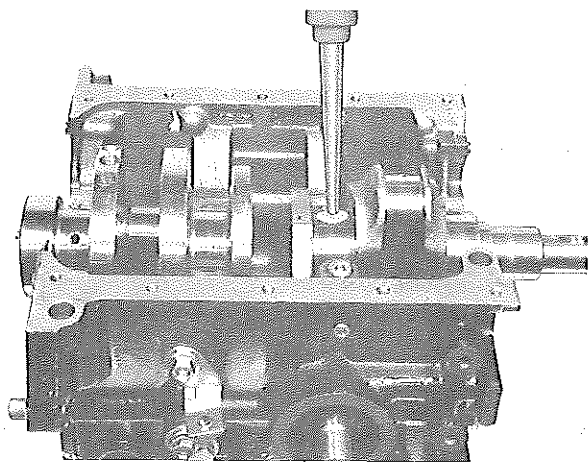


Fig. 4-102

When fitting crankshaft bearing caps to journals after setting the crankshaft in place, be sure to point the arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in the ascending order, 1, 2, 3 and 4, starting from pulley side.

Tightening torque for bearing cap bolts	43 ~ 48 N.m 4.3 ~ 4.8 kg-m (31.5 ~ 34.5 lb-ft)
--	--

Gradual and uniform tightening is important for bearing cap bolts. Make sure that the four caps become tight equally and uniformly progressively to the stated torque value.

NOTE:

After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turned over by hand.

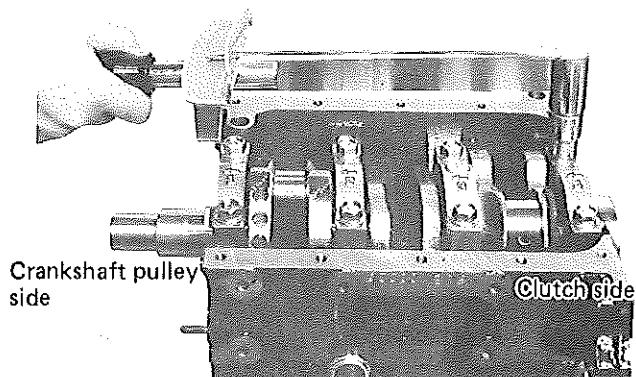


Fig. 4-103

Oil seal housing

This housing demands a new gasket: do not re-use the gasket removed in disassembly. After bolting the housing to the block, the gasket edges might bulge out; if so, cut off the edges to make the joint seam flat and smooth: use a sharp knife. After cutting, apply SUZUKI BOND No.4, as shown.

NOTE:

Just before mounting the housing, oil the lip portion of the oil seal.

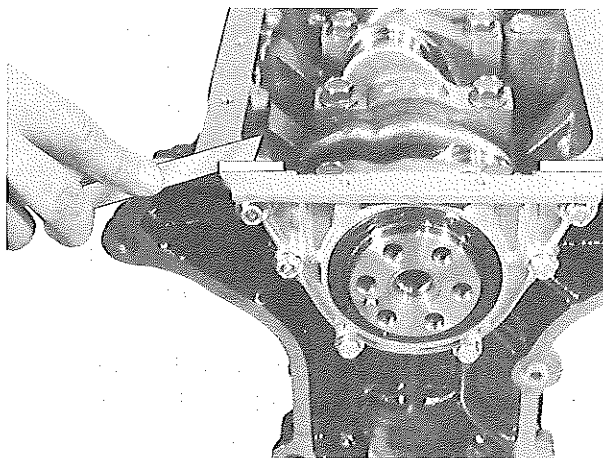


Fig. 4-104

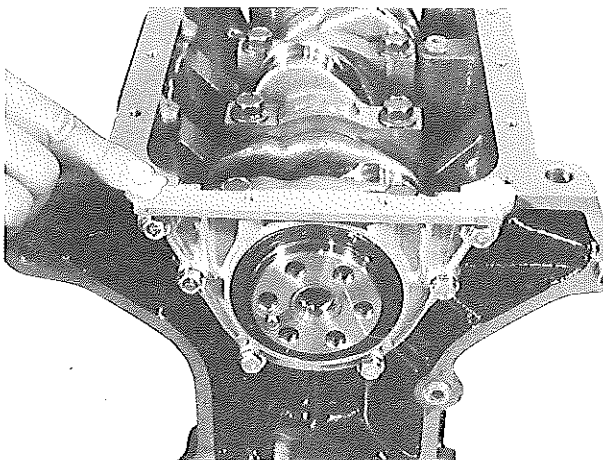


Fig. 4-105

Oil pump

The gasket for oil pump case must be new. As in the case of oil seal housing, cut off the gasket edges with a knife to smoothen the joint seam.

NOTE:

Before fitting the pump case, oil the oil seal lip, and apply SUZUKI BOND NO.4 (Parts NO. 99000-31030) on the mating surfaces around the oil discharging port of both the oil pump case and the cylinder block.

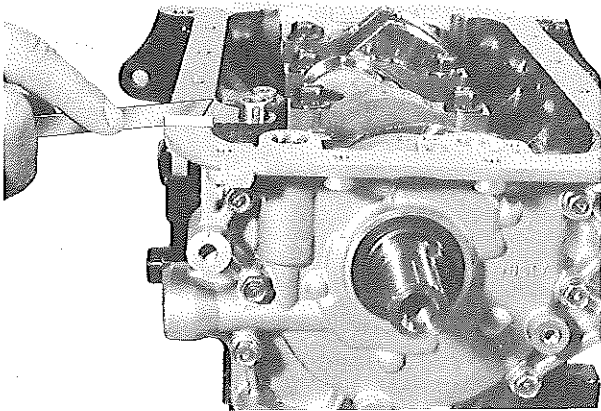


Fig. 4-106

After cutting the gasket edges, apply SUZUKI BOND No. 4.

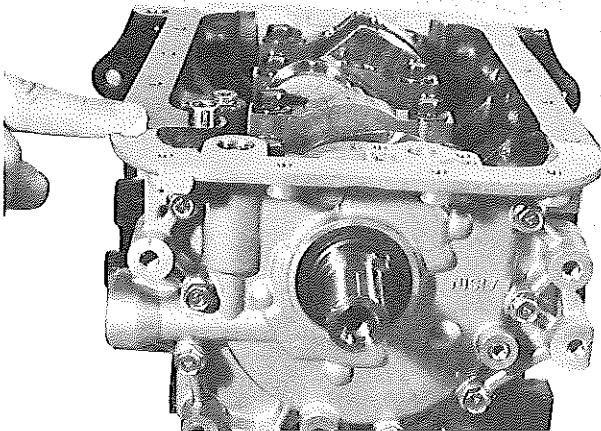


Fig. 4-107

Piston and piston rings

POSITION OF PISTON RELATIVE TO CONNECTING ROD: The arrow ① on the crown points to crankshaft pulley side, and the oil hole ② comes on inlet port side. See Fig. 4-108.

NOTE:

Before pinning piston to connecting rod, oil the small end and pin holes.

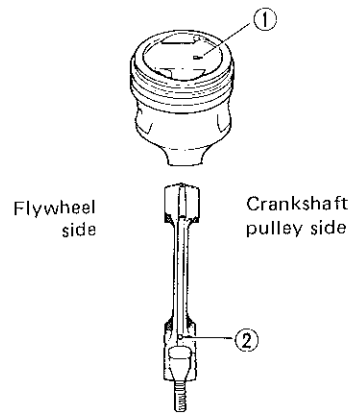


Fig. 4-108

Before fitting rings to piston, check to be sure that first ring has RN mark and second ring R mark. After mounting the three rings, distribute their end gaps as illustrated in Fig. 4-109. Remember, the marked side of each ring (1st and 2nd) comes on top side.

NOTE:

After fitting the rings, oil them in the grooves.

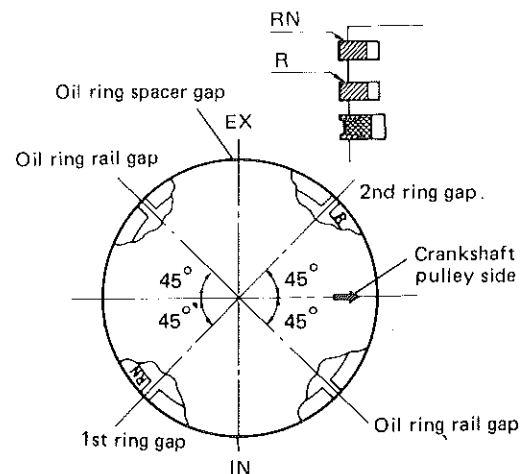


Fig. 4-109

After covering the connecting rod bolts with plastic or rubber pipes as shown in Fig. 4-110, use of the piston ring compressor **A** (09916-77310), Fig. 4-110-1, is mandatory in inserting pistons into cylinder block. Using this compressor **A**, feed the piston and connecting rod combination into the bore from the upper side of cylinder block.

Pay attention to these reminders:

- Point the piston crown arrow to pulley side.
- Be sure that the number (marked on the crown at the time of disassembly) tallies with the cylinder number.
- Liberally oil the big-end bearings before fitting them to crankpins.
- Oil the bore just before feeding in the piston.

CAUTION:

When inserting the piston and connecting rod combination into the cylinder bore, care must be taken to ensure the big end section of the connecting rod and the connecting rod bolts do not contact the cylinder wall nor the crankshaft journal, otherwise damage can occur.

