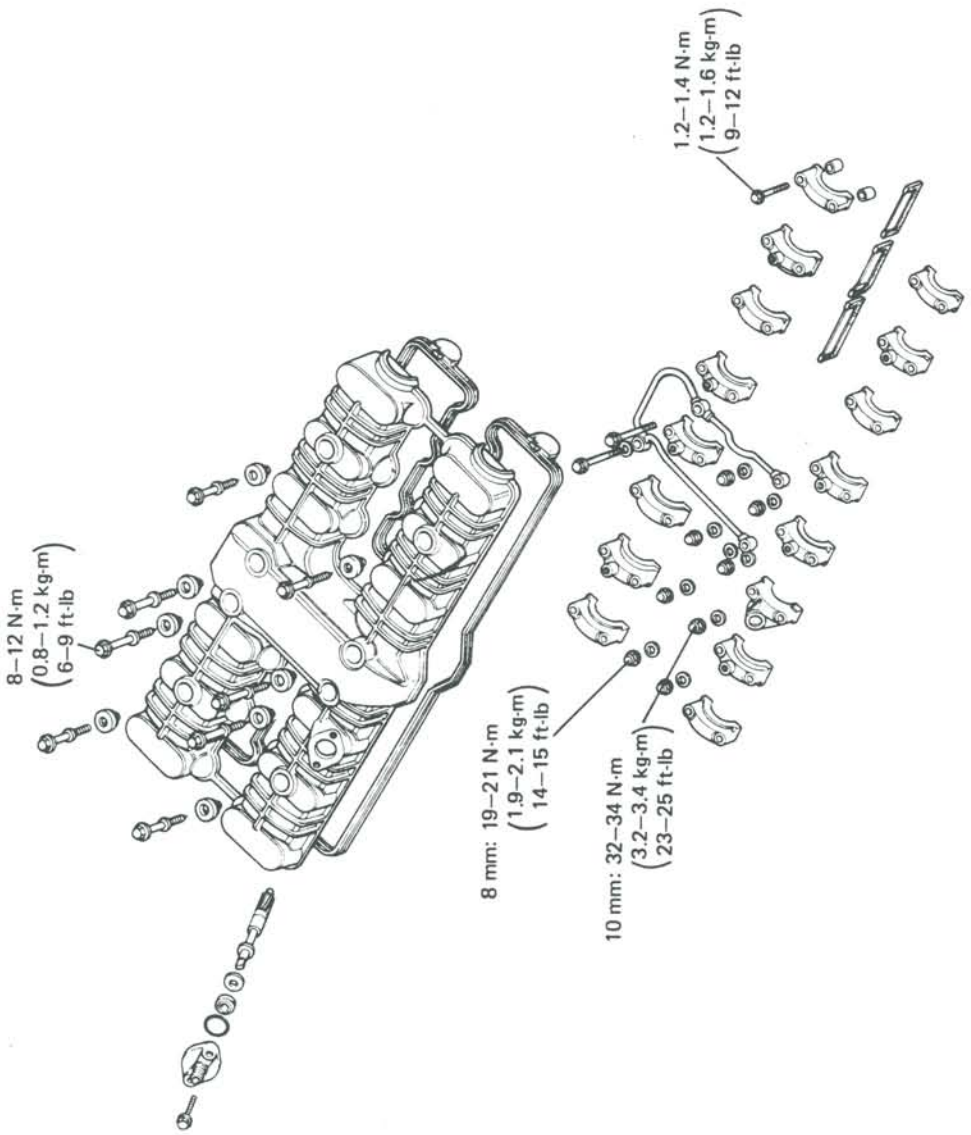
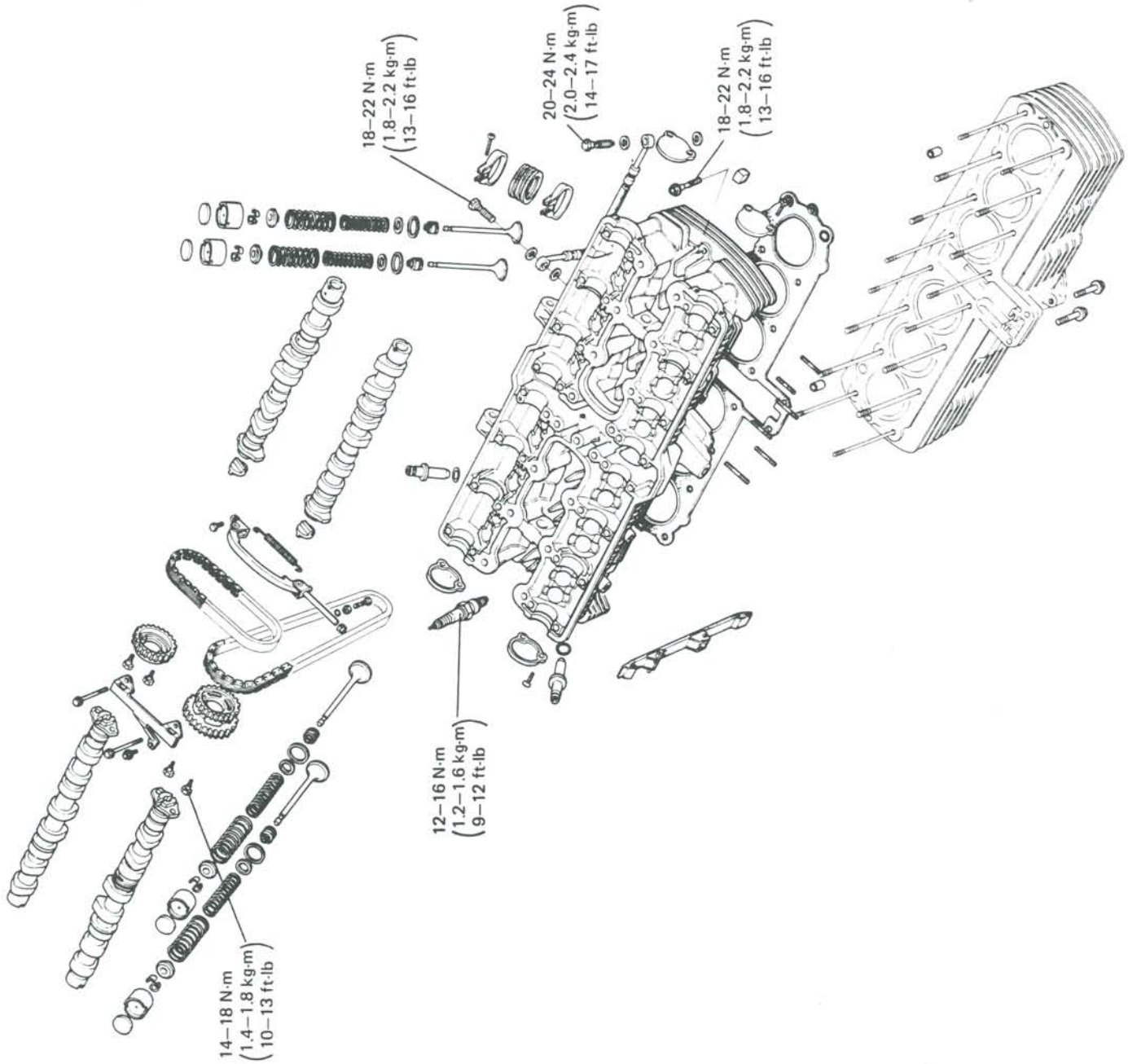
CYLINDER HEAD/VALVE
CULASSES/SOUPAPES
ZYLINDERKOPF/VENTILE
CULATAS/VALVULAS




18–22 N·m
(1.8–2.2 kg·m)
(13–16 ft·lb)
20–24 N·m
(2.0–2.4 kg·m)
(14–17 ft·lb)
18–22 N·m
(1.8–2.2 kg·m)
(13–16 ft·lb)
12–16 N·m
(1.2–1.6 kg·m)
(9–12 ft·lb)
14–18 N·m
(1.4–1.8 kg·m)
(10–13 ft·lb)

SERVICE INFORMATION	6–1	VALVE GUIDE REPLACEMENT	6–15
TROUBLESHOOTING	6–2	VALVE SEAT INSPECTION/REFACING	6–16
CAMSHAFT REMOVAL	6–3	CYLINDER HEAD ASSEMBLY	6–18
CYLINDER HEAD REMOVAL	6–10	CYLINDER HEAD INSTALLATION	6–19
CYLINDER HEAD DISASSEMBLY	6–11	CAMSHAFT INSTALLATION	6–21

SERVICE INFORMATION

WORKING PRACTICE

All cylinder head maintenance and inspection can be accomplished with the engine installed.
Camshaft lubricating oil is fed through the oil hose. Be sure the holes in the oil hose bolt are 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.
To remove the cylinder head, the engine should be tilted. The camshafts and valve lifters can be serviced without engine tilting.
Marks 1 thru 16 on the camshaft holders mean position of holders to be installed; 1 to 8 are for EXHAUST side and 9 to 16 for INTAKE side from left to right respectively. When installing, be sure the mark ⇧ faces forward.

SPECIAL TOOLS

Special Tools	
Valve Guide Reamer	07984–2000000
Valve Lifter Hole Protector	07999–4220000
CommonTools	
Valve Guide Remover (5.5 mm)	07742–0010100
Valve Spring Compressor	07757–0010000

TORQUE VALUES

Cylinder head cover	8–12 N·m (0.8–1.2 kg-m, 6–9 ft-lb)
Camshaft holder	12–14 N·m (1.2–1.4 kg-m, 9–10 ft-lb)
Cylinder head-8mm cap nut	19–21 N·m (1.9–2.1 kg-m, 14–15 ft-lb)
Cylinder head-10mm cap nut	32–34 N·m (3.2–3.4 kg-m, 23–25 ft-lb)
Cylinder head-8mm flange bolt	18–22 N·m (1.8–2.2 kg-m, 13–16 ft-lb)
Cam sprocket	14–18 N·m (1.4–1.8 kg-m, 10–13 ft-lb)
Spark plug	12–16 N·m (1.2–1.6 kg-m, 9–12 ft-lb)

SPECIFICATIONS

			STANDARD	SERVICE LIMIT
Compression ratio			1,176.8 ± 98.1 kPa (12±1 kg/cm², 171±14 psi)	———
Camshaft	Cam height	IN.	37.300–37.460 mm (1.4685–1.4748 in)	37.2 mm (1.46 in)
		EX.	37.500–37.660 mm (1.4763–1.4827 in)	37.4 mm (1.47 in)
	Oil clearance	No. 1 and 9	0.040–0.082 mm (0.0015–0.0032 in)	0.12 mm (0.005 in)
		No. 2 and 10	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 3 and 11	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 4 and 12	0.040–0.082 mm (0.0015–0.0032 in)	0.12 mm (0.005 in)
		No. 5 and 13	0.040–0.082 mm (0.0015–0.0032 in)	0.12 mm (0.005 in)
		No. 6 and 14	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 7 and 15	0.063–0.105 mm (0.0025–0.0041 in)	0.14 mm (0.006 in)
		No. 8 and 16	0.040–0.082 mm (0.0015–0.0032 in)	0.12 mm (0.005 in)
	Run out		———	0.03 mm (0.001 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)
	Cylinder head I.D.		28.000–28.021 mm (1.1024–1.1032 in)	28.03 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	124–143 N/37.5 mm (12.6–14.6 kg/37.5 mm / 27.78–32.19 lbs/1.48 in)	118 N/37.5 mm (12.0 kg/37.5 mm / 16.46 lbs/1.48 in)
		IN. Inner	63–77 N/34.5 mm (6.39–7.81 kg/34.5 mm / 14.087–17.218 lbs/1.36 in)	59 N/34.5 mm (6.0 kg/34.5 mm / 13.23 lbs/1.36 in)
		EX. Outer	124–143 N/37.5 mm (12.6–14.6 kg/37.5 mm / 27.78–32.19 lbs/1.48 in)	118 N/37.5 mm (12.0 kg/37.5 mm / 26.46 lbs/1.48 in)
		EX. Inner	63–77 N/34.5 mm (6.39–7.81 kg/34.5 mm / 14.087–17.218 lbs/1.36 in)	59 N/34.5 mm (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)	5.45 mm (0.215 in)
	Valve guide I.D.	IN.	5.500–5.512 mm (0.2165–0.2170 in)	5.54 mm (0.218 in)
		EX.	5.500–5.512 mm (0.2165–0.2170 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		0.90–1.10 mm (0.035–0.043 in)	1.5 mm (0.06 in)
Cylinder head	Warpage		———	0.10 mm (0.004 in)
Cam chain	Length		169.70–169.92 mm (6.681–6.690 in)	170.7 mm (6.72 in)

TROUBLESHOOTING

Engine top-end problems are usually performance-related and can be diagnosed by a compression test, or are engine noises which can be traced to the top-end with a sounding rod or stethoscope.

