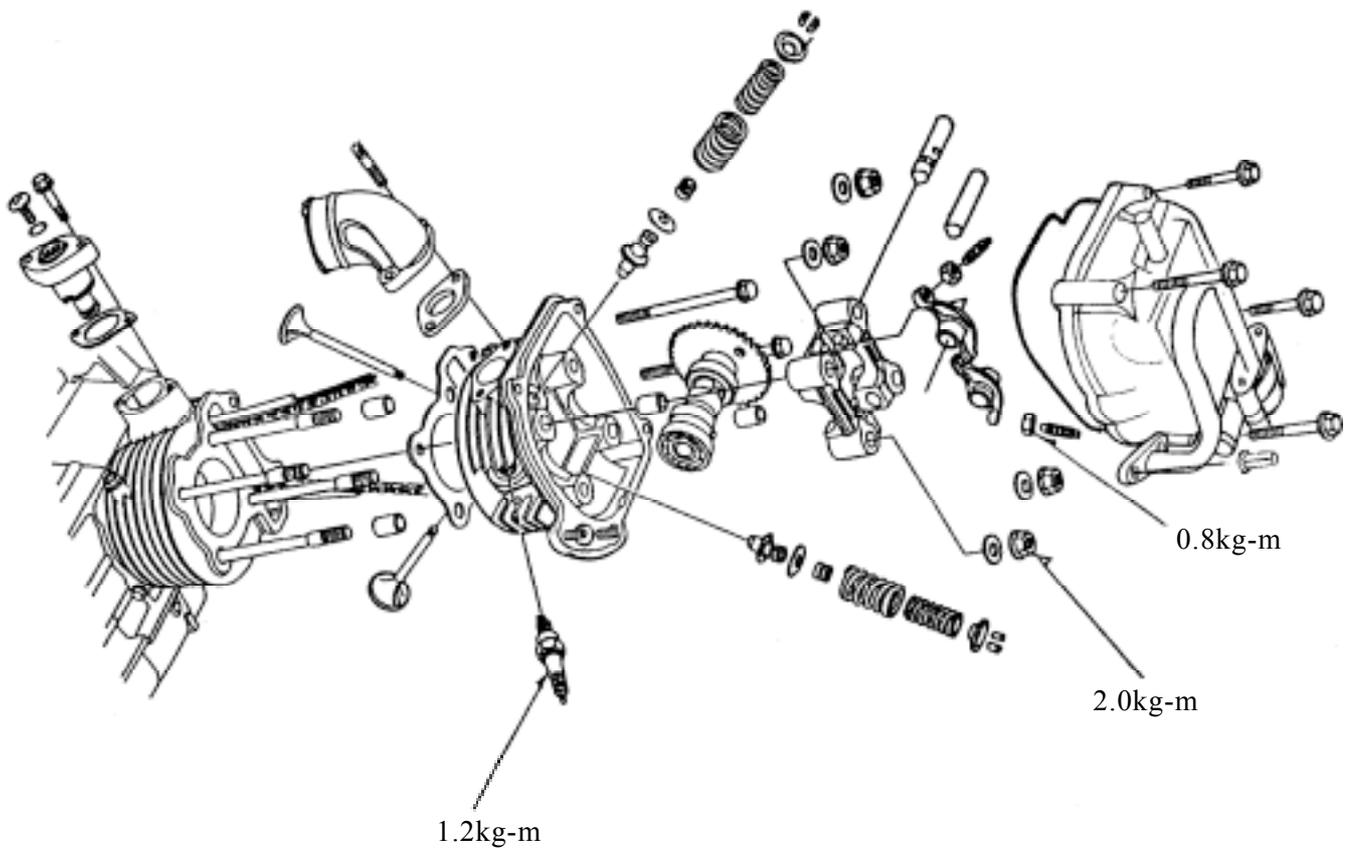


## 7. CYLINDER HEAD/VALVES

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## 7. CYLINDER HEAD/VALVES

SERVICE INFORMATION.....	7-1	VALVE GUIDE REPLACEMENT.....	7- 9
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CYLINDER HEAD DISASSEMBLY.....	7-7	CAMSHAFT INSTALLATION.....	7-14

### SERVICE INFORMATION

#### GENERAL INSTRUCTIONS

- The cylinder head can be serviced with the engine installed in the frame.
- When assembling, apply molybdenum disulfide grease or engine oil to the valve guide movable parts, valve arm and camshaft sliding surfaces for initial lubrication.
- The camshaft is lubricated by engine oil through the cylinder head engine oil passages. Clean and unclog the oil passages before assembling the cylinder head.
- After disassembly, clean the removed parts and dry them with compressed air before inspection.
- After removal, mark and arrange the removed parts in order. When assembling, install them in the reverse order of removal.

#### SPECIFICATIONS

Item		Standard (mm)	Service Limit (mm)
Valve clearance (cold)	IN	0.12	□
	EX	0.12	□
Cylinder head compression pressure		12.8kg/cm <sup>2</sup> ÷ 570rpm	
Cylinder head warpage		□	
Camshaft cam height	IN	25.965	25.57
	EX	25.810	25.41
Valve rocker arm I.D.	IN	10.000_ 10.015	10.10
	EX	10.000_ 10.015	10.10
Valve rocker arm shaft O.D.	IN	9.972_ 9.987	9.91
	EX	9.972_ 9.987	9.91
Valve seat width	IN	1.0	1.8
	EX	1.0	1.8
Valve stem O.D.	IN	4.975_ 4.990	4.90
	EX	4.955_ 4.970	4.90
Valve guide I.D.	IN	5.000_ 5.012	5.03
	EX	5.000_ 5.012	5.03
Valve stem-to-guide clearance	IN	0.010_ 0.037	0.08
	EX	0.030_ 0.057	0.10

# 7. CYLINDER HEAD/VALVES

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## TORQUE VALUES

Cylinder head nut	2.0kg-m	Apply engine oil to threads
Valve clearance adjusting nut	0.9kg-m	Apply engine oil to threads

## SPECIAL TOOLS

Valve spring compressor	
Valve seat cutter, 24.5mm	45° IN/EX
Valve seat cutter, 25mm	Plane cutter 32° IN
Valve seat cutter, 22mm	Plane cutter 32° EX
Valve seat cutter, 26mm	Plane cutter 60° IN/EX
Cutter clip, 5mm	
Valve spring compressor attachment	
Valve wrench	
Valve guide driver	
Valve guide reamer	

## TROUBLESHOOTING

- The poor cylinder head operation can be diagnosed by a compression test or by tracing engine top-end noises.