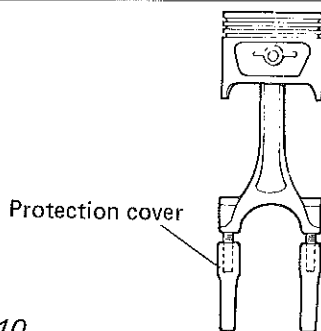


Fig. 4-110

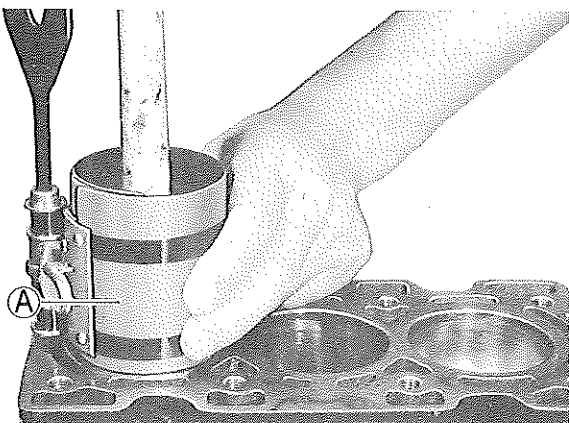


Fig. 4-110-1

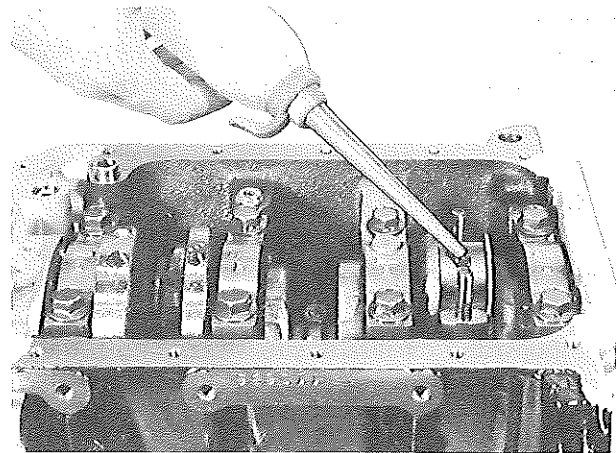


Fig. 4-111

Connecting rods

Two stoppers **①** **②**, Fig. 4-113 determine the position of each big-end bearing cap relative to the big end. At the time of installing these caps, be sure to locate stopper **①** of cap in the direction of stopper **②**.

NOTE:

The two stoppers do not coincide in longitudinal direction: the coincidence is meant in the direction shown in Figs. 4-112 and 4-113.

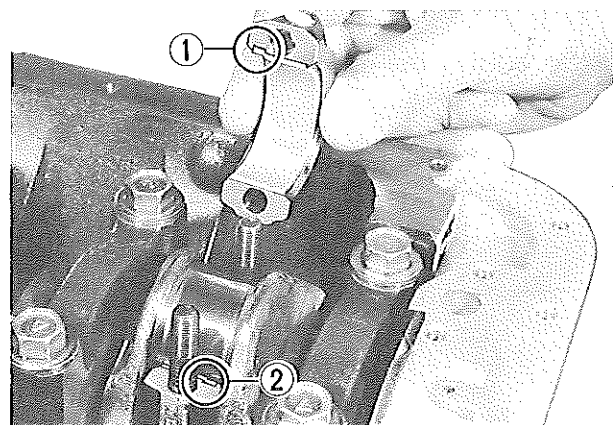


Fig. 4-112

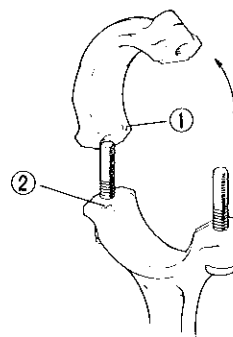


Fig. 4-113

After fitting all three big-end bearing caps, start tightening them uniformly, being sure to equalize tightness between right and left on each cap. The sequence here is similar to that for crankshaft bearing caps.

Tightening torque for big-end caps	28 - 32 N.m 2.8 - 3.2 kg-m (20.5 - 23.0 lb-ft)
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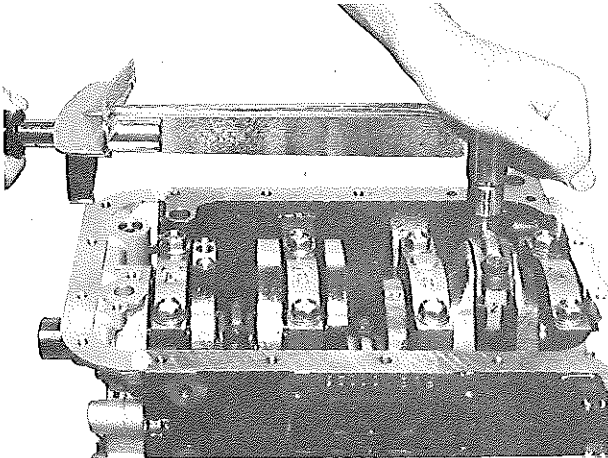


Fig. 4-114

NOTE:

After installing crankshaft and pistons, as above, double-check to be sure that the arrows on piston crowns are all pointing to crankshaft pulley side.

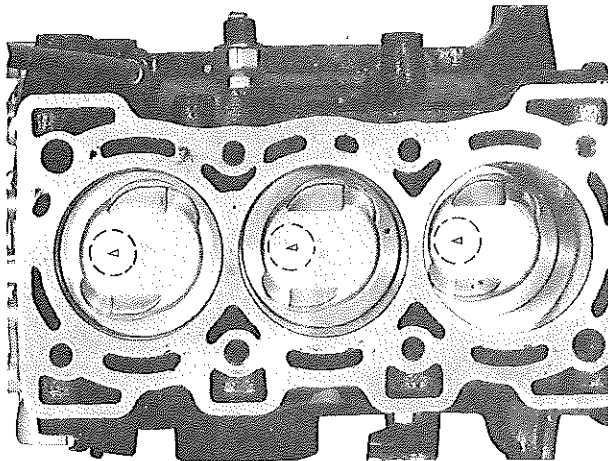


Fig. 4-115

Oil pump strainer

Bear in mind that "O" ring ① is often forgotten and left out in reassembly. Absence of this ring defeats the purpose served by the strainer.

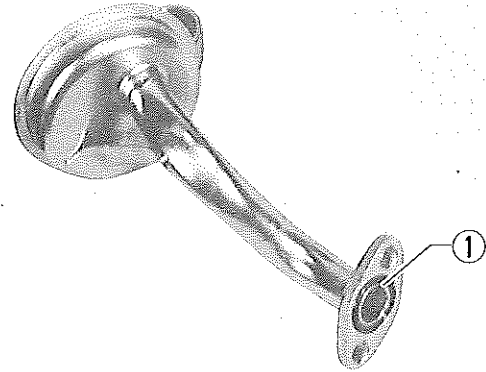


Fig. 4-116

Oil pan

After fitting the oil pan to the block, run in the securing bolts and start tightening at the center: move the wrench outward, tightening one bolt at a time.

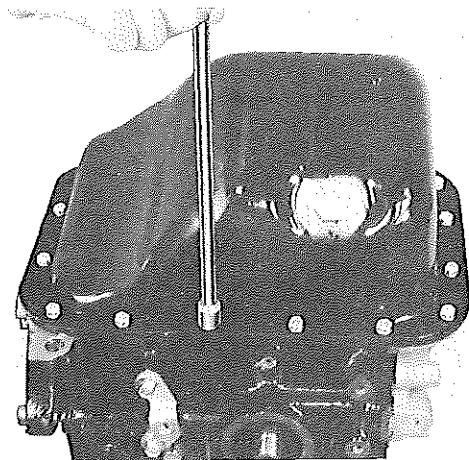


Fig. 4-117

Flywheel

The first step of flywheel installation is to check to be sure that locating pin ① is studded in the crankshaft.

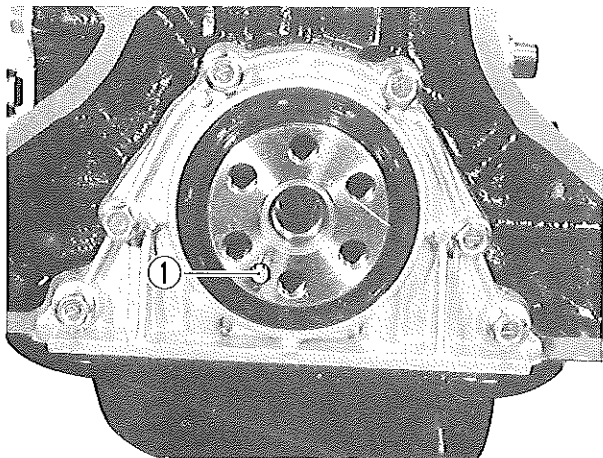


Fig. 4-118

Cylinder head

Oil valve stems before inserting them into guides.

CAUTION:

Be sure to distinguish between inlet valves and exhaust valves. The difference is in diameter and marking. Refer to the embossed marks, shown in Fig. 4-119.

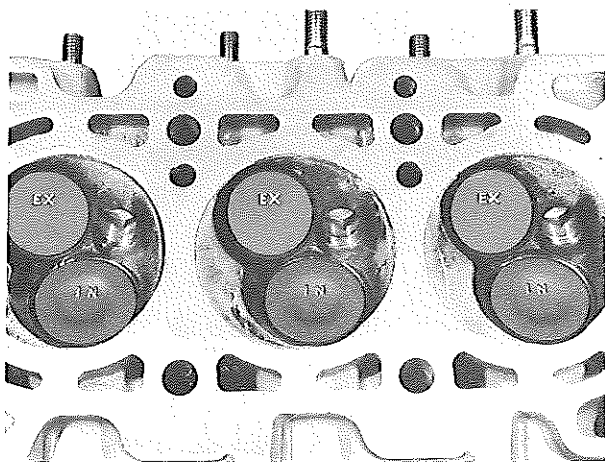


Fig. 4-119

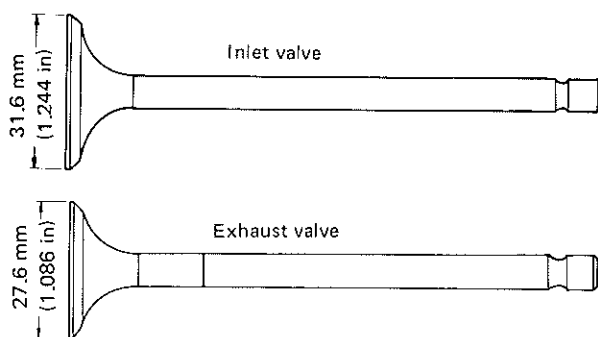


Fig. 4-120

Each valve spring has top end (large-pitch end) and bottom end (small-pitch end). Be sure to position the springs in place so that their bottom ends come on bottom side.

