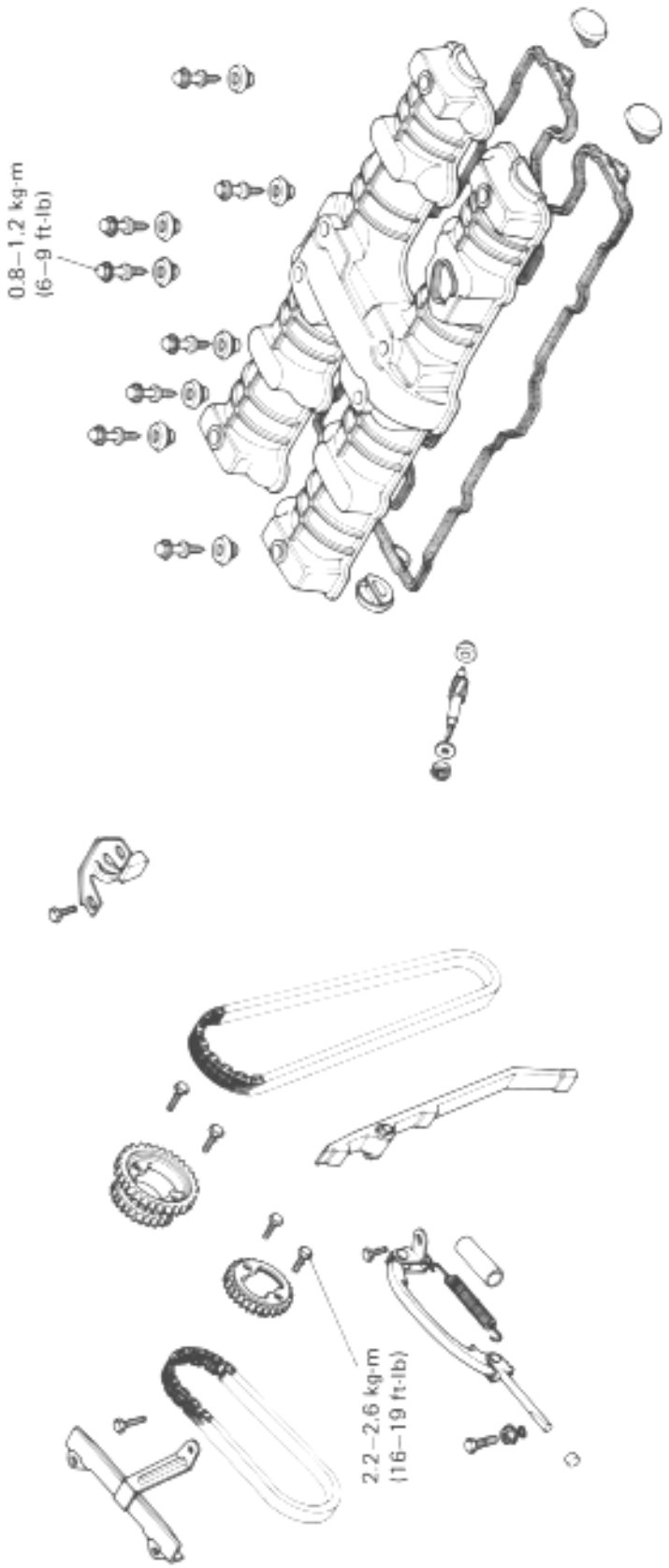
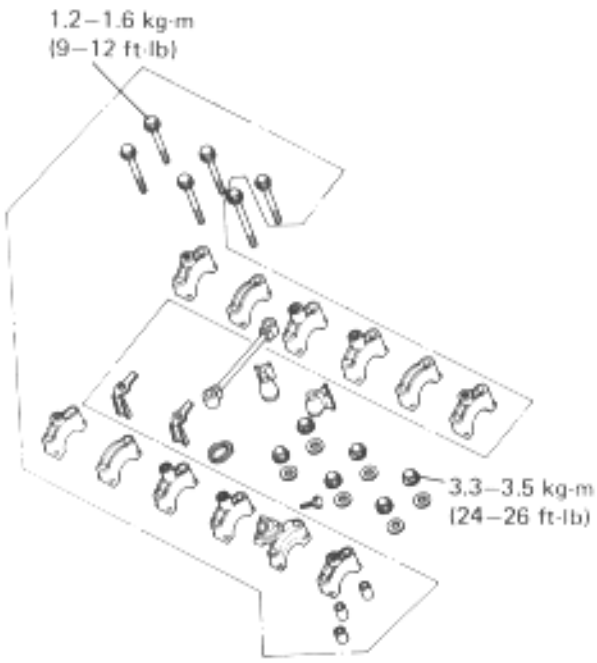
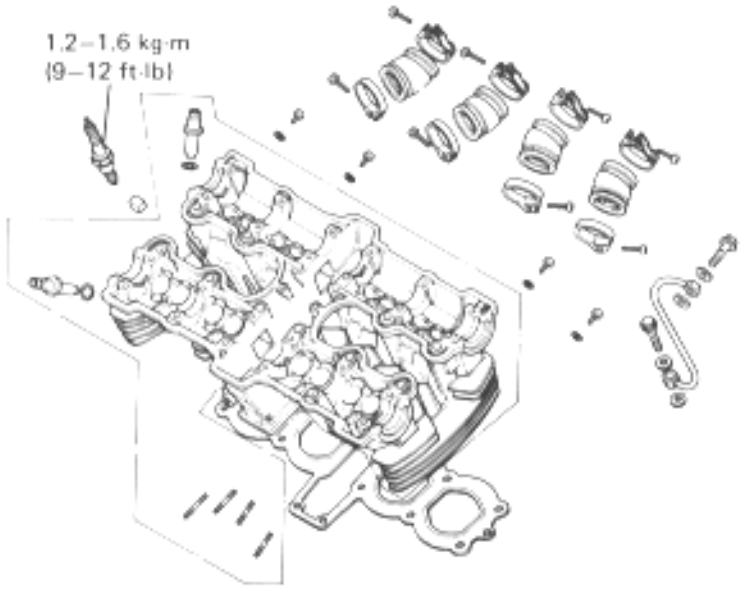

0.8–1.2 kg-m
(6–9 ft-lb)
2.2–2.6 kg-m
(16–19 ft-lb)


1.2–1.6 kg·m
(9–12 ft·lb)
3.3–3.5 kg·m
(24–26 ft·lb)


1.2–1.6 kg·m
(9–12 ft·lb)

## SERVICE INFORMATION

### GENERAL INSTRUCTIONS

- The engine must be removed from the frame to remove the cylinder head.
- Camshaft lubricating oil is fed through an oil line. Be sure the hole in the oil line is not clogged.
- During assembly, apply molybdenum disulfide to the camshaft bearings to provide initial lubrication. Pour clean engine oil into the oil pockets in the cylinder head to lubricate the camshafts.
- Marks A thru L on the camshaft holders mean position of holders to be installed; A to E are for EX. side and F to L for IN. side from left to right respectively. When installing, be sure the mark ⇧ faces forward.

### SPECIAL TOOLS

| | |
|---|---|
| Special Tools | |
| Valve Guide Reamer | 07984–2000000 |
| Tappet Hole Protector | 07999–4220000 |
| Common Tools | |
| Valve Guide Remover (5.5 mm) | 07742–0010100 |
| Valve Guide Driver | 07742–0020200 |
| Valve Spring Compressor | 07757–0010000 |

### TORQUE VALUES

| | |
|---|---|
| Cylinder head cover | 0.8–1.2 kg-m ( 6– 9 ft-lb) |
| Camshaft holder | 1.2–1.6 kg-m ( 9–12 ft-lb) |
| Cylinder head | 3.6–4.0 kg-m (26–29 ft-lb) |
| Cam sprocket | 2.2–2.6 kg-m (16–19 ft-lb) |
| Spark plug | 1.2–1.6 kg-m ( 9–12 ft-lb) |

### SPECIFICATIONS

| | | | STANDARD | SERVICE LIMIT |
|---|---|---|---|---|
| Compression pressure | | | 12 ± 1 kg/cm² (171 ± 14 psi) | ——— |
| Camshaft | Cam height | IN. | 37.000–37.160 mm (1.4567–1.4630 in) | 36.9 mm (1.45 in) |
| | | EX. | 37.500–37.660 mm (1.4763–1.4827 in) | 37.4 mm (1.47 in) |
| | Oil clearance | A and F | 0.040– 0.082 mm (0.0016–0.0032 in) | 0.13 mm (0.0051 in) |
| | | Gear holder and G | 0.062– 0.109 mm (0.0024–0.0043 in) | 0.16 mm (0.0063 in) |
| | | B and H | 0.085– 0.139 mm (0.0033–0.0055 in) | 0.19 mm (0.0075 in) |
| | | C and J | 0.085– 0.139 mm (0.0033–0.0055 in) | 0.19 mm (0.0075 in) |
| | | D and K | 0.062– 0.109 mm (0.0024–0.0043 in) | 0.16 mm (0.0063 in) |
| | | E and L | 0.040– 0.082 mm (0.0016–0.0032 in) | 0.13 mm (0.0051 in) |
| | Run out | | ——— | 0.05 mm (0.002 in) |

| | | | STANDARD | SERVICE LIMIT |
|---|---|---|---|---|
| Valve lifter | Valve lifter O.D. | | 27.972–27.993 mm (1.1013–1.1021 in) | 27.96 mm (1.101 in) |
| | Valve lifter bore I.D. | | 28.000–28.016 mm (1.1024–1.1030 in) | 28.04 mm (1.104 in) |
| | Lifter to cylinder head clearance | | ——— | 0.07 mm (0.003 in) |
| Valve spring | Free length | IN. Outer | 43.9 mm (1.73 in) | 42.5 mm (1.67 in) |
| | | IN. Inner | 40.7 mm (1.60 in) | 39.8 mm (1.57 in) |
| | | EX. Outer | 43.9 mm (1.73 in) | 42.5 mm (1.67 in) |
| | | EX. Inner | 40.7 mm (1.60 in) | 39.8 mm (1.57 in) |
| | Preload/length | IN. Outer | 12.6–14.6 kg/37.5 mm (27.78–32.19 lbs/1.48 in) | 12.0 kg/37.5 mm (26.46 lbs/1.48 in) |
| | | IN. Inner | 6.39–7.81 kg/34.5 mm (14.087–17.218 lbs/1.36 in) | 6.0 kg/34.5 mm (13.23 lbs/1.36 in) |
| | | EX. Outer | 12.6–14.6 kg/37.5 mm (27.78–32.19 lbs/1.48 in) | 12.0 kg/37.5 mm (26.46 lbs/1.48 in) |
| | | EX. Inner | 6.39–7.81 kg/34.5 mm (14.087–17.218 lbs/1.36 in) | 6.0 kg/34.5 mm (13.23 lbs/1.36 in) |
| Valve guide | Valve stem O.D. | IN | 5.475–5.490 mm (0.2156–0.2161 in) | 5.47 mm (0.215 in) |
| | | EX. | 5.455–5.470 mm (0.2148–0.2154 in) | 5.44 mm (0.214 in) |
| | Valve guide I.D. | IN. | 5.500–5.515 mm (0.2165–0.2171 in) | 5.54 mm (0.218 in) |
| | | EX. | 5.500–5.515 mm (0.2165–0.2171 in) | 5.54 mm (0.218 in) |
| | Stem-to-guide clearance | IN. | ——— | 0.07 mm (0.003 in) |
| | | EX. | ——— | 0.09 mm (0.004 in) |
| | Valve seat width | | 0.99–1.27 mm (0.039–0.050 in) | 1.5 mm (0.06 in) |
| Cylinder head | Warpage | | ——— | 0.10 mm (0.004 in) |
| Cam chain | Length | | 175.70–175.92 mm (6.917–6.926 in) | 177.1 mm (6.97 in) |

# TROUBLESHOOTING

Engine top-end problems usually affect engine performance. These can be diagnosed by a compression test, or by tracing noises to the top-end with a sounding rod or stethoscope.

**Low compression**

1. Valves
   - Incorrect valve adjustment
   - Burned or bent valves
   - Incorrect valve timing
   - Broken valve spring
2. Cylinder head
   - Leaking or damaged head gasket
   - Warped or cracked cylinder head
3. Cylinder and piston (Refer to Section 7)

**Compression too high**

1. Excessive carbon build-up on piston head or combustion chamber

**Excessive noise**

1. Incorrect valve adjustment
2. Sticking valve or broken valve spring
3. Damaged or worn camshaft
4. Loose or worn cam chain
5. Worn or damaged cam chain tensioner
6. Worn cam sprocket teeth



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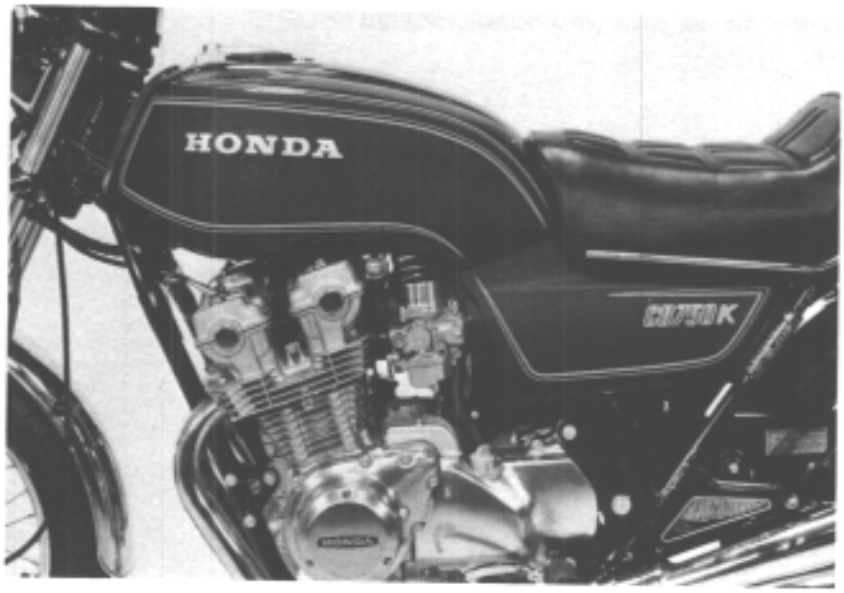
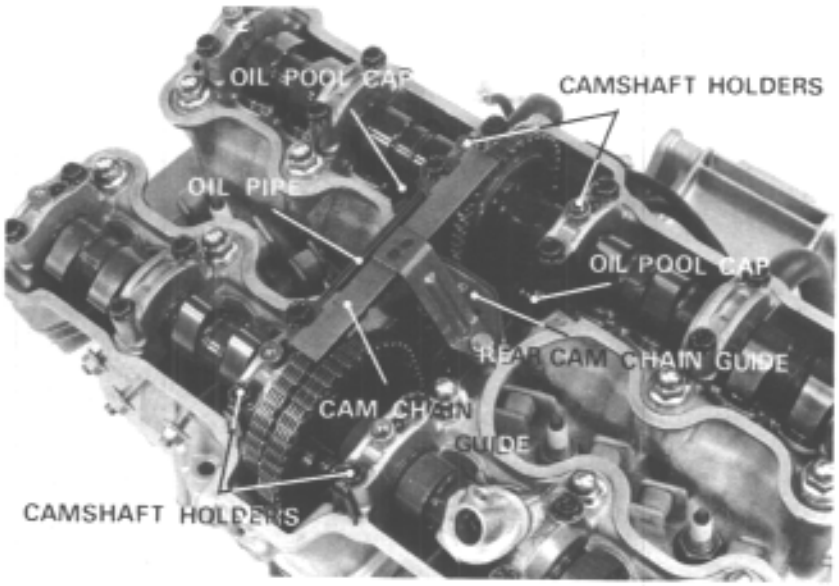
## CAMSHAFT REMOVAL