Low Compression or Uneven 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

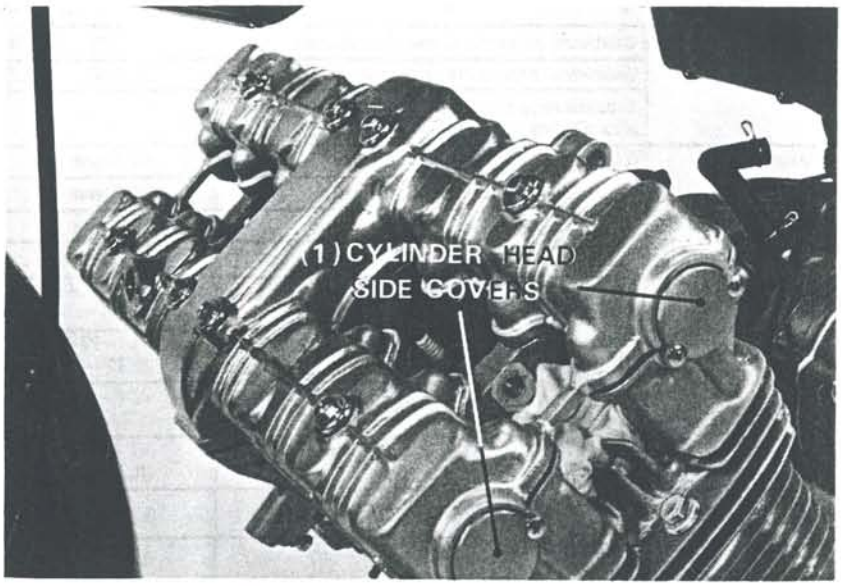
Excessive Noise

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

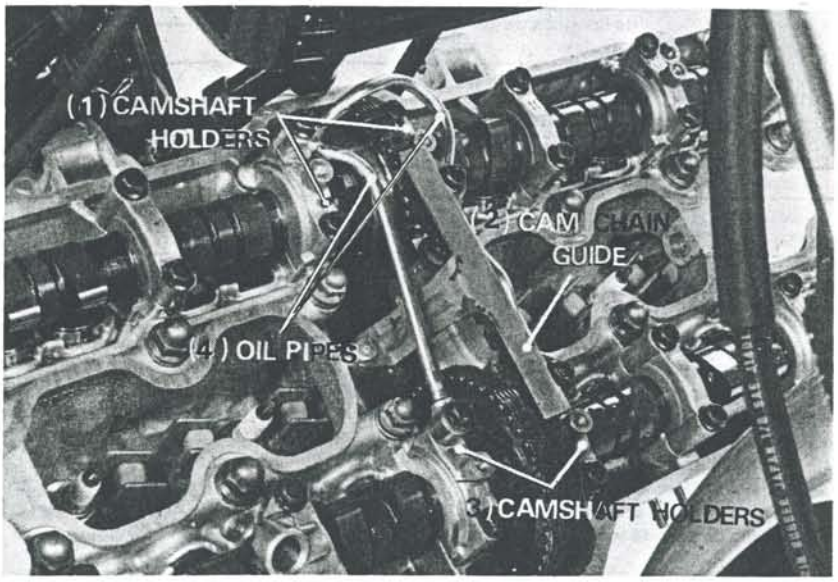
CAMSHAFT REMOVAL

Place the motorcycle on its side stand for 2-3 minutes to allow oil to drain from the cylinder head to the sump.
Then, place the motorcycle on its center stand.

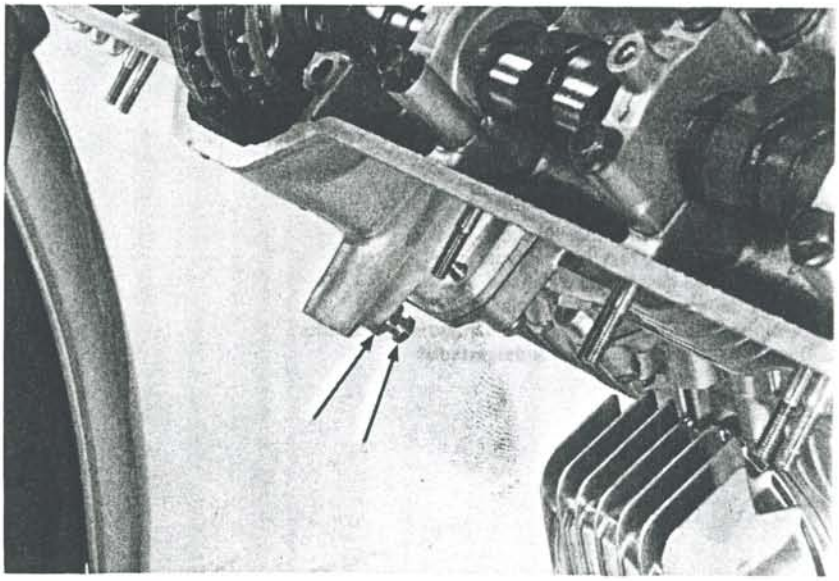
Disconnect the tachometer cable and remove the tachometer drive gear.
Remove the four cylinder head side covers.



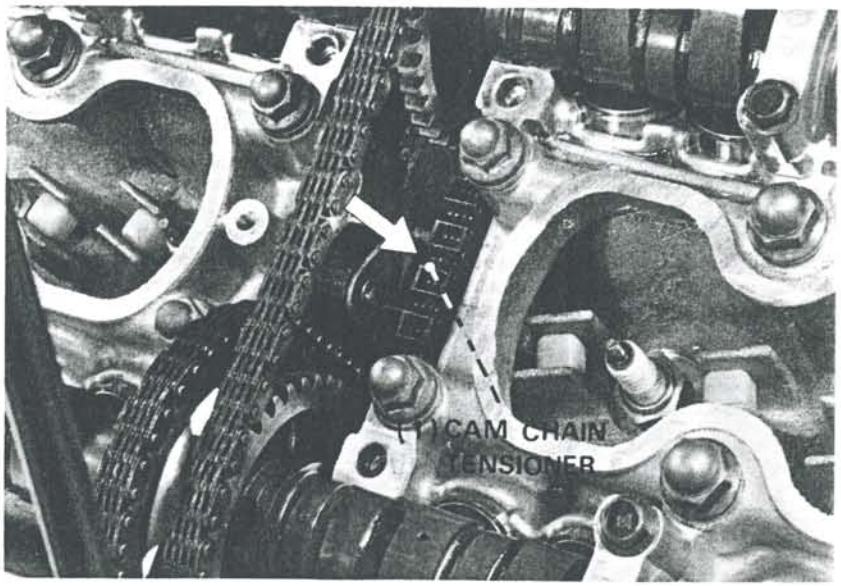
emove the cylinder head cover bolts and the cylinder head cover.
Remove the oil pool plates.
Remove the oil pipes and cam chain guide.
Remove the No. 4, No. 5, No. 12 and No. 13 camshaft holders.
Remove the dowel pins.



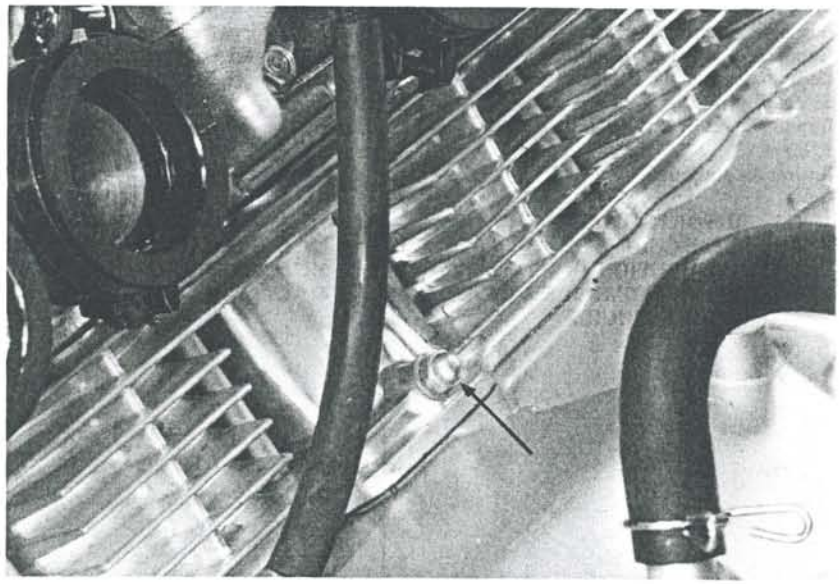
Loosen the front cam chain tensioner lock nut and bolt.



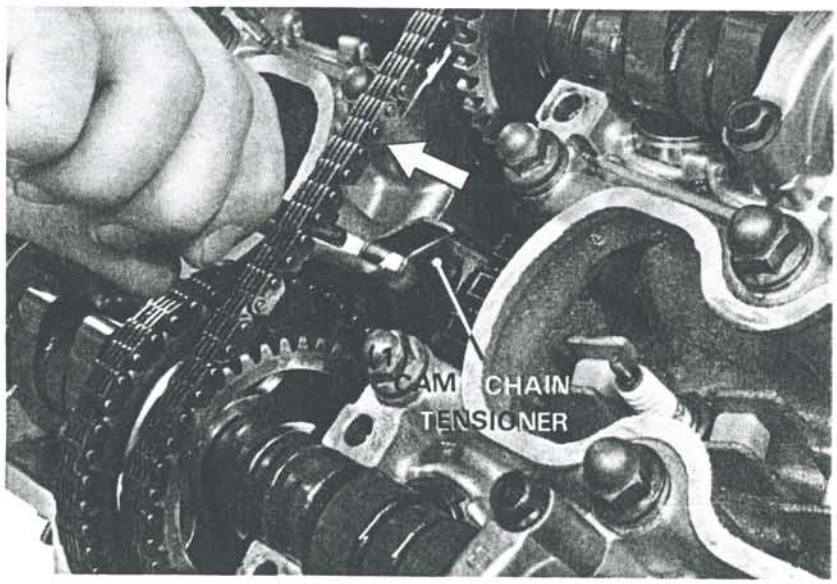
Press the cam chain tensioner down to reduce chain tension.
Tighten the lock bolt and nut.



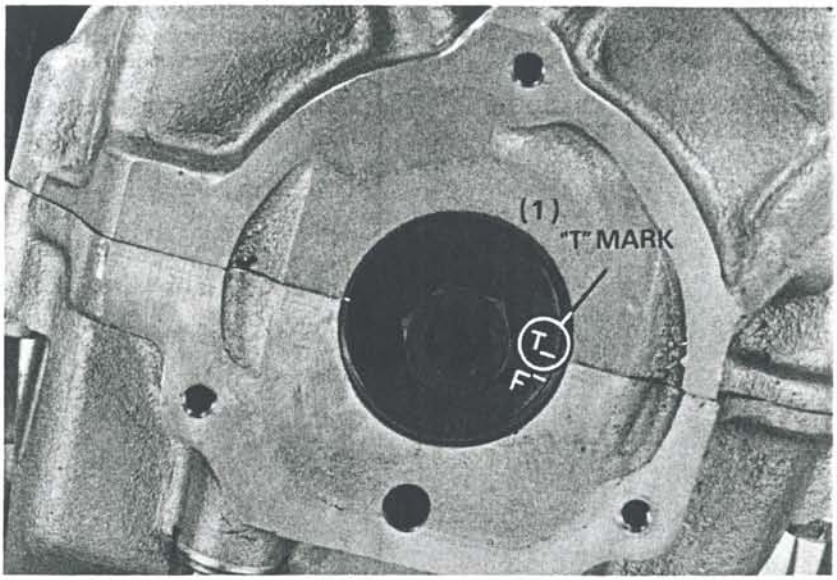
Loosen the rear cam chain tensioner lock nut.



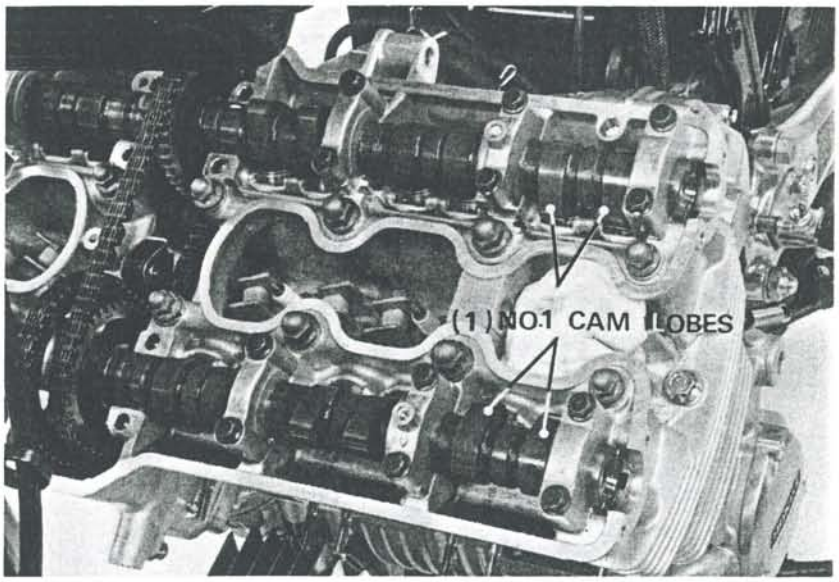
Pull the cam chain tensioner up to reduce chain tension and tighten the bolt and lock nut.