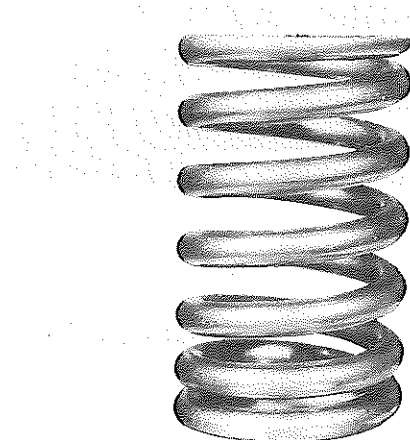


Fig. 4-121

To fit valve cotters to the groove provided on the end portion of each valve stem, be sure to use the valve lifter ① (09916-14510): compress the valve spring with this lifter and mount the cotter pieces, as shown in Fig. 4-122.

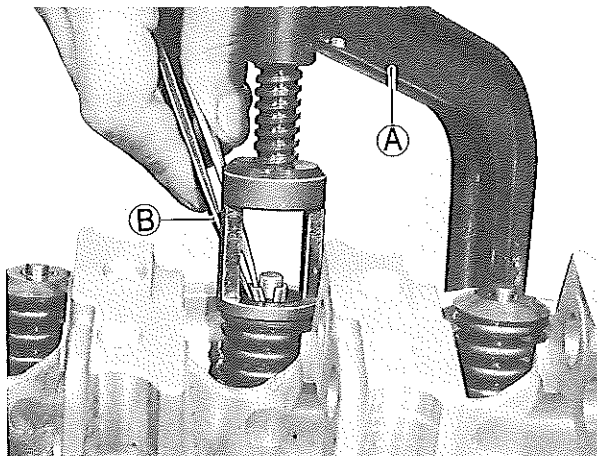


Fig. 4-122 ② Forceps (09916-84510)

At the time of installing the cylinder head, be sure to position the head gasket correctly on the cylinder block. "TOP" mark ①, provided on the gasket, comes on top side, "IN" mark ② comes on inlet manifold side and "EX" mark comes on exhaust side.

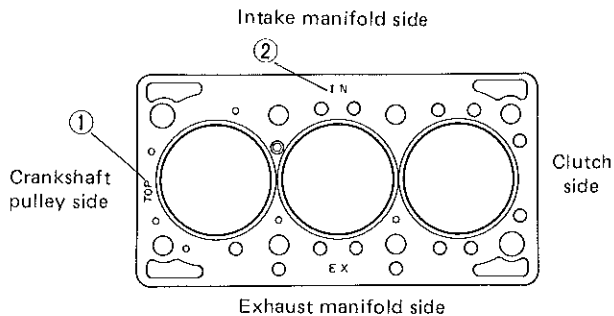


Fig. 4-123

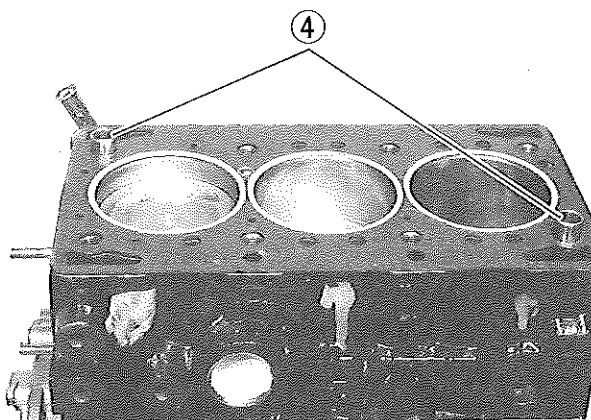


Fig. 4-124 ④ Locating pins

The position the cylinder head takes on the block is but one, which is shown in Fig. 4-125. When placing the head on the block, be sure that it is correctly oriented: the clue is the inlet ports ⑤.

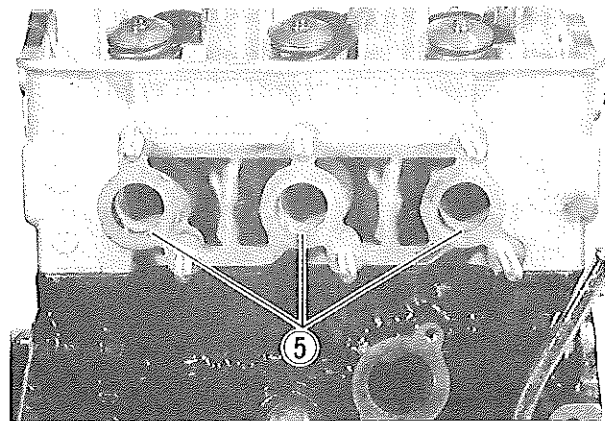


Fig. 4-125

The tightening sequence for cylinder head bolts is indicated in the photo. Tighten the bolts in that sequence to the specified torque value:

Tightening torque for cylinder head bolts	55 - 60 N.m 5.5 - 6.0 kg-m (40.0 - 43.0 lb-ft)
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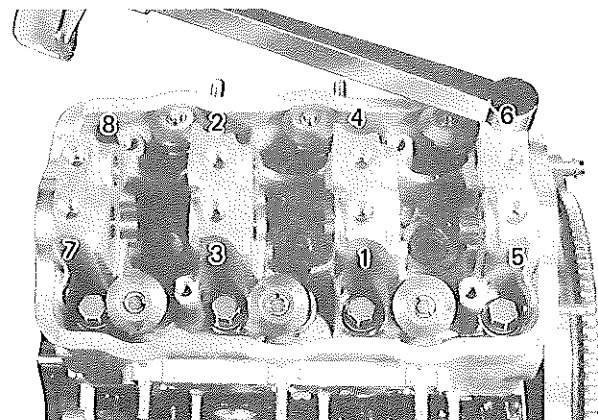


Fig. 4-126

Camshaft

The camshaft goes into cylinder head from distributor gear case side. Before inserting it, be sure to oil its journals.

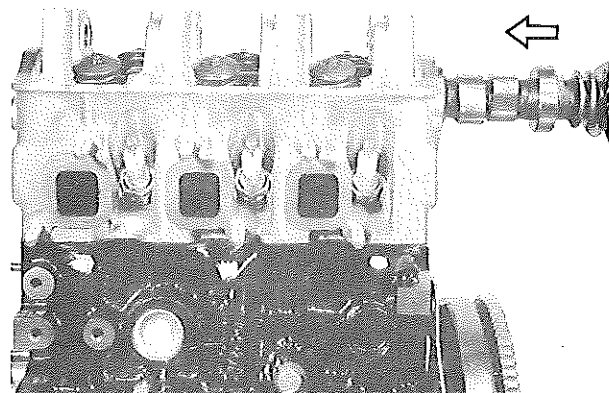


Fig. 4-127

Be careful not to leave out the thrust plate ① when installing the camshaft. After setting this shaft in place, with its thrust plate properly fitted, turn the shaft by hand to be sure it rotates smoothly.

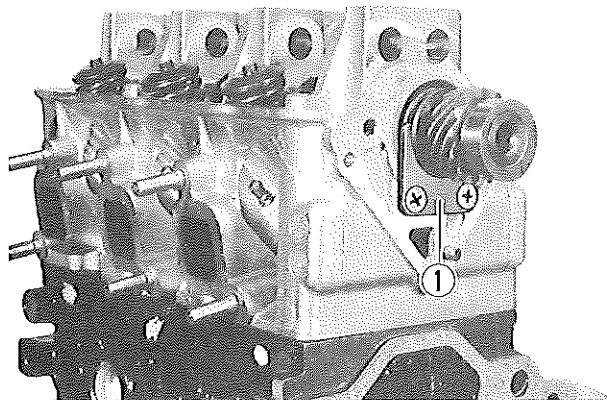


Fig. 4-128

Rocker-arm shafts

CAUTION:

Before installing the rocker-arm shaft on the head, be sure to locate the crankshaft keyway ② in the $50^{\circ} - 70^{\circ}$ angular range, as shown in Fig. 4-129.

This crankshaft position is necessary because, if its keyway is in any other angular position, some valves will touch piston crowns, possibly resulting in damaged valves or piston crowns. Keep crankshaft in that angular position until the job of adjusting the timing belt tension is completed.



Fig. 4-129

The two rocker-arm shafts are identical, there being no need to distinguish between the two. However, each shaft takes but one position in place. See Fig. 4-130.

- On the inlet side, the stepped end ③ comes on camshaft pulley side.
- On the exhaust side, the stepped end ④ comes on flywheel side.

NOTE:

Oil rocker-arm shafts just before installing them.

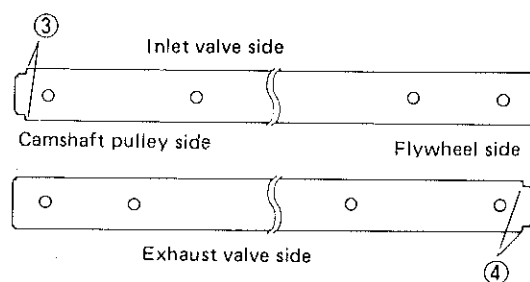


Fig. 4-130

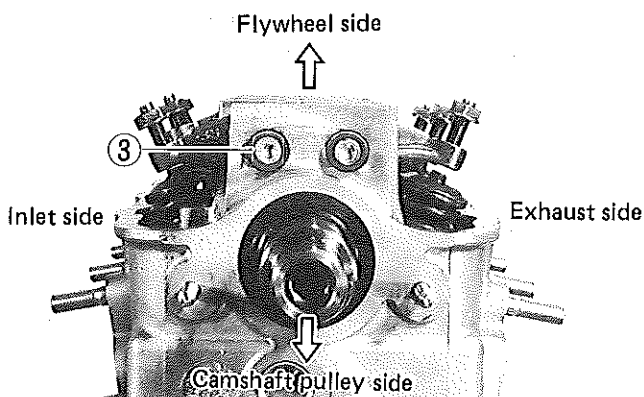


Fig. 4-131

As to the positions of rocker arms and springs on each rocker-arm shaft, refer to Fig. 4-132.