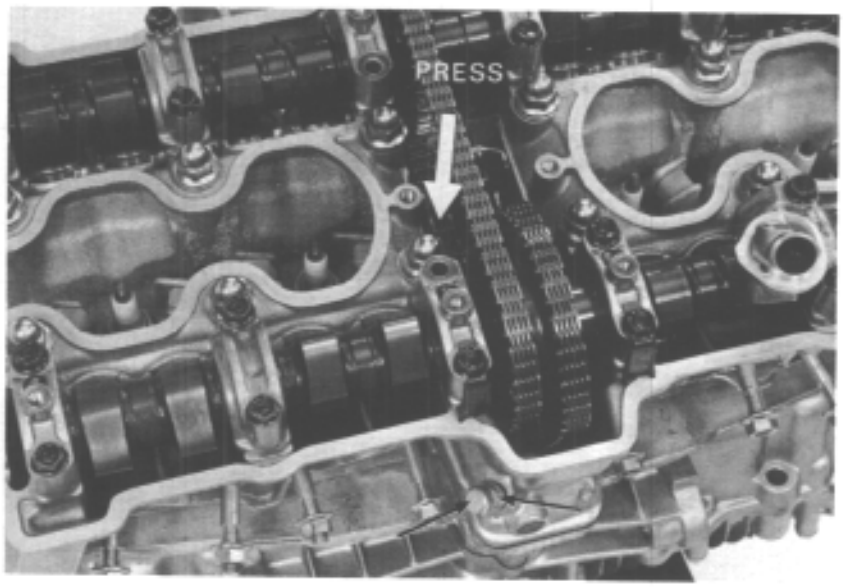
Place the motorcycle on its center stand.
Raise the seat and remove the fuel lines and fuel tank.
Disconnect the tachometer cable, and remove the spark plug caps.



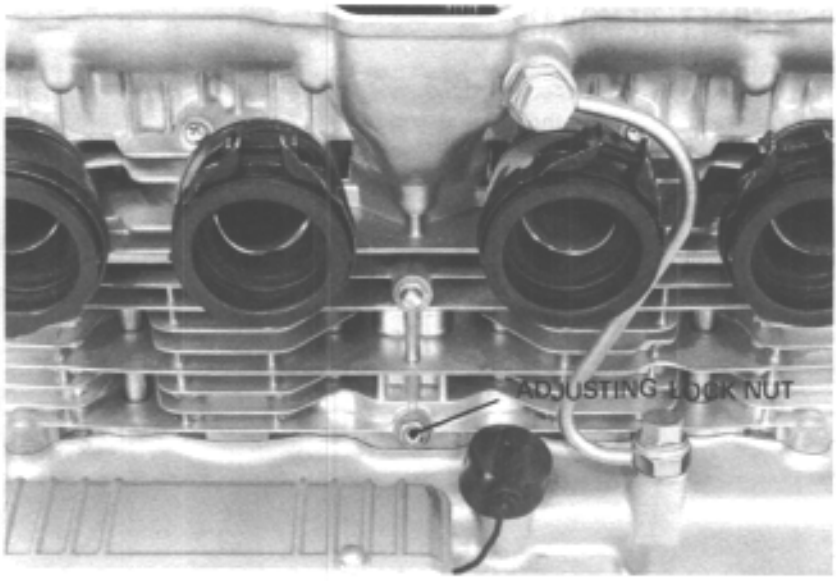

Remove the cylinder head cover bolts and the cylinder head cover.
Remove the oil line and cam chain guide.
Remove the No. B, No. C, No. H and No. J camshaft holders.
Remove the oil pool caps and REAR cam chain guide attaching plate.
Remove the dowel pins.



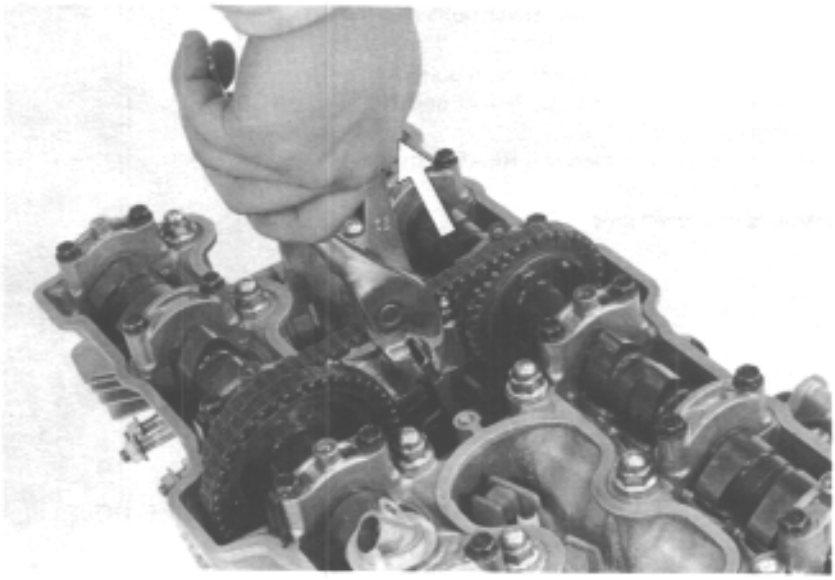

Loosen the front cam chain tensioner lock nut and bolt.
Press the cam chain tensioner down to reduce chain tension.
Tighten the lock bolt and nut.



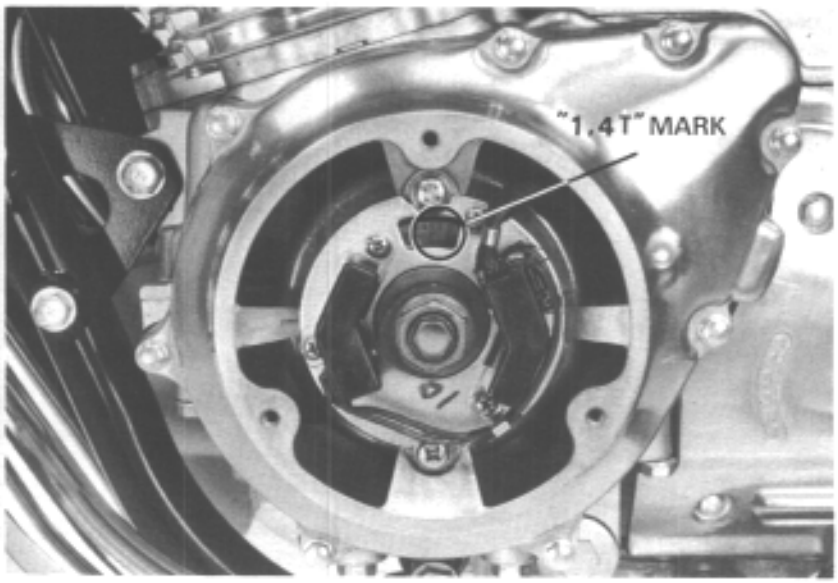
Loosen the rear chain tensioner adjusting lock nut.




Pull the rear cam chain tensioner up to reduce chain tension and tighten the adjusting lock nut.



Remove the pulser generator cover.
Turn the crankshaft counterclockwise until the "1.4T" marke aligns with the index mark.



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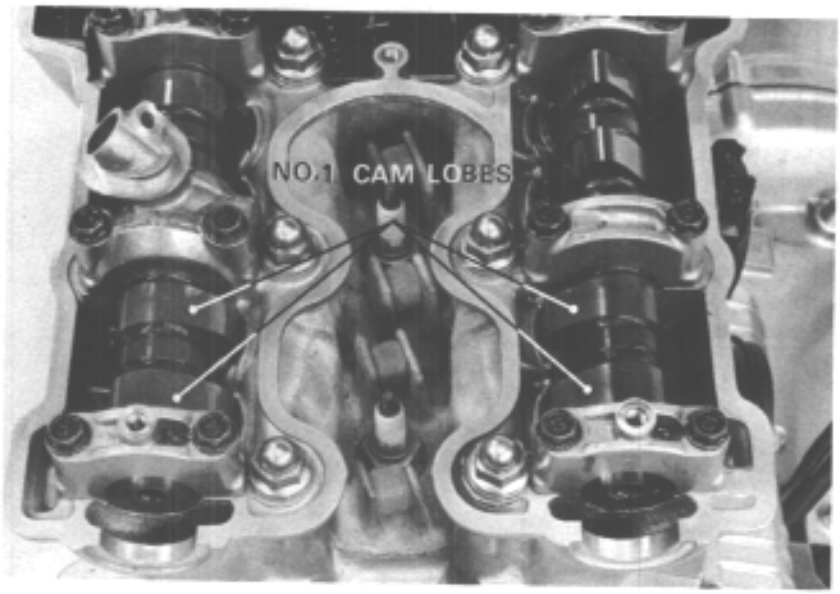
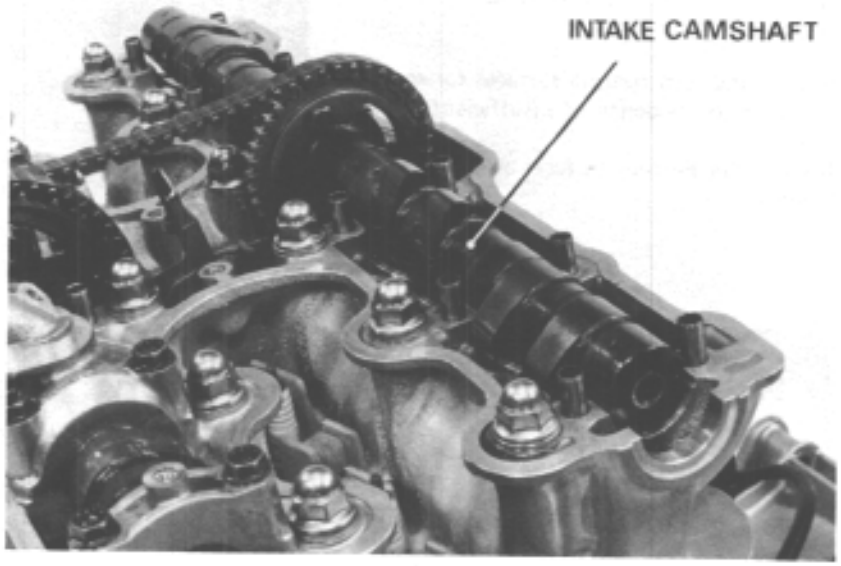
Make sure the No. 1 or 4 cylinder intake and exhaust cam lobes face the spark plug.

Remove the No. G and K camshaft holders.
Remove the No. F and L holders.
Remove the dowel pins.



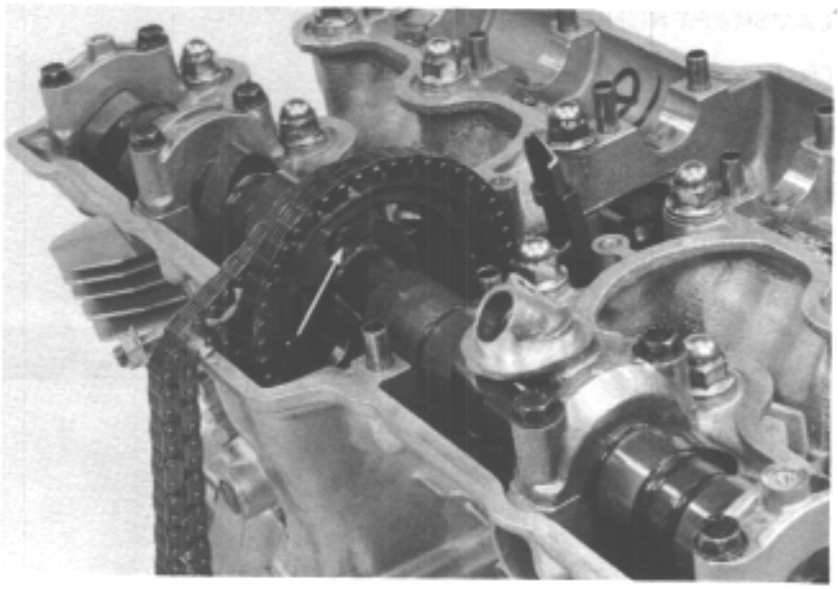

Remove the intake camshaft.




Loosen the exhaust cam sprocket blot.
Turn the crankshaft counterclockwise until cam lift is minimal and the other cam sprocket bolt can be removed.

Remove the No. D and gear camshaft holders.
Remove the No. A and E holders.

Remove the exhaust camshaft.
Remove the dowel pins.



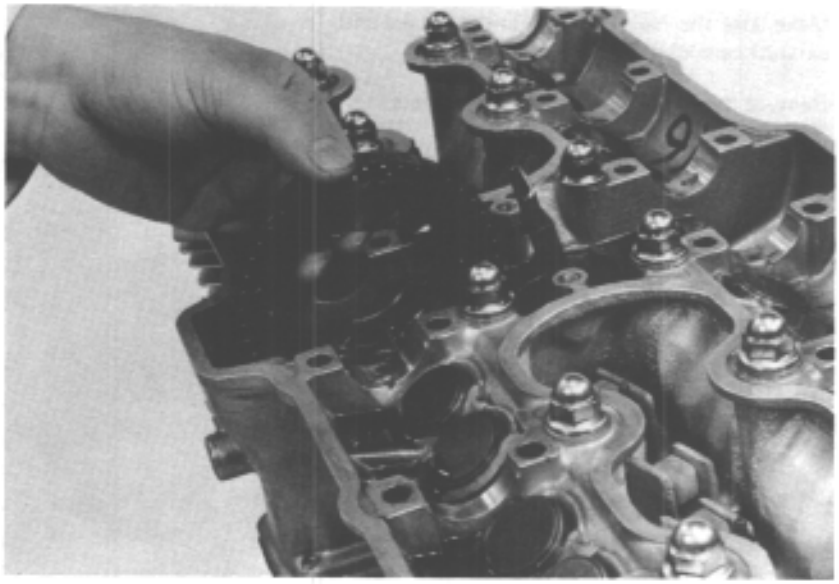
NOTE

Suspend the cam chain with a piece of wire to keep it from falling into the engine.

Remove the cam sprocket and cam chain.