### Poor performance at idle speed

- Compression too low

### Compression too low

- Incorrect valve clearance adjustment
- Burned or bent valves
- Incorrect valve timing
- Broken valve spring
- Poor valve and seat contact
- Leaking cylinder head gasket
- Warped or cracked cylinder head
- Poorly installed spark plug

### Compression too high

- Excessive carbon build-up in combustion chamber

### White smoke from exhaust muffler

- Worn valve stem or valve guide
- Damaged valve stem seal

### Abnormal noise

- Incorrect valve clearance adjustment
- Sticking valve or broken valve spring
- Damaged or worn camshaft
- Worn cam chain guide
- Worn camshaft and rocker arm

## 7. CYLINDER HEAD/VALVES

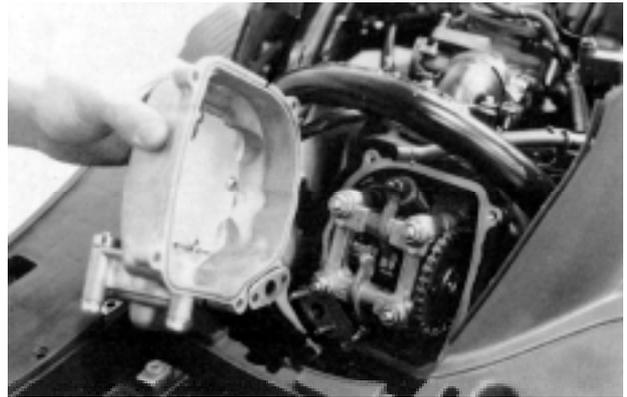
### CAMSHAFT REMOVAL

Remove the center cover. (⇒2-3)

Remove the four cylinder head cover bolts to remove the cylinder head cover.

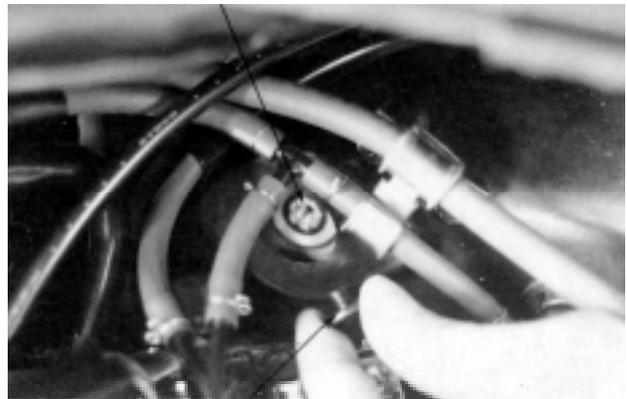
Remove the two nuts attaching the secondary air inlet tube.

Cylinder Head Cover



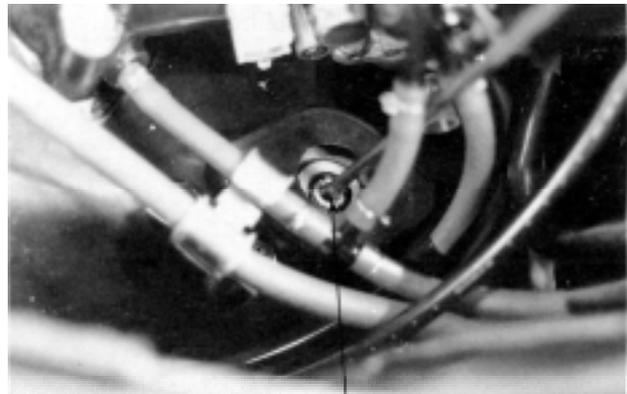
Remove the cam chain tensioner cap screw and the O-ring.

O-ring



Screw

Turn the cam chain tensioner screw clockwise to tighten it.



Tensioner Screw

Turn the flywheel counterclockwise so that the "T" mark on the flywheel aligns with the index mark on the crankcase to bring the round hole on the camshaft gear facing up to the top dead center on the compression stroke.

Camshaft Gear



Round Hole

Punch Marks

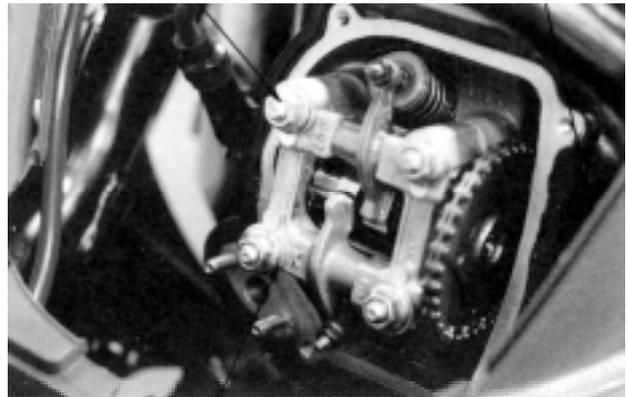
## 7. CYLINDER HEAD/VALVES

Remove the two cylinder head bolts.  
Remove the four cylinder head nuts and washers.

\* Diagonally loosen the cylinder head nuts in 2 or 3 times.

Nut

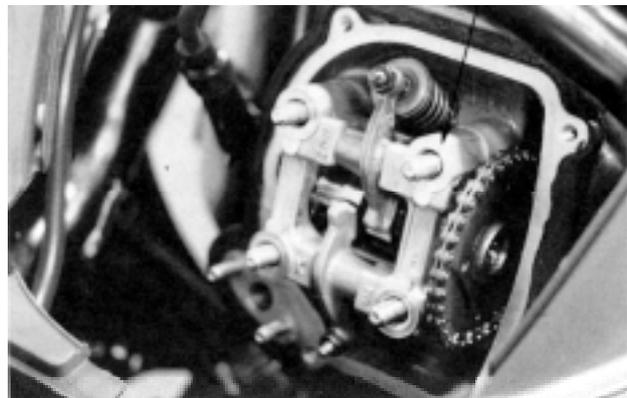
Bolt



Washer

Camshaft Holder

Remove the camshaft holder and dowel pins.



Camshaft

Dowel Pins

Remove the camshaft gear from the cam chain and remove the camshaft.



Cam Chain

Camshaft Gear

### CAMSHAFT INSPECTION

Check each cam lobe for wear or damage.  
Measure the cam lobe height.

#### Service Limits:

IN : 25.57mm replace if below

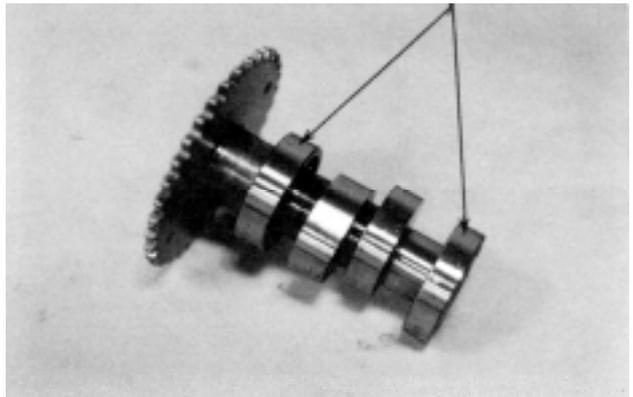
EX: 25.41mm replace if below



## 7. CYLINDER HEAD/VALVES

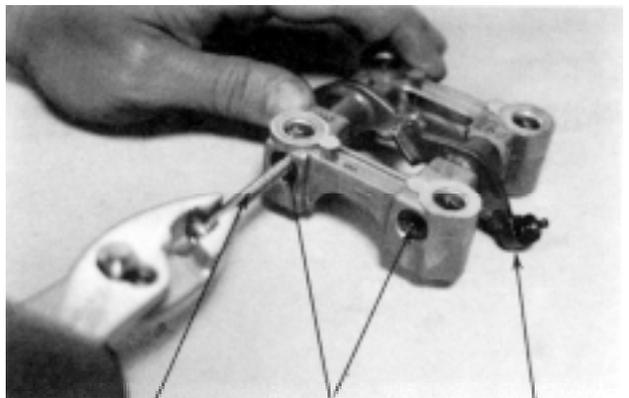
Check each camshaft bearing for play or damage. Replace the camshaft assembly with a new one if the bearings are noisy or have excessive play.