"Camshaft pulley side" is meant by "1";
"distributor gear side" by "2".

NOTE:

When installing rocker-arm shafts, be sure to have valve adjusting screws loosened fully but do not remove them.

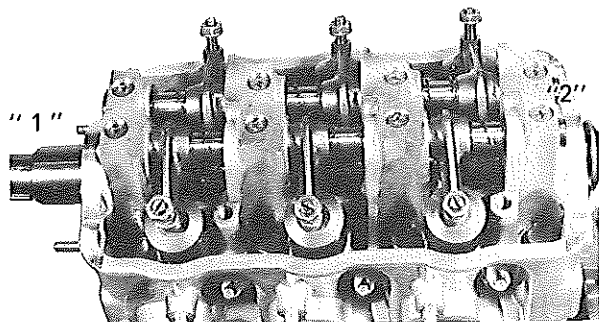


Fig. 4-132

Water inlet pipe

The angle that this pipe takes in place is important. When installing it, be sure to angle it as shown in Fig. 4-133.

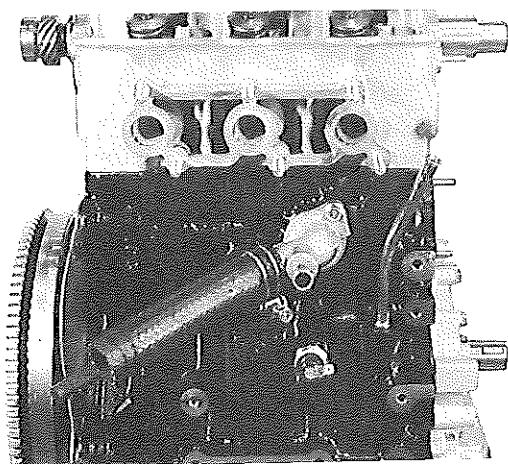


Fig. 4-133

Timing belt inside cover stud bolts

When reinstalling the stud bolts to cylinder head, apply SUZUKI BOND No. 4 (99000-31030) to the threads of these screws, because the bolt holes for the two extend into the interior of cylinder head.

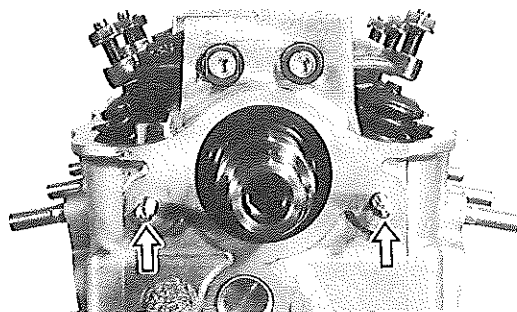


Fig. 4-134

Crankshaft timing belt guide

This guide takes its position on crankshaft as shown in Fig. 4-135. Remember, one side of this guide faces the cylinder block and the other side faces the timing belt pulley: the former side being distinct from the latter.

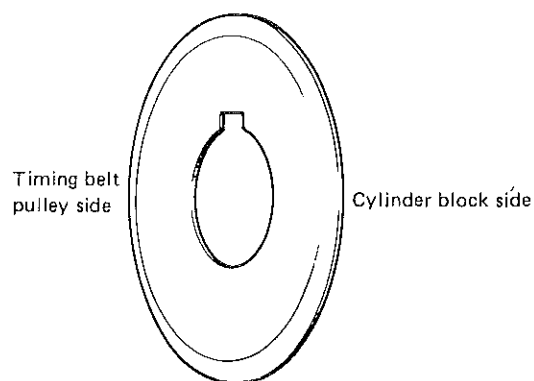


Fig. 4-135

Camshaft timing belt pulley

This pulley has a punch-mark ① to show that the marked side faces the timing belt outside cover. When installing the pulley, bring this mark on timing belt outside cover side and index it to the camshaft keyway ②. Secure the pulley in this position.

CAUTION:

Before installing the pulley as above, check to be sure that crankshaft keyway ③ is in the $50^{\circ} - 70^{\circ}$ range, as shown in Fig. 4-136.

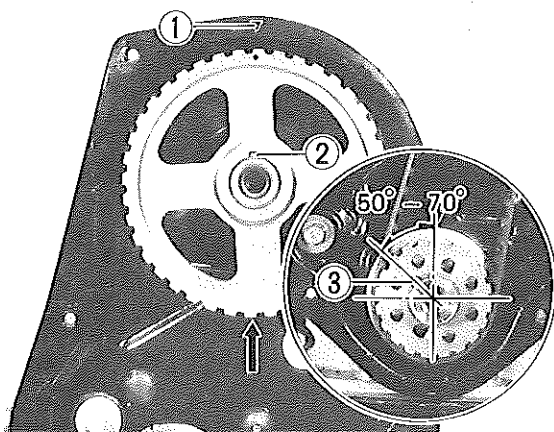


Fig. 4-136

Timing belt (valve timing adjustment)

A certain sequence must be followed installing the timing belt. Here's the sequence:

- 1) Put the tensioner and the spring together before installing them as one to the timing belt cover. Tighten the bolt and the nut to the extent that the tensioner can be moved by hand easily.

NOTE:

When carrying out the above job, make sure to loosen each lock nut and then each valve clearance adjusting screw so that the camshaft and the pulley can rotate freely.

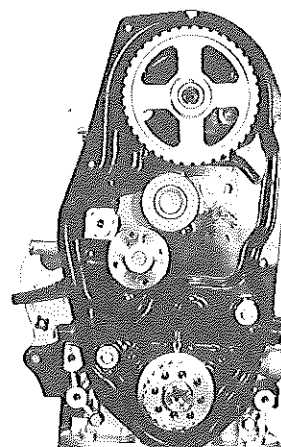


Fig. 4-137

- 2) Timing belt inside cover has an embossed mark ④.

Turn camshaft timing belt pulley to the position where mark ① meets mark ④.

- 3) The inside cover has another embossed mark ⑤. Turn crankshaft to match keyway ③ and punch-mark ⑥ of crankshaft timing belt pulley to mark ⑤.

CAUTION:

Never attempt to turn the crankshaft until mark ① is indexed to mark ④.

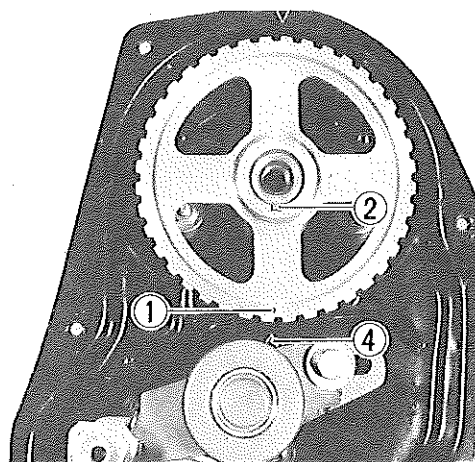


Fig. 4-138

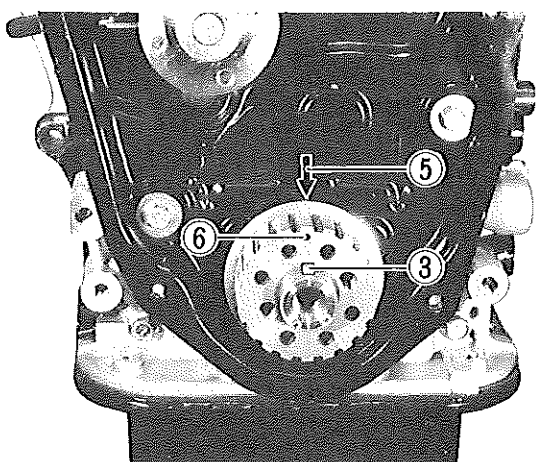


Fig. 4-139

- 4) You now have the two pulleys correctly related to each other in angular sense. Under this condition, put on the timing belt in such a way that portion of belt indicated as ⑦ is free of any slack.
- 5) After putting the belt, hook the spring on the bracket as shown in Fig. 4-140. The spring, with its own tension, adjust the belt tension to the specified value. Rotate the crankshaft clockwise fully twice and tighten the bolt and the nut to the specified torque.

NOTE:

- Apply **THREAD LOCKCEMENT SUPER 1342 (99000-32050)** to the screw part of the tensioner bolt.
- Make sure to tighten the bolt first and then the nut.

Tightening torque for tensioner bolt and nut	N.m	kg-m	lb-ft
	15 - 23	1.5 - 2.3	11.0 - 16.5

CAUTION:

After setting the belt tensioner, turn crankshaft 2 rotations in clockwise direction to see if marks ① ② ④ ⑤ ⑥ and crankshaft keyway ③ locate themselves on the same straight line. If they do not line up straight, the foregoing procedure must be repeated to satisfy this requirement.

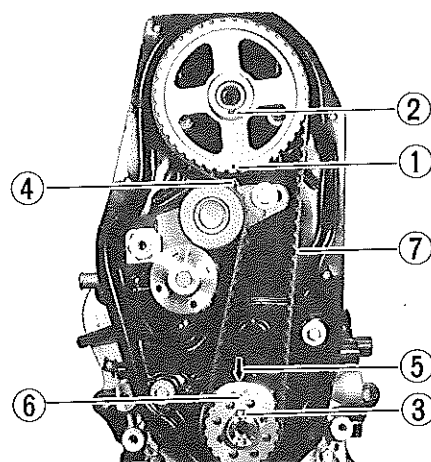


Fig. 4-140

- 6) Check to be sure that the tension is within the specified range when pushing the belt at the mid point between camshaft and crankshaft.

Timing belt tension "L"	5.5 - 6.5 mm (0.22 - 0.26 in.)
-------------------------	-----------------------------------

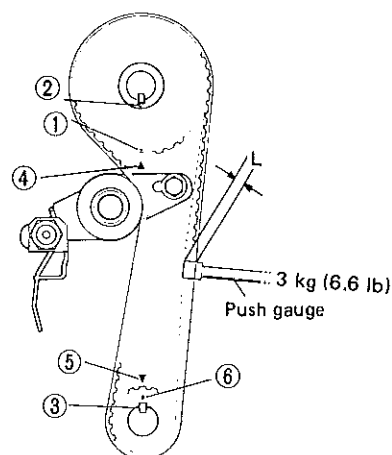


Fig. 4-141

- 7) After adjusting the belt tension within the specified range, adjust each valve clearance to the specified value.