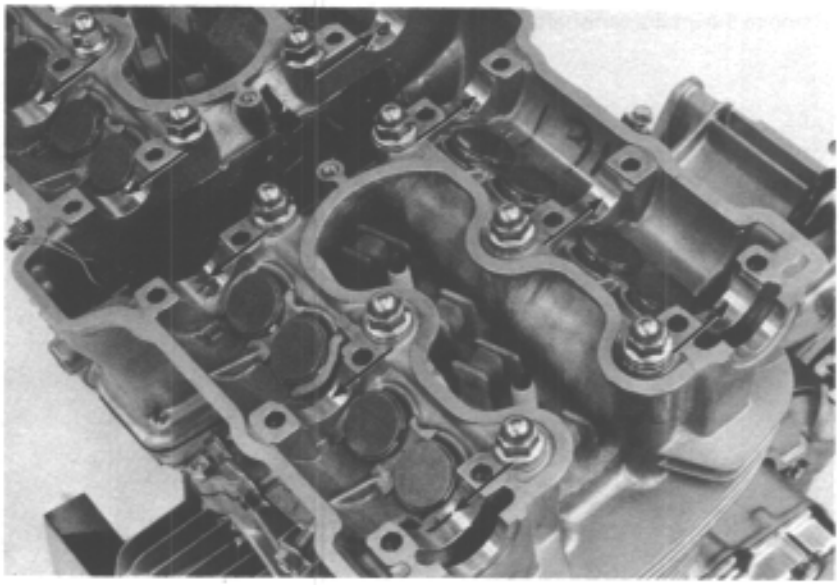
NOTE

After removing the camshaft, the valve clearance adjusting shims and valve lifters can be removed.



## CAM BEARING SURFACE INSPECTION

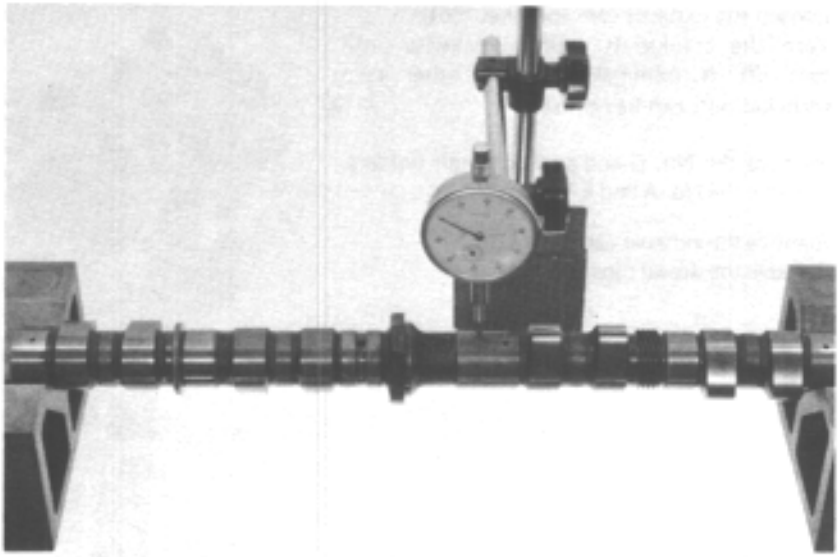
Inspect the cam bearing surfaces for scoring, scratches, or evidence of insufficient lubrication.
Inspect the bearing surface of the camshaft holders.



## CAMSHAFT RUNOUT

Check camshaft runout with a dial indicator. Support both ends of the camshaft with V-blocks.

**SERVICE LIMIT: 0.05 mm (0.002 in)**





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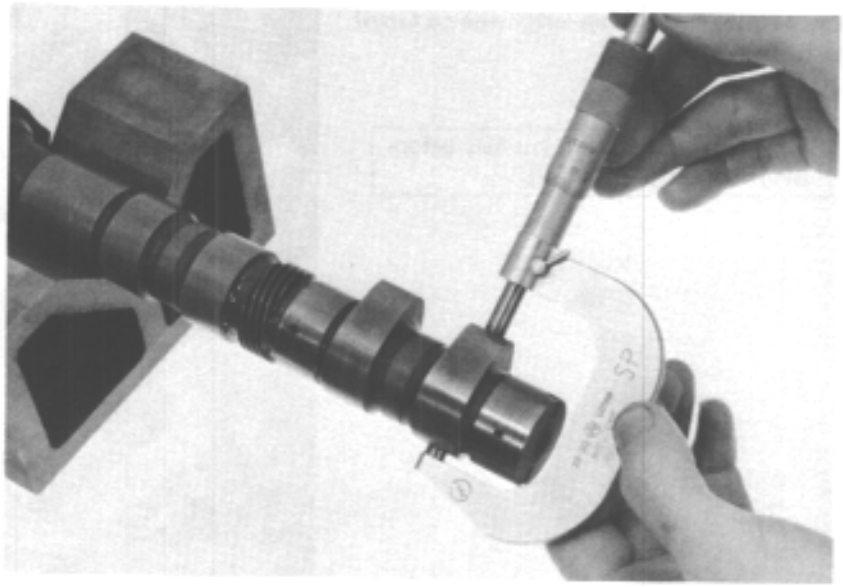
## CAM INSPECTION

Using a micrometer, measure each cam lobe. Check for wear or damage.

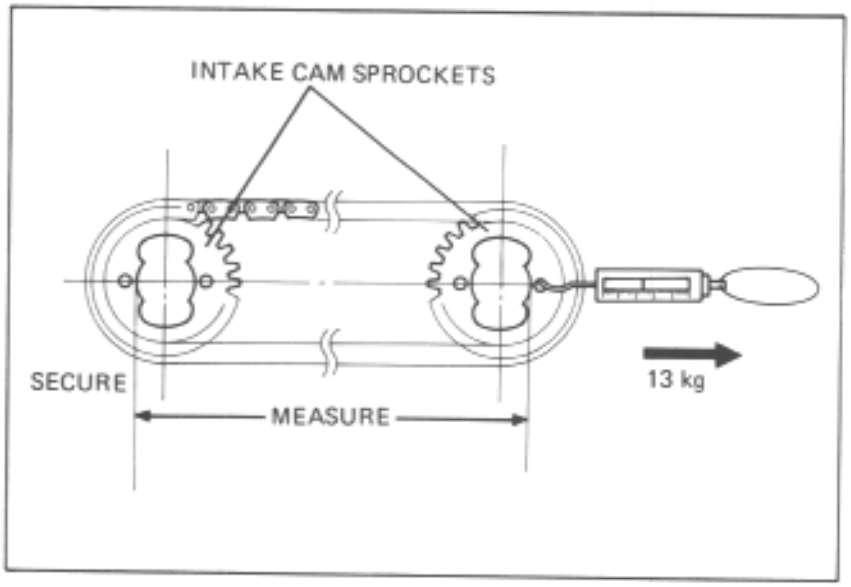
**SERVICE LIMITS: IN: 36.9 mm (1.45 in)**
**EX: 37.4 mm (1.47 in)**



## CAM CHAIN LENGTH MEASUREMENT

Place the cam chain over the intake camshaft sprockets. Secure one sprocket and apply 13 kg (29 lb) of tension with a spring scale. Measure the distance between the points as shown.

**SERVICE LIMIT: 177.1 mm (6.97 in)**




## CAM CHAIN GUIDE INSPECTION

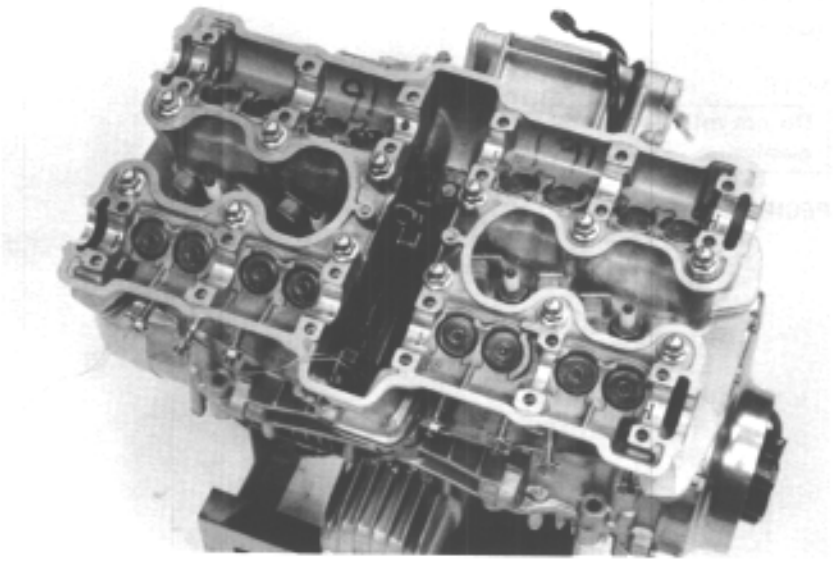
Inspect the upper cam chain guide for damage or excessive wear.

## CAMSHAFT OIL CLEARANCE

Remove the adjusting shims and the valve lifters.

NOTE

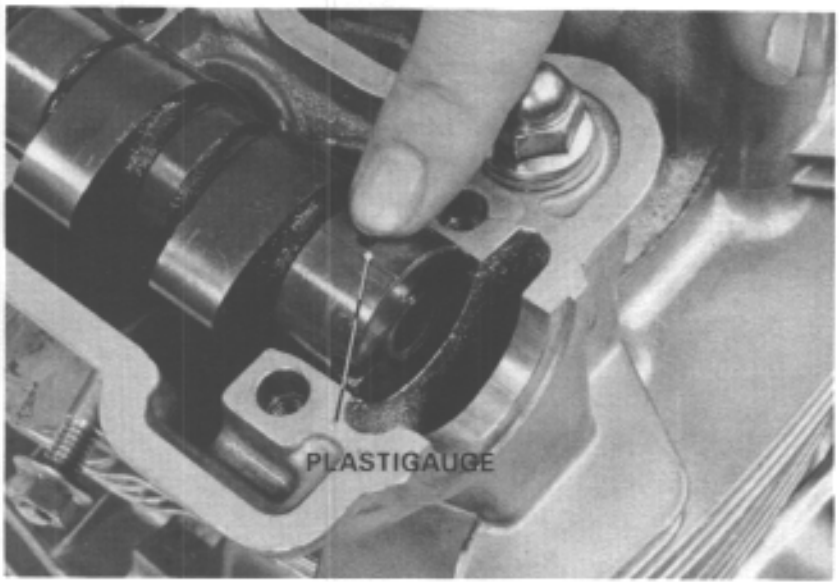
Mark each part to ensure correct reassembly.



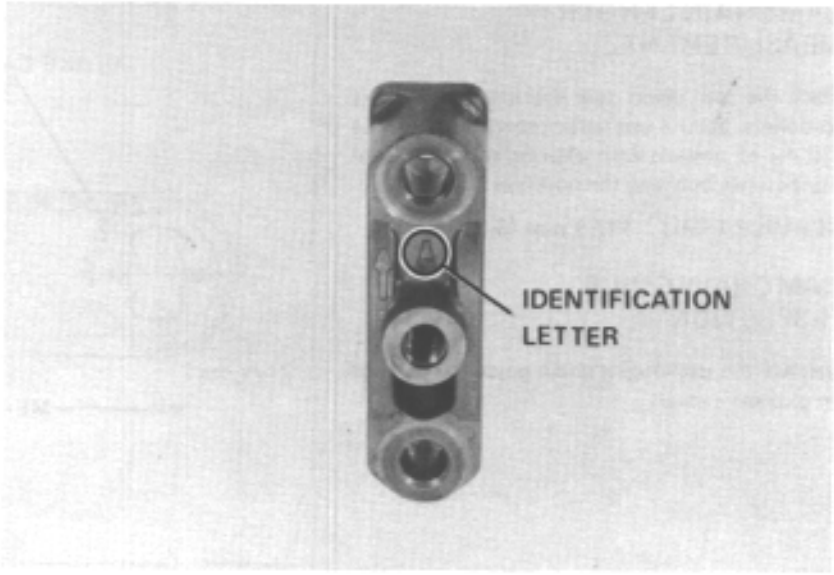
Lay a strip of plastigauge lengthwise on top of each camshaft journal.

NOTE

Wipe any oil from the journals before using plastigauge.




Check the camshaft holder identification letter before installing.

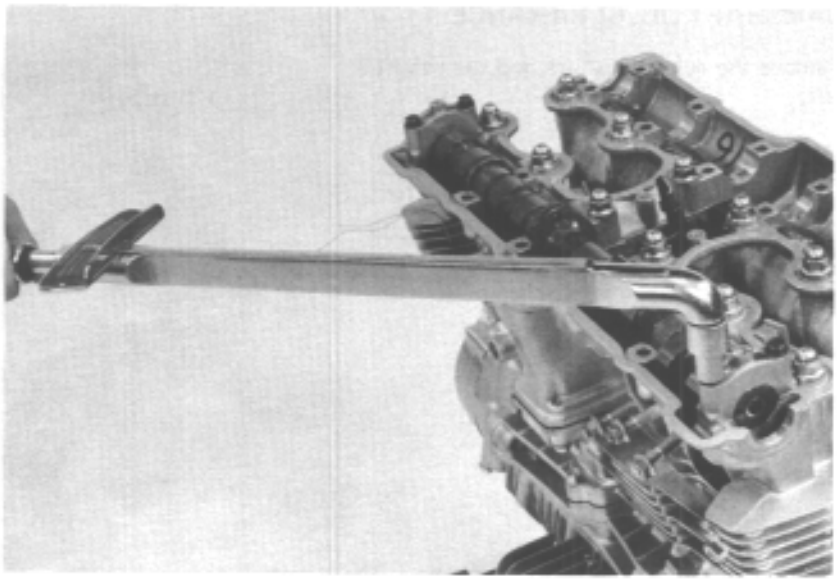



Install the camshaft holders and tighten in a criss-cross pattern.

NOTE

Do not rotate the camshaft when using plastigauge

**SPECIFIED TORQUE:**
**1.2–1.6 kg-m (9–12 ft-lb)**





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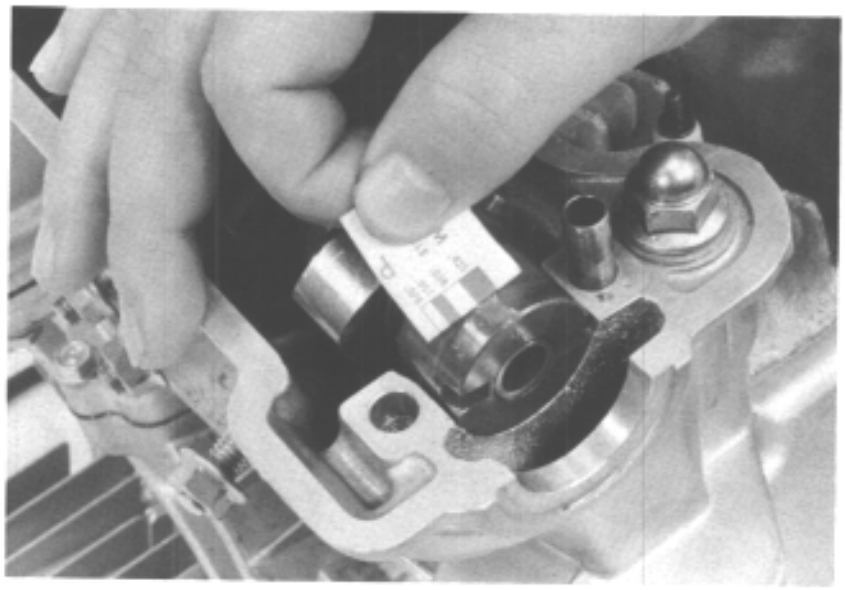
Remove the camshaft holders and measure the width of each plastigauge. The widest thickness determines the oil clearance.