Camshaft Bearings



### CAMSHAFT HOLDER DISASSEMBLY

Take out the valve rocker arm shafts using a 5mm bolt.  
Remove the valve rocker arms.

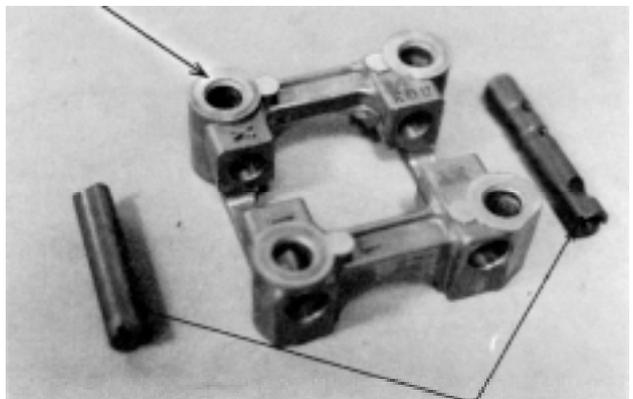


5mm Bolt Rocker Arm Shaft Rocker Arm  
Camshaft Holder

### CAMSHAFT HOLDER INSPECTION

Inspect the camshaft holder, valve rocker arms and rocker arm shafts for wear or damage.

\* If the valve rocker arm contact surface is worn, check each cam lobe for wear or damage.



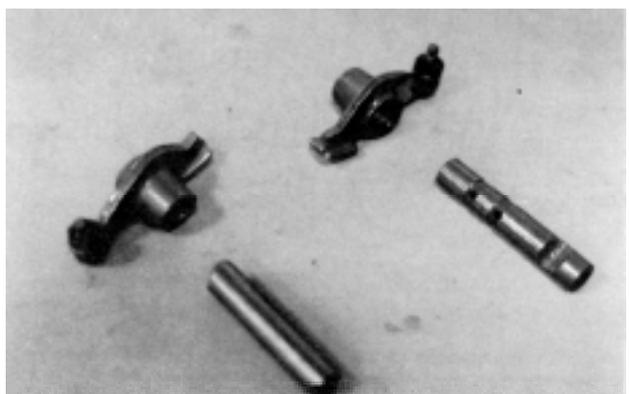
Rocker Arm Shafts

Measure the I.D. of each valve rocker arm.

**Service Limits:** IN: 10.10mm replace if over  
EX: 10.10mm replace if over

Measure each rocker arm shaft O.D.

**Service Limits:** IN: 9.91mm replace if over  
EX: 9.91mm replace if over



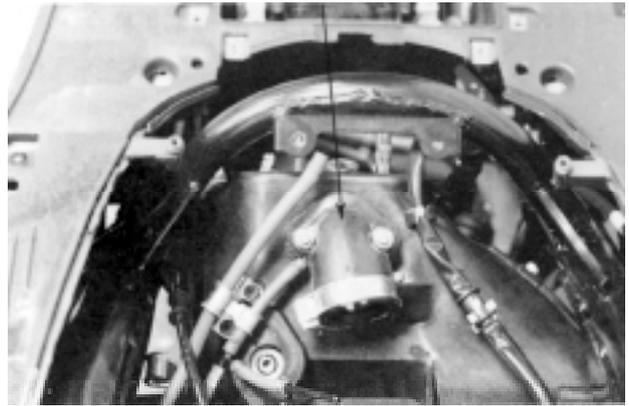
## 7. CYLINDER HEAD/VALVES

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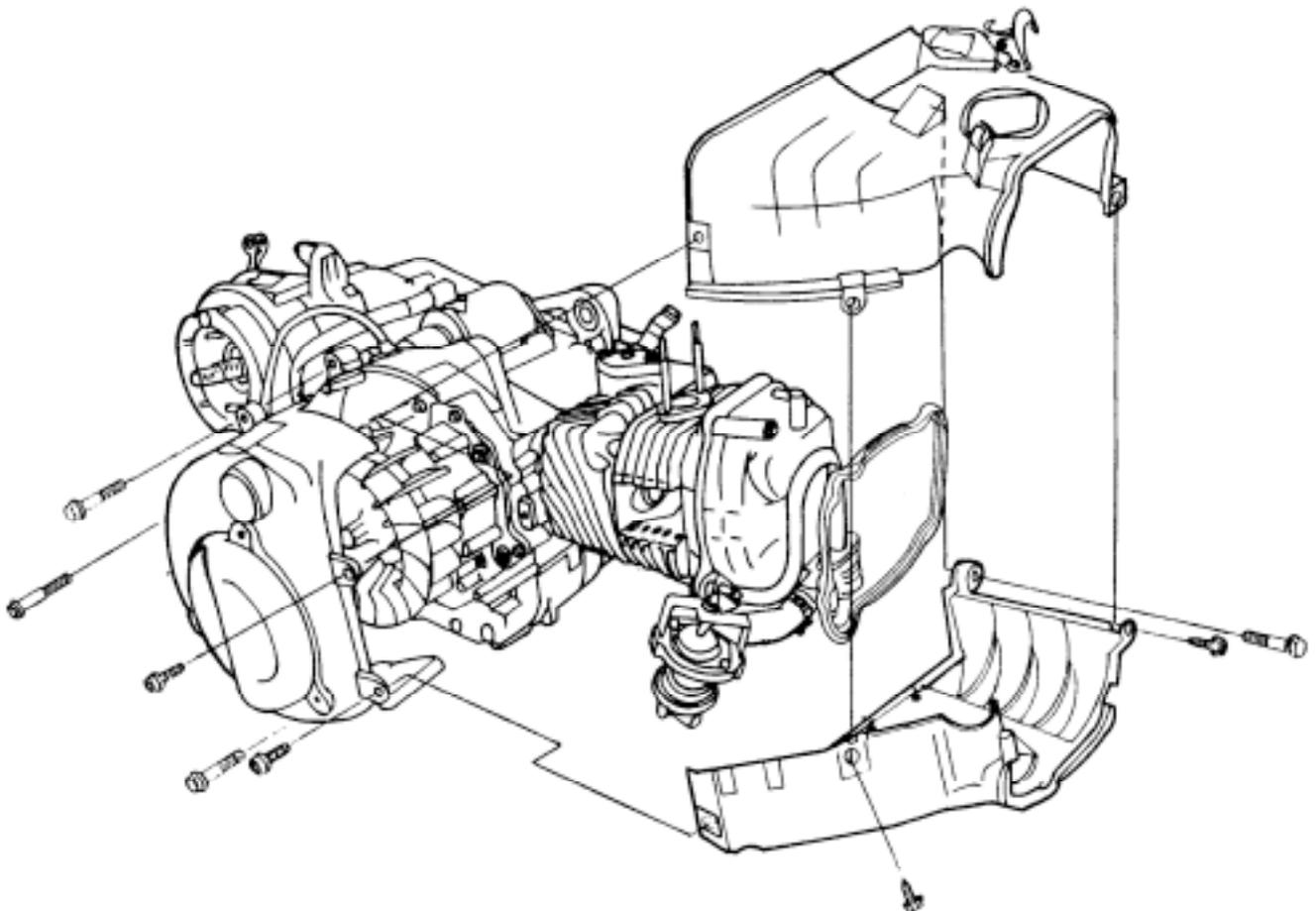
### CYLINDER HEAD REMOVAL