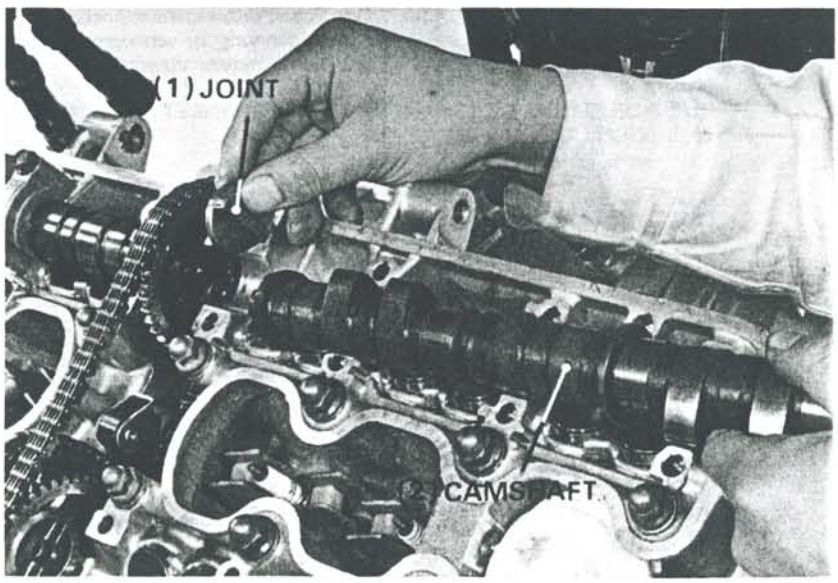
Remove the right crankshaft side cover.
Turn the crankshaft clockwise until "T" mark on the crankshaft end aligns with the forward crankcase mating surface.



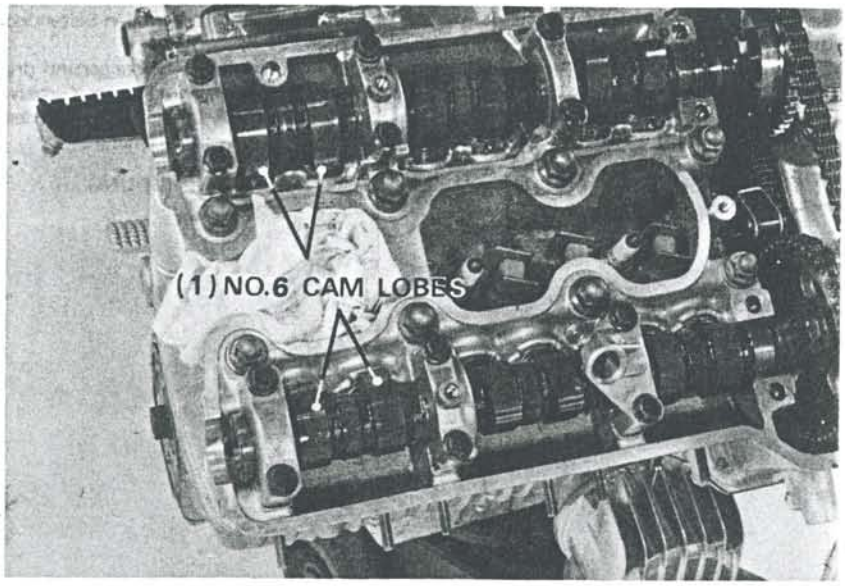
ake sure the No. 1 cylinder intake and exhaust cam lobes face the spark plug.
If they do not, turn the crankshaft 360 degrees clockwise and realign the "T" mark.
Remove the No. 2 and 10 camshaft holders.
Remove the No. 1, 9, 3 and 11 holders.
Remove the dowel pins.



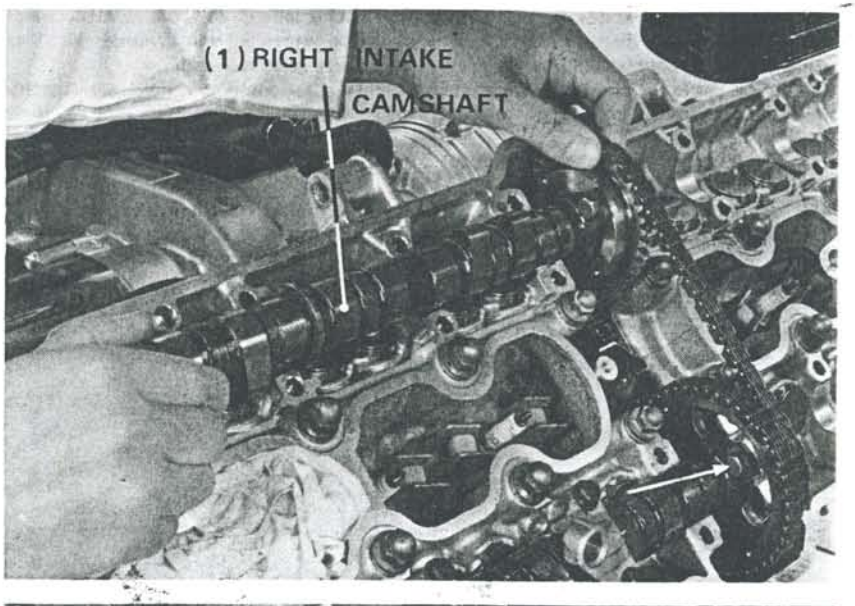
Remove the left camshafts and joints.



Turn the crankshaft 360 degrees clockwise and realign the "T" mark with the crankcase mating surfaces.
The No.6 intake and exhaust cam lobes face the spark plug.
Remove the No.15 camshaft holder.
Then remove the No.16 and 14 camshaft holders.
Remove the dowel pins.



Remove the right intake camshaft.
Loosen the cam sprocket bolt.



Turn the crankshaft clockwise until cam lift is minimal and the other cam sprocket bolt can be removed.
Remove the cam sprocket with the cam chain.

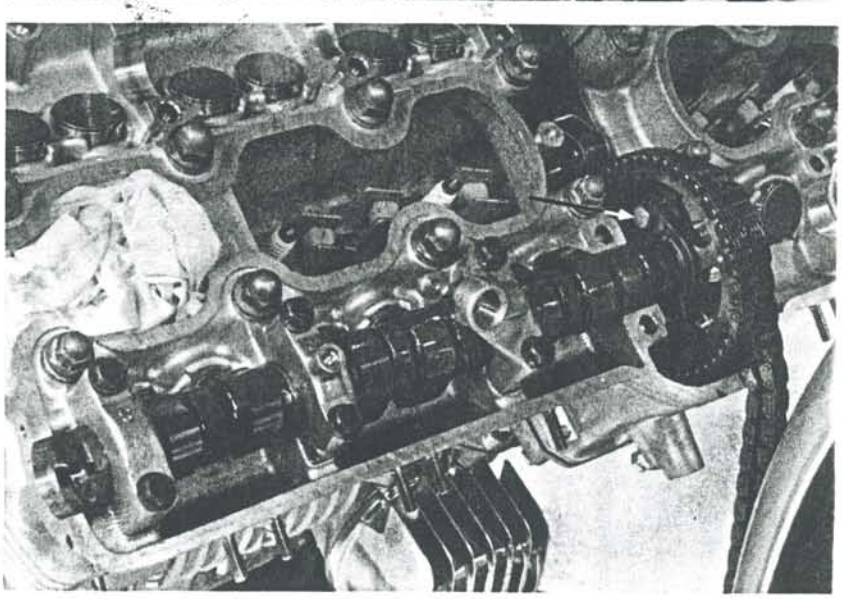
NOTE

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

Remove the No. 7 camshaft holder, then remove the No. 8 and 6 camshaft holders.
Remove the right exhaust camshaft.

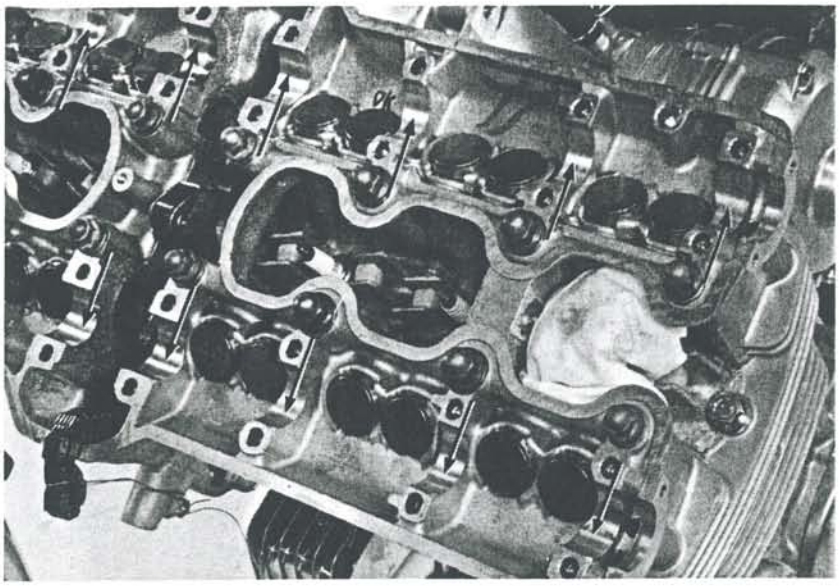
NOTE

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



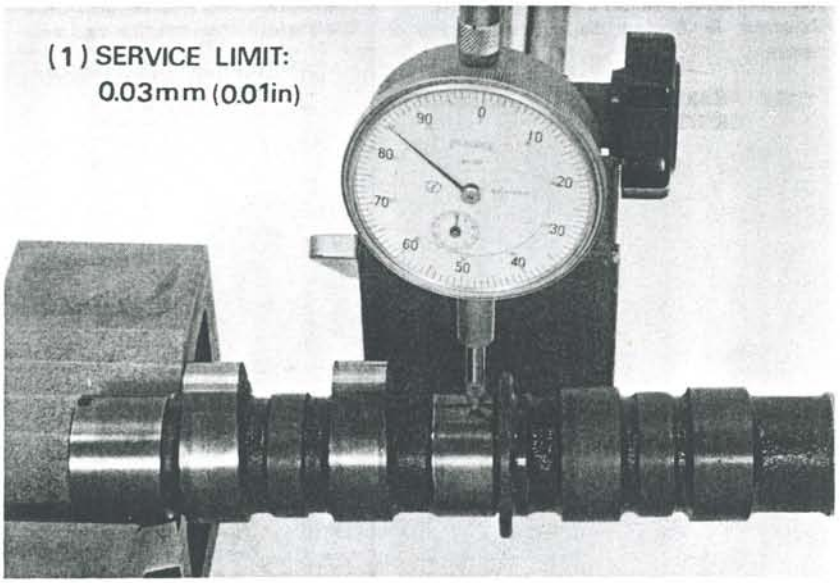
CAM BEARING SURFACE INSPECTION

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



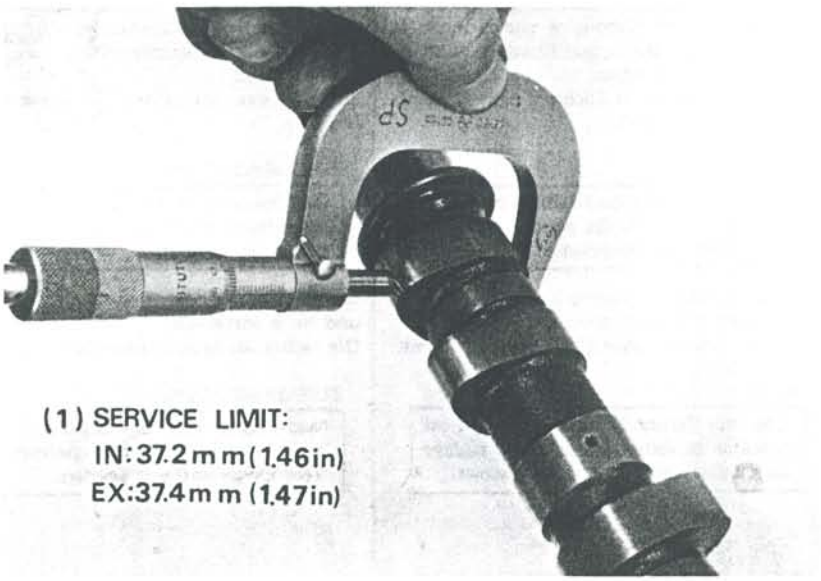
CAMSHAFT RUNOUT

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



CAM LOBE INSPECTION

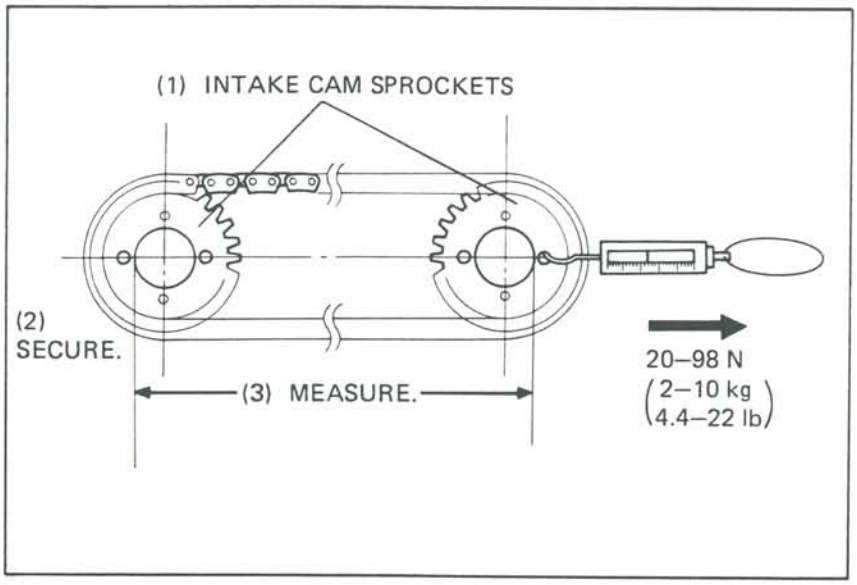
Measure the height of each cam lobe.
Inspect the cam lobes for wear or damage.