Valve clearance adjustment

The method of valve clearance adjustment is conventional. It is accomplished by means of adjusting screw ⑧. Nut ⑨ is for locking the screw. Use a feeler (thickness) gauge to measure the clearance between screw ⑧ and stem ⑩ when the rocker arm is turned up all the way.

Valve clearance specification (when cold)	Intake	0.13 - 0.18 mm (0.005 - 0.007 in.)
	Exhaust	

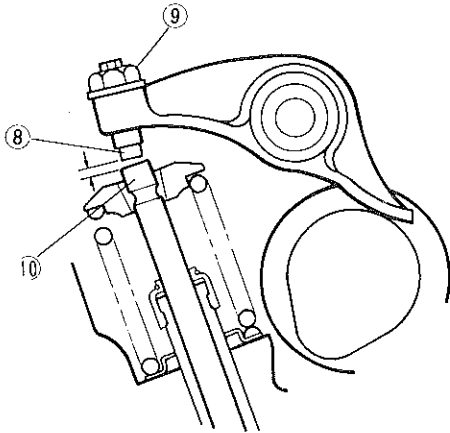


Fig. 4-142

If the engine has been disassembled, it is absolutely necessary to check each valve clearance and set it to the specification, as explained above, upon engine reassembly.

CAUTION:

When checking the valve clearance, be sure that the rocker arm is off the camshaft cam. The clearance reading is meaningless if the arm is riding on the cam. Stick to this rule for each valve.

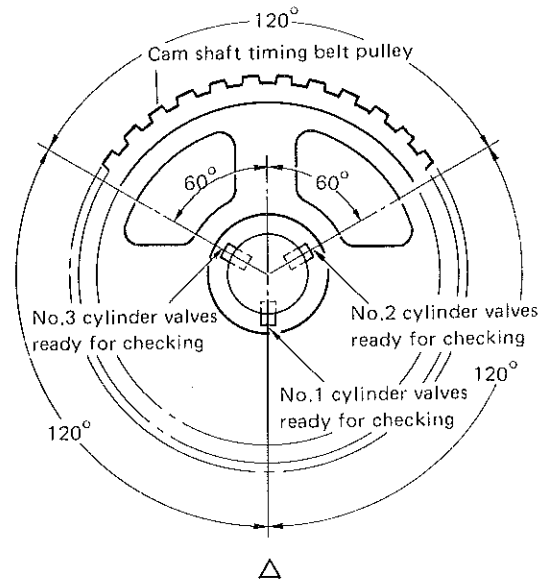


Fig. 4-143

Distributor gear case

Bolts ① are for securing this gear case to the cylinder block. When installing the case, be sure to apply SUZUKI BOND No. 4 (99000-31030) to the threads of these bolts.

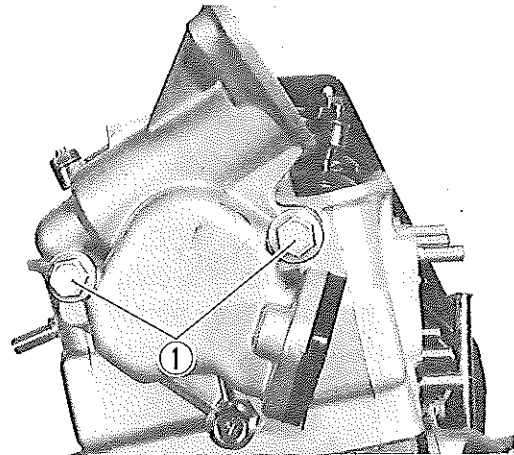


Fig. 4-144

Distributor

The distributor takes its mounted position correctly only when it is inserted into the gear case under a specific condition. The condition is this: Turn over crankshaft to locate the piston at B.T.D.C. 7° (No. 1 Piston being compression stroke), and insert the distributor into the case, with center ② of distributor rotor lined up with embossed mark ③ of distributor housing, as shown in Fig. 4-145.

NOTE:

For the checking and adjusting steps on ignition timing, refer to the section dealing with the ignition system, page 9-9.

CAUTION:

Where the distributor gear case has been removed, it is necessary to fill in 60 cc (2.03/2.11 US/Imp oz) of engine oil after re-installing the gear case.

Pour this much oil in through the distributor mounting hole. The gear could develop trouble if this step is ignored.

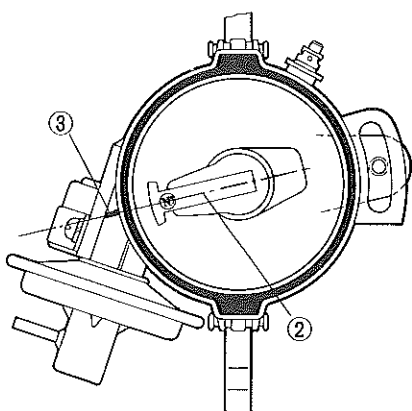


Fig. 4-145

Water pump pulley

Be sure to position the pulley as shown in Fig. 4-146.

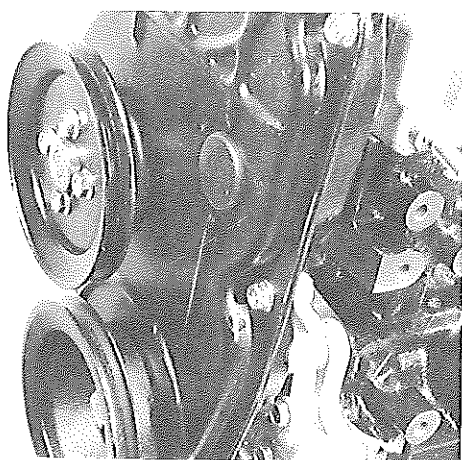


Fig. 4-146

Alternator

The water pump drive belt, by which the alternator too is driven, must be tensioned to the specification after the alternator is installed. Check the tension at the middle point of the belt between water pump pulley and alternator pulley. To vary the tension for adjustment, displace the alternator in place.

Drive belt tension
(in terms of belt
deflection as shown)

10 - 15mm (0.4 - 0.6
in.) under 10 kg
(22.0 lb) thumb
pressure

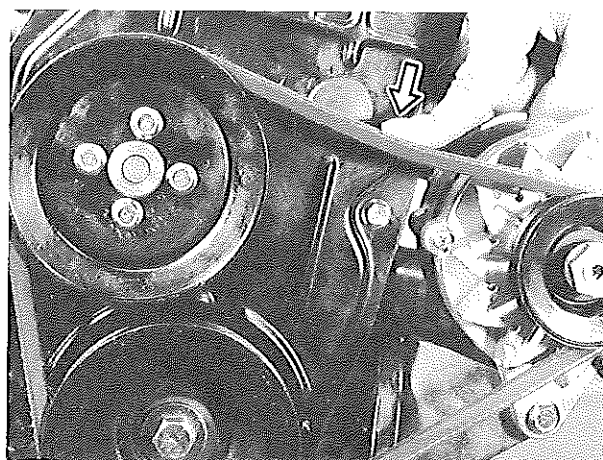


Fig. 4-147

Clutch

At the time of bolting the clutch cover after mounting the clutch disc, the disc must be trued up and centered. Carry out this centering job with the use of the special tool (A) (09923-37810).

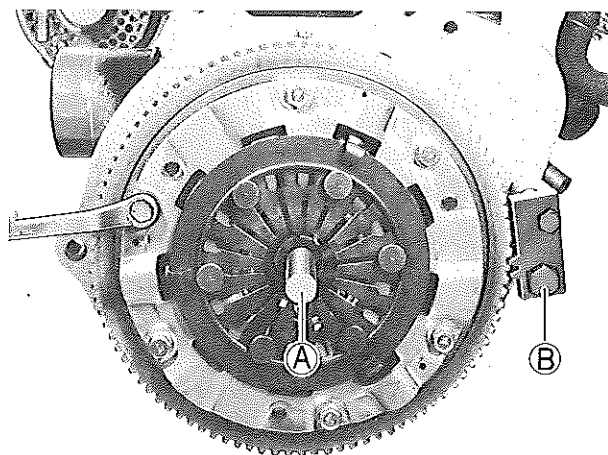


Fig. 4-148 (B) Flywheel stopper (09916-97820)

4-7. Mounting the Engine

Engine mounting torque rods

Install the torque rods between the engine and the body using care for the following. Its improper installation may cause abnormal vibration and noise.

When tightening bolts ③, slide and adjust it in the ellipse holes ④ so that the torque rod is right angle to bolt ②.

Tighten bolts ③ before tightening bolts ① and ②.

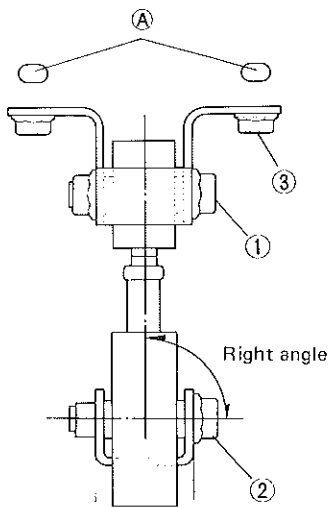


Fig. 4-149

Clearance "D" of each slit of the torque rod big rubber side should exceed 2 mm (0.079 in). If not, loosen nut ⑥ and adjust torque rod length "C" to obtain a correct clearance.

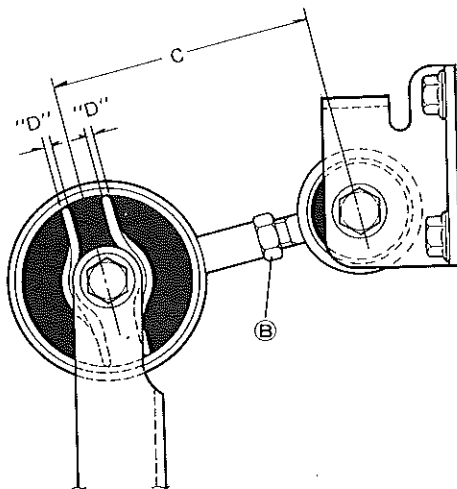


Fig. 4-150

4-8. Engine Inspection and Adjustments

Water pump belt

Adjust the belt tension as outlined in the section for ENGINE COOLING SYSTEM (Page 7-8).