- Remove the camshaft. (⇒7-3)
- Remove the carburetor. (⇒5-3)
- Remove the exhaust muffler. (⇒2-6)
- Remove the carburetor intake manifold.

Intake Manifold



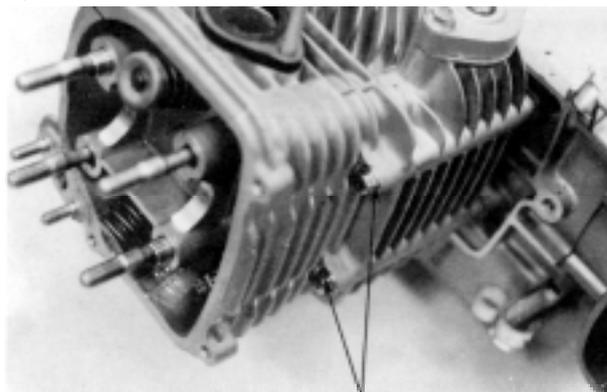
- Remove the cooling fan cover. (⇒14-6)
- Remove the engine cover bolts and screws.
- Separate the engine cover joint claws.



## 7. CYLINDER HEAD/VALVES

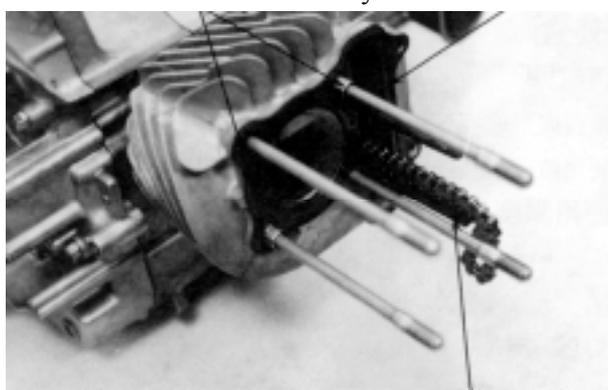
Remove the cylinder head.

Cylinder Head



Remove the dowel pins and cylinder head gasket.  
Remove the cam chain guide.

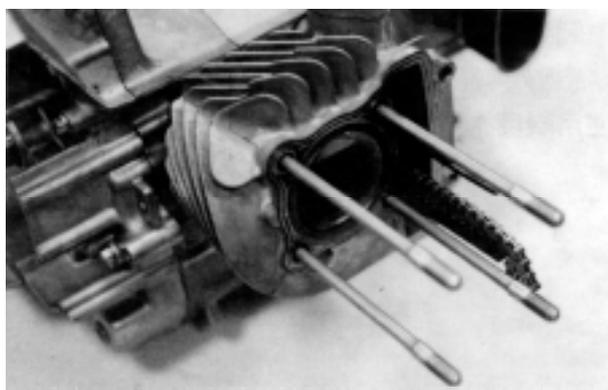
Dowel Pins      Bolts  
Cylinder Head Gasket



Cam Chain Guide

Remove all gasket material from the cylinder mating surface.

- \* Avoid damaging the cylinder mating surface.
- \* Be careful not to drop any gasket material into the engine.



### CYLINDER HEAD DISASSEMBLY

Remove the valve spring cotters, retainers, springs, spring seats and valve stem seals using a valve spring compressor.

- \* Be sure to compress the valve springs with a valve spring compressor.
- \* Mark all disassembled parts to ensure correct reassembly.

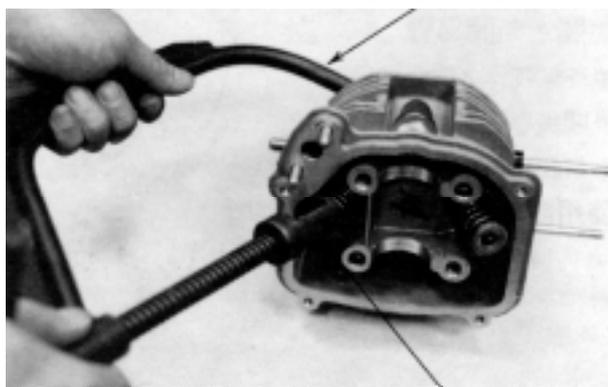
Special

Valve Spring Compressor

Special

Valve Spring Compressor Attachment

Valve Spring Compressor



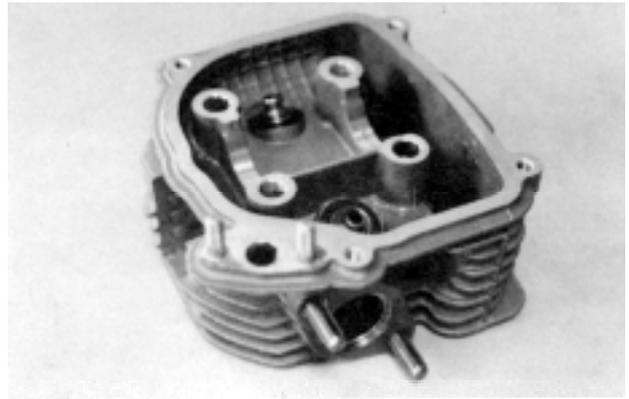
Valve Spring Compressor Attachment

## 7. CYLINDER HEAD/VALVES

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Remove carbon deposits from the combustion chamber.  
Clean off any gasket material from the cylinder head mating surface.

\* Be careful not to damage the cylinder head mating surface.



### INSPECTION

#### CYLINDER HEAD

Check the spark plug hole and valve areas for cracks.

Check the cylinder head for warpage with a straight edge and feeler gauge.