CAM CHAIN LENGTH MEASUREMENT

Place the cam chain over the intake camshaft sprockets. Secure one sprocket and apply 20–98 N (2–10 kg, 4.4–22 lb) of tension with a spring scale. Measure the distance between the points as shown.

SERVICE LIMIT: 170.7 mm (6.72 in)



CAM CHAIN GUIDE INSPECTION

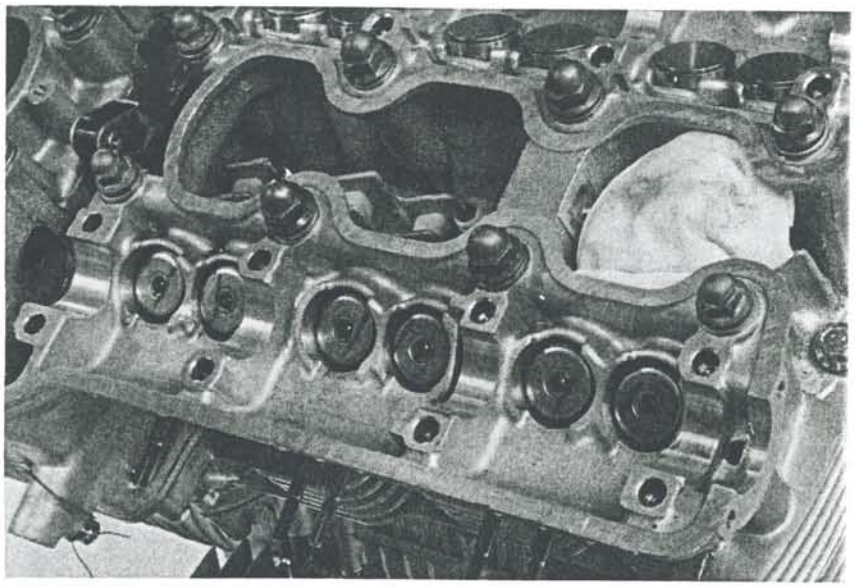
Inspect the cam chain guide for damage or 'ocal or excessive wear.

CAMSHAFT OIL CLEARANCE

Remove the adjusting shims and the valve lifters.

NOTE

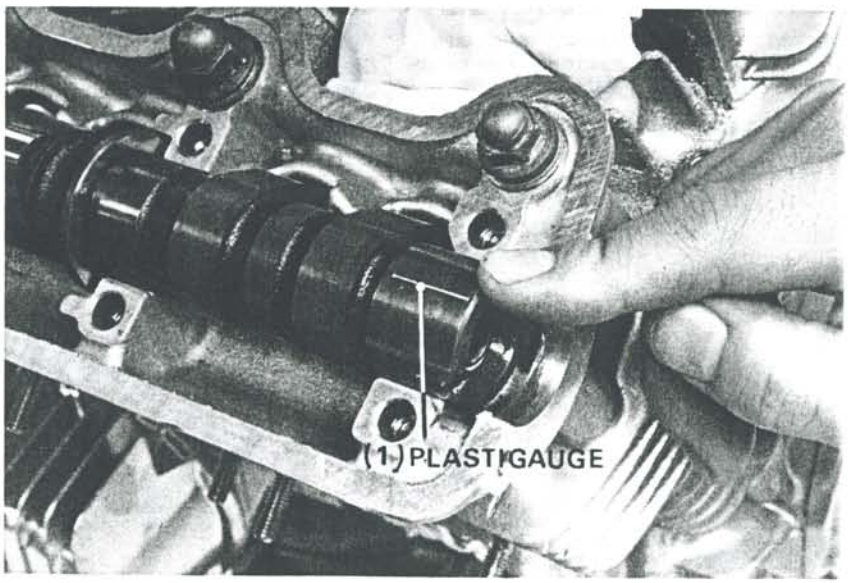
Mark each part to ensure original assembly.



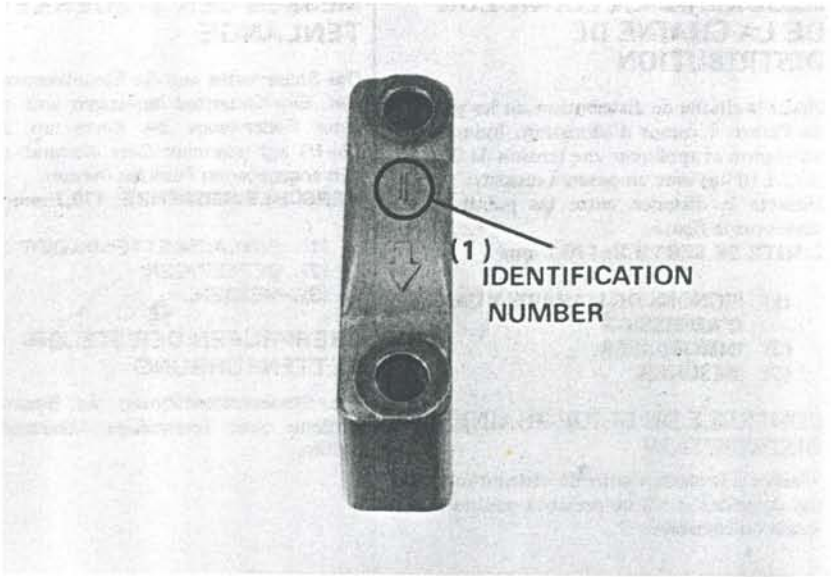
Lay a strip of plastigauge lengthwise on top of each camshaft journal.

NOTE

Wipe any oil from the journals before using plastigauge.



Determine the camshaft holder identification number before installing.

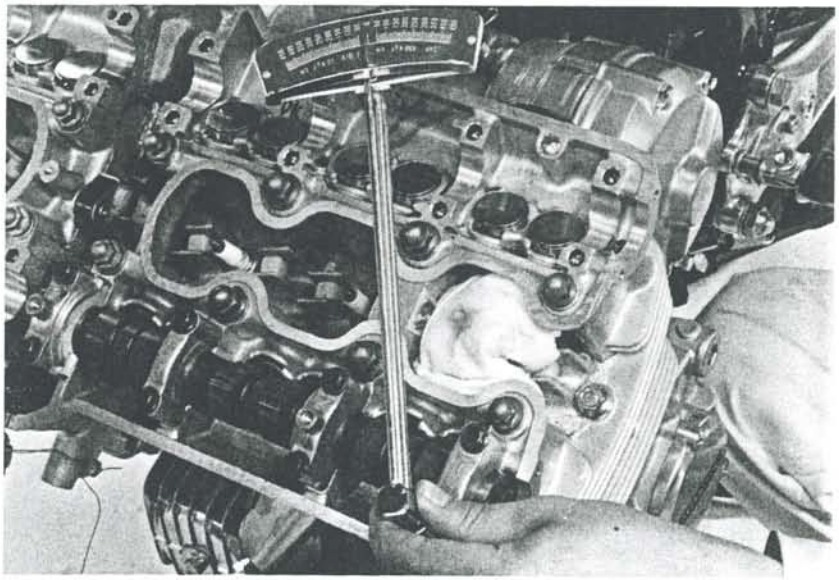


Install the camshaft holders and tighten to the specified torque in a crisscross pattern.

NOTE

Do not rotate the camshaft when using plastigauge.

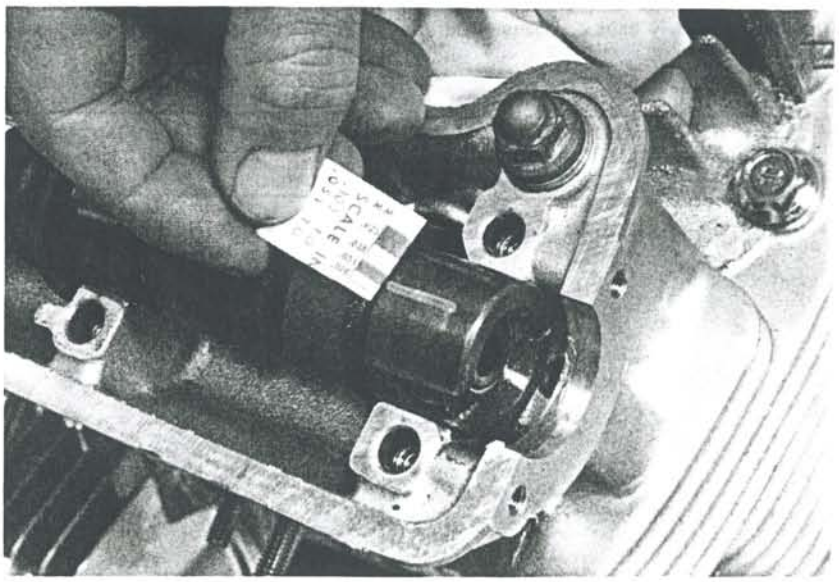
TORQUE: 12–14 N·m (1.2–1.4 kg-m, 9–10 ft-lb)



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

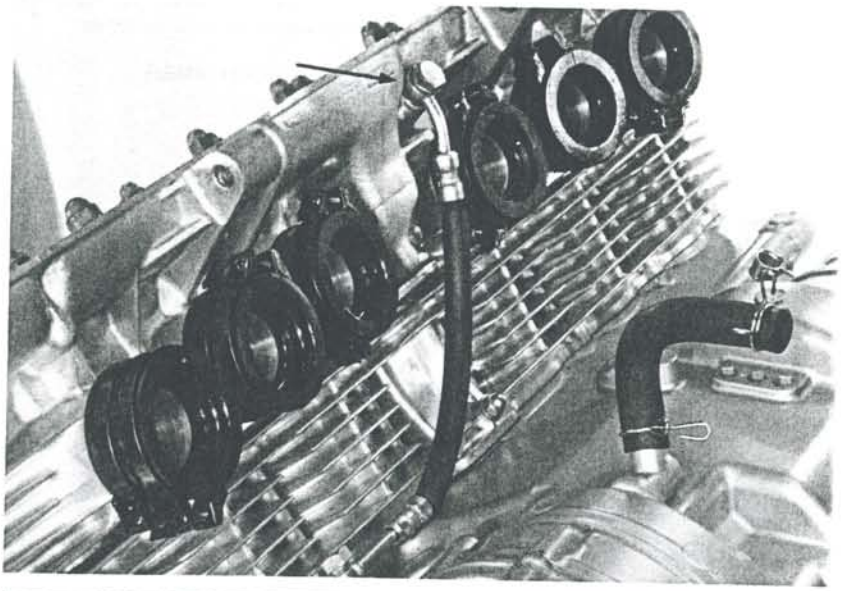
SERVICE LIMITS:
No. 1, 4, 5, 8, 9, 12, 13 and 16:
0.12 mm (0.005 in)
No. 2, 3, 6, 7, 10, 11, 14 and 15:
0.14 mm (0.006 in)

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.

