2T & 3T ENGINE SERVICE

4

CUTAWAY VIEW

Fig. 4-1

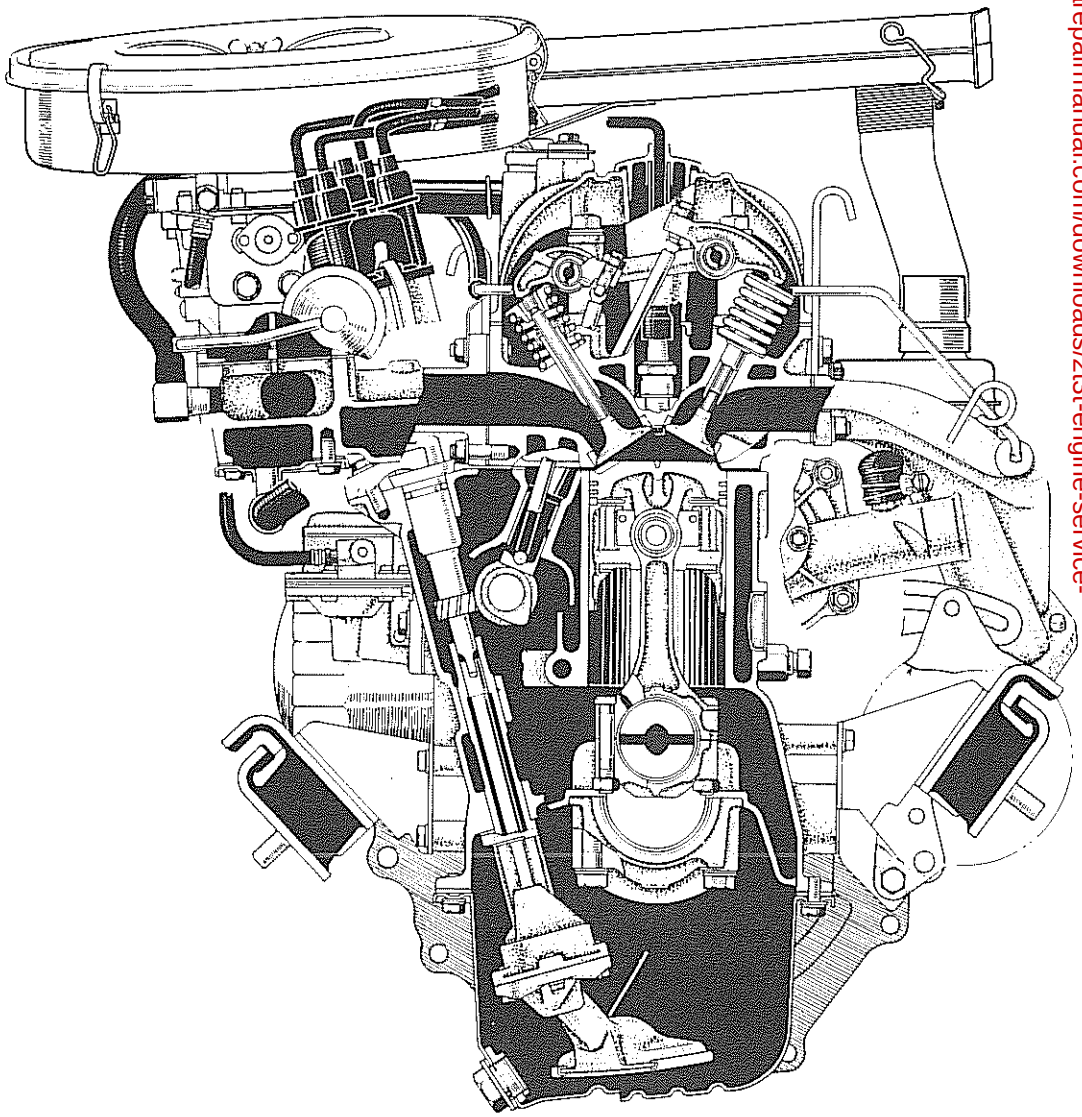
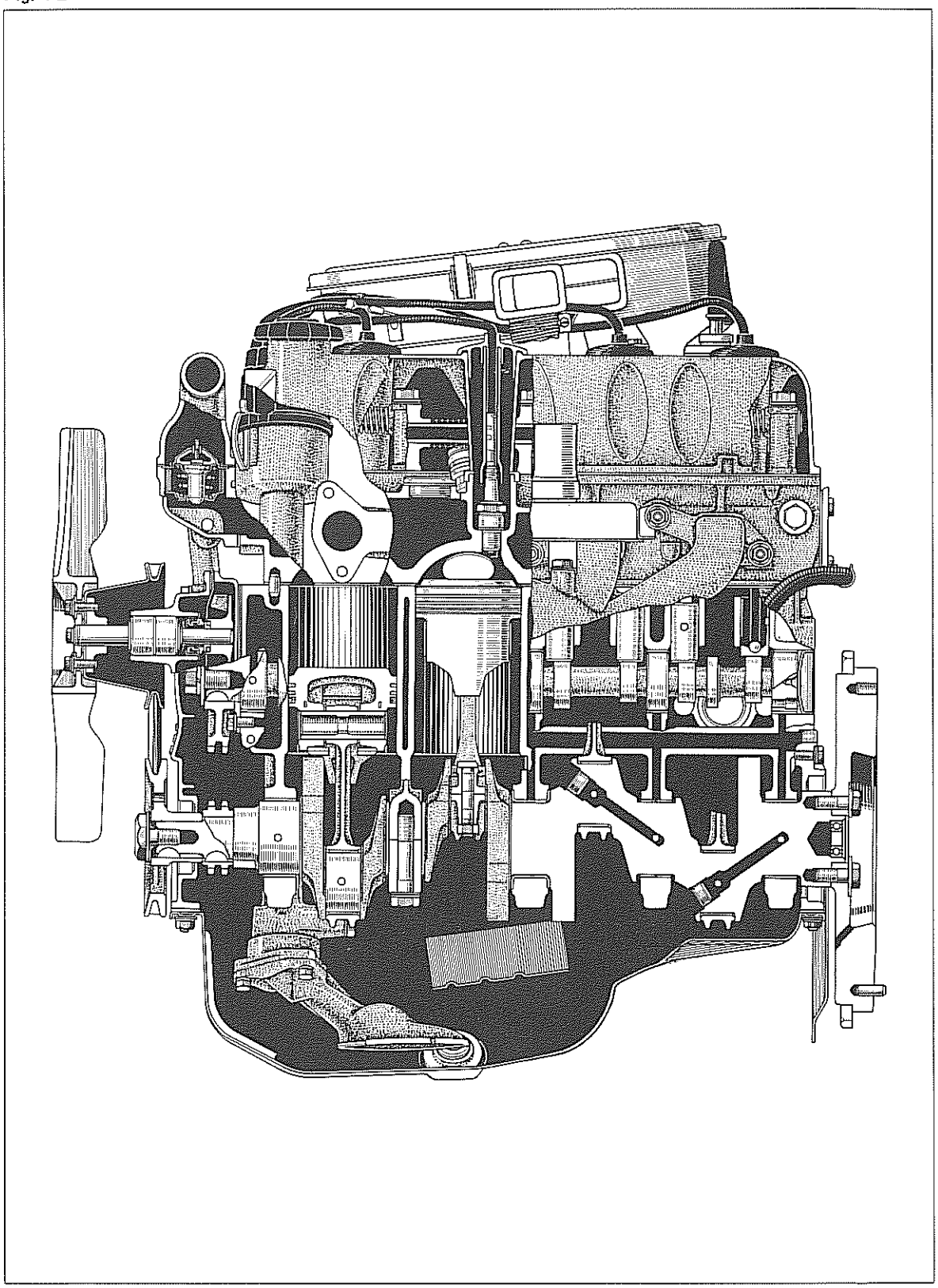


Fig. 4-2

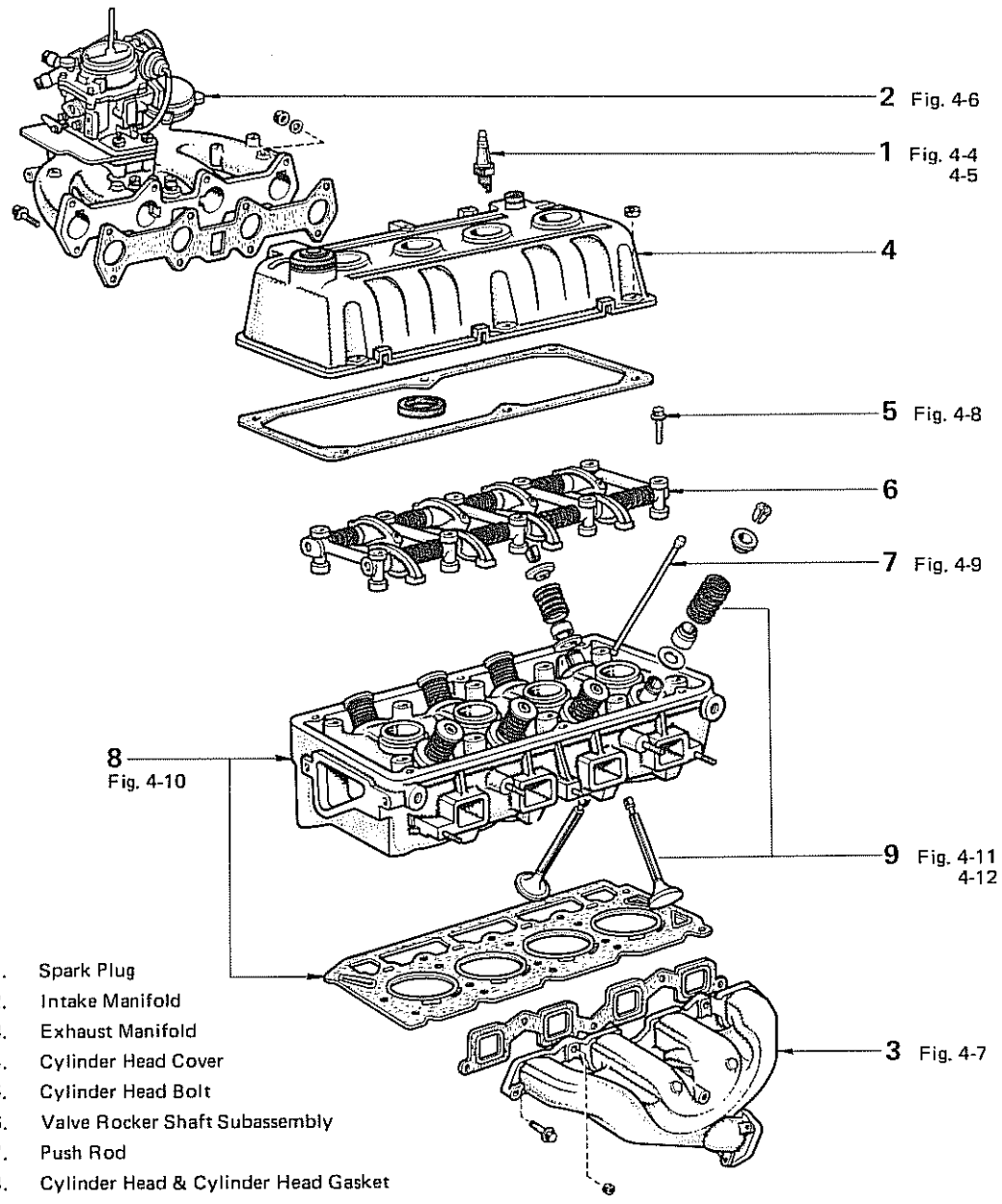


CYLINDER HEAD

DISASSEMBLY

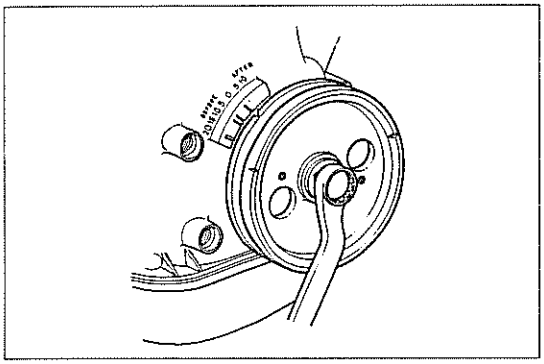
Disassemble the parts in the numerical order shown in the figure.