**Service Limit:** 0.05mm repair or replace if over

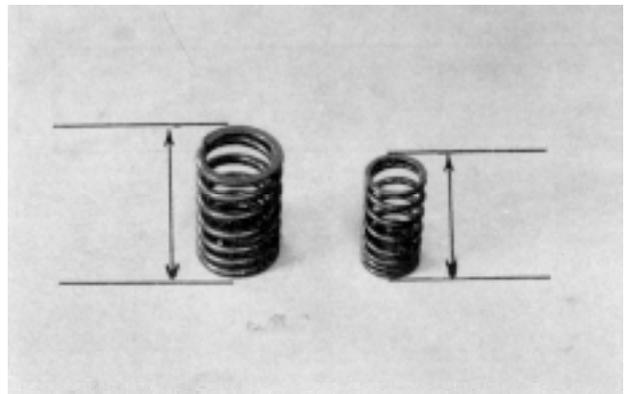
#### VALVE SPRING FREE LENGTH

Measure the free length of the inner and outer valve springs.

**Service Limits:**

Inner : 31.2mm replace if below

Outer : 34.1mm replace if below



#### VALVE /VALVE GUIDE

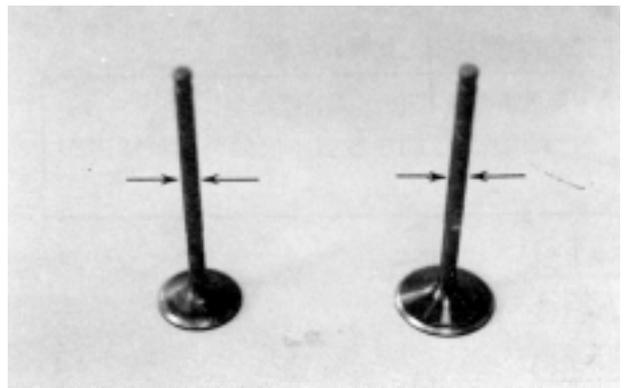
Inspect each valve for bending, burning, scratches or abnormal stem wear.

Check valve movement in the guide.

Measure each valve stem O.D.

**Service Limits:** IN : 4.90mm replace if below

EX: 4.90mm replace if below



## 7. CYLINDER HEAD/VALVES

Ream the guides to remove any carbon build-up using a valve guide reamer.

**Special**

Valve Guide Reamer

- \* During this operation, rotate the reamer clockwise and do not insert or remove it straight when it is stopped.

Measure each valve guide I.D.

**Service Limits:** IN : 5.03mm replace if over  
EX: 5.03mm replace if over

Subtract each valve stem O.D. from the corresponding guide I.D. to obtain the stem-to-guide clearance.

**Service Limits:** IN : 0.08mm replace if over  
EX: 0.10mm replace if over

- \* If the stem-to-guide clearance exceeds the service limits, replace the guides as necessary. Reface the valve seats whenever the valve guides are replaced.

### VALVE GUIDE REPLACEMENT

Heat the cylinder head to 100\_ 150°C for this operation.

- \* The cylinder head must be heated evenly and rapidly to avoid warpage.
- \* Wear heavy gloves when handling the heated cylinder head to avoid burns.

Drive out the old valve guides.

- \* Be careful not to damage the cylinder head mating surface.

**Special**

Valve Guide Driver

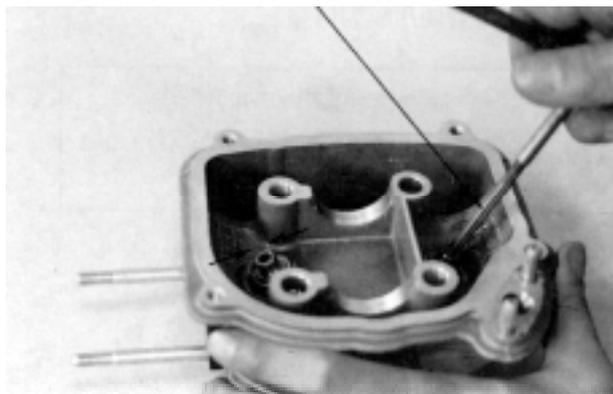
Apply engine oil to a new O-ring and drive a new valve guide from the camshaft side. The cylinder head should still be hot for installation of a new guide.

- \* Be careful not to damage the cylinder head mating surface.
- \* After drive in the new guide, check it for damage.

**Special**

Valve Guide Driver

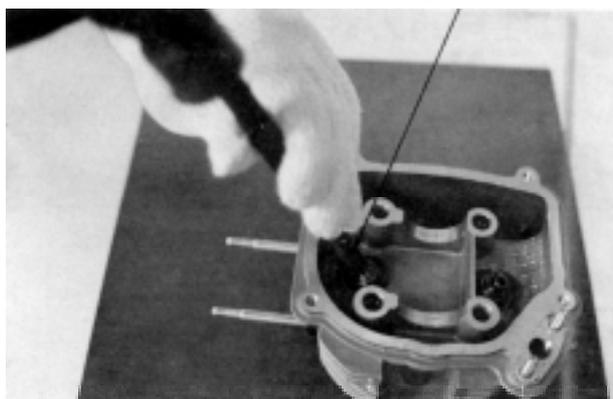
Valve Guide Reamer



Valve Guide Driver



Valve Guide Driver



# 7. CYLINDER HEAD/VALVES

Ream the new valve guides with a valve guide reamer.

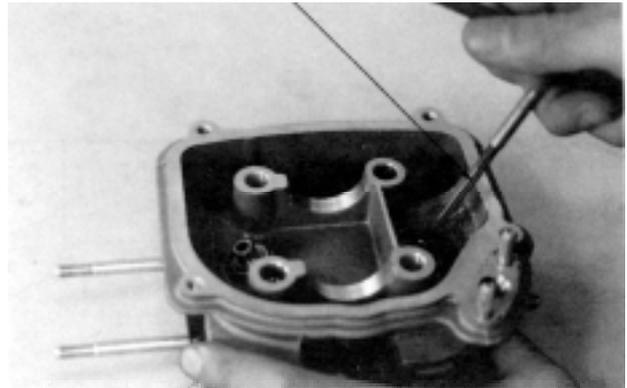
- \* Use cutting oil on the reamer during this operation.
- Rotate the reamer clockwise and do not insert or remove it straight when it is stopped.

Clean the cylinder head and remove any metal particles.

**Special**

Valve Guide Reamer

Valve Guide Reamer



## VALVE SEAT INSPECTION & REFACING

### VALVE SEAT INSPECTION

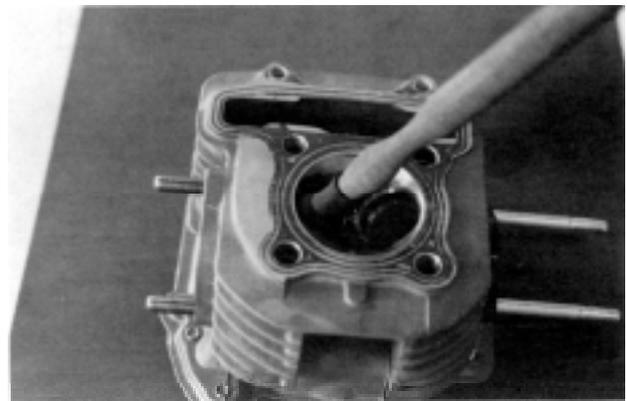
Remove carbon deposits from the combustion chamber and valves.