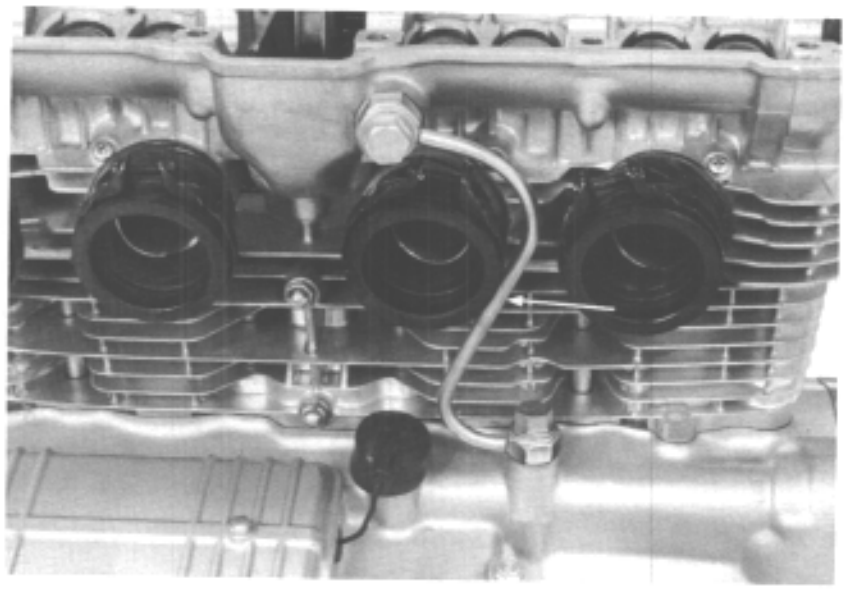
**SERVICE LIMITS:**
**No. A, E, F and L:**
**0.13 mm (0.0051 in)**
**Gear holder, No. D, G and K:**
**0.16 mm (0.0063 in)**
**No. B, C, H and J:**
**0.19 mm (0.0075 in)**

When the service limits are exceeded, replace the camshaft and recheck the oil clearance. Replace the cylinder head and camshaft holders if the clearance still exceeds service limits.

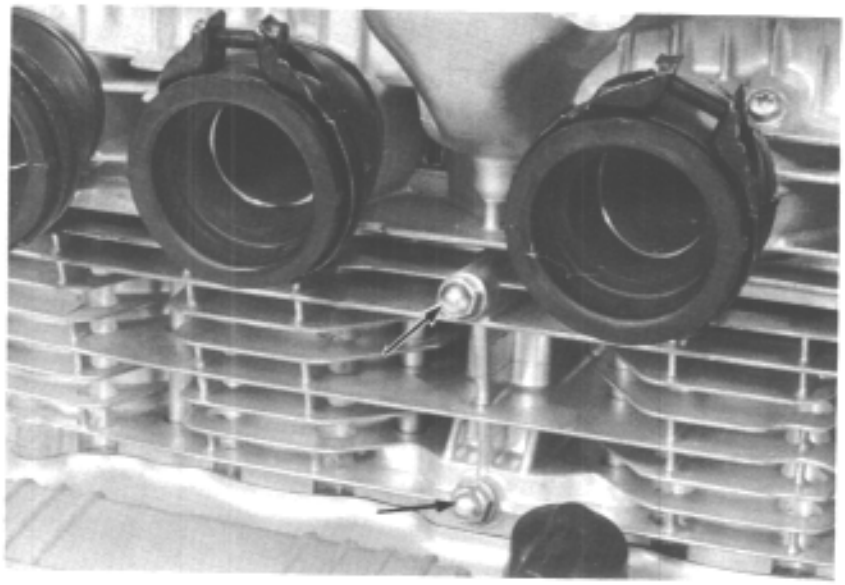


## CYLINDER HEAD REMOVAL

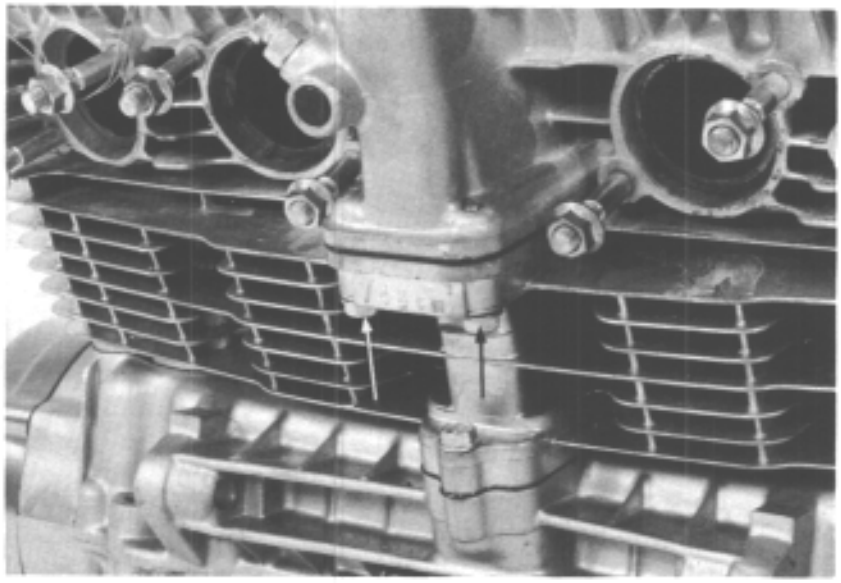
Remove the oil line.



Remove the two rear cam chain tensioner lock nuts.



Remove the two bolts at the cam chain housing.

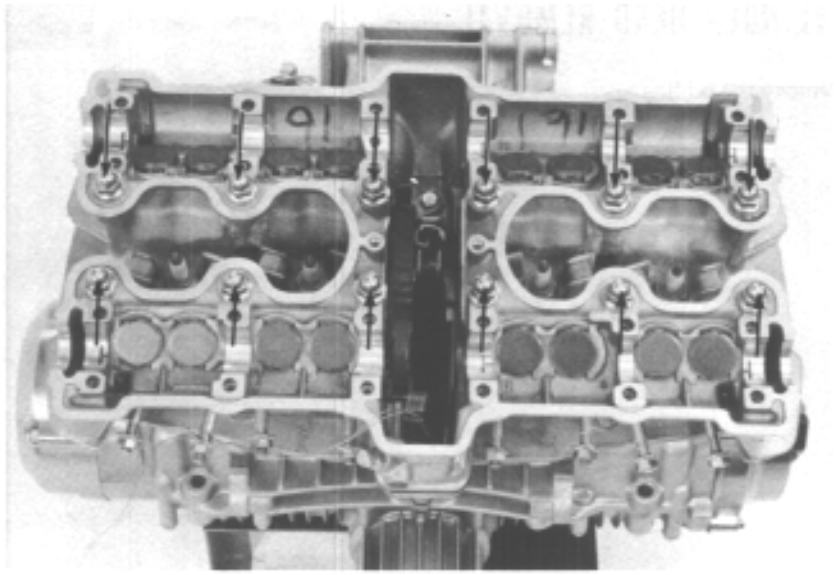


Remove the 12 cap nuts.

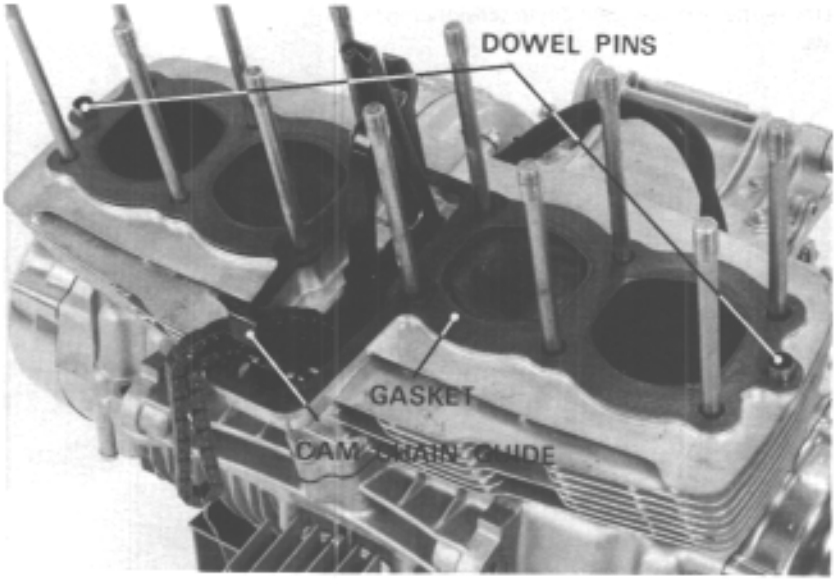
NOTE

Remove the nuts in 2-3 steps in a criss-cross pattern to prevent warpage.

Remove the cylinder head.



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



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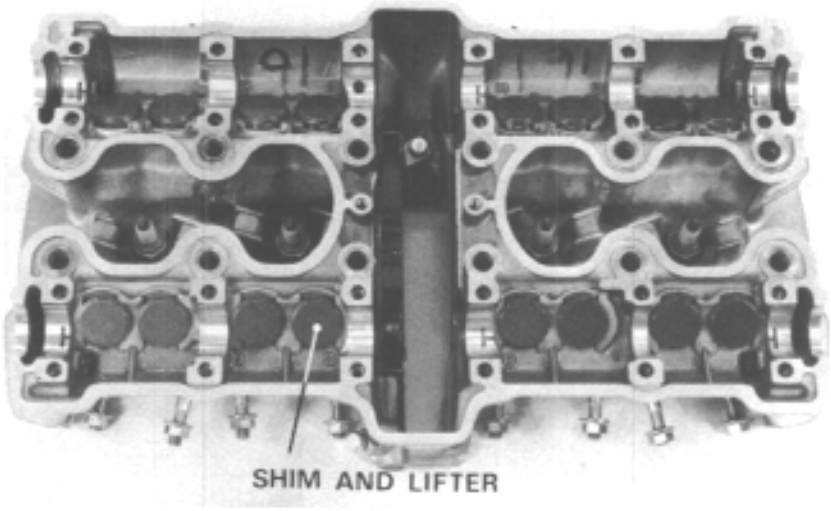
# CYLINDER HEAD DISASSEMBLY

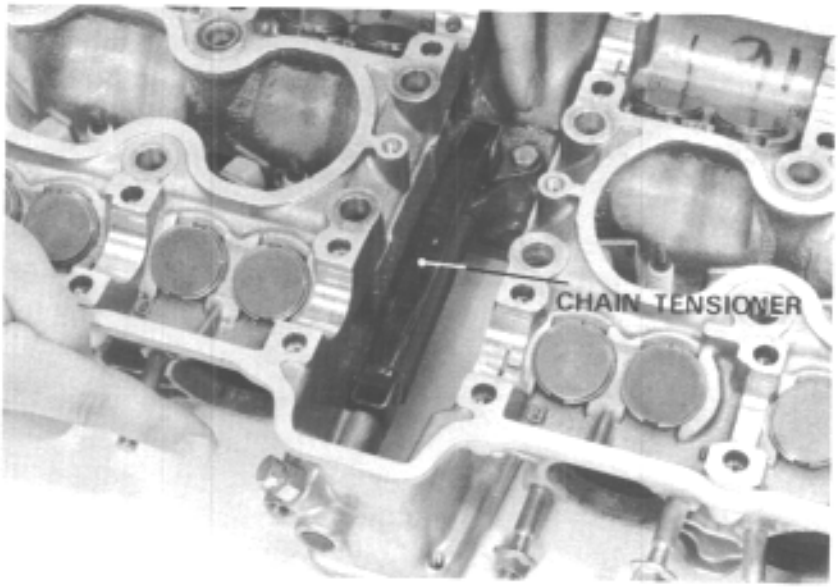
Remove the valve clearance adjusting shims.
Remove the valve lifters.

NOTE

Mark all disassembled parts to ensure correct reassembly.




Loosen the cam chain tensioner lock nut and bolts.
Remove the bolt in the cylinder head.
Pull the chain tensioner back and remove.




Remove the valve spring cotters, retainers, springs and valves.

*CAUTION*

*To prevent loss of tension, do not compress the valve springs more than necessary to remove the keepers.*

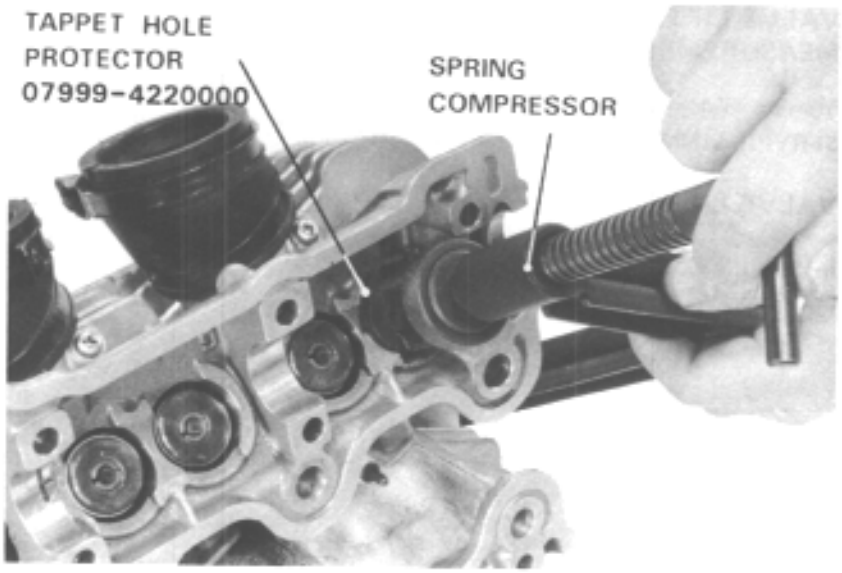
NOTE

Avoid damaging the lifter sliding surface.

NOTE

Mark all disassembled parts to ensure correct reassembly.

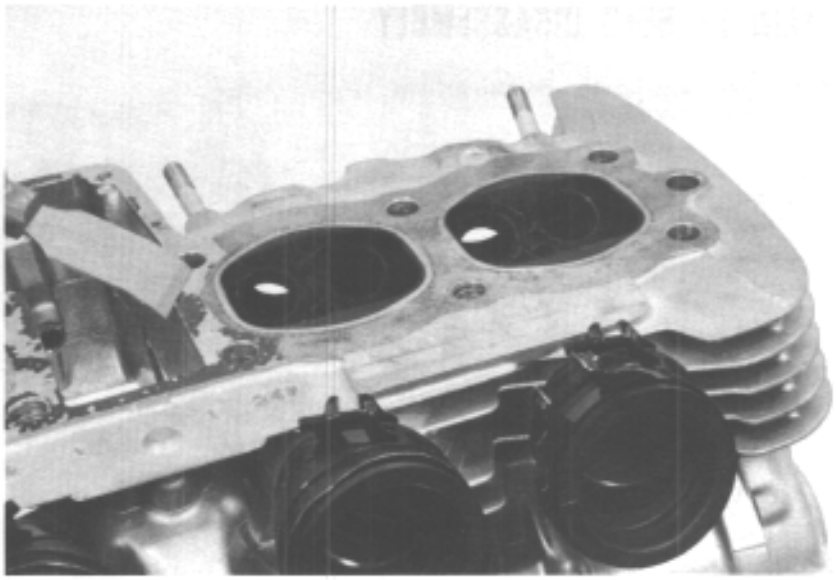
Remove the valve stem seals.