Fig. 4-3



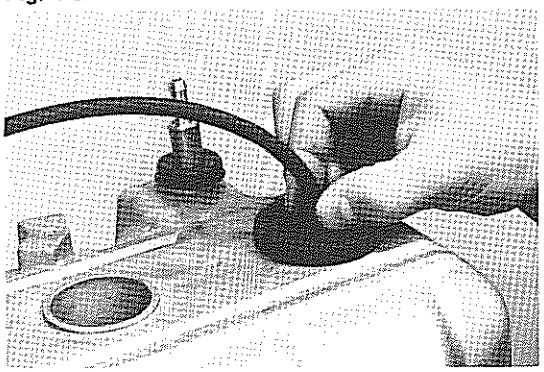
1. Spark Plug
2. Intake Manifold
3. Exhaust Manifold
4. Cylinder Head Cover
5. Cylinder Head Bolt
6. Valve Rocker Shaft Subassembly
7. Push Rod
8. Cylinder Head & Cylinder Head Gasket
9. Valve & Valve Spring

Fig. 4-4



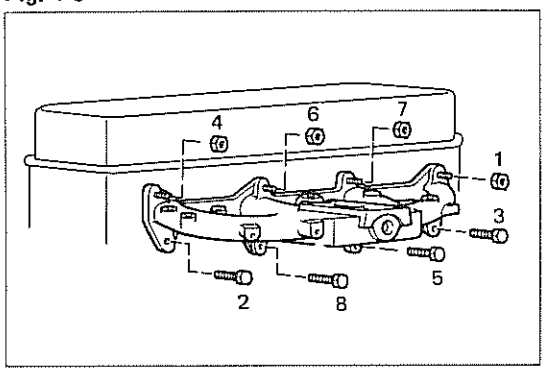
Set the No.1 cylinder to TDC/compression.

Fig. 4-5



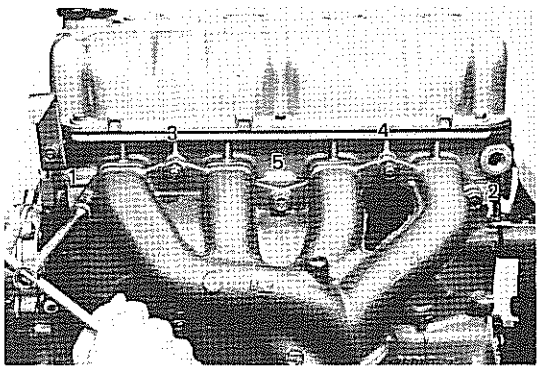
Remove the plug cords by carefully pulling on the rubber boots.

Fig. 4-6



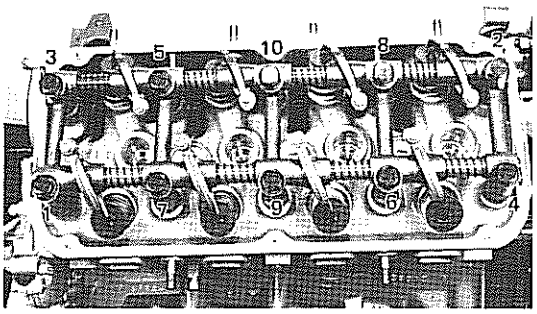
Loosen the each intake manifold bolt and nut a little at a time, and in the sequence shown in the figure.

Fig. 4-7



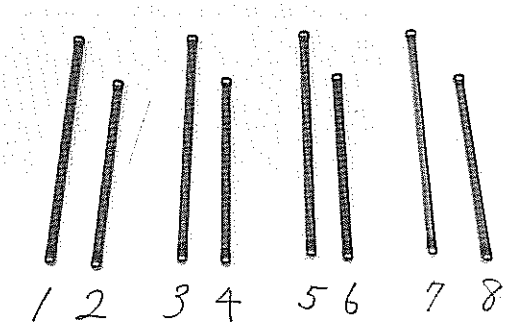
Loosen the each exhaust manifold bolt and nut a little at a time, and in the sequence shown in the figure.

Fig. 4-8



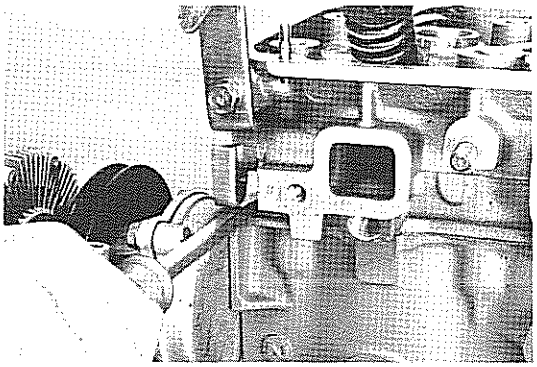
Loosen each cylinder head bolt a little at a time and in the sequence shown in the figure.

Fig. 4-9



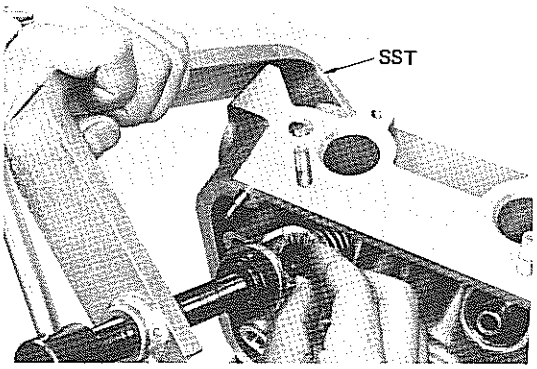
Arrange the push rods in order.

Fig. 4-10



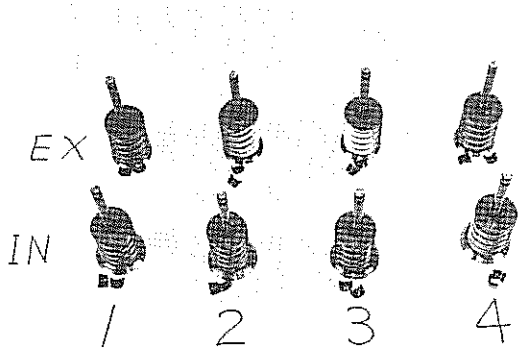
If the cylinder head is difficult to lift off, pry with a screwdriver between the had and block as shown in the figure.

Fig. 4-11



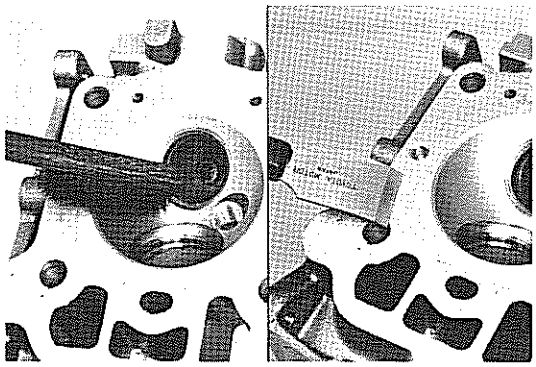
Remove the valve spring with SST.
SST [09202-43012]

Fig. 4-12



Arrange the disassembled parts in order.

Fig. 4-13

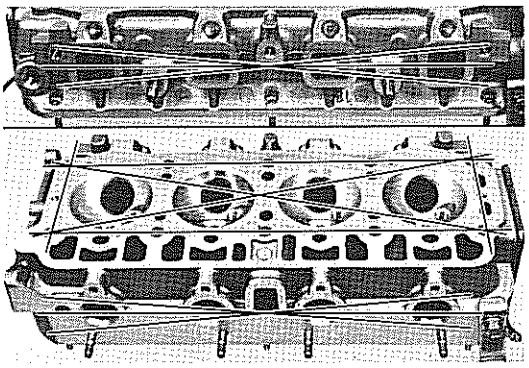


INSPECTION & REPAIR

Cylinder Head

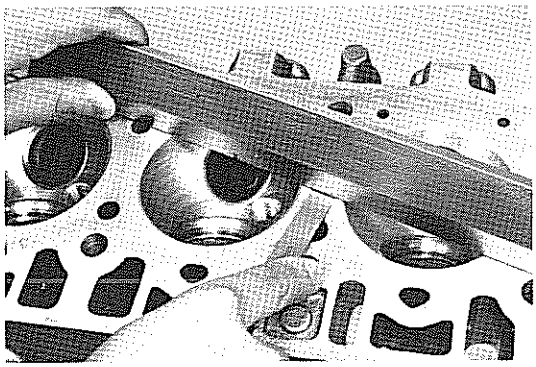
1. Clean the cumbustion chamber and remove any gasket material from the manifold and head surface.
   Check the cylinder head for cracks or excessively burnt valve surfaces.

Fig. 4-14



2. Check the cylinder head surface flatness with a precision straight edge.

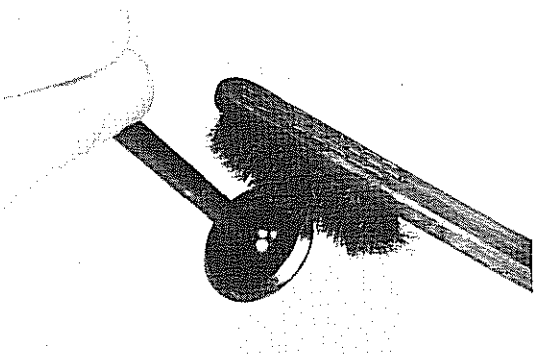
Fig. 4-15



3. If warpage exceeds the limit, correct it by machining, or replace the head.

Cylinder head surface warpage:
Limit 0.05 mm (0.002 in.)
Maximum reface:
Limit 0.2 mm (0.01 in.)
Manifold mounting surface warpage:
Limit 0.10 mm (0.004 in.)