Distributor point gap

The method of adjusting the contact point gap is described in the section for IGNITION SYSTEM (page 9-9).

Ignition timing

Refer to IGNITION TIMING, Page 9-9.

Carburetor

Adjustments to be made are detailed in Page 5-8.

Valve clearance

Valve clearance specification (COLD)	Intake	0.13 - 0.18 mm (0.005 - 0.007 in.)
	Exhaust	

To check and adjust valve clearance with the engine mounted in place, that is, secured to the chassis, be sure to remove the cylinder head cover, so that you can take a good look at rocker arms and camshaft. Remember, a clearance reading is meaningful only when it is taken with the rocker arm clear of and not riding on the cam.

Remove the ignition timing check hole plug provided at the joint between engine and transmission to gain visual access to the "T" mark. Turn over crankshaft to index mark ① to timing match mark ②, and see if the rocker arms of No. 1 cylinder are off the respective cam lobes (of camshaft); if so, valves ① and ②, Fig. 4-151, are ready for clearance checking and adjustment: if not, turn over crankshaft further by 360° to index mark ① to mark ② again. This 360° turning should bring about the desired state. (in which the two valves are ready for checking and adjustment).

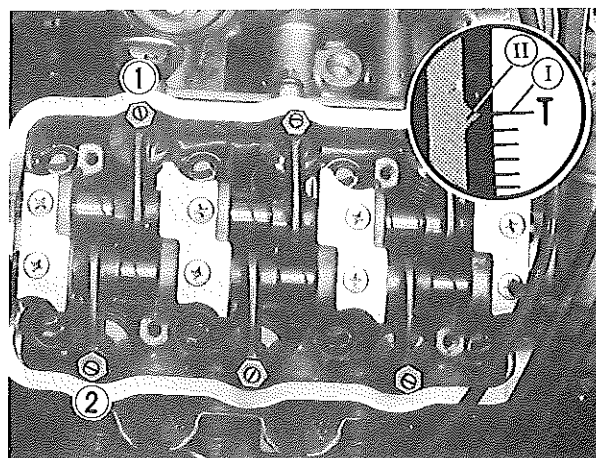


Fig. 4-151

Turn over the crankshaft 240° from "T" mark, check and adjust the valves ⑤ and ⑥.

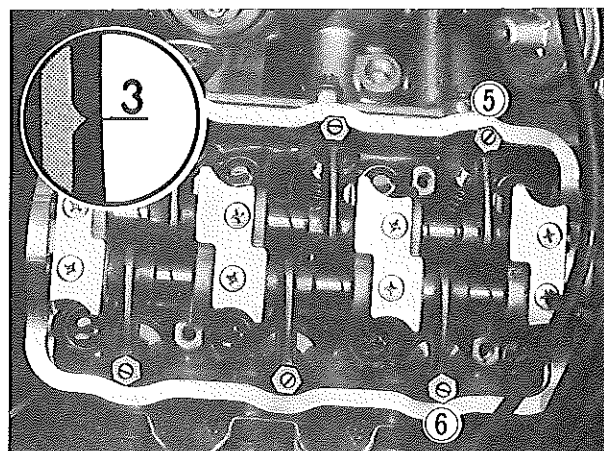


Fig. 4-152

Turn over the crankshaft 240° from "3" mark, check and adjust the valves ③ and ④.

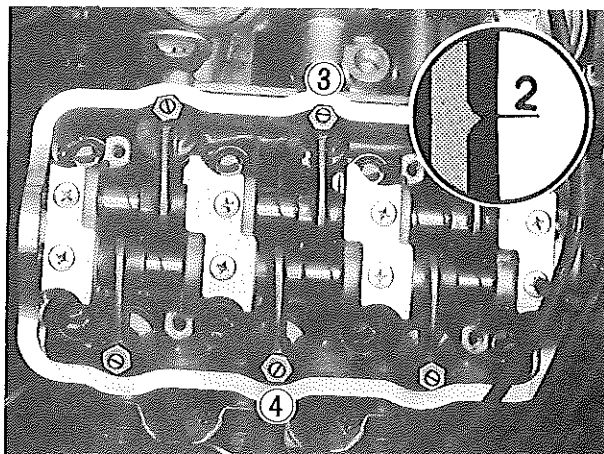


Fig. 4-153

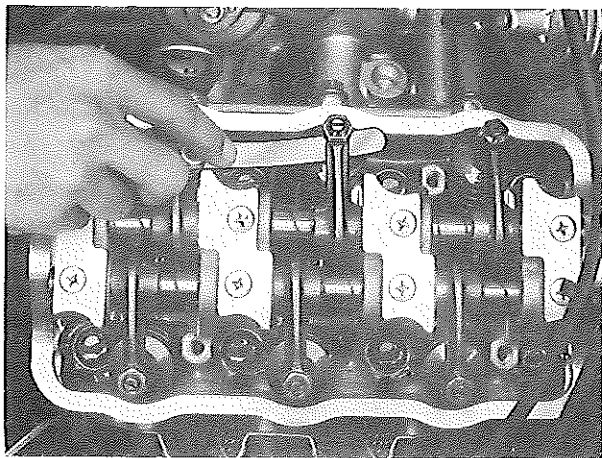


Fig. 4-154 Measuring valve clearance

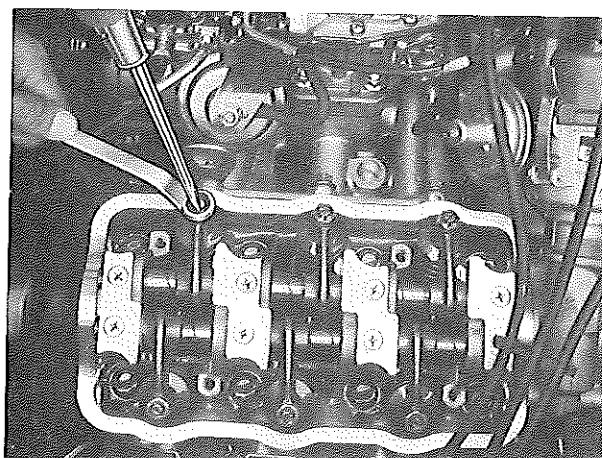


Fig. 4-155 Adjusting valve clearance

Timing belt

This belt must be inspected periodically, inspect it for cracks, cleanliness, oil stains and signs of breakage and replace the belt when necessary. Remove the inspection cap on the timing belt cover, and check the belt.

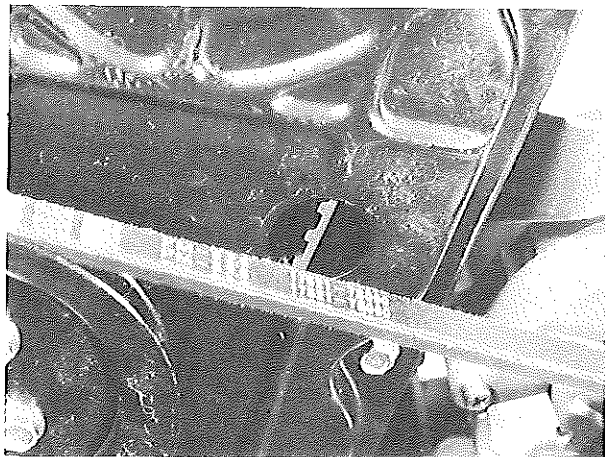


Fig. 4-156

Oil pump discharge pressure measurement

The method of pressure measurement is outlined in the section on ENGINE LUBRICATION (Page 4—54).

Compression pressure measurement

Check the compression pressure on all three cylinders, as follows:

- 1) Remove all spark plugs.
- 2) Install the compression gauge (A) (09915-64510) on one of the cylinders, making the connection perfectly air-tight.
- 3) Disengage the clutch (to lighten starting load on engine), and depress the accelerator all the way to make the throttle full-open.
- 4) Crank the engine with the starter motor, and read the highest pressure on the compression gauge.
- 5) Carry out the steps 2) through 4) on each cylinder to obtain three readings.

Compression pressure

Standard	Limit	Difference
13.5 kg/cm ² (192.0 psi)/ 400 r/min	10.0 kg/cm ² (142.2 psi)/ 400 r/min	1.0 kg/cm ² (14.2 psi)/ 400 r/min between any two cylinders

NOTE:

There is some trouble in the engine when the compression pressure is not higher than the limit. Refer to TROUBLE-SHOOTING GUIDE (Page 3—3) for possible causes.

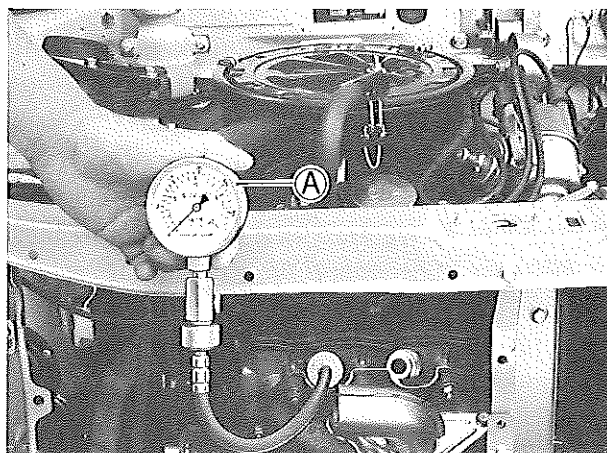


Fig. 4-157

NOTE:

The compression pressure value is measured by using the special tool (compression gauge 09915-64510).

Vacuum measurement

The vacuum that develops in the intake line is a good indicator of the condition of the engine. It is for this reason that the vacuum is measured. The measuring procedure is as follows:

- 1) Run the engine until its coolant temperature rises to a level between 75° C and 85° C (167° F - 185° F).
- 2) Install the vacuum gauge (A) (09915-67310), as shown in Fig.4-158. Install an engine tachometer.