Remove carbon deposits from the combustion chamber.
Clean off the head gasket surfaces.

NOTE

- Avoid damaging the gasket surfaces.
- Gasket will come off easier if soaked in solvent.



## VALVE LIFTER O.D. MEASUREMENT

Measure valve lifter O.D..

**SERVICE LIMIT: 27.96 mm (1.101 in)**

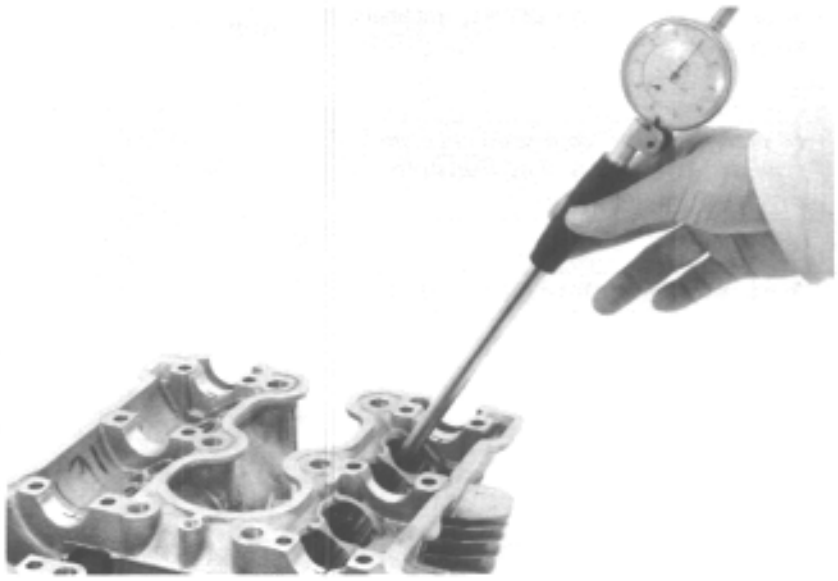
## VALVE LIFTER BORE MEASUREMENT

Measure valve lifter bore I.D.

**SERVICE LIMIT: 28.04 mm (1.104 in)**

## VALVE LIFTER BORE

Inspect the valve lifter for scoring, scratches, or evidence of insufficient lubrication.





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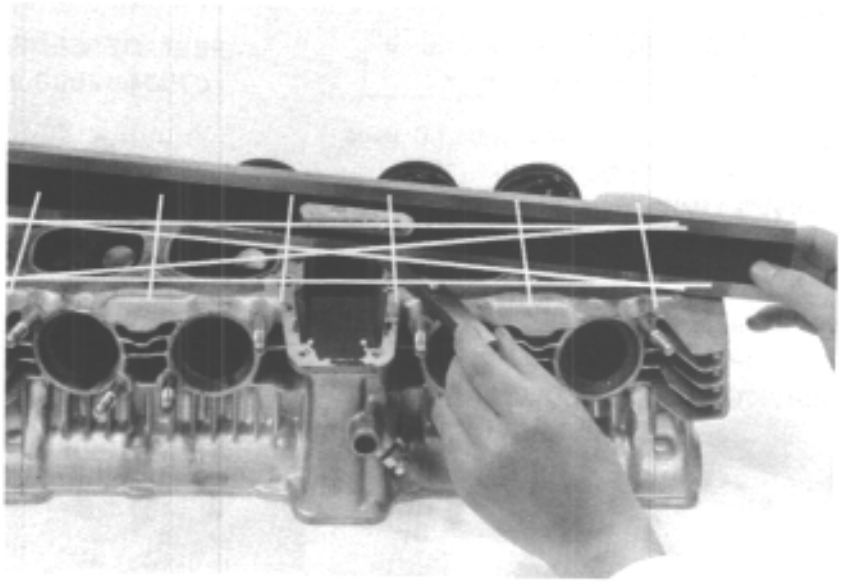
Check the spark plug hole and valve areas for cracks.
Check the cylinder head for warpage with a straight edge and a feeler gauge.

**SERVICE LIMIT: 0.10 mm (0.004 in)**

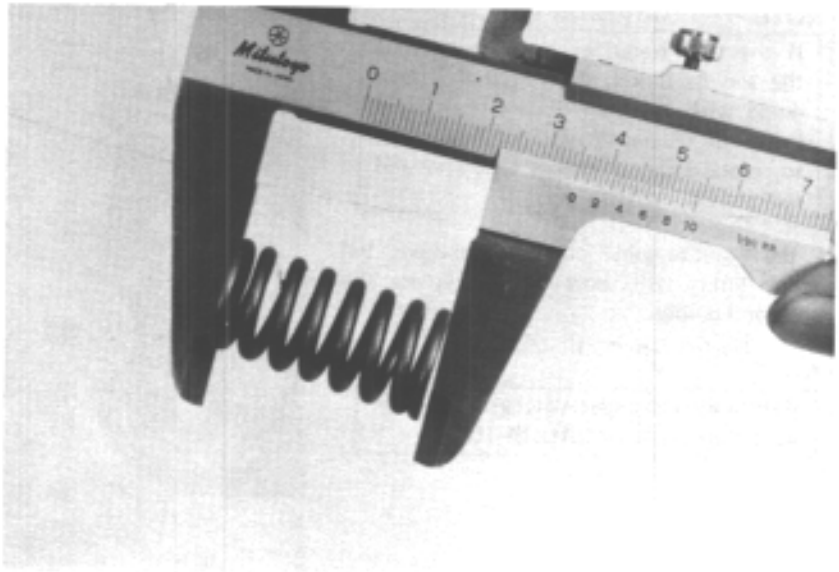


## VALVE SPRING FREE LENGTH INSPECTION

Measure the length of the inner and outer valve springs.

**SERVICE LIMITS:**

| | | |
|---|---|---|
| **Inner:** | **IN.** | **39.8 mm (1.57 in)** |
| | **EX.** | **39.8 mm (1.57 in)** |
| **Outer:** | **IN.** | **42.5 mm (1.67 in)** |
| | **EX.** | **42.5 mm (1.67 in)** |



## VALVE STEM-TO-GUIDE CLEARANCE

Inspect each valve for bending, burning, scratches or abnormal stem wear.
Check valve movement in the guide.
Measure and record each valve stem O.D.

**SERVICE LIMITS: IN: 5.47 mm (0.215 in)**
**EX: 5.44 mm (0.214 in)**

NOTE

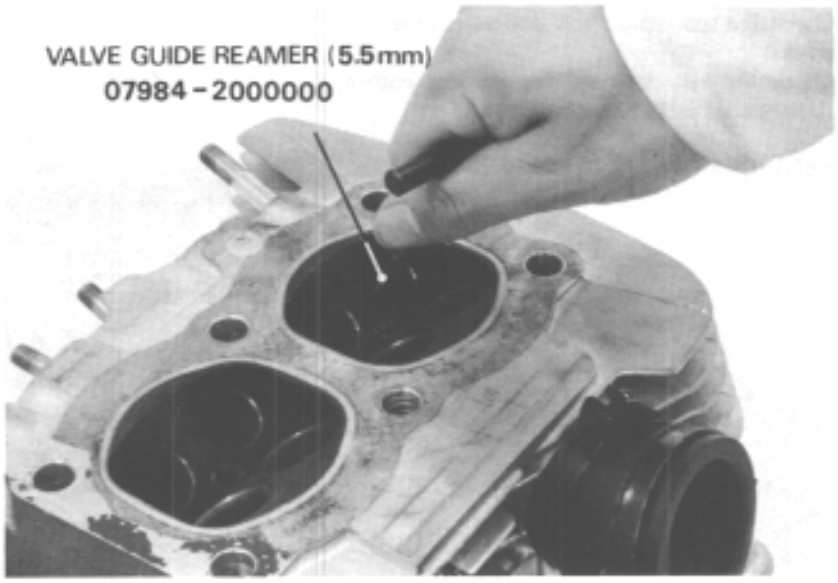
Ream the guides to remove any carbon build-up before checking clearance.

Measure and record each valve guide I.D. using a ball gauge or inside micrometer.

**SERVICE LIMIT: IN. 5.54 mm (0.218 in)**
**EX. 5.54 mm (0.218 in)**

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

**SERVICE LIMITS: IN. 0.07 mm (0.003 in)**
**EX. 0.09 mm (0.004 in)**



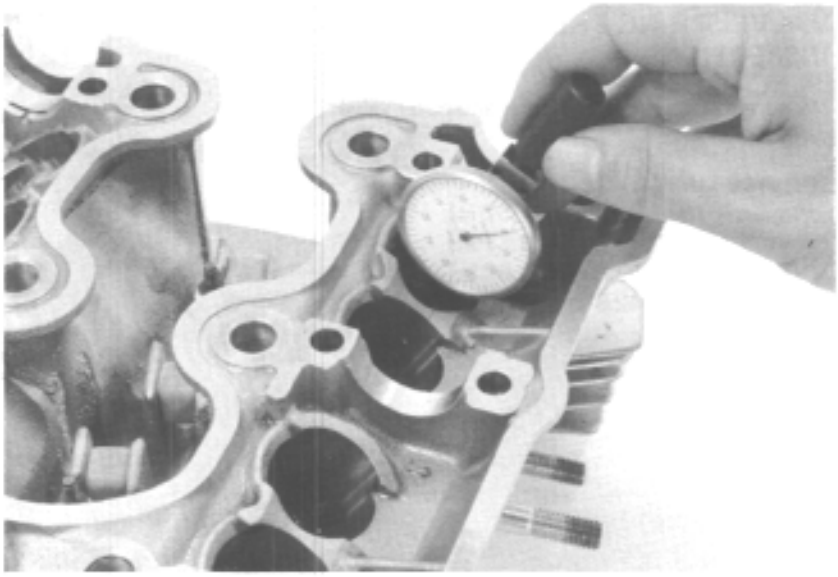

NOTE

If the stem-to-guide clearance exceeds the service limits, determine if a new guide with standard dimensions would bring the clearance within tolerance. If so, replace any guides as necessary and ream to fit.

If the stem-to-guide clearance exceeds the service limits with new guides, replace the valves and guides.

NOTE

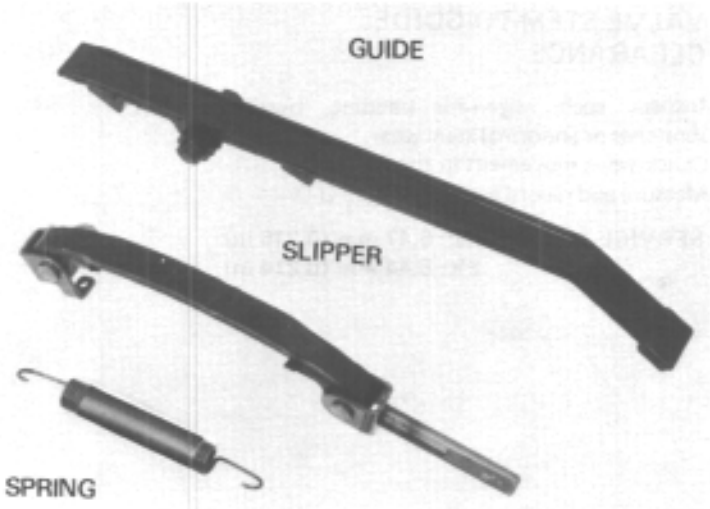
Reface the valve seats whenever the valve guides are replaced (page 6-16).



## CAM CHAIN GUIDE AND CAM CHAIN TENSIONER INSPECTION

Inspect the cam chain guide and tensioner for damage or excessive wear.

Inspect the cam chain tensioner slipper for damage or local or excessive wear.
Inspect the spring for tension.



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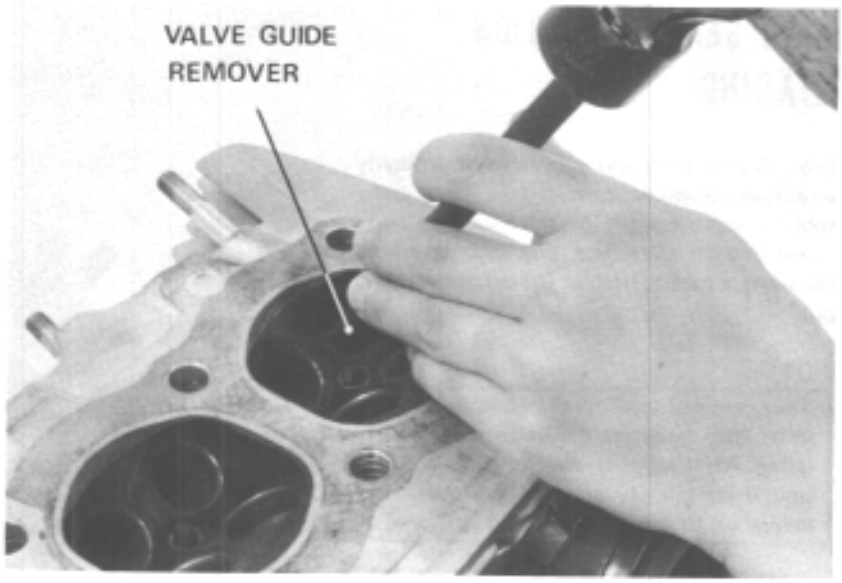
# VALVE GUIDE REPLACEMENT

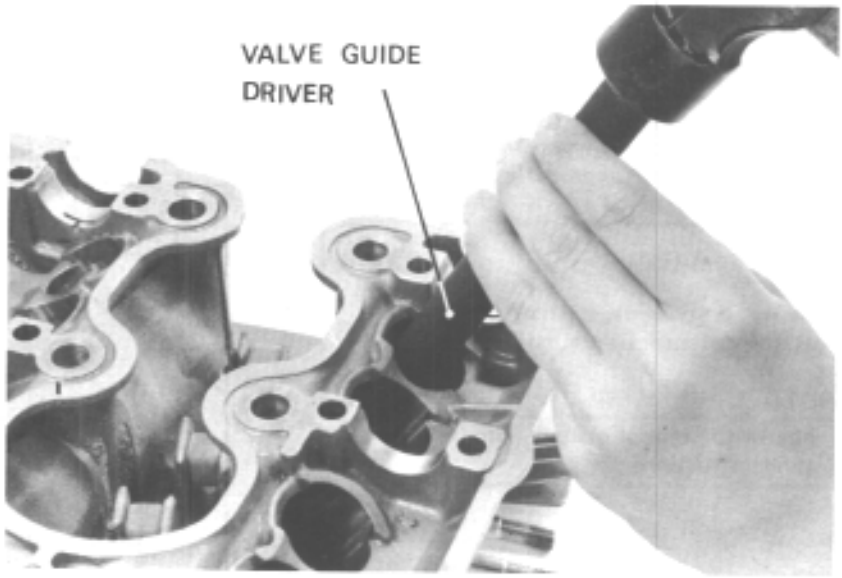
Support the cylinder head and drive out the guide from the valve port.