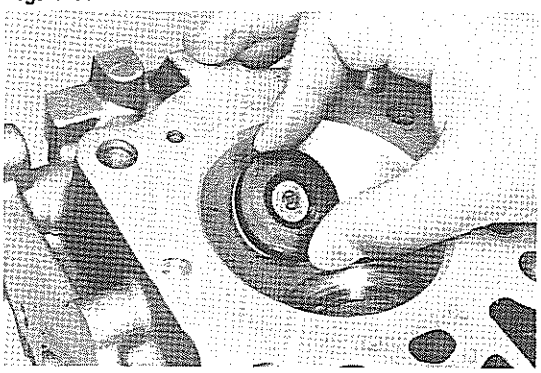
Fig. 4-16



Valve, Guide & Seat

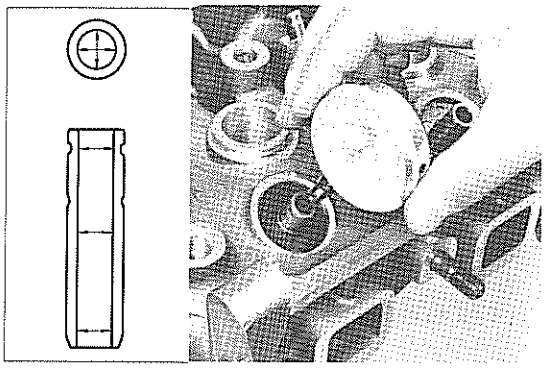
1. Clean the valves.

Fig. 4-17



2. Check the valve stem to valve guide clearance of each valve by inserting the valve stem into the guide and moving back and forth as shown in the figure.

Fig. 4-18



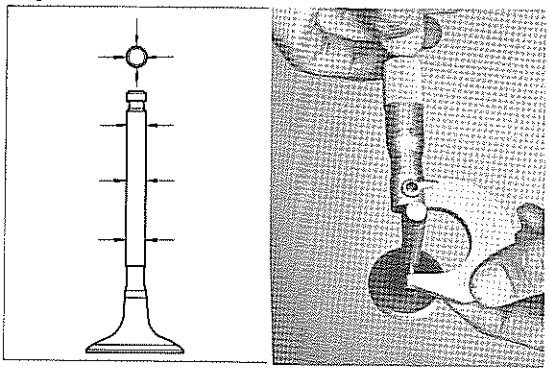
3. Measure the valve stem oil clearance.
   (1) Measure the inside diameter of the valve guide at several places with an inside dial gauge.
   (2) Measure the valve stem diameter.
   (3) Calculate the clearance between the valve stem and valve guide by subtracting the difference where the clearance is the largest.

Stem oil clearance:

Limit	**IN**	**0.08 mm (0.003 in.)**
	EX	**0.10 mm (0.004 in.)**

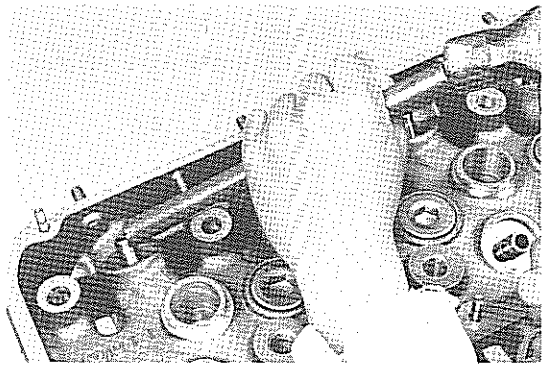
If the clearance exceeds the limit, replace both valve and guide.

Fig. 4-19



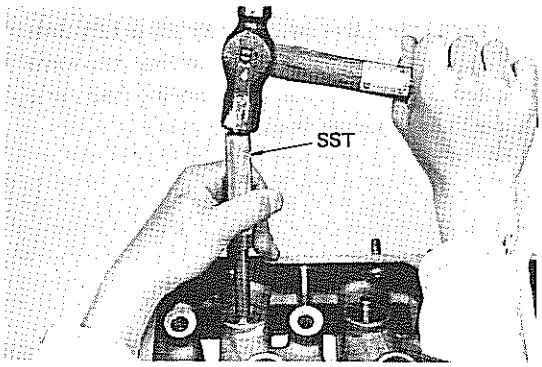
–Note –
Measure at several places and use the maximum wear for calculation.

Fig. 4-20



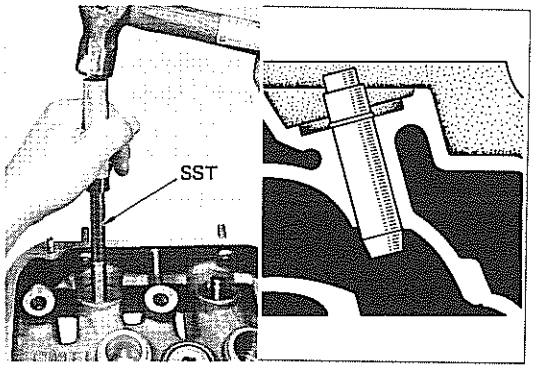
4. Replace the valve guide.
   (1) Bend the bushing.

Fig. 4-21



(2) Heat the cylinder head to 80 – 100°C (176 – 212°F).
(3) From the top, drive out the guide toward the combustion chamber with SST.
SST [09201-60011]

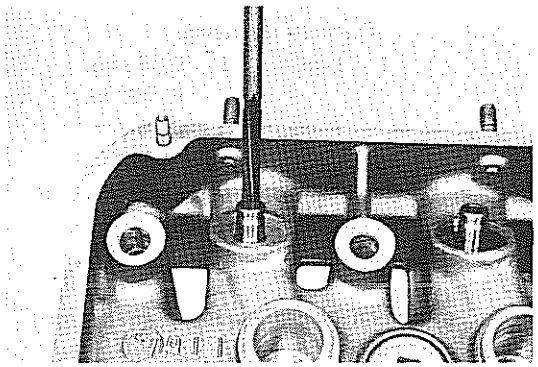
Fig. 4-22



(4) Heat the cylinder head to 80 – 100°C (176 – 212°F).
(5) With SST drive in the guide until the snap ring makes contact.
SST [09201-60011]

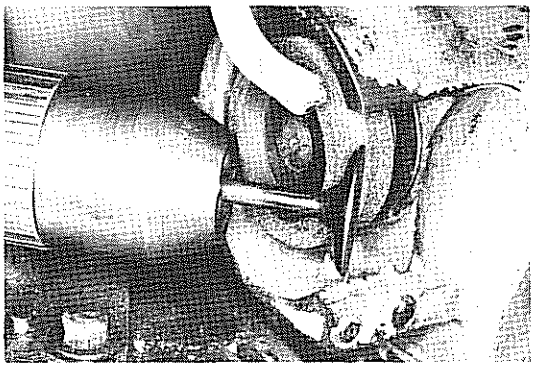
– Note –
1. **Insure that the hole is clean.**
2. **Before inserting the guide apply a thin coat of oil to it and the guide hole.**

Fig. 4-23



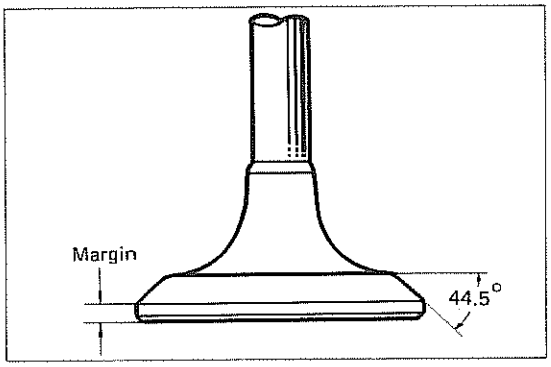
(6) Ream the guide to the specified clearance with an 8 mm (0.3 in.) reamer.
Stem oil clearance:
IN 0.025 – 0.060 mm (0.0010 – 0.0024 in.)
EX 0.030 – 0.065 mm (0.0012 – 0.0026 in.)

Fig. 4-24



5. Grinding valves and seats
(1) Grind all valves to remove the pits and carbon.
Valve face angle: 44.5°

Fig. 4-25

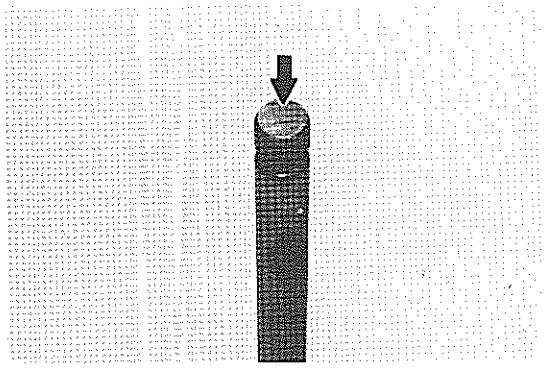


(2) Check the valve head margin and replace if less than specified.

Head edge thickness:

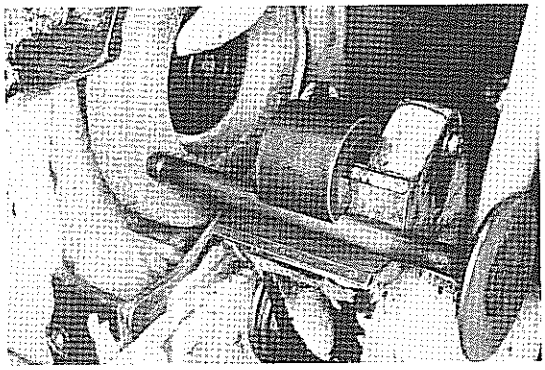
Limit	**IN**	**0.5 mm (0.02 in.)**
	EX	**0.7 mm (0.03 in.)**

Fig. 4-26



(3) Inspect the valve stem tip.

Fig. 4-27

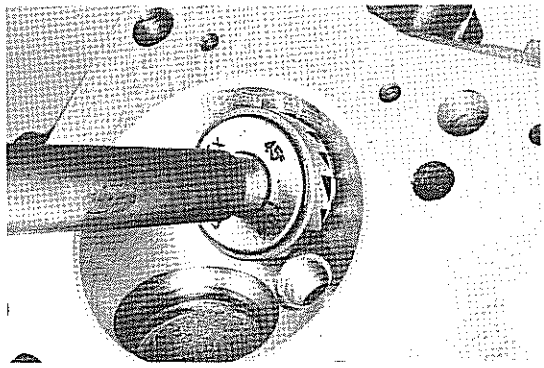


(4) If the valve stem tip is worn, resurface with a valve grinder, but do not grind off more than 0.5 mm (0.02 in.).

Overall length:

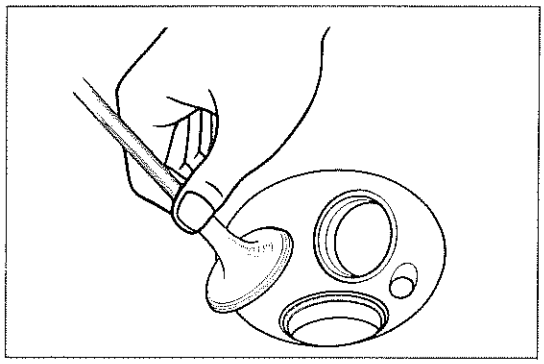
Limit	**108.5 mm (4.27 in.)**

Fig. 4-28



(5) Resurface the valve seats with a 45° carbide cutter.
Remove only enough metal to clean the seat.