NOTE:

If the vacuum gauge can not be installed, remove the torque rod bracket only to measure the vacuum at idling speed.

- 3) Run the engine at the specified idling speed and, under this running condition, read the vacuum gauge. The vacuum should be not lower than 40 cm Hg (15.7 in. Hg).

A low vacuum reading means that any combination of the following malconditions is the cause, which must be corrected before releasing the machine to the customer:

- (a) Leaky cylinder head gasket
- (b) Leaky inlet manifold gasket
- (c) Leaky valves
- (d) Weakened valve springs
- (e) Maladjusted valve clearance
- (f) Valve timing out of adjustment
- (g) Ignition mistimed
- (h) Carburetor improperly adjusted

NOTE:

Should the indicating hand of the vacuum gauge oscillate violently, turn the adjusting nut (B) to steady it.

Standard vacuum	40~45 cm Hg (15.7 ~ 17.7 in. Hg)
Idling speed specification	900 r/min (rpm) (Take vacuum reading at this speed.)

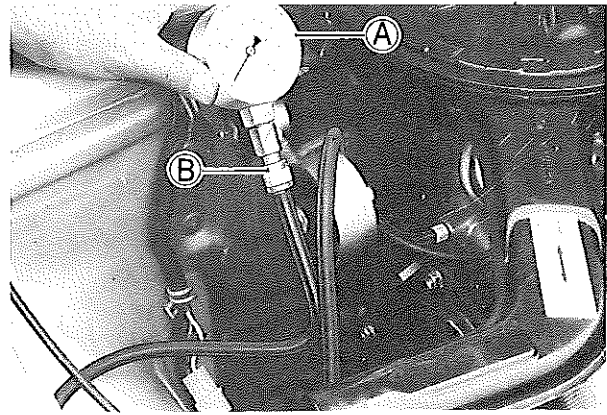


Fig. 4-158

Engine oil

Refer to the section for ENGINE LUBRICATION, Page 4-55.

Engine oil filter

The methods of checking and servicing the oil filter are outlined under ENGINE LUBRICATION, Page 4-54.

Engine coolant

This subject is covered in the section for ENGINE COOLING SYSTEM, Page 7-6.

Exhaust line and muffler

Inspect each exhaust line connection for tightness, and examine the muffler and other parts for evidence of breakage and leakage of gases. Repair or replace defective parts, if any.

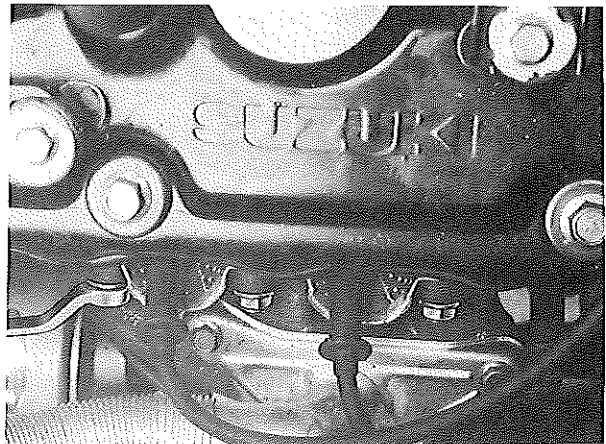


Fig. 4-159

Crankcase ventilation hose

Inspect this hose for cracks and evidence of breakage and, as necessary, replace it. Check to be sure that the hose connection is tight.

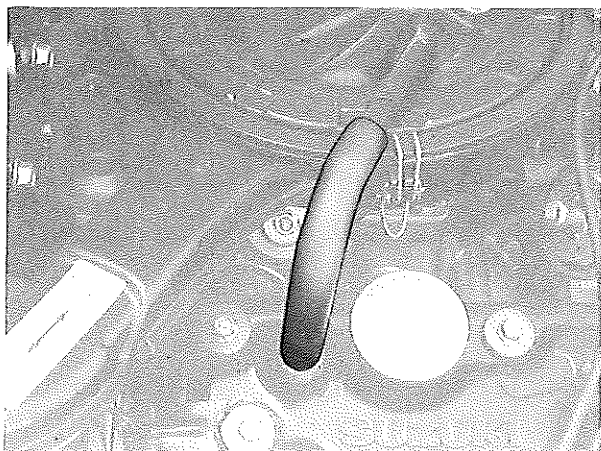


Fig. 4-160

Oil filler cap

The cap has a packing. Be sure that the packing is in good condition, free of any damage and signs of deterioration, and is tight in place: it is replaceable.



Fig. 4-161

4-9. Engine Lubrication

Description

The oil pump for pressure-feeding lubrication oil to the running parts of the engine is of an internal gear type, in which an outer ring-like gear is internally meshed with an inner gear, there being a separating crescent-like stator between the two. The pump is mounted at the crankshaft pulley side of the engine, and is driven by the crankshaft.

Oil Circuit:

The oil pump lifts oil through the strainer and discharges it under pressure, forcing the oil through the oil filter. The filtered oil flows into two paths inside the cylinder block. In one path, oil reaches the crankshaft journal bearings and big-end bearings on crankpins. Some of this oil goes to the connecting-rod small ends and lubricates piston pins there and also the walls of cylinder bores.

In the other path, oil goes up to the cylinder head through the camshaft No. 2 journal and enters the internal oilway of rocker arm shafts to lubricate the sliding parts of these shafts and rocker arms, and also other three journals of the camshaft.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure comes over about 3.0 kg/cm^2 (42.7 psi). Relieved oil flows back to the oil pan.

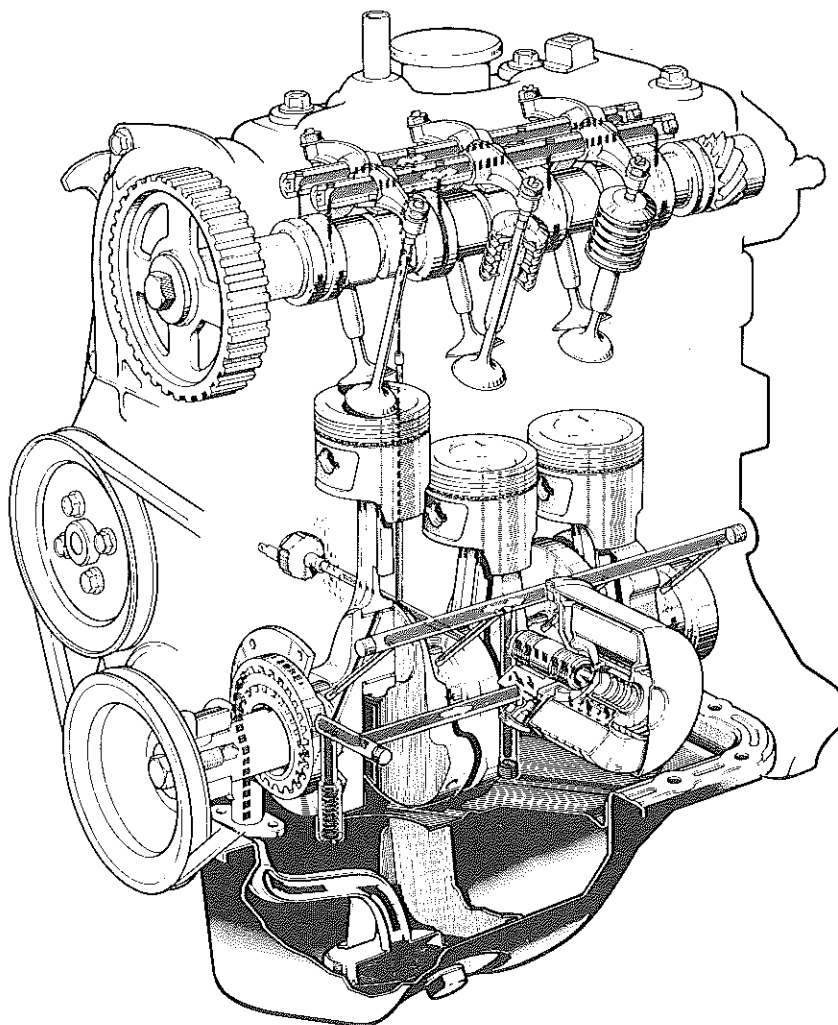


Fig. 4-162

Oil pump disassembly

Remove oil pump gear plate.

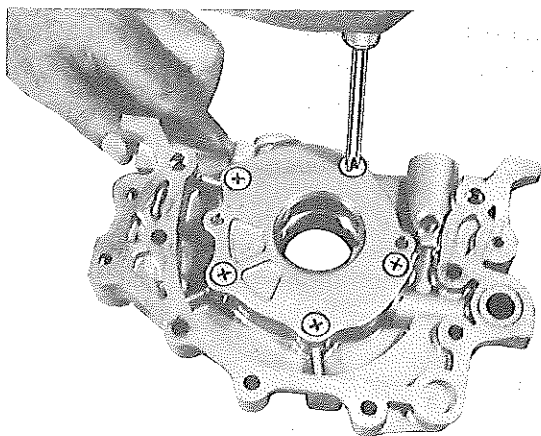


Fig. 4-163

Take out inner gear.

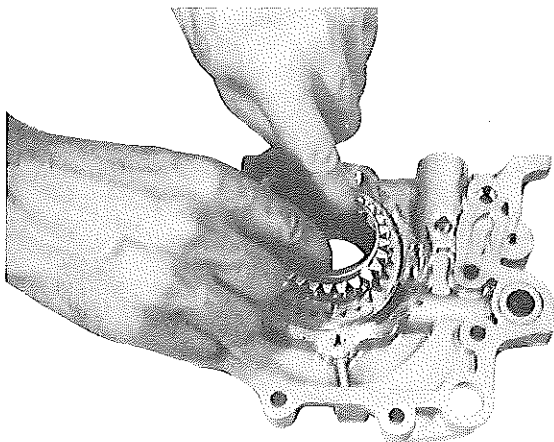


Fig. 4-164

Take out outer gear.