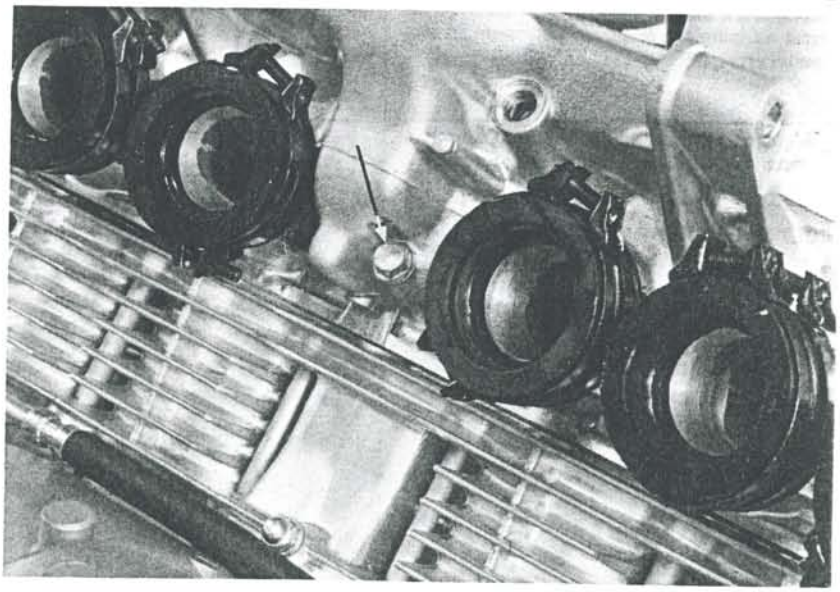


CYLINDER HEAD REMOVAL

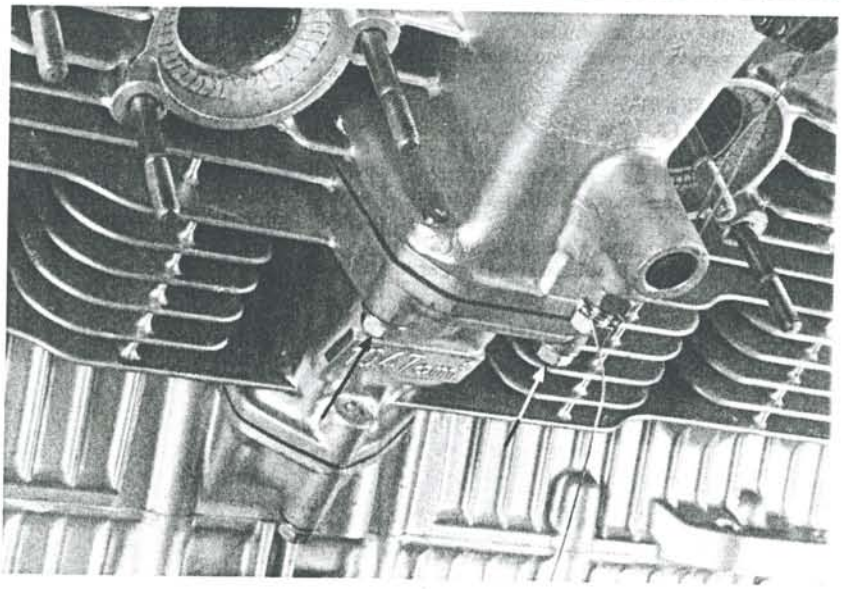
Tilt the engine (Refer to Section 5).
Remove the oil hose bolt.



Remove the rear cam chain tensioner bolt.



Remove the two cam chain housing bolts.

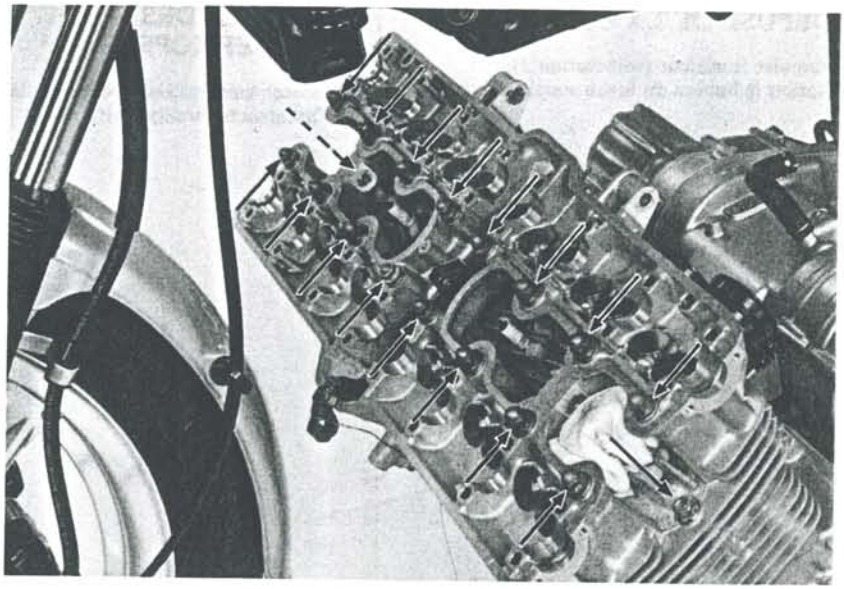


Remove the 16 cap nuts and two bolts.

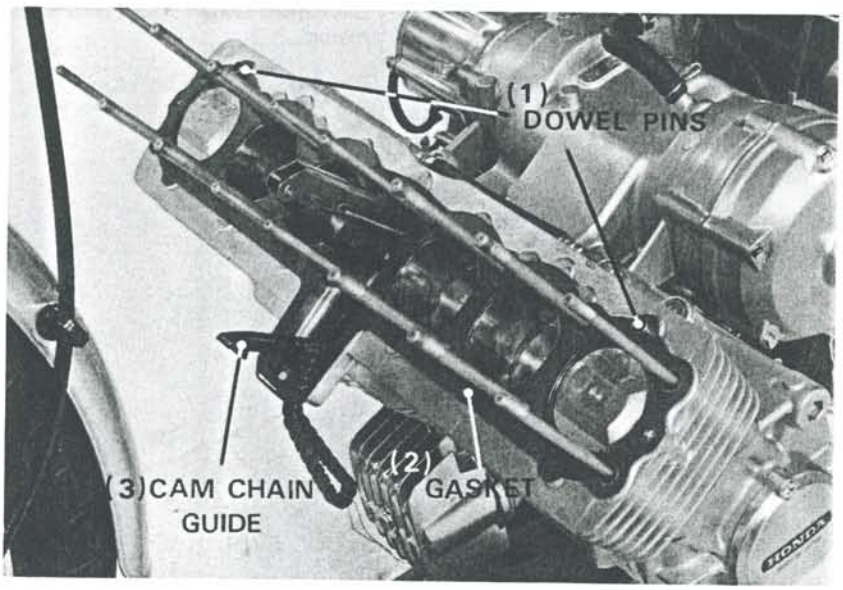
NOTE

Remove the nuts and bolts in 2-3 steps and in a crisscross pattern to prevent warpage.

Remove the cylinder head.



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

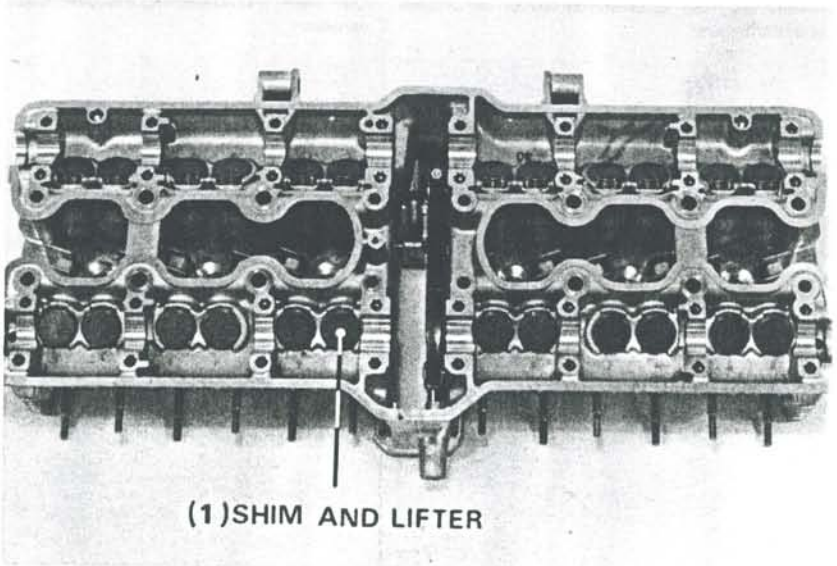


CYLINDER HEAD DISASSEMBLY

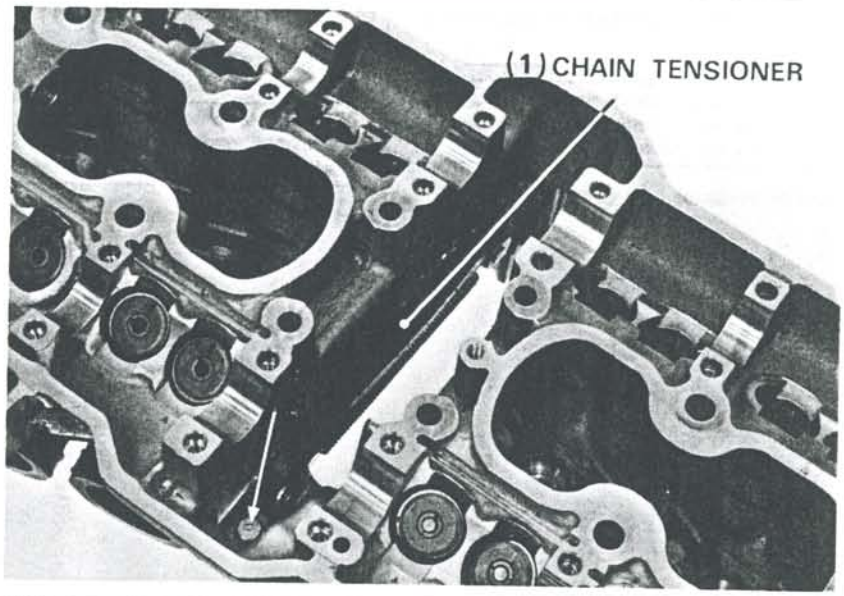
Remove the valve shims.
Remove the valve lifters.

NOTE

Mark all disassembled parts to ensure original assembly.



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 keepers, retainers, springs and valves.

CAUTION

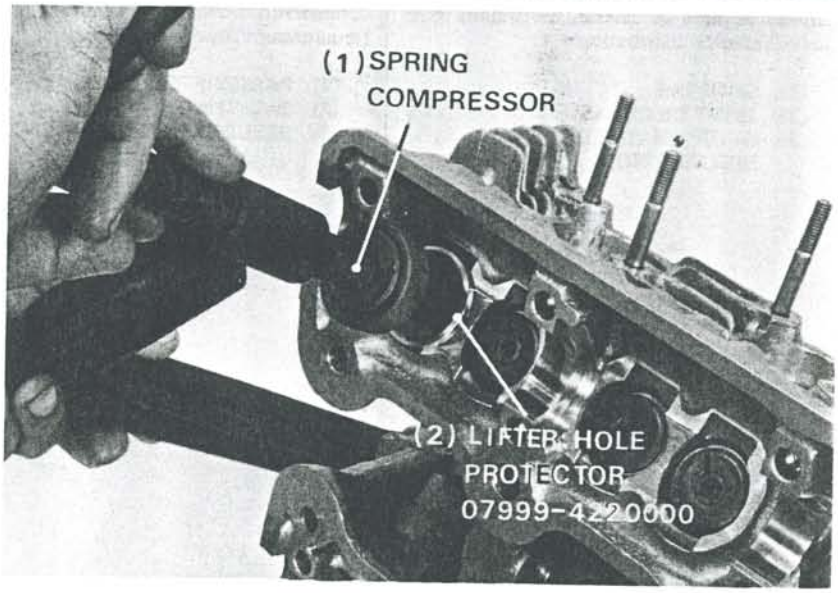
To prevent loss of tension, do not compress the valve springs more than necessary to remove the keepers.

NOTE

Avoid damaging the lifter sliding surface.

NOTE

Mark all disassembled parts to ensure original assembly.