Fig. 4-29



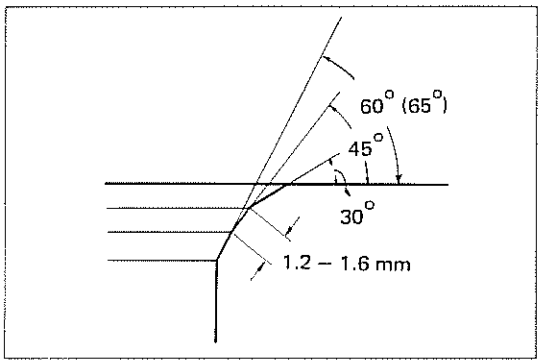
(6) Coat the valve face with prussian blue or white lead. Locate the contact point on the valve by rotating the valve against seat.

– Note –

Seat contact should be in middle of valve face with the following width:

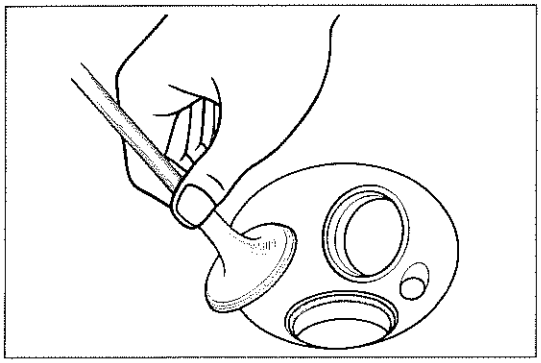
IN	**1.2 – 1.6 mm (0.05 – 0.06 in.)**
EX	**1.2 – 1.6 mm (0.05 – 0.06 in.)**

Fig. 4-30



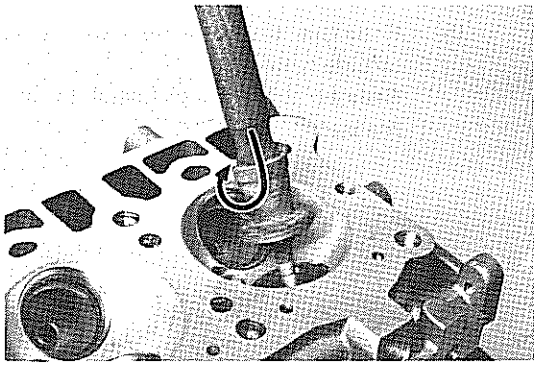
(7) Correct the seat position.
To correct seating that is too high, use 30° and 45° cutters. If seating is too low, use 60° (IN) or 65° (EX) and 45° cutters.

Fig. 4-31



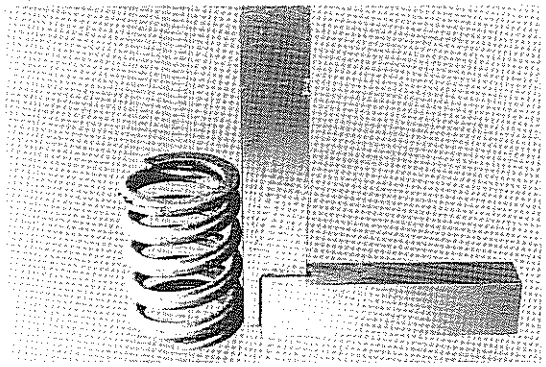
(8) Check valve concentricity.
Lightly coat seat with prussian blue. Install valve and rotate. If blue appears 360° around face, valve stem and face are concentric. If not, replace the valve.

Fig. 4-32



(9) Valve seat grinding
Turn the stem slightly with each light tap on the valve seat.

Fig. 4-33

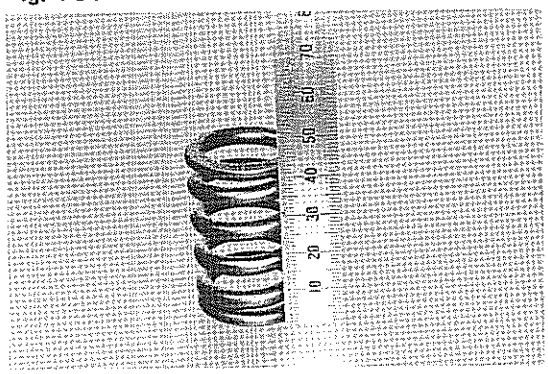


Valve Spring

1. Check the squareness of the valve springs with a steel square and surface plate. Turn the spring around slowly and observe the space between the top of the spring and the square. Replace the spring if it is out of square more than the specified limit.

Squarness limit: 1.9 mm (0.08 in.)

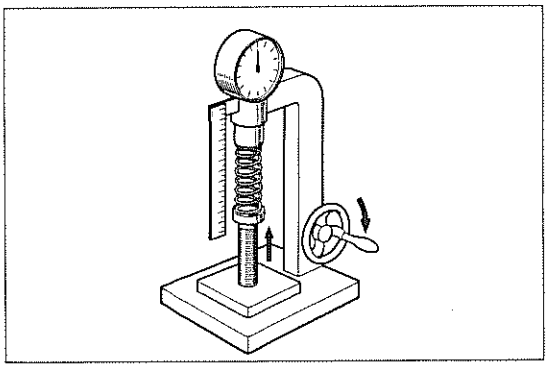
Fig. 4-34



2. Measure the spring free height. Replace springs that do not meet specification.

Free length: 42.1 mm (1.66 in.)

Fig. 4-35



3. Using a spring tester, measure the tension of each spring at the specified installed height. Replace any spring that does not meet specification.

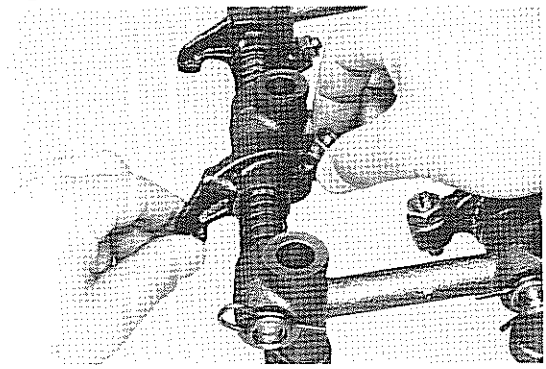
Installed length: 37.7 mm (1.48 in.)

Installed load:

STD 26.3 kg (58.0 lb)

Limit 23.7 kg (52.3 lb)

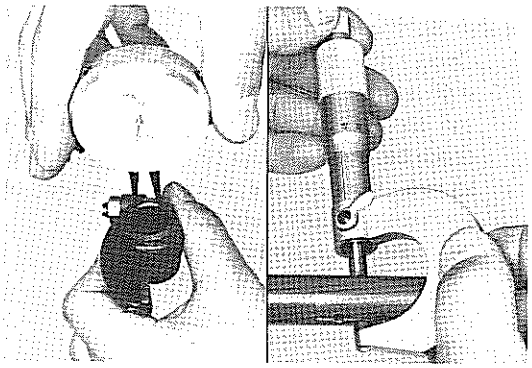
Fig. 4-36



Rocker Arm & Shaft

1. Check the rocker arm to shaft clearance. If worn excessively, disassemble and inspect.

Fig. 4-37



2. Measure the clearance with a dial indicator and outside micrometer.
If clearance exceeds the limit, replace the rocker arm bushings and/or shaft.

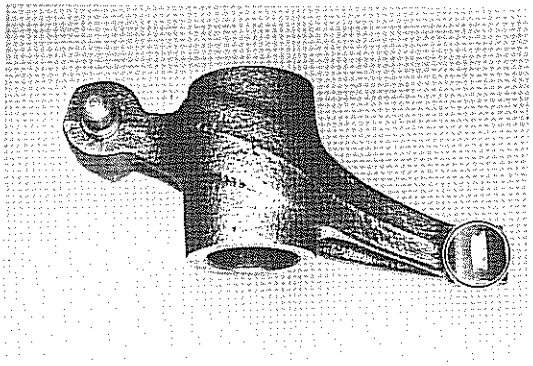
Oil clearance:

STD	**0.01 – 0.05 mm (0.0004 – 0.0020 in.)**
Limit	**0.06 mm (0.0024 in.)**

– Note –

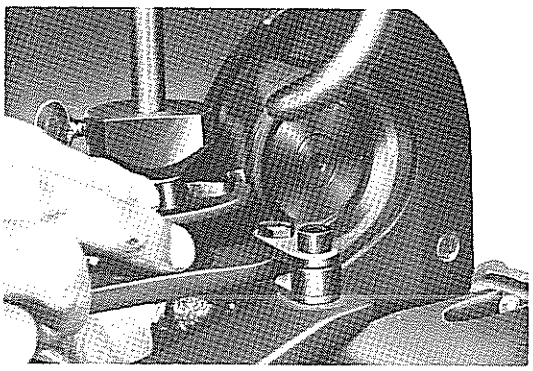
Measure at the maximum wear point on the rocker arm installation part.

Fig. 4-38



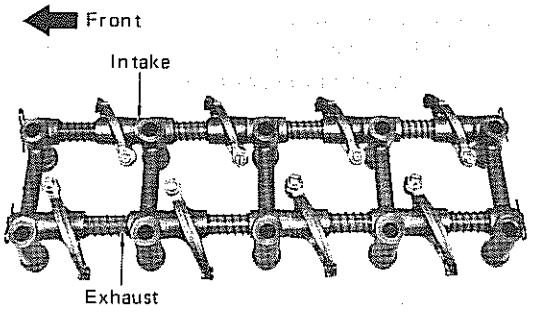
3. Check the contact surface of the valve rocker arm stem end.

Fig. 4-39



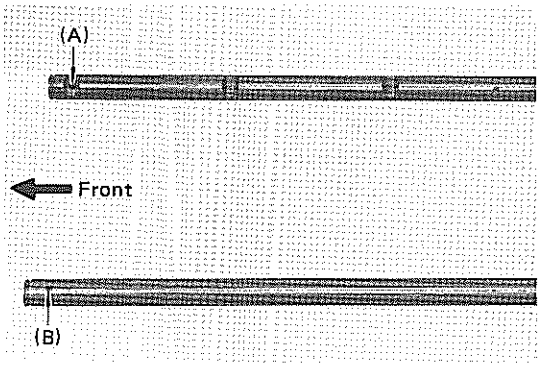
4. If the valve rocker arm surface contacting the valve stem end is worn excessively, either grind or replace the rocker arm.

Fig. 4-40



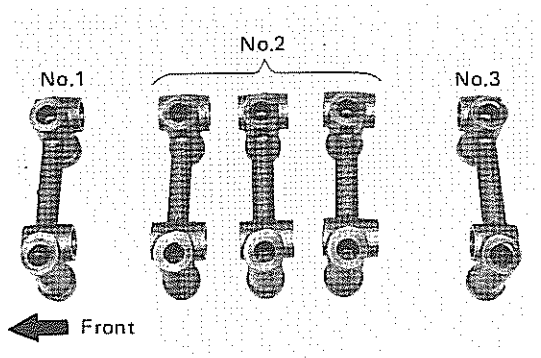
5. Assemble the rocker arm and shaft.
   (1) Assemble the rocker arm, springs and supports as shown in the figure.