NOTE

When driving out the valve guide, do not damage the head.



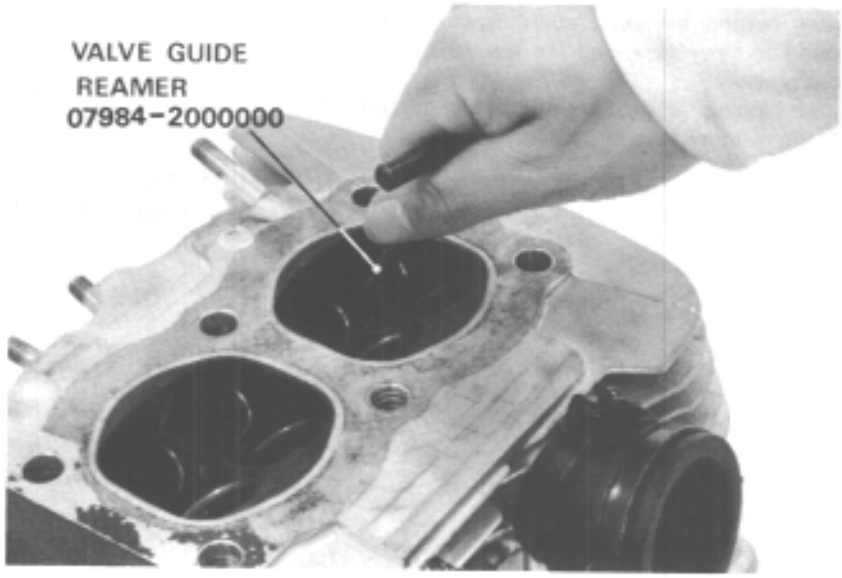

Install an oversize valve guide from the top of the head.




Ream the new valve guide after installation.

NOTE

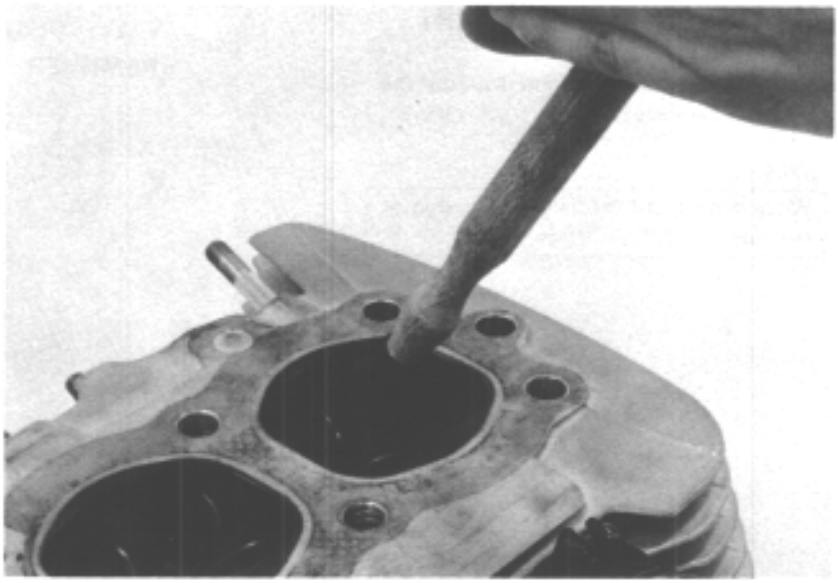
- Use cutting oil on the reamer during this operation.
- Rotate the reamer when inserting and removing it.




Reface the valve seat (page 6-16).

Clean the cylinder head thoroughly to remove any metal particles.

# VALVE SEAT INSPECTION/ REFACING



Clean all intake and exhaust valves thoroughly to remove carbon deposits.
Apply a light coating of valve lapping compound to each valve face. Lap each valve and seat using a rubber hose or other hand-lapping tool.

NOTE

Take care not to allow the compound to enter into between the valve stem and guide. After lapping, wash out the compound completely and apply a coat of engine oil to the valve face and seat.

Remove the valve and inspect the face.

*CAUTION*

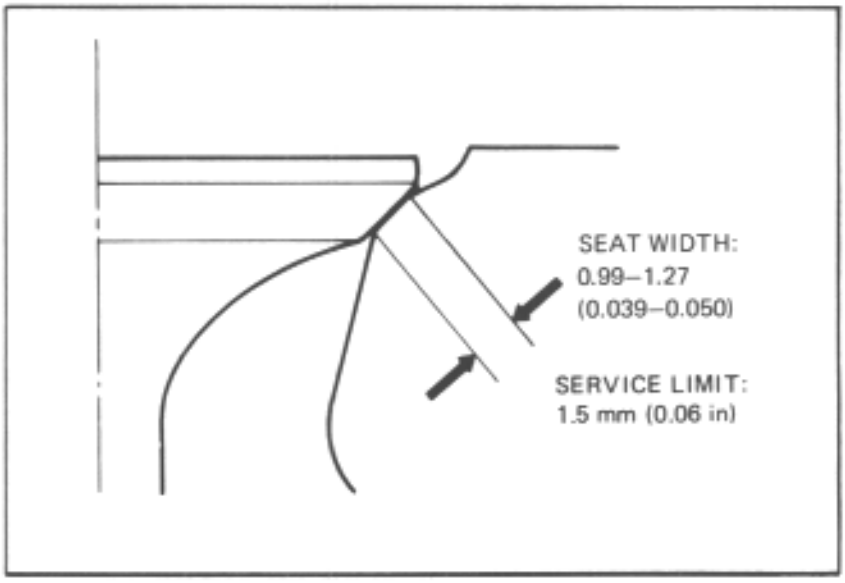
*The valves cannot be ground. If the valve face is rough, worn unevenly, or contacts the seat improperly, the valve must be replaced.*

Inspect the valve seat.

If the seat is too wide, too narrow, or has low spots, the seat must be ground.

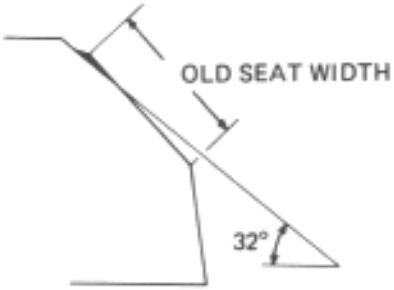
NOTE

Follow the refacer manufacturer's operating instructions.

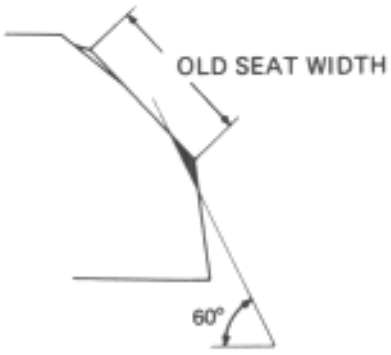



After cutting the seat, apply lapping compound to valve face, and lap the valve using light pressure.
After lapping, wash any residual compound off the cylinder head and valve.

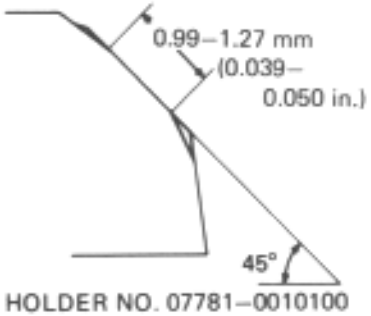
IN: CUTTER No. 07780–0012200 (30 ϕ)
EX: CUTTER No. 07780–0012100 (28 ϕ)




IN, EX: CUTTER
No. 07780–0014000 (30 ϕ)




IN: CUTTER No. 07780–0010200 (27.5 ϕ)
EX: CUTTER No. 07780–0010100 (24.5 ϕ)




HOLDER NO. 07781–0010100



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# CYLINDER HEAD ASSEMBLY

NOTE

Install new valve stem seals when assembling.

Lubricate each valve stem with molybdenum disulfide grease and insert the valve into the valve guide.

NOTE

To avoid damage to the stem seal, turn the valve slowly when inserting.

Install the valve springs and retainers.

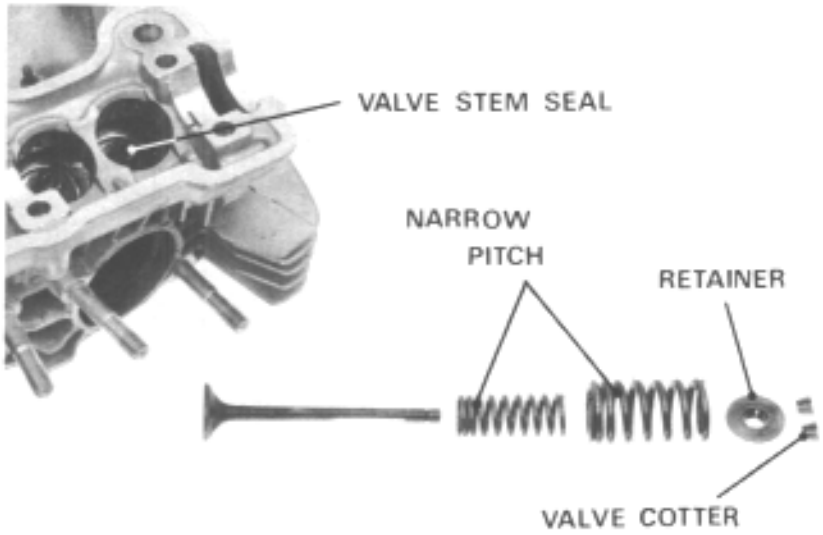
NOTE

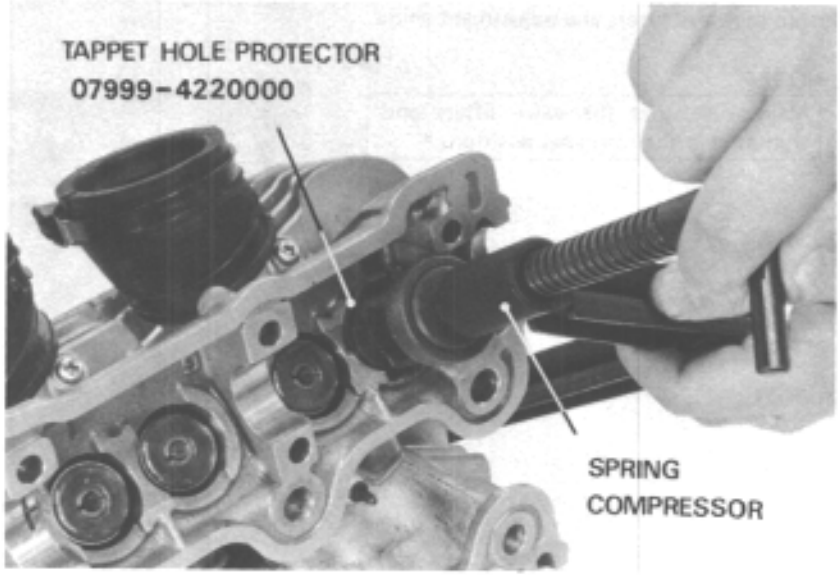
Install the valve springs with the tightly wound coils facing the cylinder head.

Install the valve cotters.

*CAUTION*

*To prevent loss of tension, do not compress the valve spring more than necessary to install the valve keepers.*

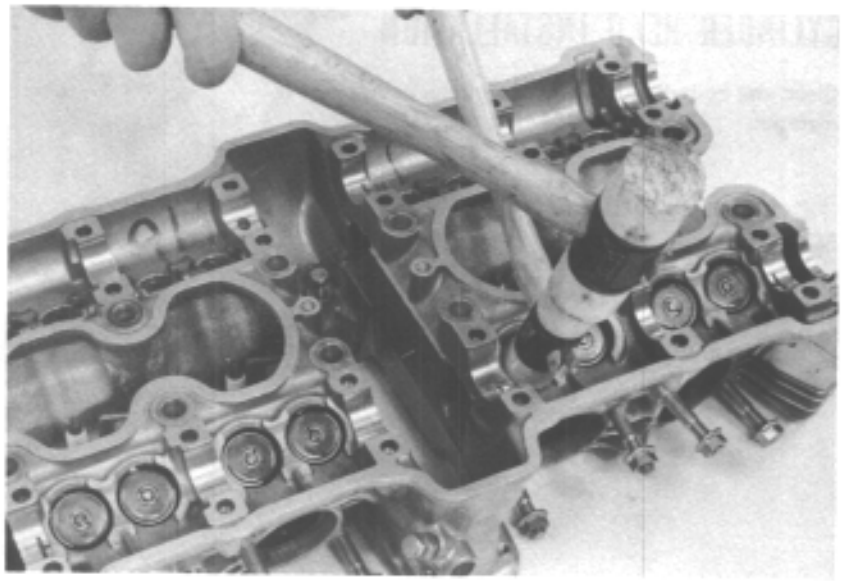


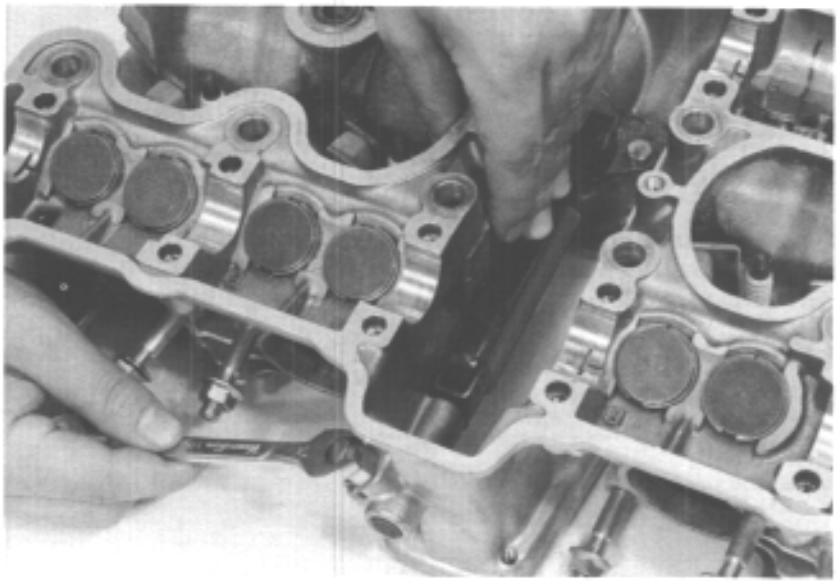

Tap the valve stems gently with a soft hammer to firmly seat the keepers.

NOTE

Support the cylinder head above the work bench surface to prevent possible valve damage.