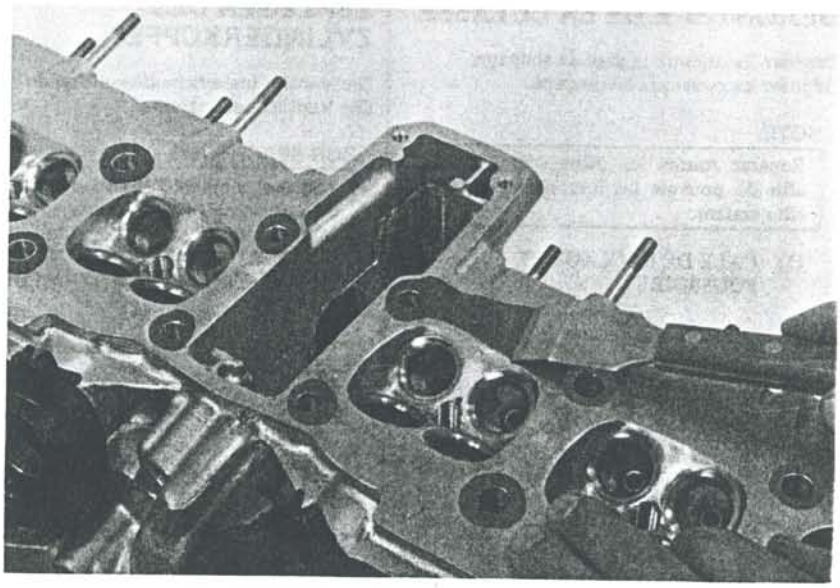


Remove the valve stem seals.

Remove the 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.



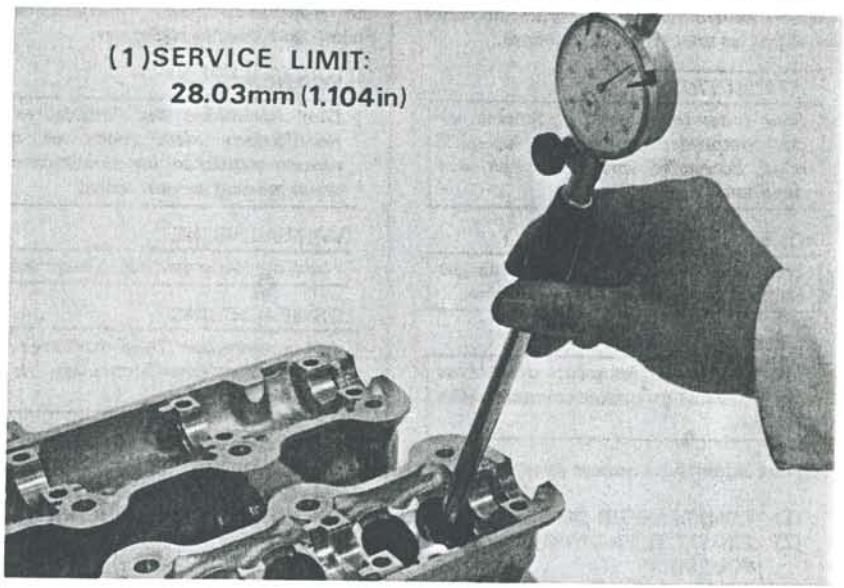
VALVE LIFTER O.D. MEASUREMENT

Measure the vale lifter O. D..



CYLINDER HEAD I.D. MEASUREMENT

Measure the cylinder head I. D..

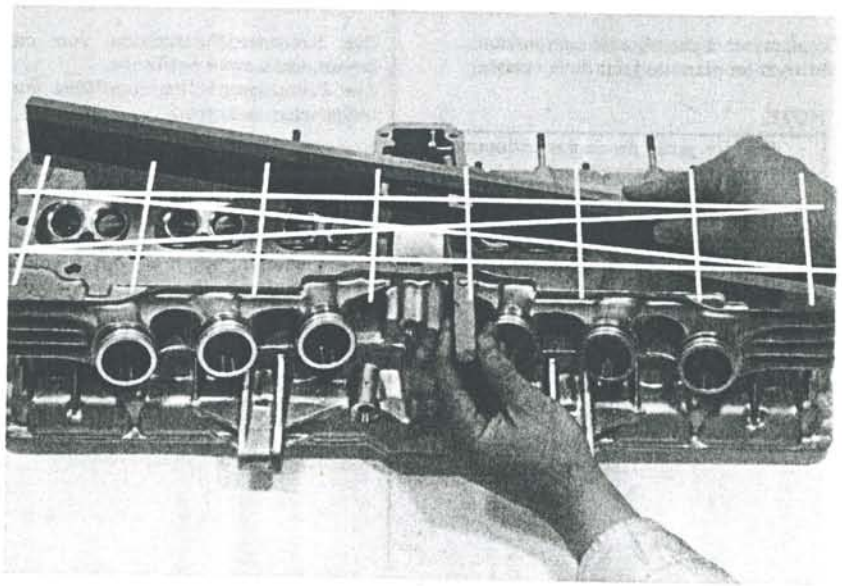


CYLINDER HEAD INSPECTION

Inspect the sliding surfaces for scoring, scratches, or evidence of insufficient lubrication.

Check the spark plug hole and valve areas for cracks.

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

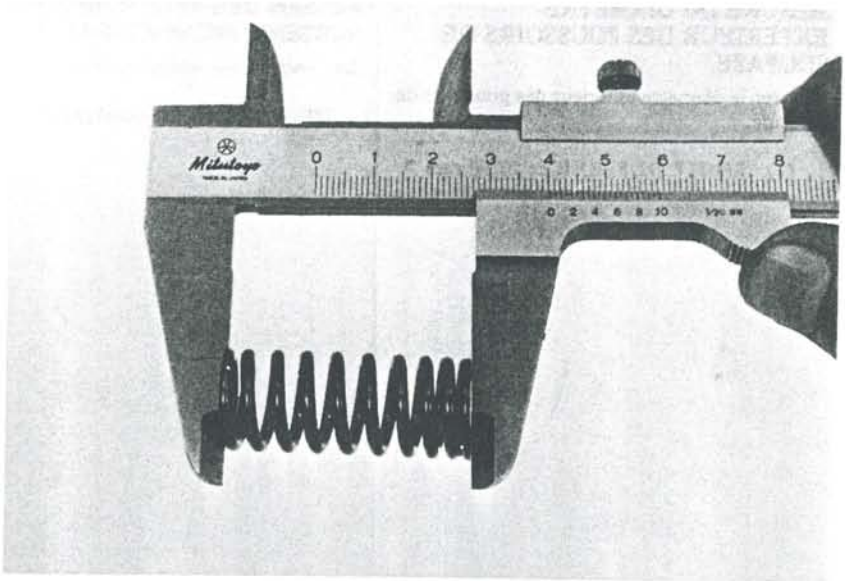


VALVE SPRING FREE LENGTH INSPECTION

Measure the length of the inner and outer valve springs.

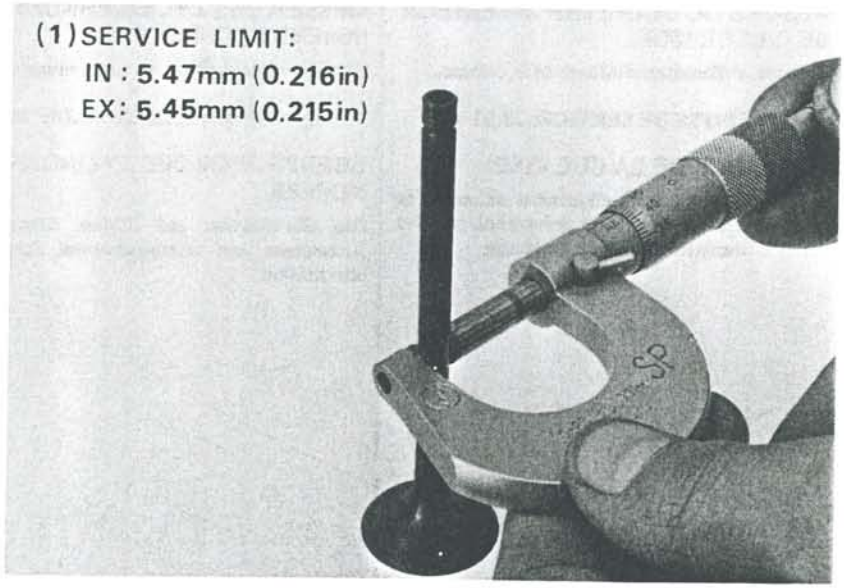
SERVICE LIMITS:

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 the valve movement in the guide.
Measure and record each valve stem O.D.



NOTE

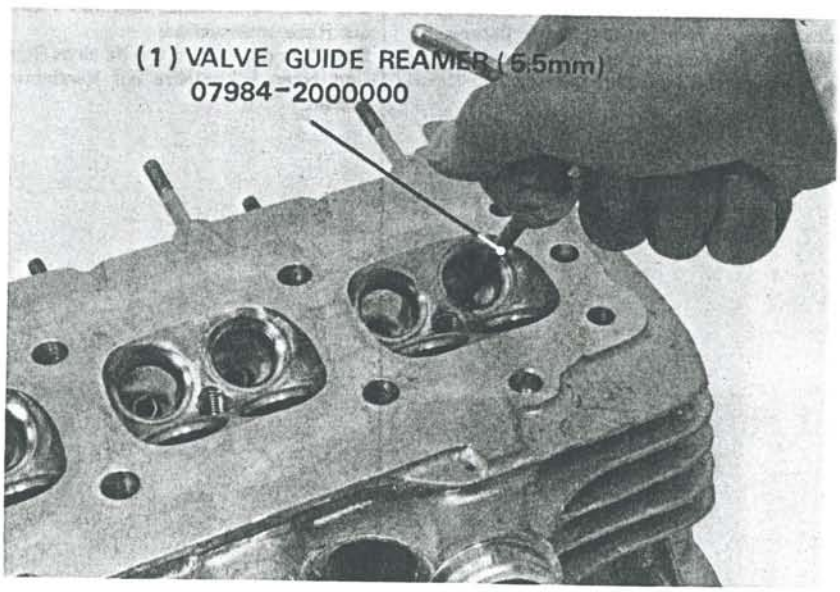
Ream the guides to remove any carbon build-up before checking clearance.

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

SERVICE LIMITS: IN. 5.54 mm (0.215 in)
EX. 5.54 mm (0.215 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)



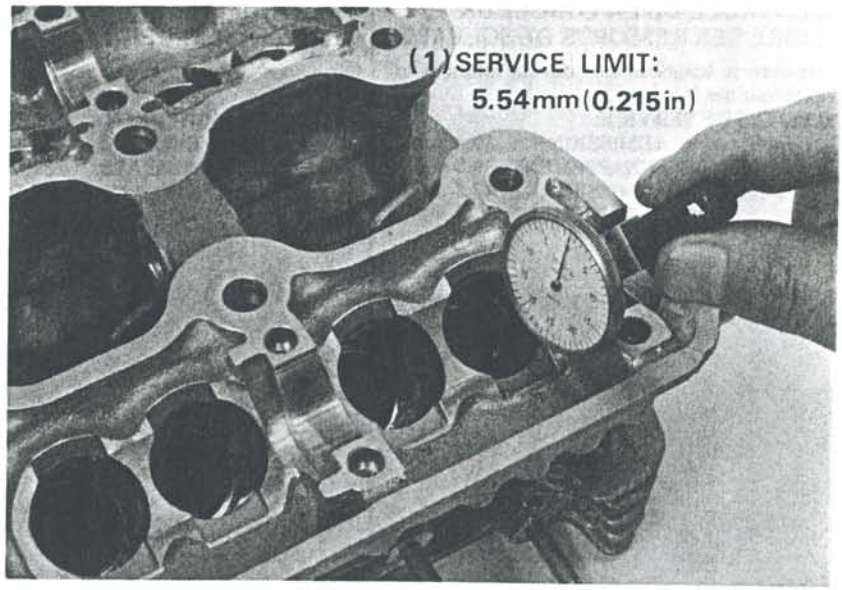
NOTE

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

NOTE

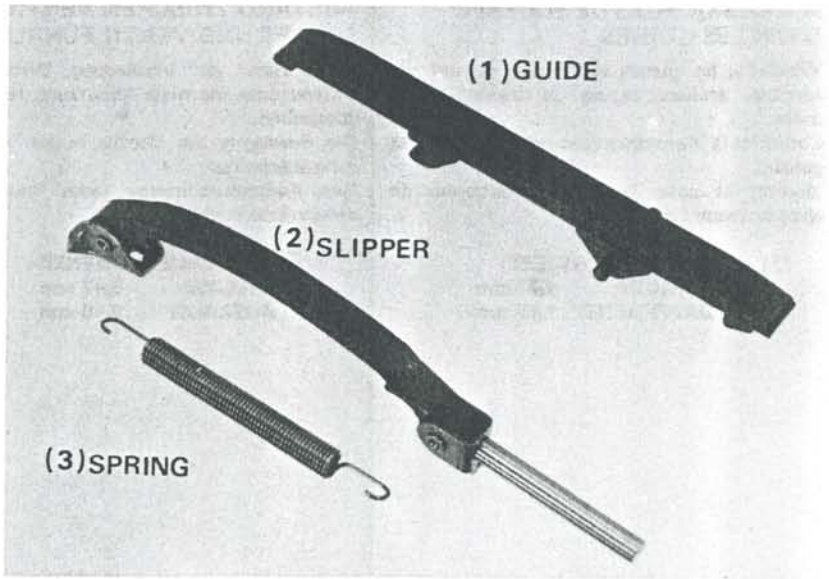
Reface the valve seats whenever the valve guides are replaced.