Fig. 4-41



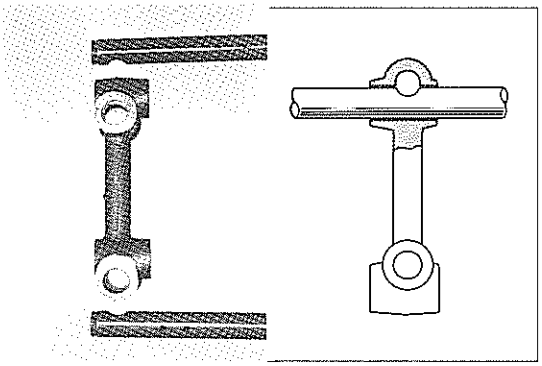
(2) Face the hole of intake rocker shaft (A) and exhaust rocker shaft (B) towards the front.

Fig. 4-42



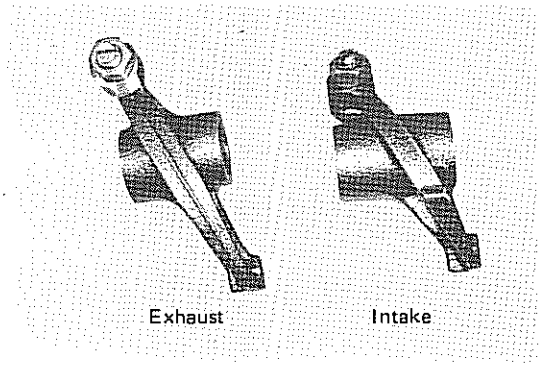
(3) As there are 3 types of rocker supports, install No.1 to the front side and No.3 to the rear side.
(4) Face the side of the rocker support with an F mark toward the front.
(5) The short rocker arm is for intake side.

Fig. 4-43



(6) Align the hole of the rocker support with the rocker shaft groove and install to the cylinder head bolt.

Fig. 4-44



(7) The short rocker arms are for intake and the long for exhaust.

Fig. 4-45

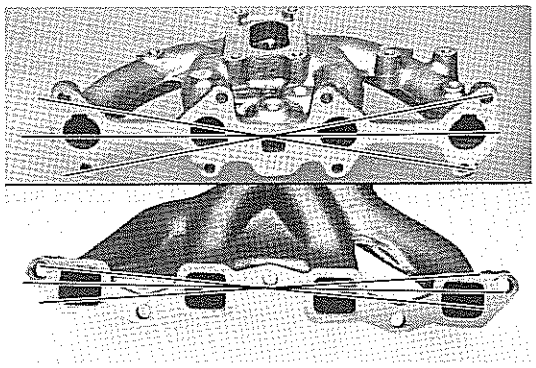
Manifold

1. Inspect the cylinder head contacting surfaces for warpage and replace the manifold if it exceeds the limit.

Installing surface warpage:

Limit 0.3 mm (0.01 in.)

Fig. 4-46



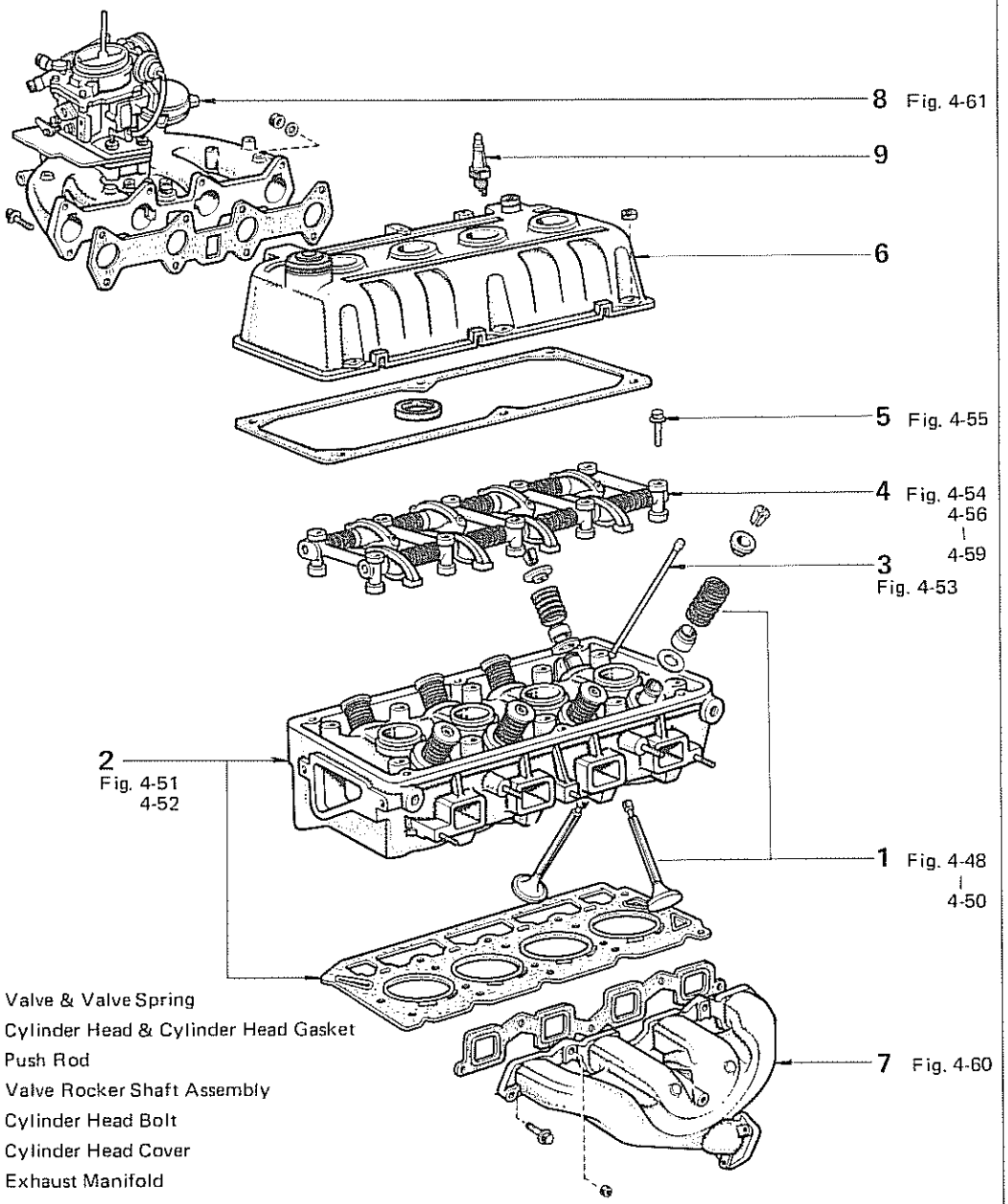
2. Check the manifold surface for flatness with a precision straight edge.

ASSEMBLY

Assemble the parts in the numerical order shown in the figure.

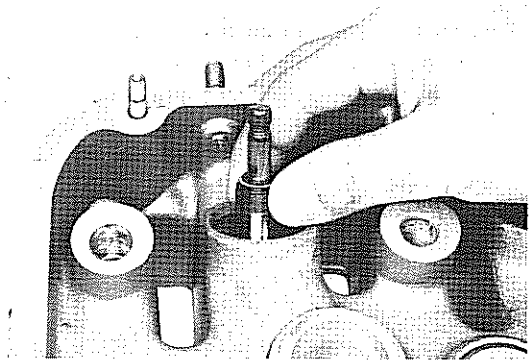
Fig. 4-47

- **Thoroughly clean the parts to be assembled.**
- **Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.**



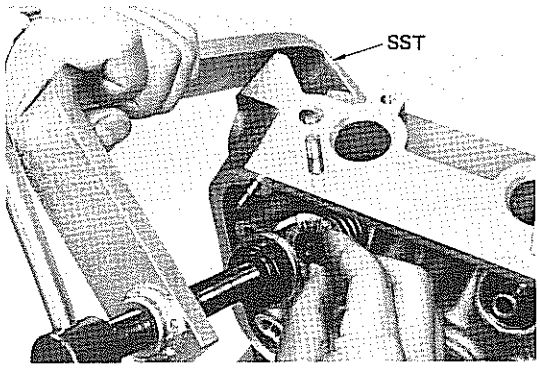
1. Valve & Valve Spring
2. Cylinder Head & Cylinder Head Gasket
3. Push Rod
4. Valve Rocker Shaft Assembly
5. Cylinder Head Bolt
6. Cylinder Head Cover
7. Exhaust Manifold
8. Intake Manifold
9. Spark Plug

Fig. 4-48



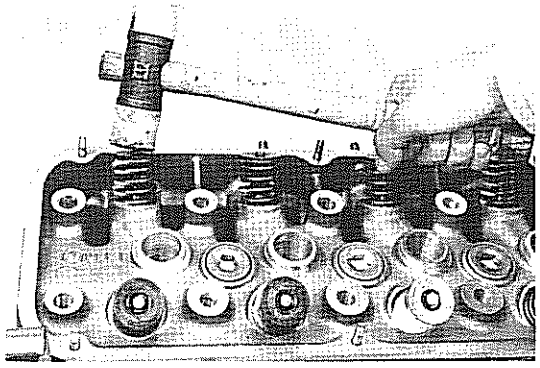
Install the spring seat and oil seal as shown in the figure. The head must be clean and the oil seal inserted to where the end contacts the spring seat top.

Fig. 4-49



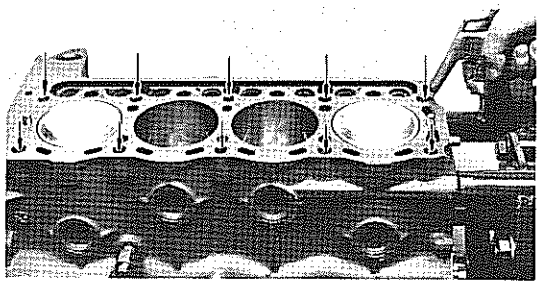
Assemble the valve spring and install the retainer locks with SST.
SST [09202-43012]

Fig. 4-50



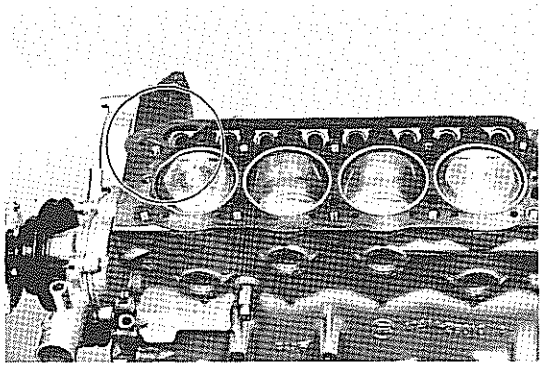
Tap the valve stems lightly to assure proper fit.