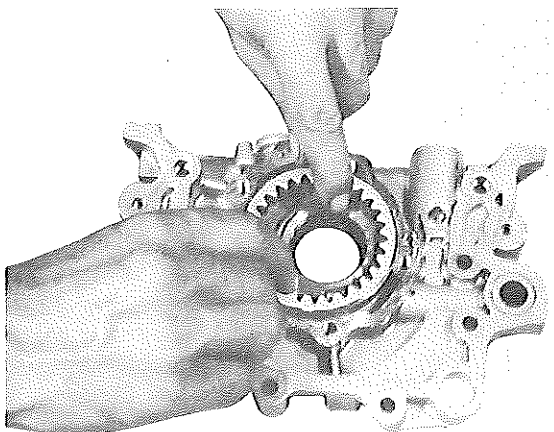


Fig. 4-165

Oil pump inspection

Radial clearance between inner gear and crescent.

Standard	0.177 ~ 0.328 mm (0.0070 ~ 0.0129 in.)
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Radial clearance between outer gear and crescent.

Standard	0.058 ~ 0.310 mm (0.0023 ~ 0.0122 in.)
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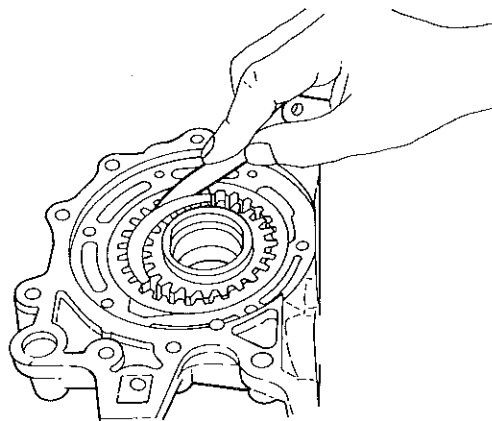


Fig. 4-166

Radial clearance between outer gear and pump case.

Standard	0.05 ~ 0.10 mm (0.0020 ~ 0.0039 in.)
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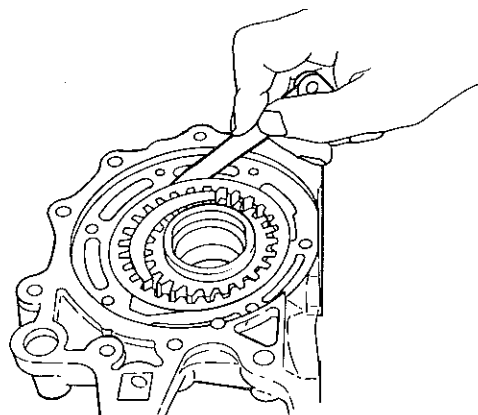


Fig. 4-167

Side clearance:

Using a straightedge, determine the side clearance in terms of the thickness gauge reading taken between straight edge and gear, as shown in Fig. 4-168.

Limit on side clearance	0.15 mm (0.0059 in.)
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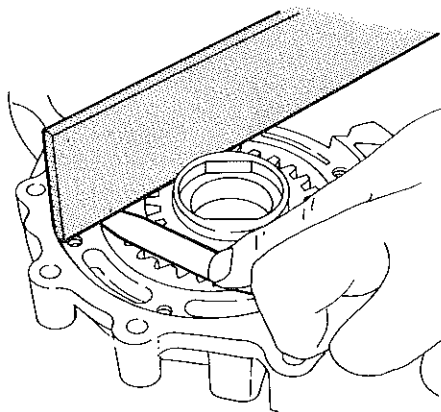


Fig. 4-168

Oil pump reassembly

Have all disassembled parts washed clean, and rebuild the pump to meet each of the following requirements:

When installing the gears in the case, apply the engine oil to each gear. After mounting the gear plate, check to be sure that each gear turns smoothly by hand.

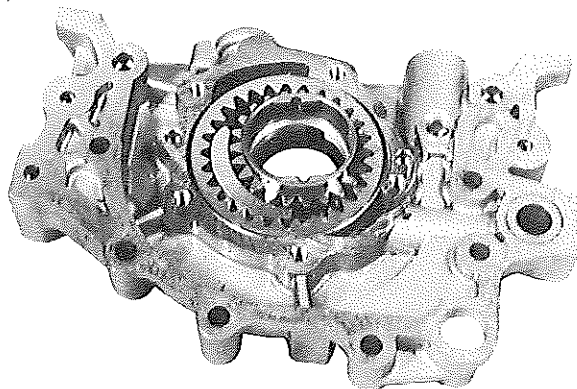


Fig. 4-169

- Use a new gasket when fitting the oil pump case to the cylinder block. The edge of the gasket might bulge out; if it does, cut the bulge off with a sharp knife, making the edge smooth and flush with the end face of the pump case, and apply SUZUKI BOND No. 4 to the cut edge.

NOTE:

Before fitting the pump case, oil the oil seal lip, and apply SUZUKI BOND No. 4 (Parts No. 99000-31030) on the mating surfaces around the oil discharging port of both the oil pump case and the cylinder block.

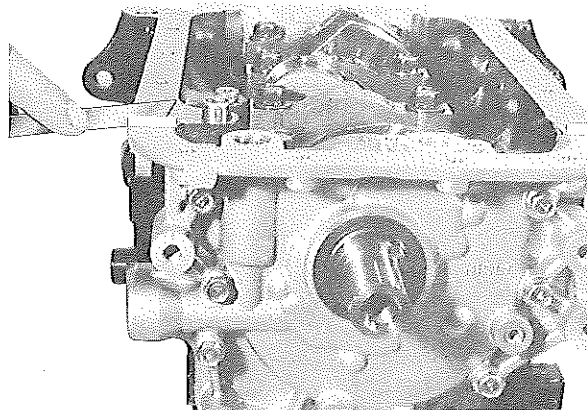


Fig. 4-170

- Installation of crankshaft timing belt pulley and timing belt must be carried out in strict conformity to the special instructions given in Page 4-42 for engine reassembly.

CAUTION:

Strict adherence to the special instructions is essential, for an improperly installed pulley and timing belt prevents the engine from operating as designed.

Oil filter servicing

At intervals stated below, replace the oil filter element. The element must be replaced not only periodically but also whenever it is found dirty.

Initial replacement to be made:	After 1,000 km (1,000 miles)
Replace at intervals of:	Every 10,000 km (6,000 miles)

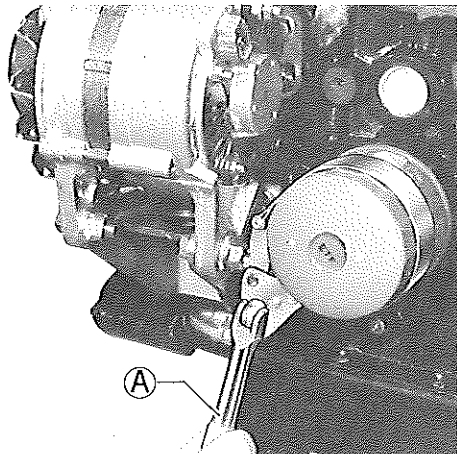


Fig. 4-171 Oil filter wrench (A) (09915-47310)

Oil pump strainer servicing

- Inspect the strainer periodically and, as necessary, clean it by washing to remove dirty matters clogging its screen.

Checking the oil pressure

When the engine is idling, not to mention fast running, the oil pressure light should remain completely off; if not, it is a cause for checking the oil pressure in the following manner:

- 1) Be sure that engine oil is up to level in the oil pan. Refill the oil pan, as necessary, to raise the oil to and above "LOW" line on the level gauge. Be sure, too, that the oil filter is clean and that the oil pump strainer is not clogged. Check to be sure that there is no oil leakage from any part of the engine.
- 2) Remove the oil pressure unit, which is mounted on that side of the cylinder block where the oil filter is located. Into the vacated threaded hole, screw the pressure gauge connection to install the gauge (B) (09915-77310) and the attachment (09915-77610).

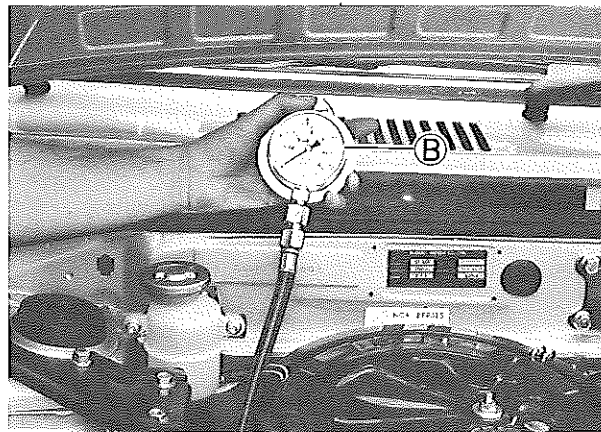


Fig. 4-172

- 3) Start up the engine and idle it until the coolant temperature rises to a level between 75° and 85°C (167° - 185°F). At this temperature, raise engine speed to 3,000 r/min and read to pressure gauge indication.

Oil pressure specification	3.0 - 4.5 kg/cm ² (42.66 - 63.99 psi) At 3,000 r/min
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If the pressure read is not up to the specification, the oil pump must be checked.

CAUTION:

When re-installing the oil pressure unit, be sure to wrap its screw threads with a sealing tape. Tighten the unit to a torque value of 12 to 15 N.m (1.2 - 1.5 kg-m, 9.0 - 10.5 lb-ft).

Engine oil servicing

For the engine oil, use a 4-stroke engine oil (Refer to page 1—14). Each oil change requires this much oil.

Periodical oil change	2,500 cc (5.28/4.40 US/Imp pt)
Filling up after engine overhauling	3,000 cc (6.34/5.28 US/Imp pt)

Oil level:

Refill the engine oil whenever necessary, in order to maintain the oil surface between "LOW" and "FULL" level holes on the oil level gauge.

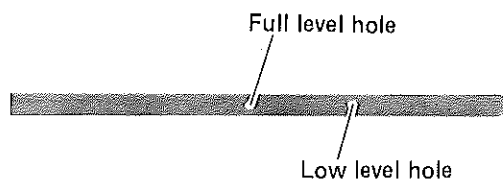


Fig. 4-173 Oil level gauge