Apply emery to each valve and valve seat contact face.

Lap each valve using a hand lapper.

Remove the valve and inspect the face.

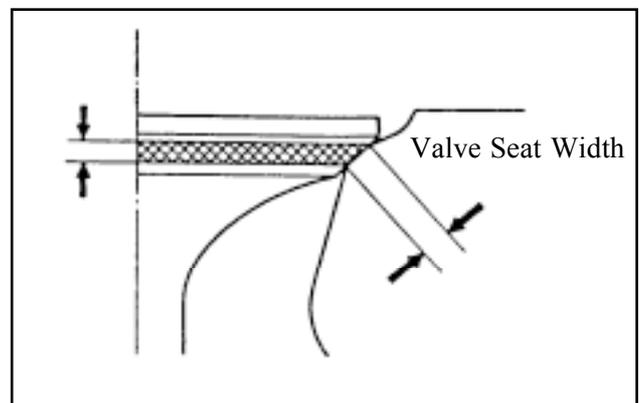
If the valve face is rough, worn unevenly, or contacts the seat improperly, the valve must be replaced.



Inspect the valve seat width.

**Service Limit:** 1.8mm replace if over

If the seat is too wide or too narrow, the seat must be ground using a valve seat cutter.



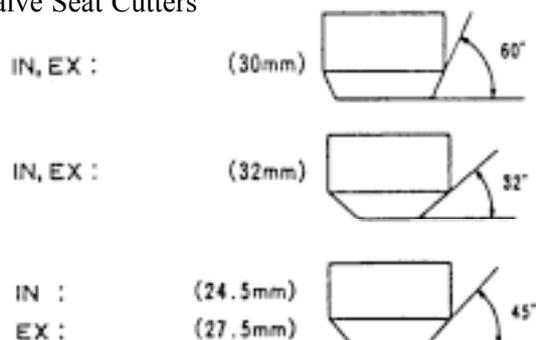
### VALVE SEAT CUTTERS

Refer to the Instructions supplied with the Valve Seat Refacing Equipment for details.

When refacing the seat, apply a force of 4\_ 5kg to press the valve seat cutter for grinding operation.

- \* Apply engine oil to the cutter and reuse it after all grinding residuals are removed.

Valve Seat Cutters

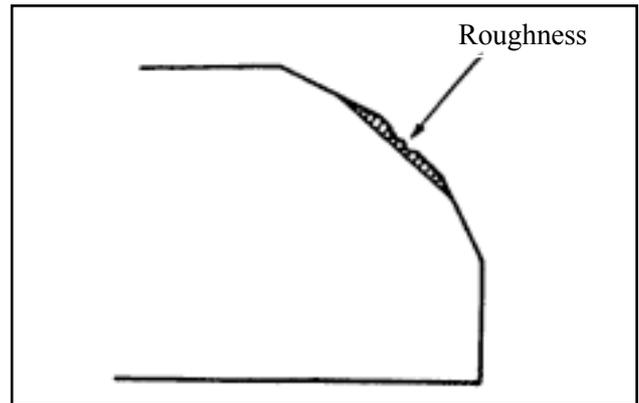


## 7. CYLINDER HEAD/VALVES

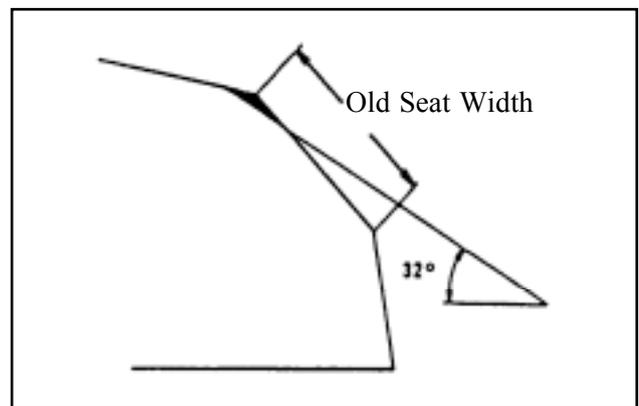
### VALVE SEAT GRINDING

Remove any roughness or irregularities from the seat using a 45° cutter.

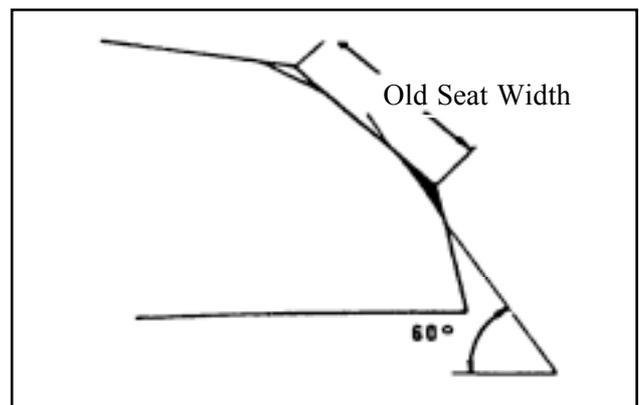
\* Be careful not to grind too much.



Use a 32° cutter to remove the upper existing valve seat material.

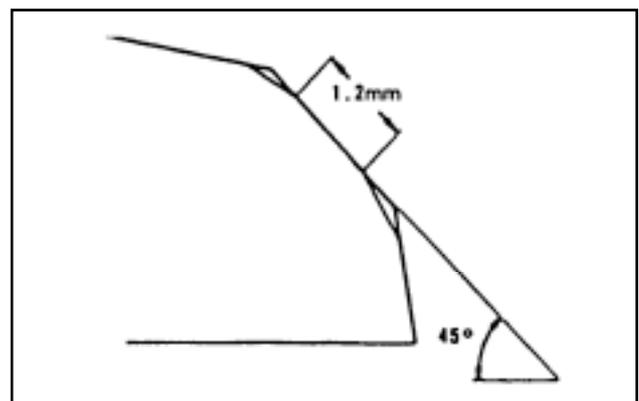


Use a 60° cutter to remove the lower existing valve seat material.



Install a 45° finish cutter and cut the seat to the proper width.

**Standard Seat Width:** 1.0mm



## 7. CYLINDER HEAD/VALVES

Inspect the valve seat contact area.

If the contact area is too high on the valve, the seat must be lowered using a 32° cutter.