Fig. 4-51



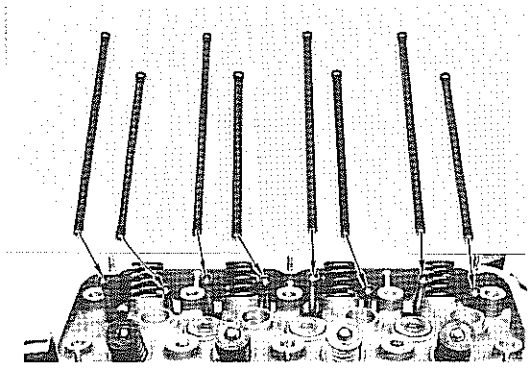
Clean the bolt hole with compressed air.

Fig. 4-52



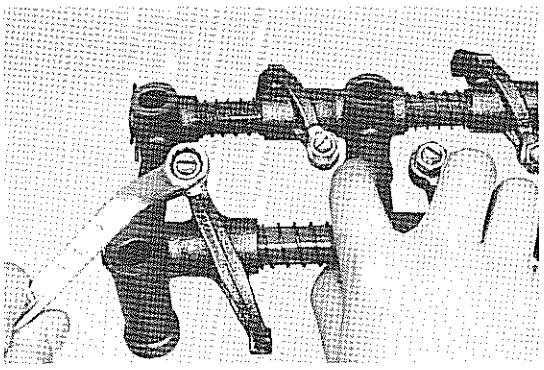
Install a new gasket as shown in the figure.

Fig. 4-53



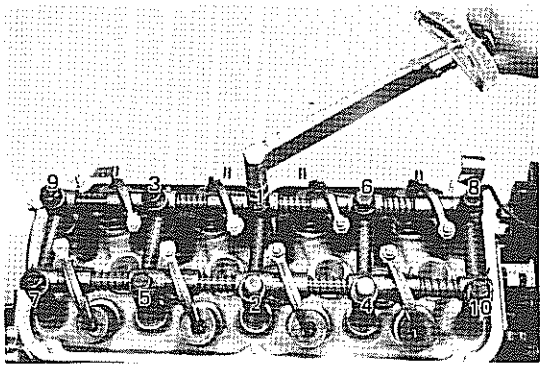
The short push rods are for intake and the long for exhaust.

Fig. 4-54



Loosen the adjusting screw lock nut before installing.

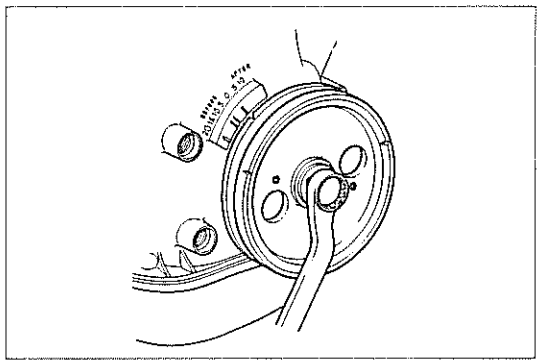
Fig. 4-55



Tighten each cylinder head bolt a little at a time to the specified torque in the sequence shown in the figure.

Tightening torque: 8.5 – 9.5 kg-m (61 – 69 ft-lb)

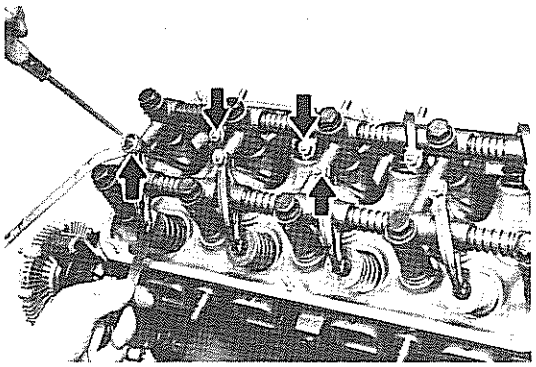
Fig. 4-56



Adjust the valve clearance.

1. Set No.1 cylinder TDC/compression.

Fig. 4-57



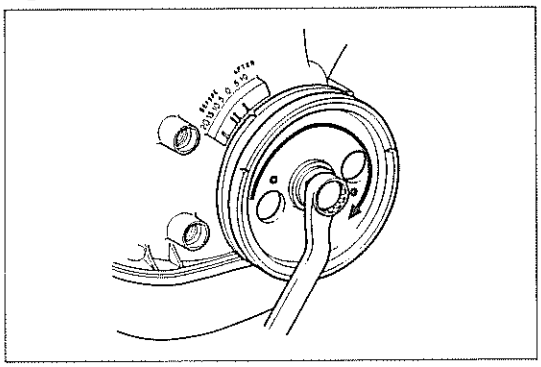
2. First, adjust the valve clearance of only the valves indicated by arrows in the figure.

Valve clearance:

IN 0.18 mm (0.007 in.)

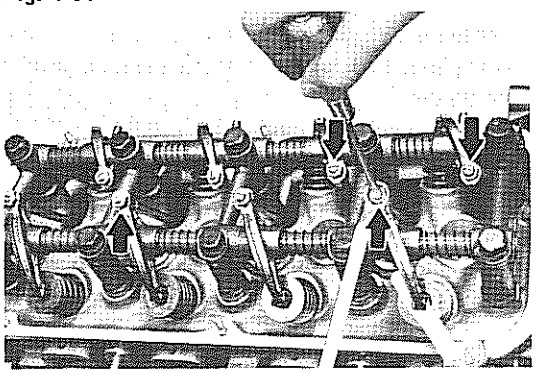
EX 0.30 mm (0.012 in.)

Fig. 4-58



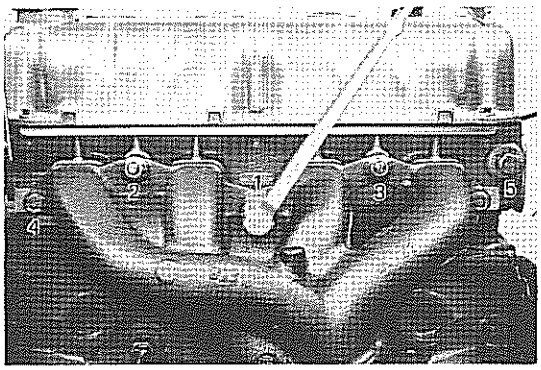
3. Turn the crankshaft 360° and align the mark.

Fig. 4-59



4. Next, adjust the clearances of the remaining valves (indicated by arrows).

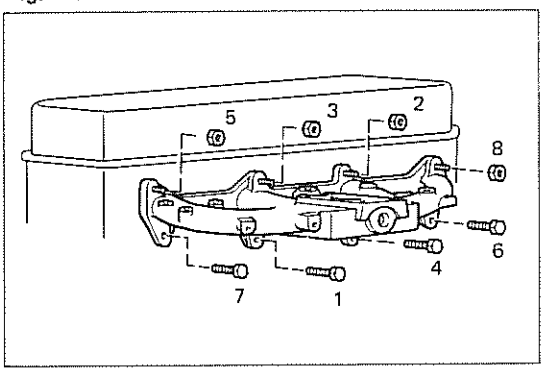
Fig. 4-60



5. Tighten the each exhaust manifold bolt and nut a little at a time to the specified torque in the sequence shown in the figure.

Tightening torque: 3.0 – 4.5 kg-m (22 – 32 ft-lb)

Fig. 4-61



6. Tighten the each intake manifold bolt and nut a little at a time to the specified torque in the sequence shown in the figure.

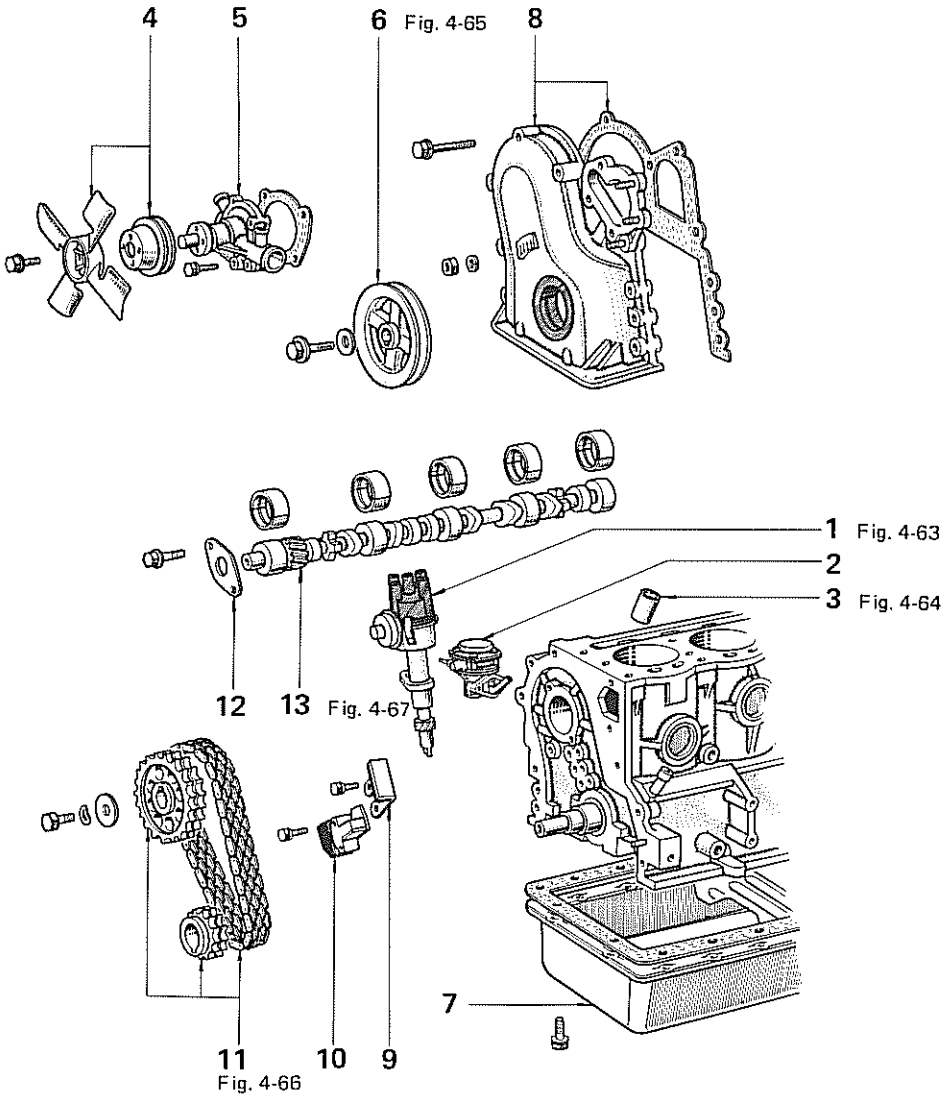
Tightening torque: 1.8 – 2.5 kg-m (13 – 18 ft-lb)

TIMING CHAIN

DISASSEMBLY

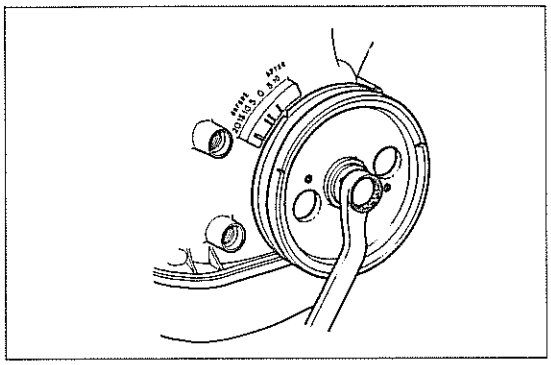
Disassemble the parts in the numerical order shown in the figure.