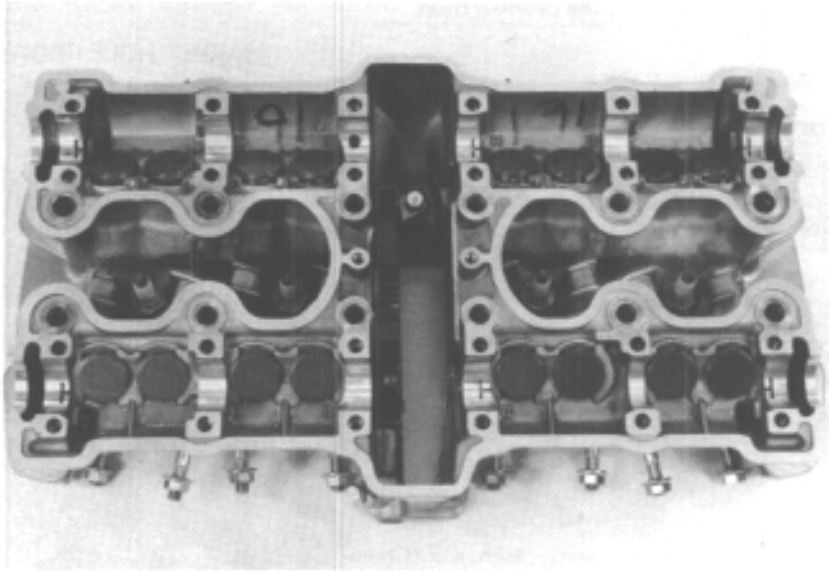
Install the front cam chain tensioner.
Push the chain tensioner and tighten the lock nut.



Install the valve lifters and adjustment shims.

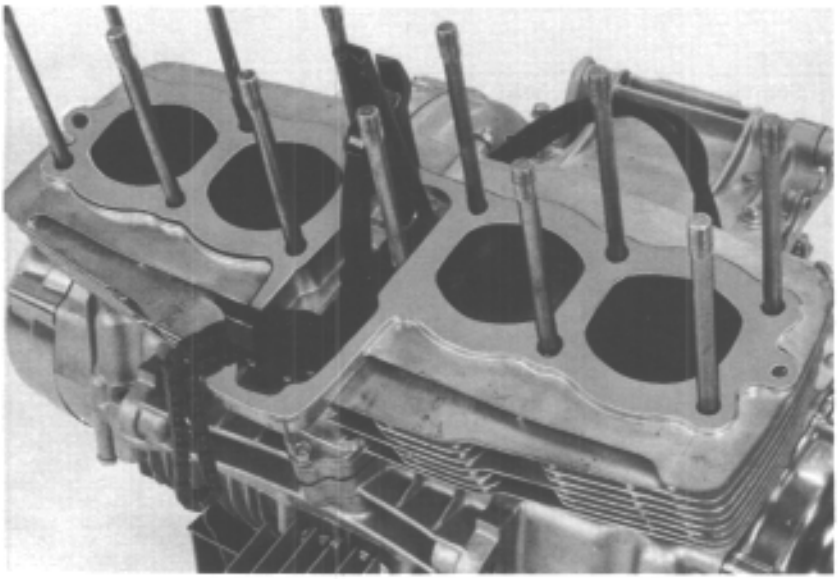
NOTE

Make sure that the valve lifters and shims are in their original positions.



## CYLINDER HEAD INSTALLATION

Clean the cylinder head surfaces of any gasket material.





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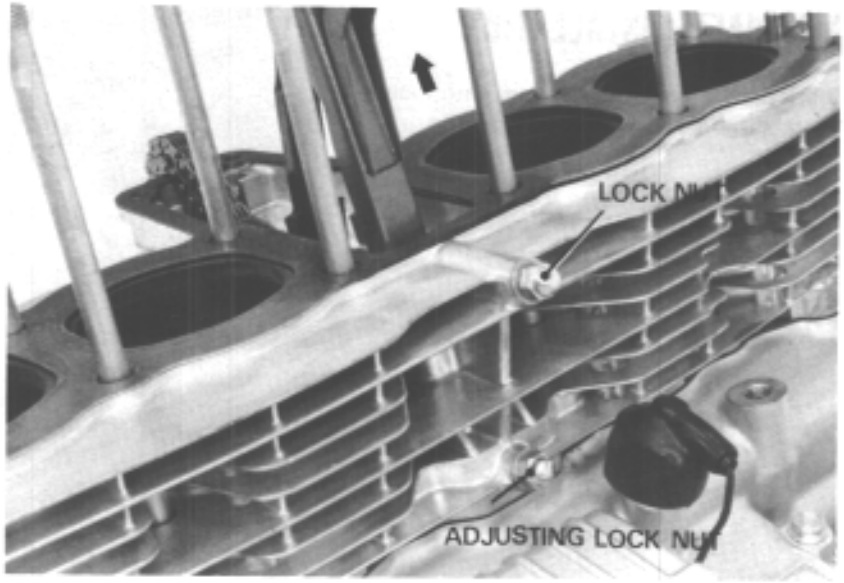
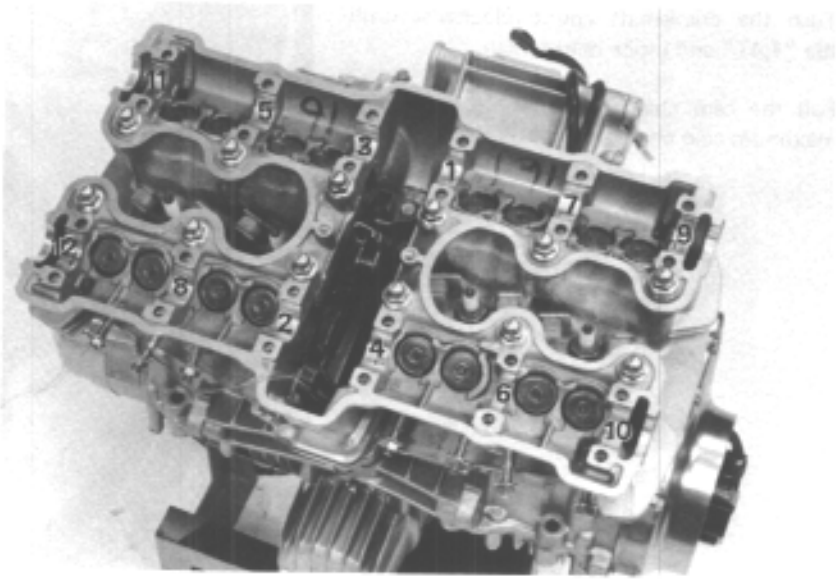
Tighten the two cam chain tensioner lock nuts.
Loosen the adjusting lock nut and pull the tensioner up.
Retighten the lock nut.
Install the dowel pins, a new gasket and cam chain guide.




Install the cylinder head assembly.
Tighten the cap nuts in the sequence shown.

**SPECIFIED TORQUE:**
**10 mm cap nut: 3.6–4.0 kg-m (26–29 ft-lb)**




Tighten the two bolts at the cam chain housing.

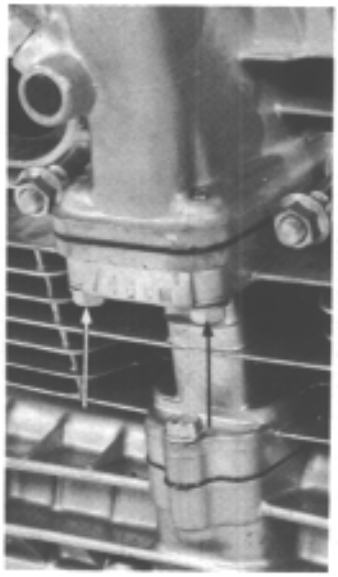
NOTE

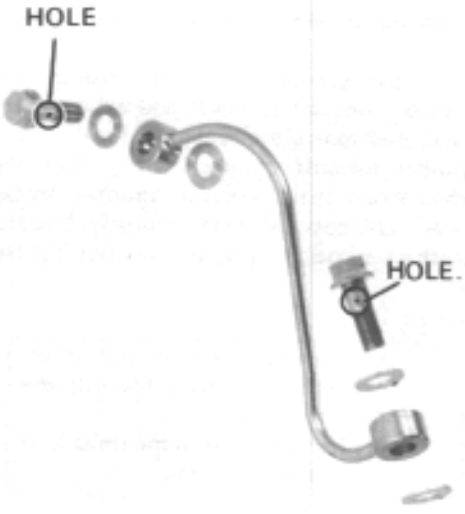
Apply molybdenum disulfide grease to the threads of the cylinder bolts.

Tighten the two oil pipe bolts.

NOTE

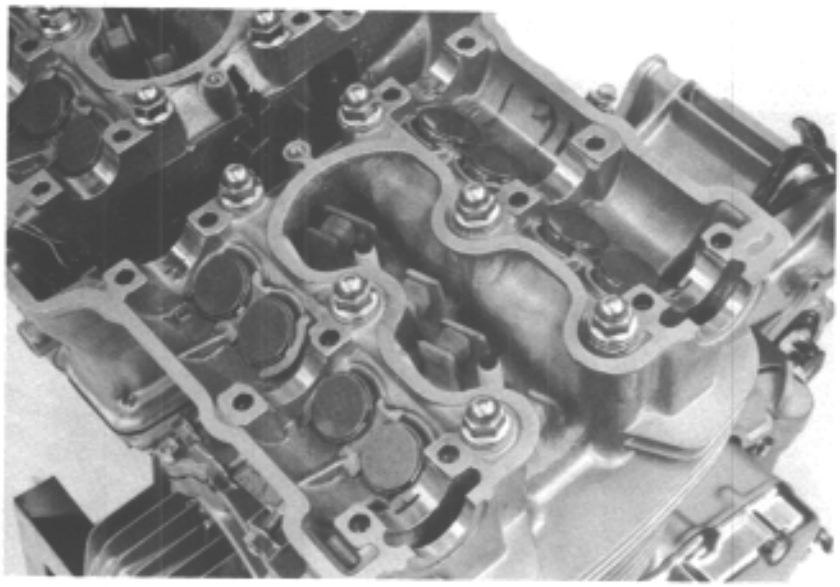
Install the bolt with bigger hole to tighten the upper oil pipe.





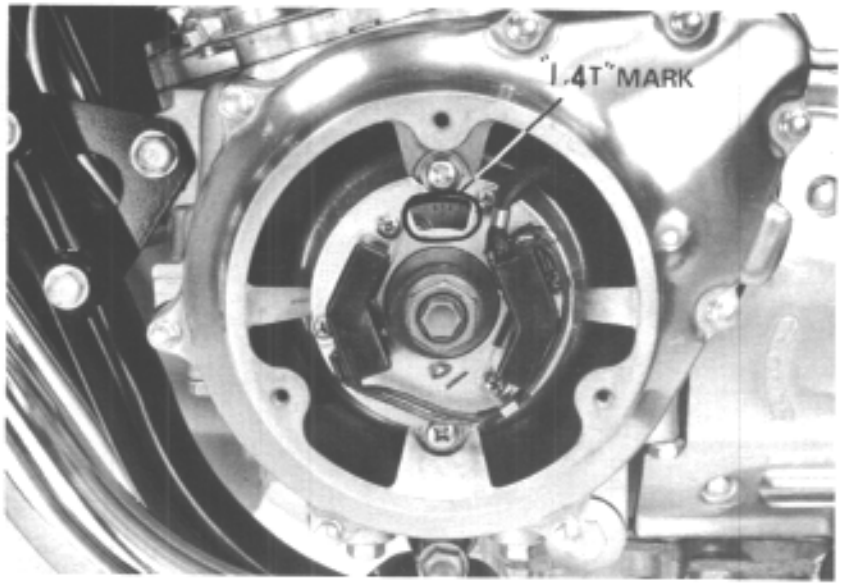
## CAMSHAFT INSTALLATION

Lubricate the camshaft bearings with molybdenum disulfide grease.



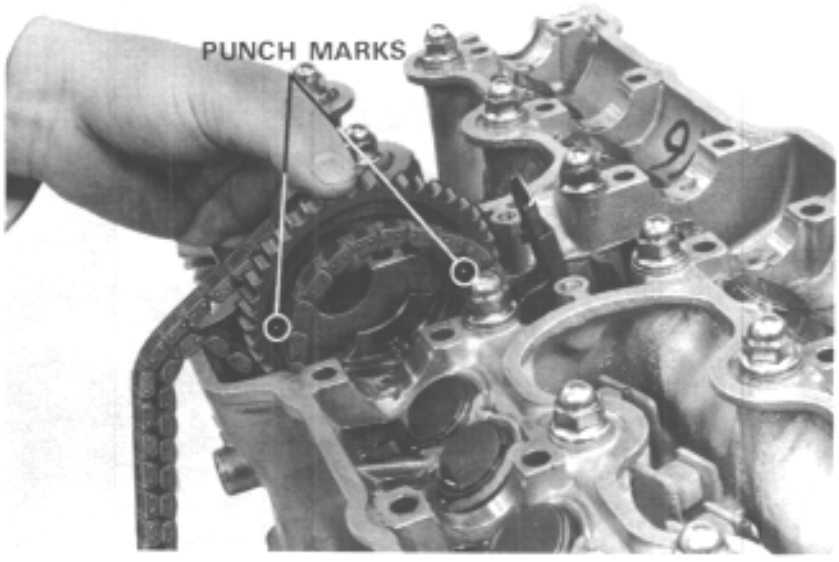
Turn the crankshaft counterclockwise until the "1,4T" and index marks align.

Pull the cam chain tensioner up to provide maximum cam chain slack.




Place the intake cam chain over the exhaust camshaft sprocket, aligning the sprocket punch marks with the cylinder head surface.

Place the exhaust camshaft through the exhaust camshaft sprocket and exhaust cam chain, positioning the cam lobes for the No. 1 cylinder towards the spark plug. Place the exhaust cam chain over the sprocket. Install the A and E camshaft holders loosely. Install a camshaft sprocket bolt, but do not tighten yet.




NOTE

- Install camshaft holders with directional arrows pointing towards the front of the engine.
- Apply locking agent to the threads of camshaft sprocket bolts.



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Loosely install the D camshaft holder and the tachometer drive gear/camshaft holder. Position the camshaft so its flange fits into the slot in the D holder.

Turn the crankshaft counterclockwise 360° and install the other camshaft sprocket bolt and tighten to the specified torque. Turn the crankshaft another 360° and tighten the sprocket bolt which was installed earlier.

NOTE

Apply locking agent to the threads of camshaft sprocket bolts.

**TORQUE: 2.2–2.6 kg-m (16–19 ft-lb)**

Tighten the camshaft holder bolts in a criss-cross pattern.

**TORQUE: 1.2–1.6 kg-m (9–12 ft-lb)**

Adjust the front cam chain with the lock nut on the rear of the engine (page 3-11).

Make sure that the "1,4T" and index marks are aligned as shown on page 6-20 and the cam lobes for the No. 1 cylinder face toward the spark plug. Recheck the position of the exhaust camshaft sprocket; the punch marks must align with the cylinder head surface. Place the intake cam chain over the intake camshaft and sprocket, aligning the sprocket punch marks with the cylinder head surface.

Install the intake camshaft, positioning the cam lobes for the No. 1 cylinder toward the spark plugs. Install a camshaft sprocket bolt, but do not tighten yet.