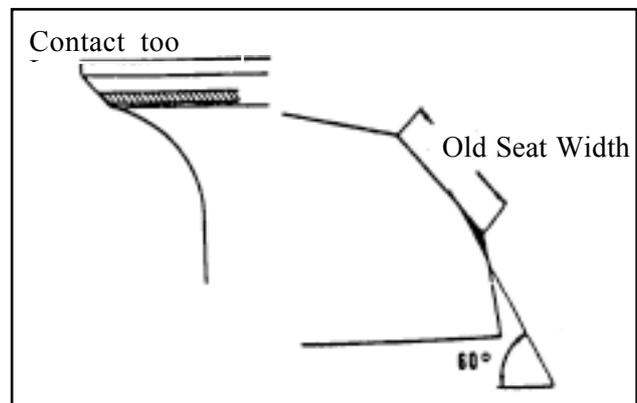
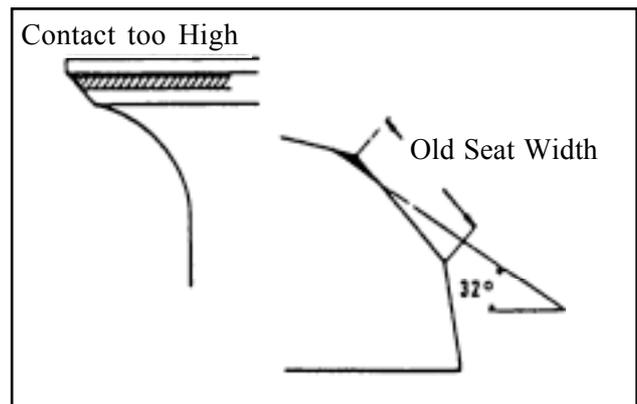
If the contact area is too low on the valve, the seat must be raised using a 60° cutter.

Refinish the seat to specifications using a 45° seat cutter.

After cutting the seat, apply emery to each valve contact face and lap the valve. After lapping, wash all residuals off the cylinder head and valves.

- \* • When lapping, use a light pressure and avoid damaging the valve seat due to forcedly lapping.
- Use care not to allow emery to enter the valve stem and guide.

After refacing and lapping, apply red lead to the 45° valve seat to make sure that the center of the valve contact face is even.



### CYLINDER HEAD ASSEMBLY

Install the valve spring seats and valve stem seals.

- \* Be sure to install new valve stem seals.

Lubricate each valve stem with engine oil and insert the valves into the valve guides.

Install the valve springs and retainers.

Compress the valve springs using the valve spring compressor, then install the valve cotters.

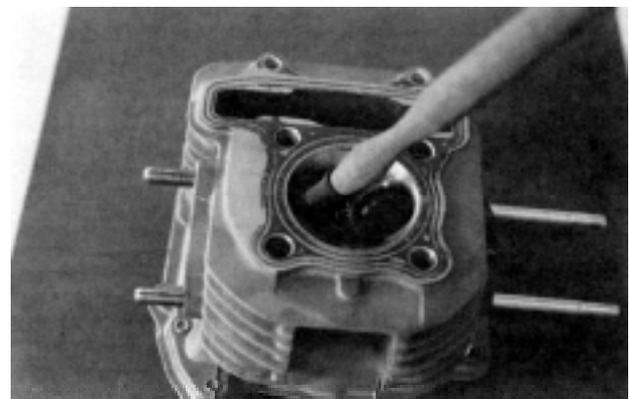
- \* • When assembling, a valve spring compressor must be used.
- Install the cotters with the pointed ends facing down from the upper side of the cylinder head.

Special

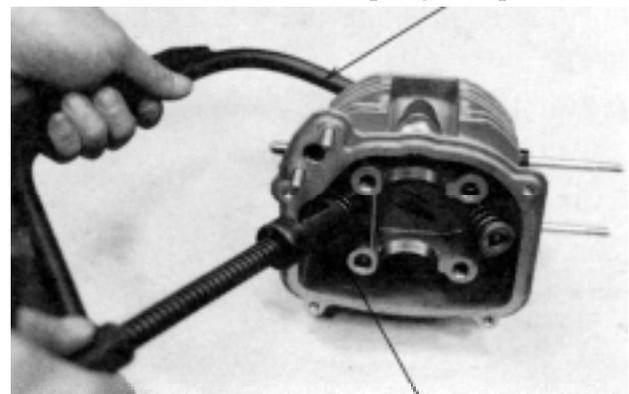
Valve Spring Compressor

Special

Valve Spring Compressor Attachment



Valve Spring Compressor

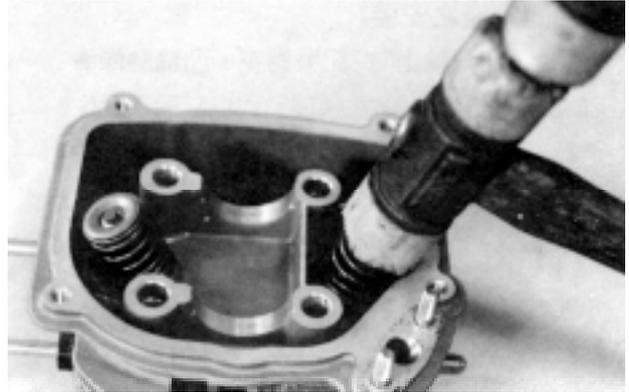


Valve Spring Compressor Attachment

## 7. CYLINDER HEAD/VALVES

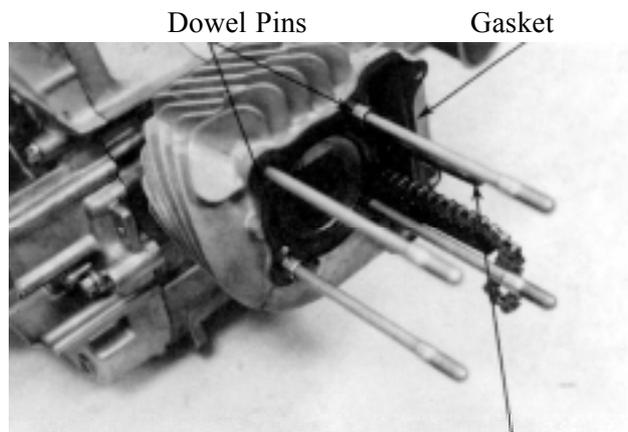
Tap the valve stems gently with a plastic hammer for 2\_ 3 times to firmly seat the cotters.

- \* Be careful not to damage the valves.



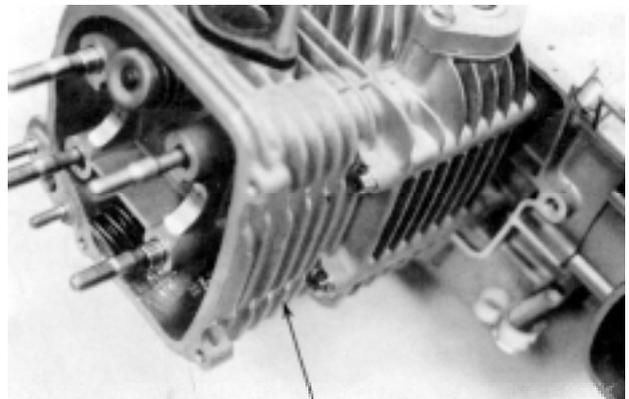
### CYLINDER HEAD INSTALLATION

Install the dowel pins and a new cylinder head gasket.  
Install the cam chain guide.



Cam Chain Guide

Install the cylinder head.