CAM CHAIN GUIDE AND CAM CHAIN TENSIONER INSPECTION

Inspect the cam chain guide for damage or excessive wear.

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

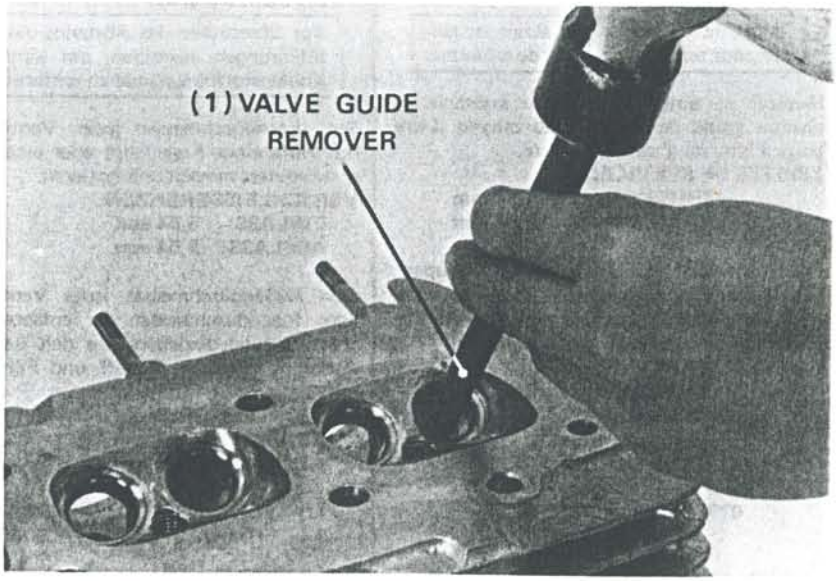


VALVE GUIDE REPLACEMENT

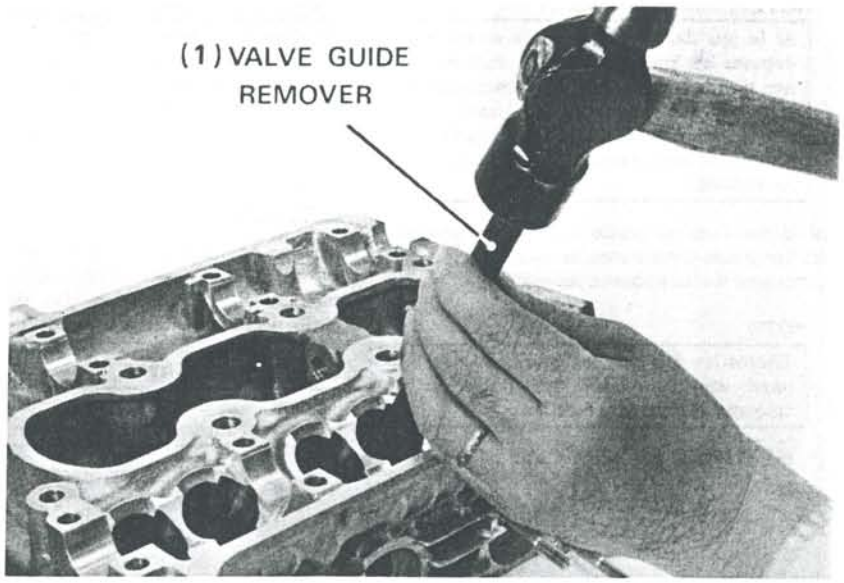
Support the cylinder head and drive out the guide from the valve port.

NOTE

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



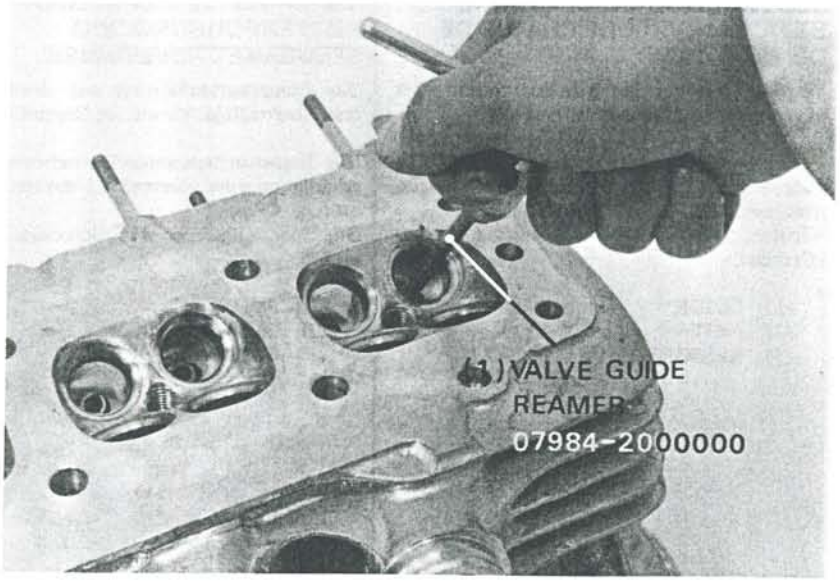
Install a new oversize valve guide from the top of the head.



Ream the new valve guide after installation.

NOTE

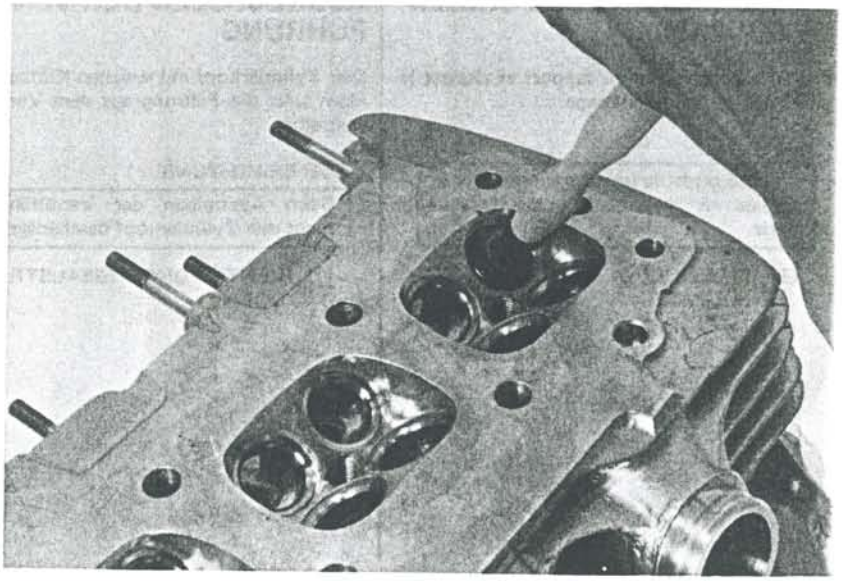
- Use cutting oil on the reamer during this operation.
- Rotate the reamer when inserting and removing it.



Reface the valve seat.
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.



Remove the valve and inspect the face.

CAUTION

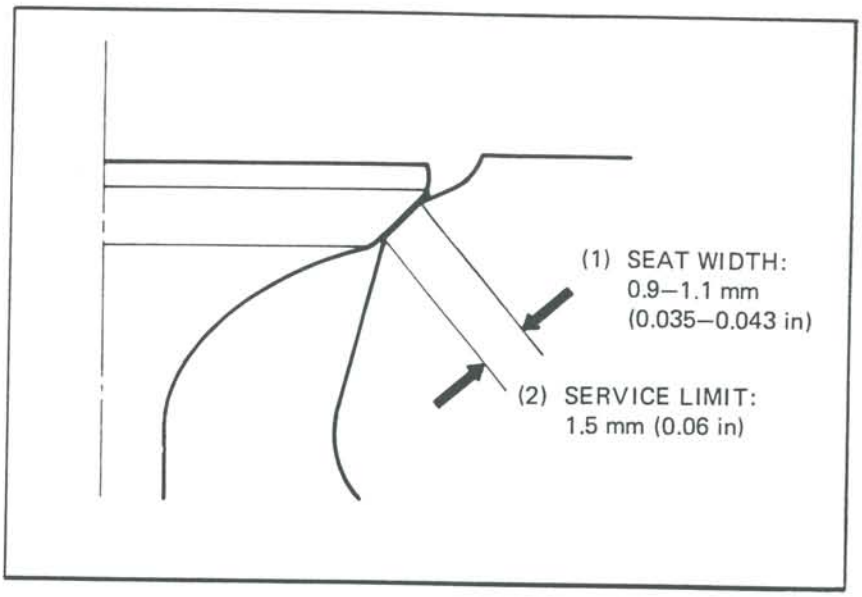
The valves cannot be ground. If the valve face is rough, worn unevenly, or contacts the seat improperly, the valve must be replaced.

Inspect the valve seat.

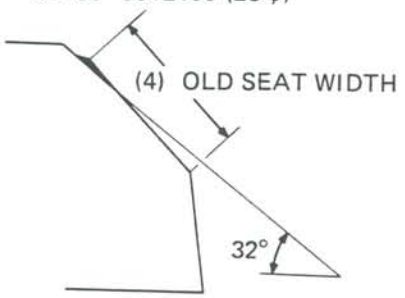
If the seat is too wide, too narrow, or has low spots, the seat must be ground.

NOTE

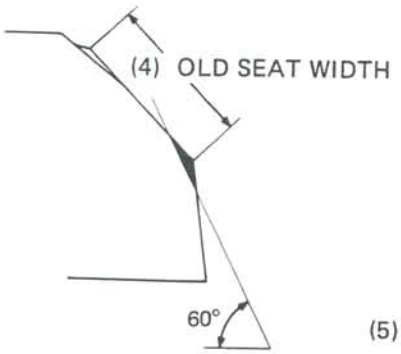
Follow the refacer manufacturer's operating instructions.



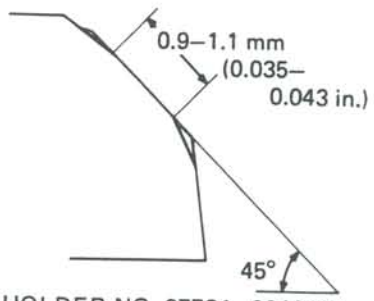
(1) CUTTER NO.
07780–0012100 (28 ϕ)



(2) CUTTER NO.
07780–0014000 (30 ϕ)

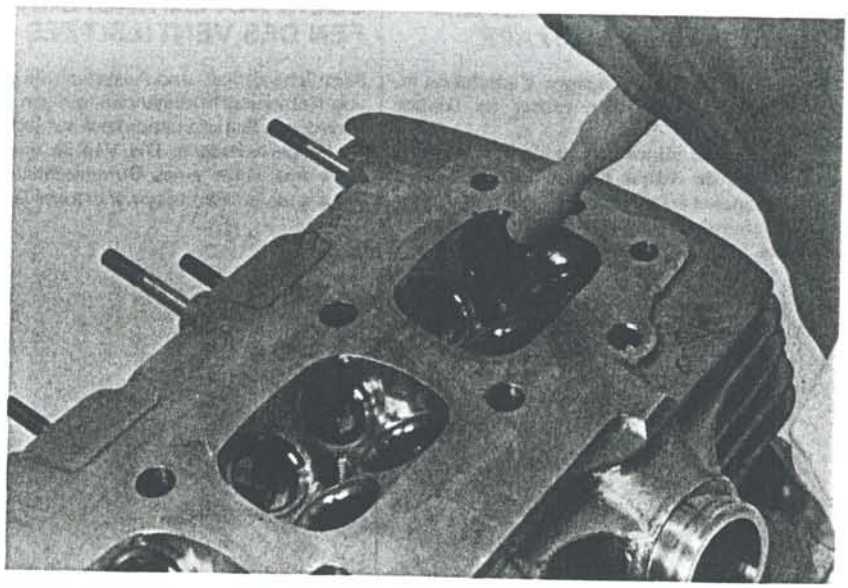


(3) CUTTER NO.
07780–0010200 (27.5 ϕ)



(5) HOLDER NO. 07781–0010100

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.



CYLINDER HEAD ASSEMBLY

NOTE

Install new valve stem seals when reassembling.

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.