NOTE

If the sprocket was not removed from the camshaft during disassembly, then reinstall as an assembled set.

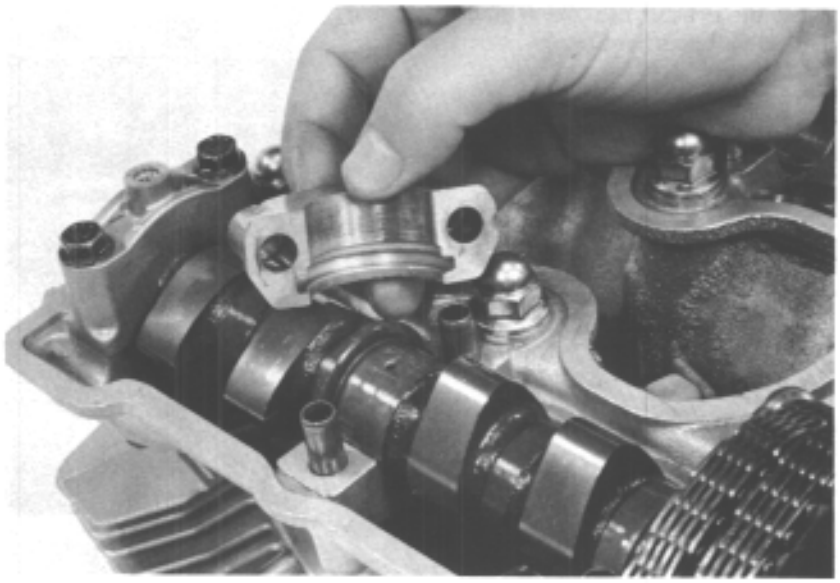
Loosely install the F and L camshaft holders. Install the G and K holders loosely, positioning the camshaft so its flange fits into the slot in the K holder.

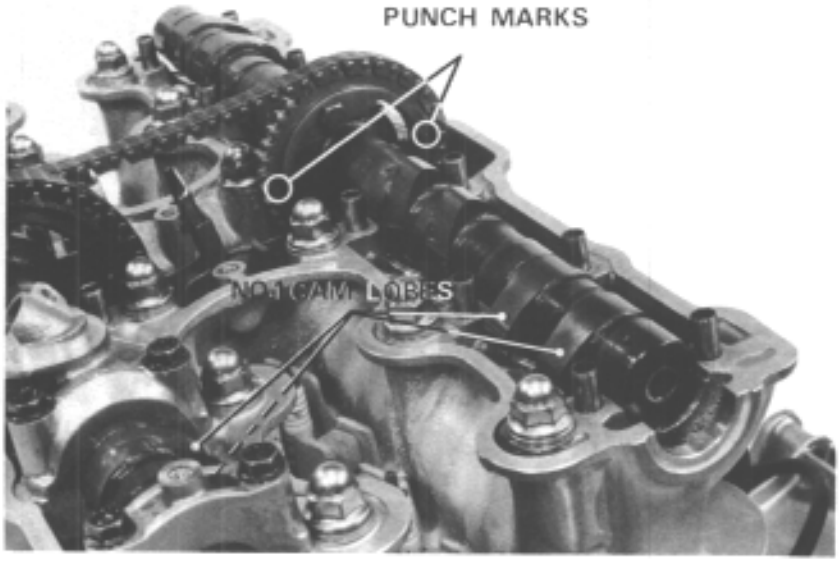
Install and tighten the camshaft sprocket bolts, following the same procedures described for exhaust camshaft installation.

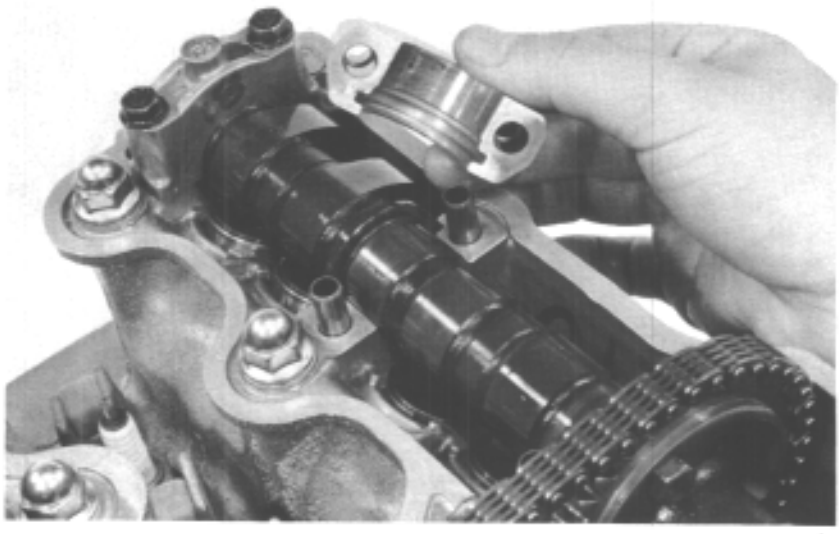
Tighten the camshaft holder bolts in a criss-cross pattern.

Adjust the intake cam chain tensioner with the lock nut on the front of the engine (page 3-11).

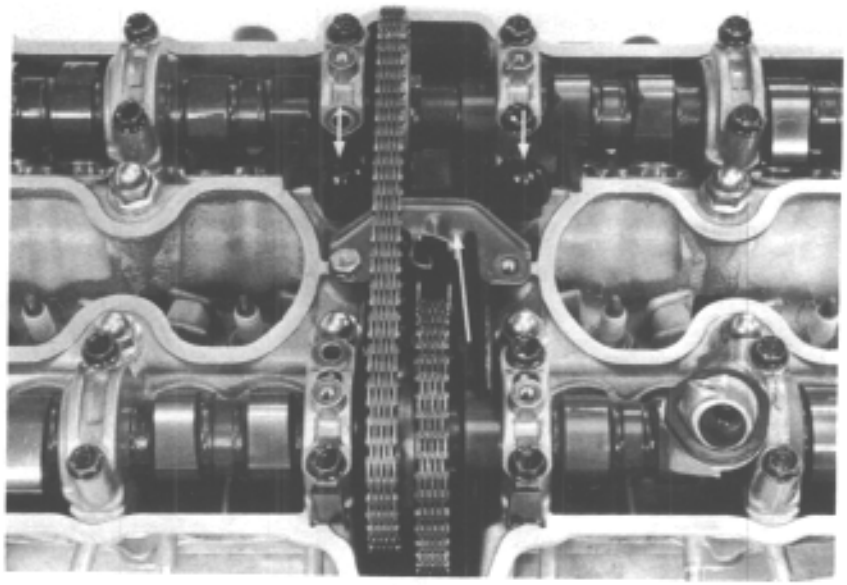
Recheck the crankshaft and camshaft sprocket alignment.



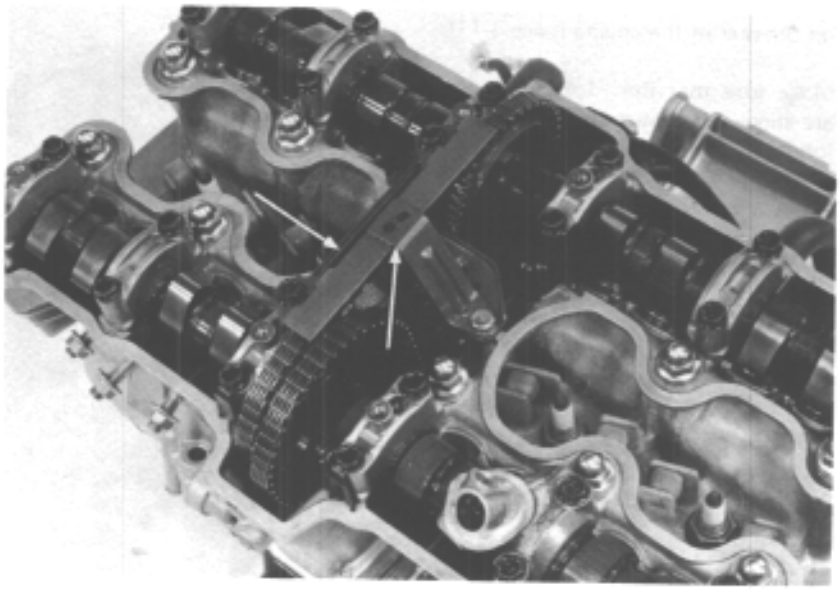


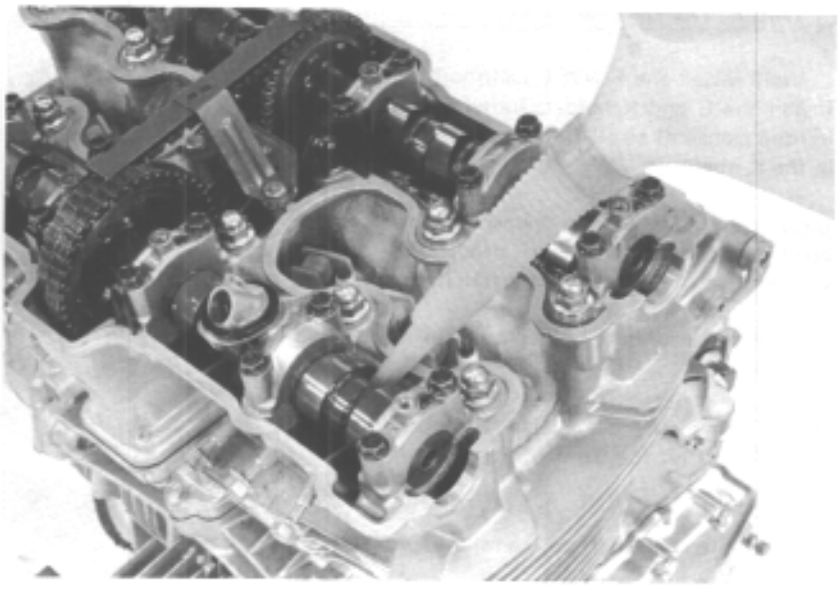
Install the exhaust cam chain guide attaching plate and oil pool caps.



Install the oil line and cam chain guide with the B, C, H and J holders.
Tighten in a criss-cross pattern.



Fill the oil pockets in the head with oil so that the cam lobes are submerged.
Adjust the valve clearance (page 3–7).





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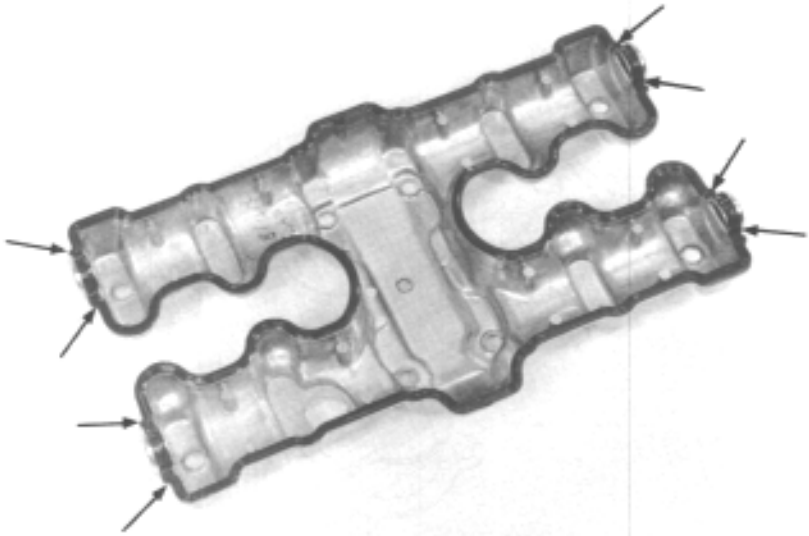
Inspect the cylinder head cover gasket for damage or deterioration.
Apply a sealant on the cylinder gasket at eight places as shown.

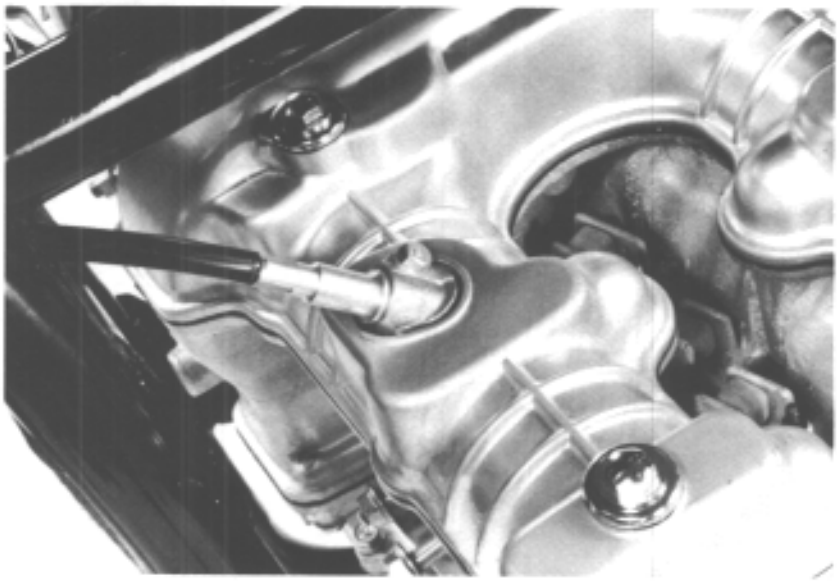
NOTE

Clean the gasket before applying sealant.



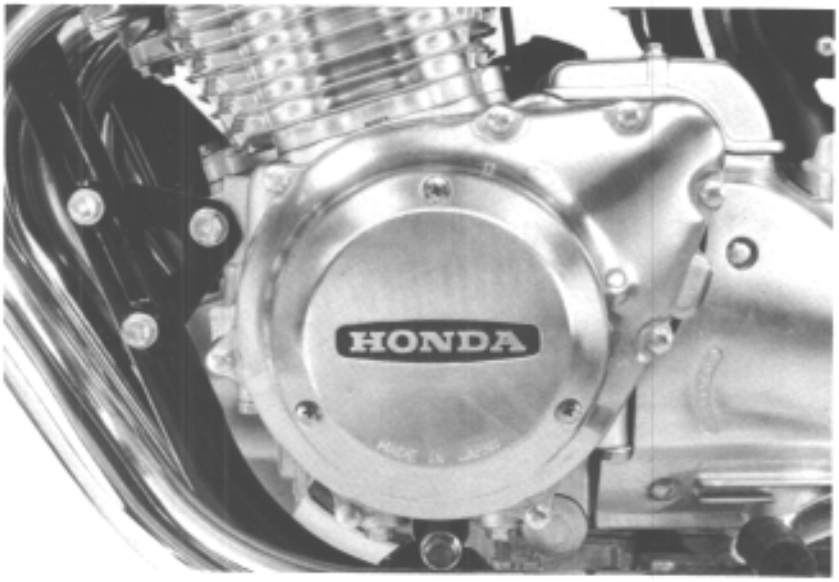
Install the cylinder head cover.

Connect the tachometer cable.
Install the spark plug caps.



Install the pulser generator cover.

Adjust cam chain tension (page 3–11).



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