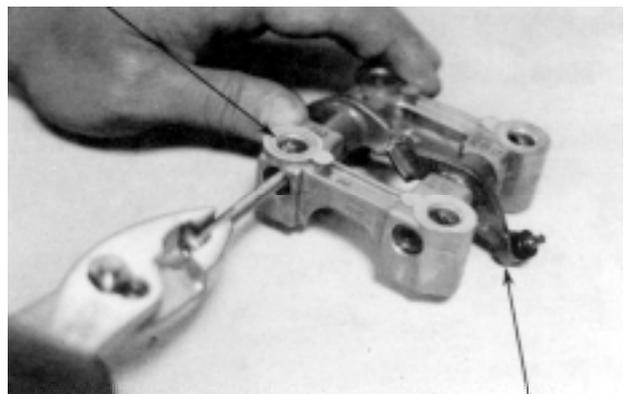


Camshaft Holder

### CAMSHAFT HOLDER ASSEMBLY

Install the exhaust valve rocker arm to the "EX" mark side of the camshaft holder.  
Install the intake valve rocker arm and the rocker arm shafts.

- \*
  - Align the cutout on the front end of the intake valve rocker arm shaft with the bolt of the camshaft holder.
  - Align the cross cutout on the exhaust valve rocker arm shaft with the bolt of the camshaft holder.



Valve Rocker Arm

## 7. CYLINDER HEAD/VALVES

### CAMSHAFT INSTALLATION

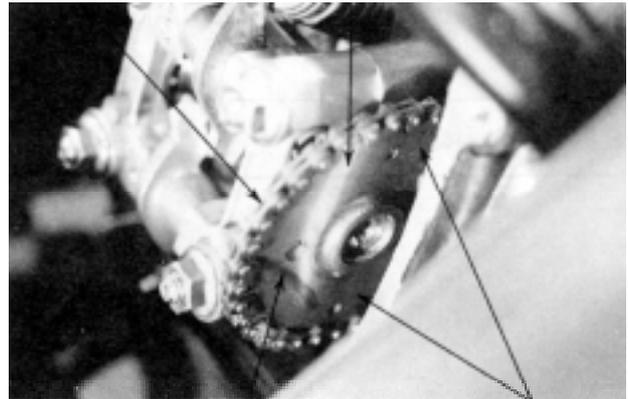
Turn the flywheel so that the “T” mark on the flywheel aligns with the index mark on the crankcase.

Keep the round hole on the camshaft gear facing up and align the punch marks on the camshaft gear with the cylinder head surface (Position the intake and exhaust cam lobes down.) and install the camshaft onto the cylinder head.

Install the cam chain over the camshaft gear.

Cam Chain

Camshaft Gear



Round Hole

Punch Marks

Install the dowel pins.

Dowel Pins



Install the camshaft holder, washers and nuts on the cylinder head.

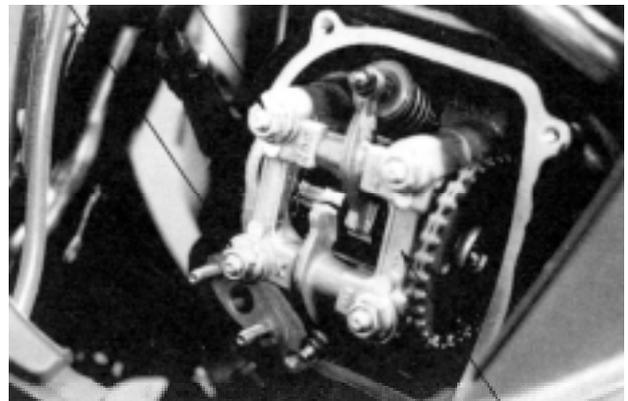
Tighten the four cylinder head nuts and two bolts.

**Torque:** Cylinder head nut: 2.0kg-m

- \* Apply engine oil to the threads of the cylinder head nuts.
- \* Diagonally tighten the cylinder head nuts in 2\_ 3 times.

Washer

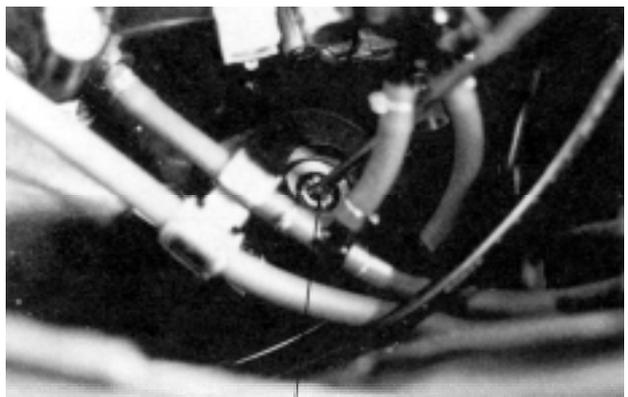
Nut



Camshaft Holder

Adjust the valve clearance. (⇒3-5)

Turn the cam chain tensioner screw counter-clockwise to release it.



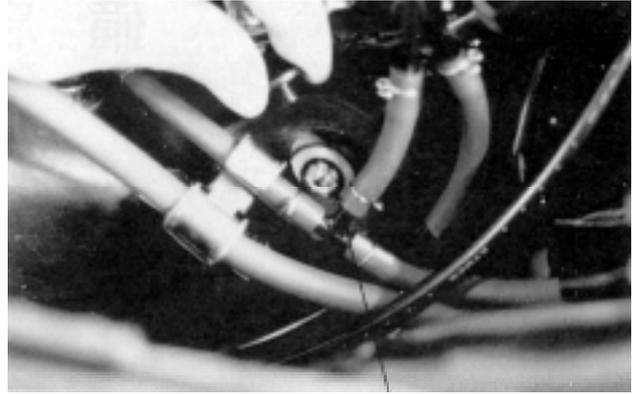
Tensioner Screw

## 7. CYLINDER HEAD/VALVES

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Apply engine oil to a new O-ring and install it.  
Tighten the cam chain tensioner cap screw.

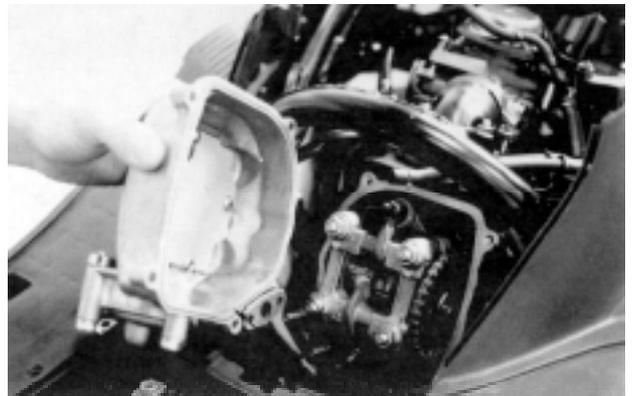
- \* Be sure to install the O-ring into the groove properly.



O-ring

Install a new cylinder head cover O-ring and install the cylinder head cover.  
Install and tighten the cylinder head cover bolts.

- \* Be sure to install the O-ring into the groove properly.



Cylinder Head Cover