Fig. 4-62



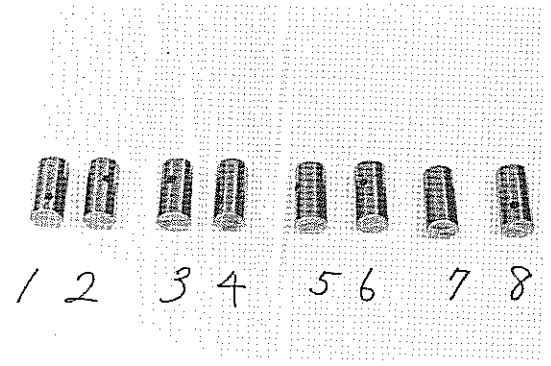
1. Distributor
2. Fuel Pump & Insulator
3. Valve Lifter
4. Fan & Fan Pulley
5. Water Pump
6. Crankshaft Pulley
7. Oil Pan
8. Timing Chain Cover & Gasket
9. Chain Damper
10. Chain Tensioner
11. Timing Chain & Timing Gear
12. Camshaft Thrust Plate
13. Camshaft

Fig. 4-63



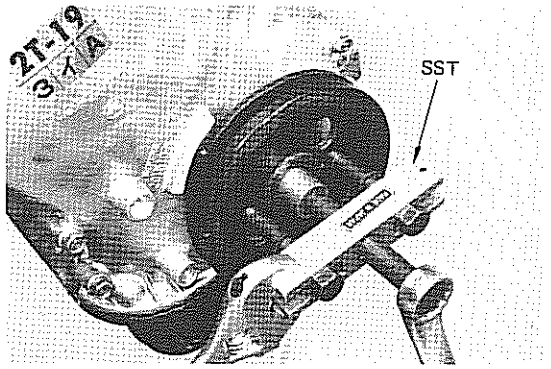
Set the No.1 cylinder to TDC/compression.

Fig. 4-64



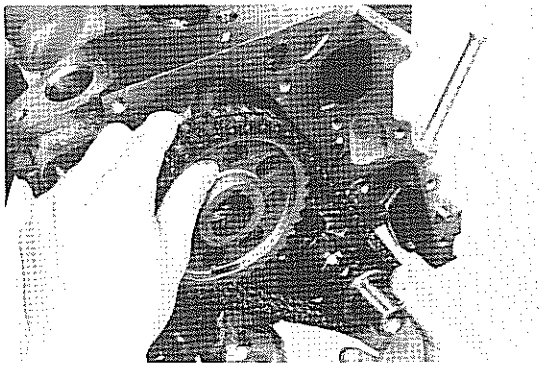
Arrange the valve lifters in order.

Fig. 4-65



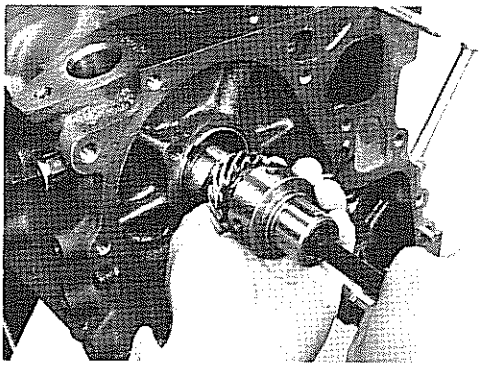
Remove the crankshaft pulley with SST.
SST[09213-31021]

Fig. 4-66



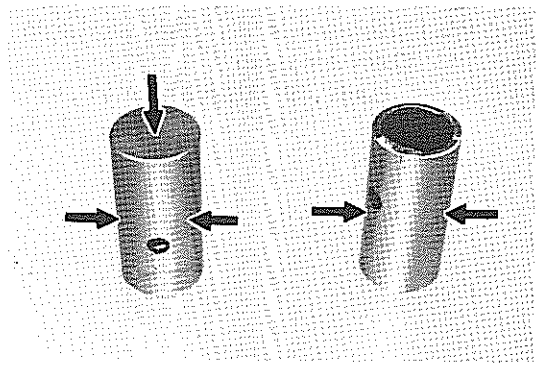
Remove the both gears by pulling them out uniformly.

Fig. 4-67



While turning the camshaft, slowly pull out so as not to damage the camshaft bearing.

Fig. 4-68

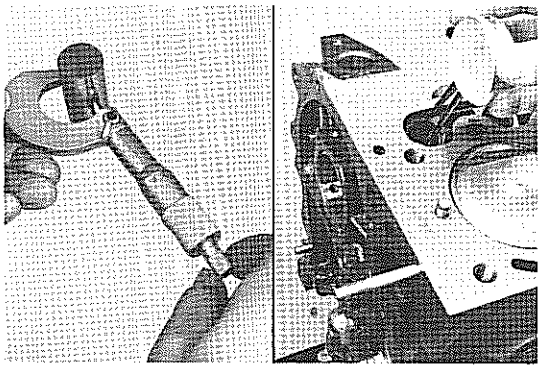


INSPECTION & REPAIR

Valve Lifter

Check the valve lifter for wear or damage.

Fig. 4-69



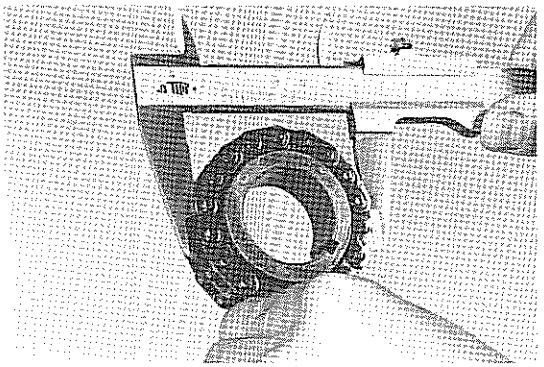
Inspect the lifters and lifter bores for wear.

Oil clearance:

STD 0.02 – 0.03 mm (0.0008 – 0.0012 in.)

Limit 0.1 mm (0.004 in.)

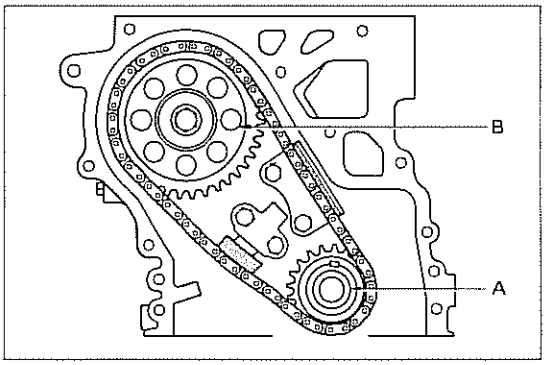
Fig. 4-70



Timing Gear & Chain

1. Inspect gears and chains for cracks, wear or chipped teeth.
   If damaged, replace gears and chain.
2. Measure the gear for wear in the method shown in the figure.

Fig. 4-71



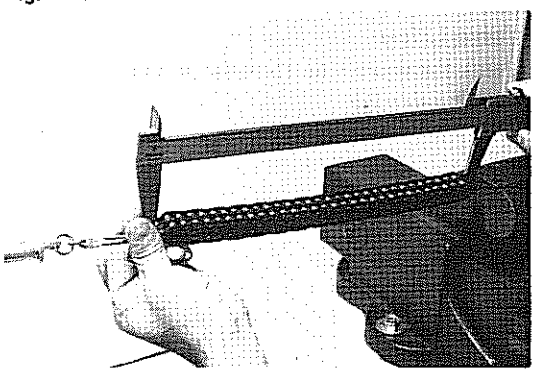
3. If measurement is below limit, replace gears and chains.

Wear limit:

A Crankshaft sprocket 59.4 mm (2.34 in.)

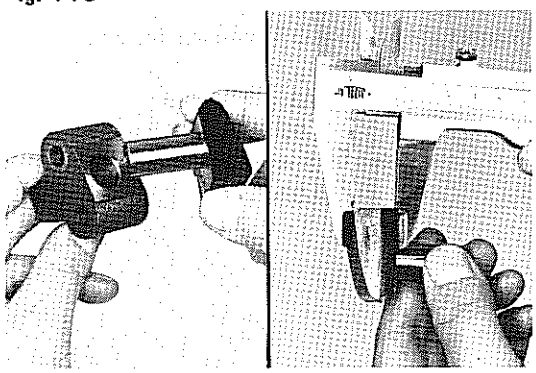
B Camshaft sprocket 113.8 mm (4.48 in.)

Fig. 4-72



4. Measure the elongation of the timing chain.
   Chain elongation:
   Limit 291.4 mm tension at 5 kg
   (11.47 in.) (11 lb)

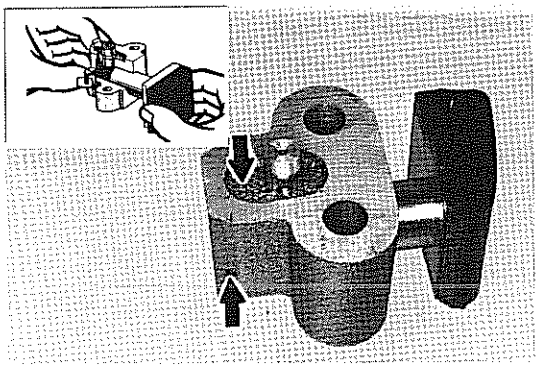
Fig. 4-73



Chain Tensioner

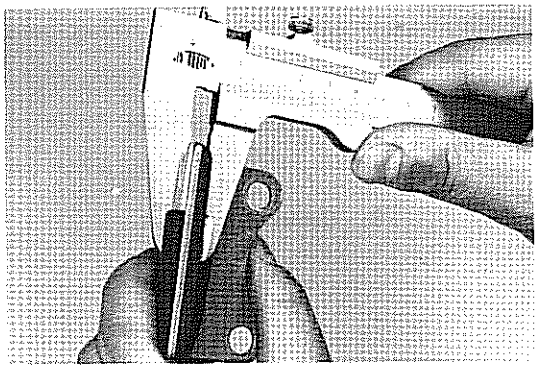
1. Check the body and plunger for wear and measure the tensioner head as shown in the figure. If worn down over the limit, replace as a unit.
   Plunger head thickness:
   Limit 12.5 mm
   (0.49 in.)

Fig. 4-74



2. Tensioner plunger and body cylinder air tightness test.
   Take out the plunger spring. Coat the plunger with engine oil, close off the 2 oil orifices on the tensioner body and pull the plunger. If there is a return pulling force on the plunger, it is air tight.

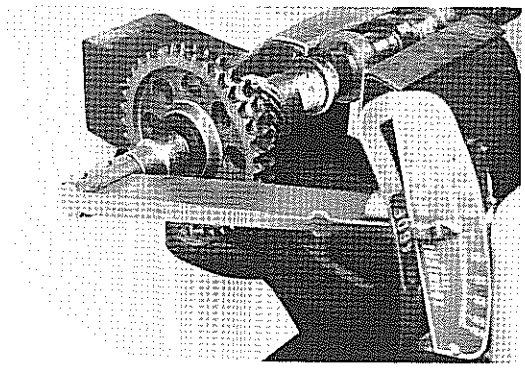
Fig. 4-75



Chain Damper

Inspect the chain damper for wear.
Measure chain damper and check for wear.
Damper thickness: Limit 5.0 mm
(0.20 in.)

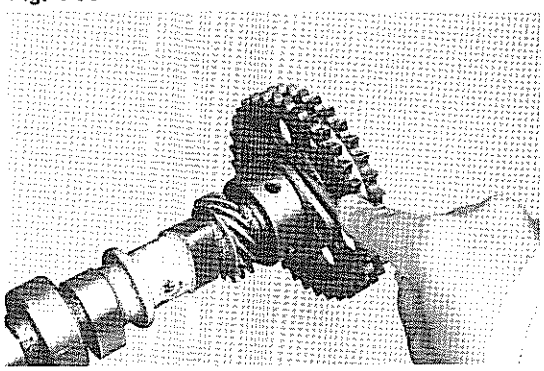
Fig. 4-76



Timing Gear & Thrust Plate

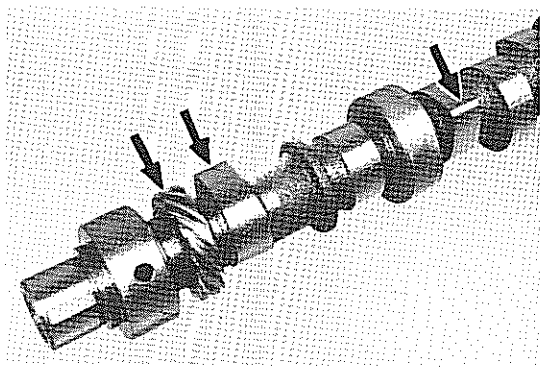
1. Install the thrust plate and timing gear to the camshaft.
   Tighten the camshaft timing gear set bolt.
   Tightening torque: 7.0 – 11.0 kg-m (51 – 79 ft-lb)

Fig. 4-77



2. Measure the thrust clearance.
   If it exceeds limit, replace the thrust plate.
   Thrust clearance:
   STD 0.07 – 0.15 mm (0.003 – 0.006 in.)
   Limit 0.3 mm (0.01 in.)

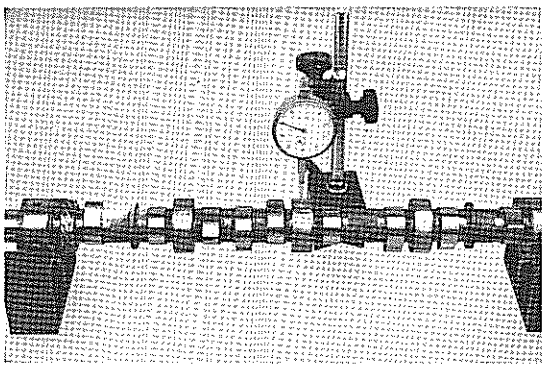
Fig. 4-78



Camshaft

1. Inspect the gear and cam for cracks, wear or chipped teeth.
   If damaged, replace the camshaft.

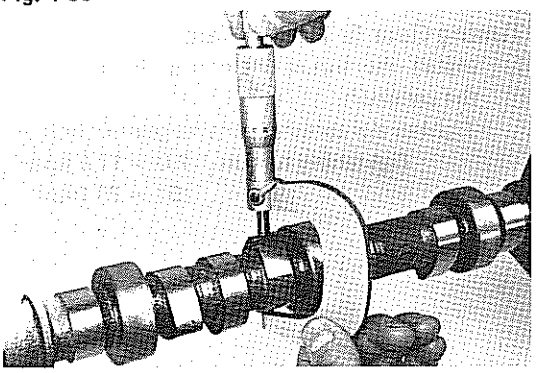
Fig. 4-79



2. Check the camshaft for runout. Replace camshaft if it exceeds the limit.
   Runout limit: 0.06 mm (0.002 in.)

– Note –
Rotate the camshaft one turn, and divide the maximum gauge difference by 2.

Fig. 4-80

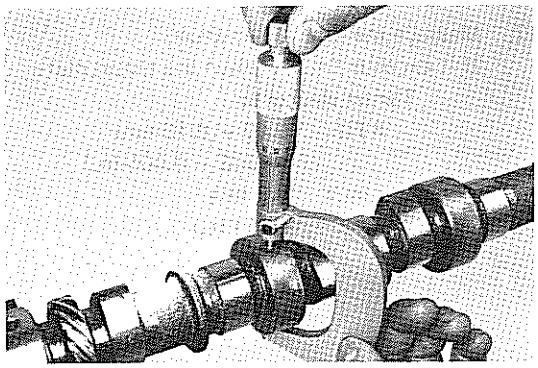


3. Measure the cam lobe height. If wear exceeds the limit, replace the camshaft.

Cam height:

Limit	**IN**	**38.29 mm (1.507 in.)**
	EX	**38.19 mm (1.504 in.)**

Fig. 4-81

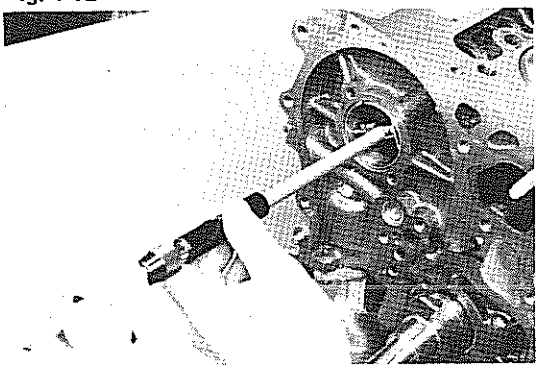


4. Measure the oil clearance.
   (1) Measure the camshaft journal.

Journal diameter:

No.1	**46.459 – 46.475 mm (1.8291 – 1.8297 in.)**
No.2	**46.209 – 46.225 mm (1.8192 – 1.8199 in.)**
No.3	**45.959 – 45.975 mm (1.8094 – 1.8100 in.)**
No.4	**45.709 – 45.725 mm (1.7996 – 1.8002 in.)**
No.5	**45.459 – 45.475 mm (1.7897 – 1.7904 in.)**

Fig. 4-82

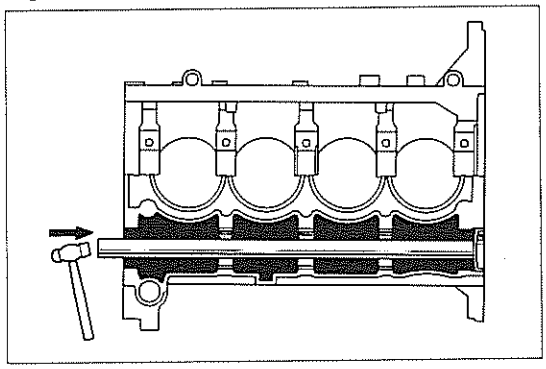


   (2) Measure the inner diameter of the bearing.

Oil clearance:

STD	**0.025 – 0.066 mm (0.0010 – 0.0026 in.)**
Limit	**0.1 mm (0.004 in.)**

Fig. 4-83



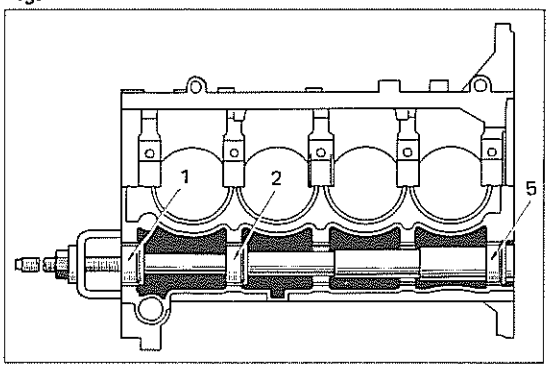
Replace The Camshaft Bearing

When replacing, use SST and remove parts in the following order:

SST [09215-25010]

1. Tight plug

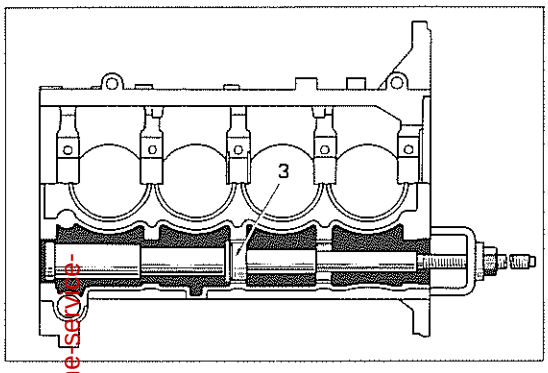
Fig. 4-84



2. Remove the No.1, No.2 and No.5 bearings.

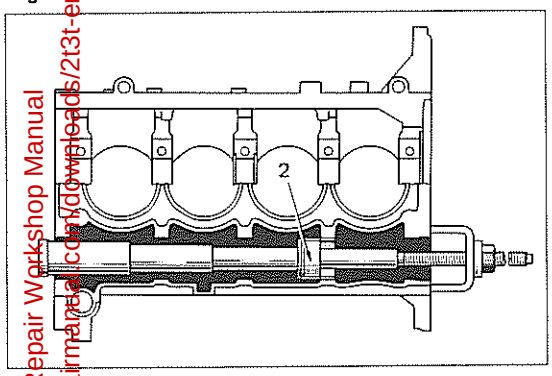
– Note –
The numbers 1 through 5 imprinted on the SST refer to the bearing number.
SST [09215-25010]

Fig. 4-85



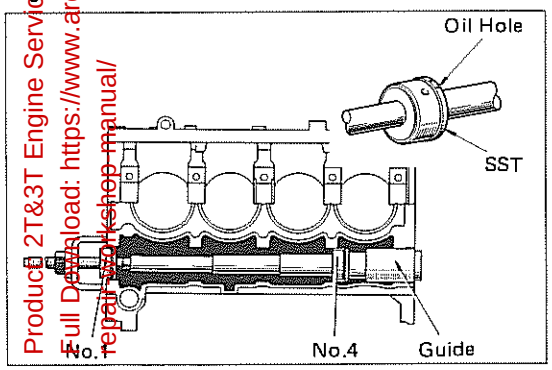
3. Remove the No.3 bearing.
Pull the No.3 bearing rearward and leave it in the cylinder block.

Fig. 4-86



4. Remove the No.3 and No.4 bearings.
Insert No.2 piece into the No.3 bearing in the block and remove both No.3 and No.4 bearings together.

Fig. 4-87



5. Install the No.4 bearing.
Use No.1 bearing as a guide.

– Note –
When inserting the bearings, align each oil hole with those on each piece.