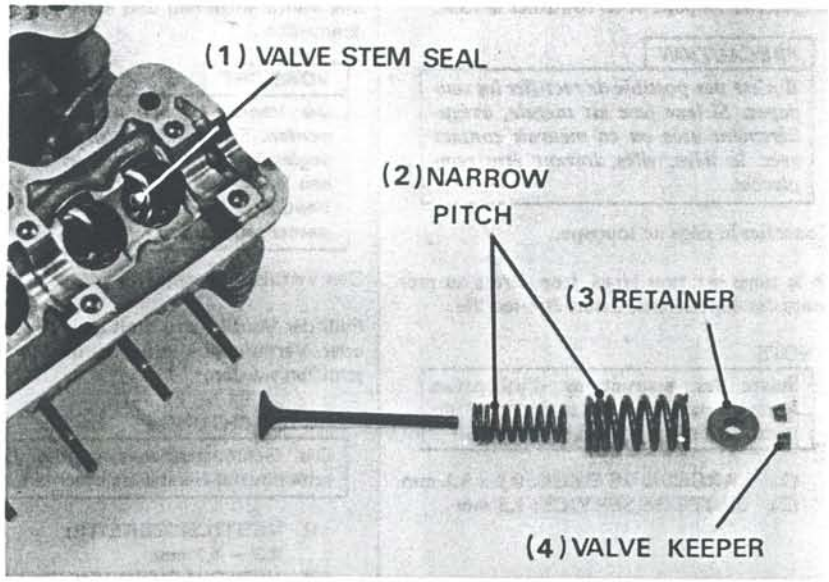
NOTE

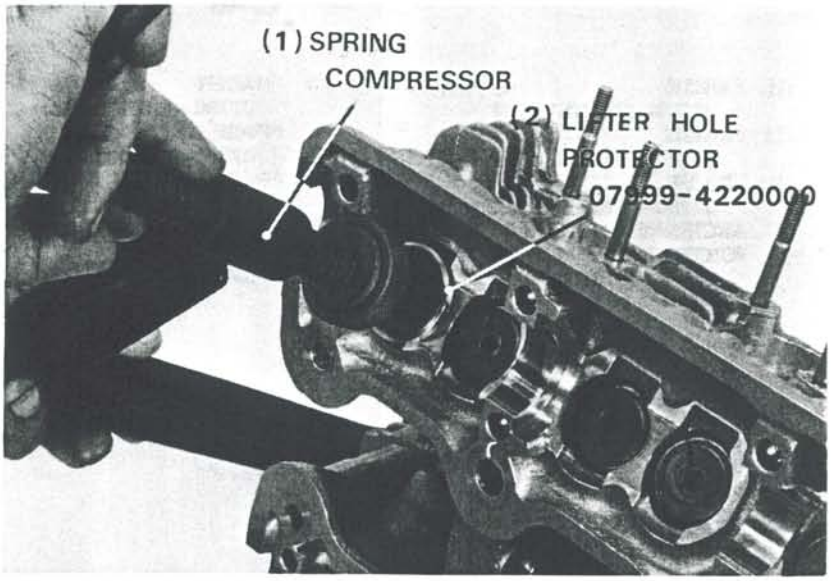
Install the valve springs with the tightly wound coils facing the cylinder head.

Install the valve keepers.

CAUTION

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

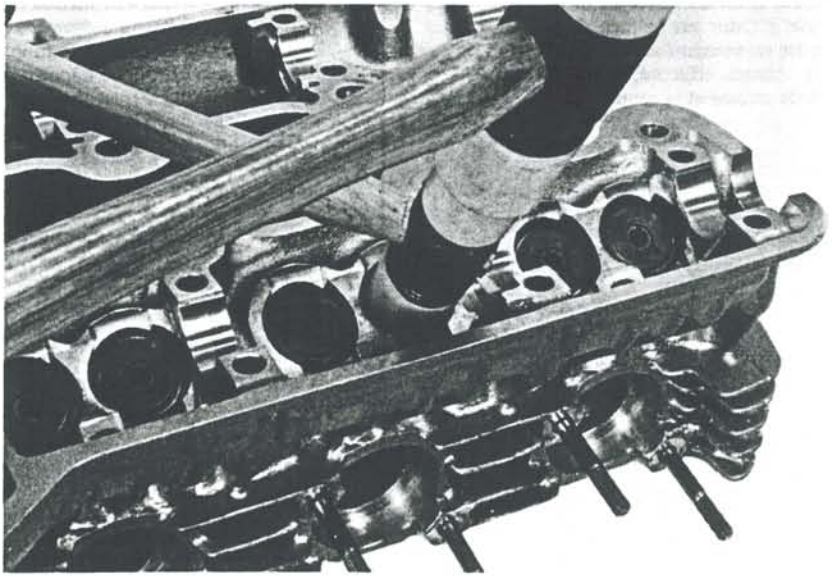




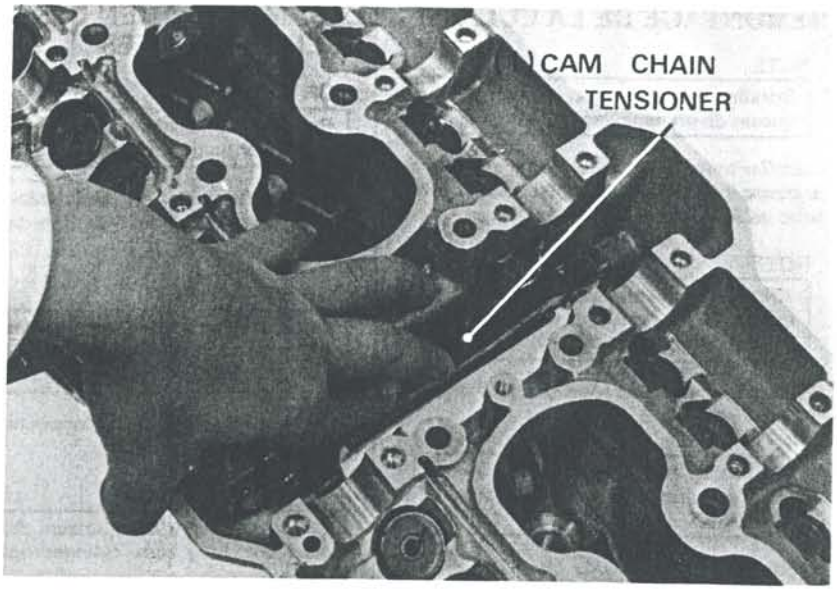
Tap the valve stems gently with a soft hammer to firmly seat the keepers.

NOTE

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



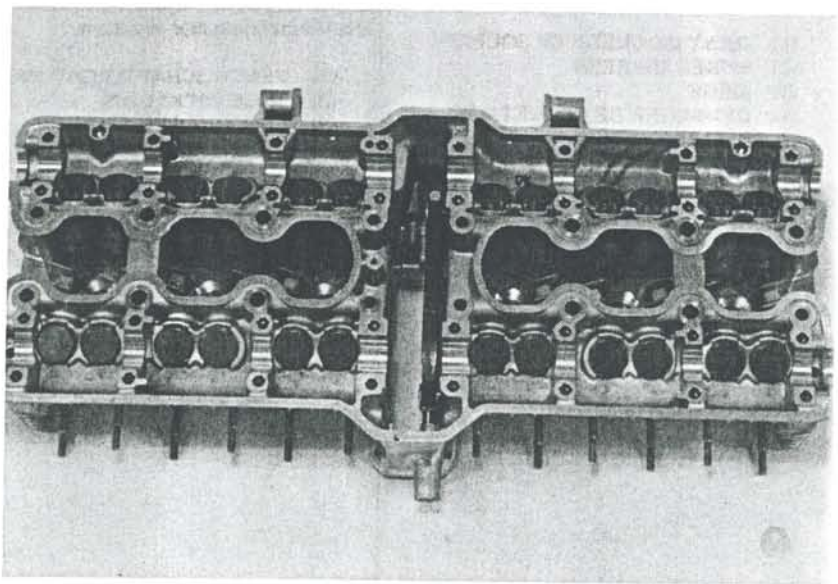
Install the cam chain tensioner.
Push the chain tensioner and tighten the lock nut.



Install the valve lifters and adjustment shims.

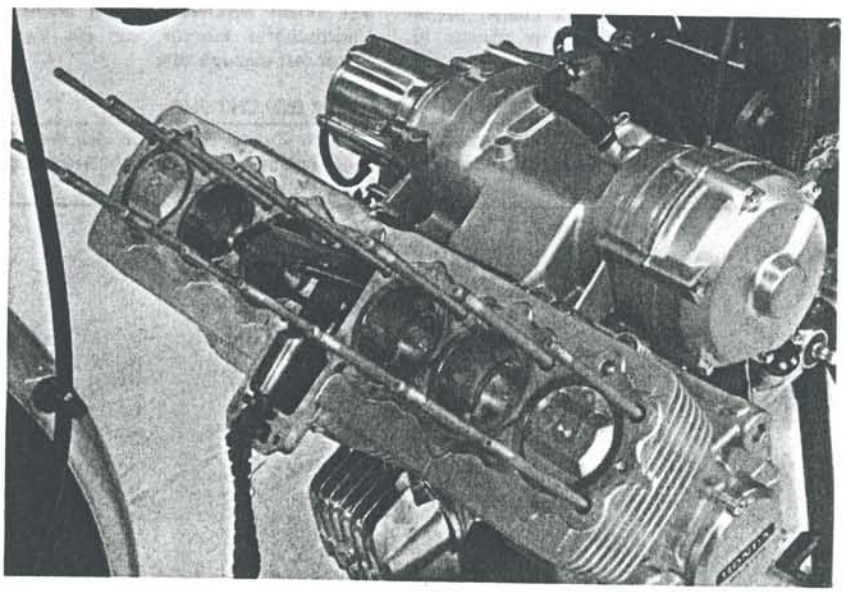
NOTE

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

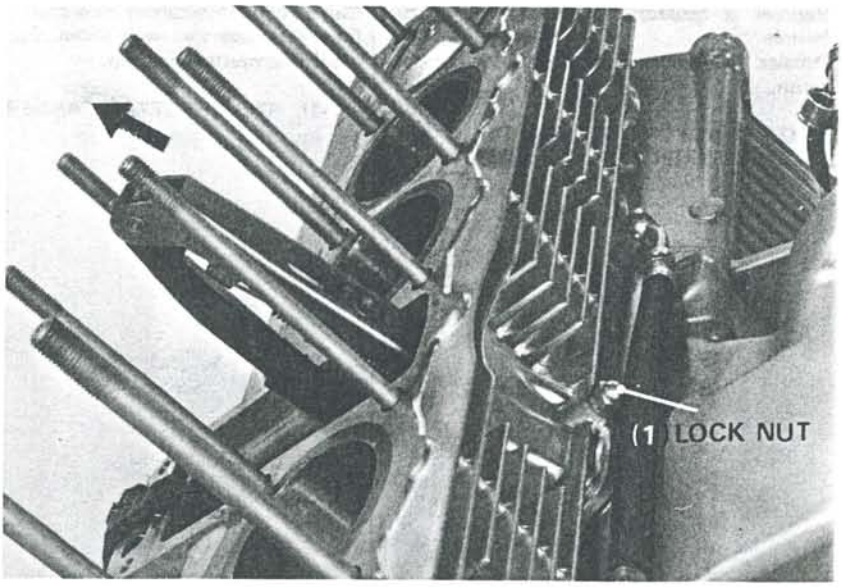


CYLINDER HEAD INSTALLATION

Clean the cylinder head gasket surfaces of any gasket material.



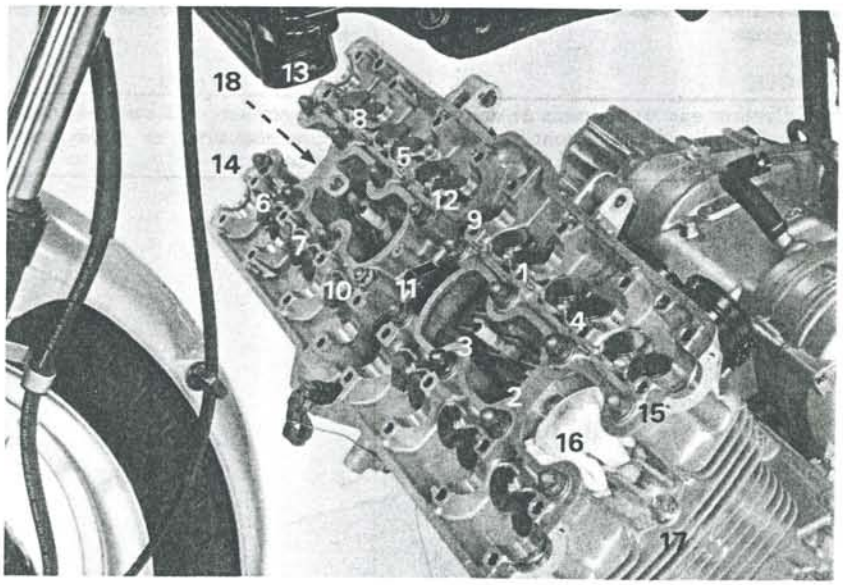
Loosen the cam chain tensioner lock nut and pull the tensioner up.
Retighten the lock nut.
Install the dowel pins, a new gasket and cam chain guide.



nstall the cylinder head assembly.
Tighten the cap nuts in the sequence shown.
Tighten the two bolts.
Tighten the two bolts at the cam chain housing.

NOTE

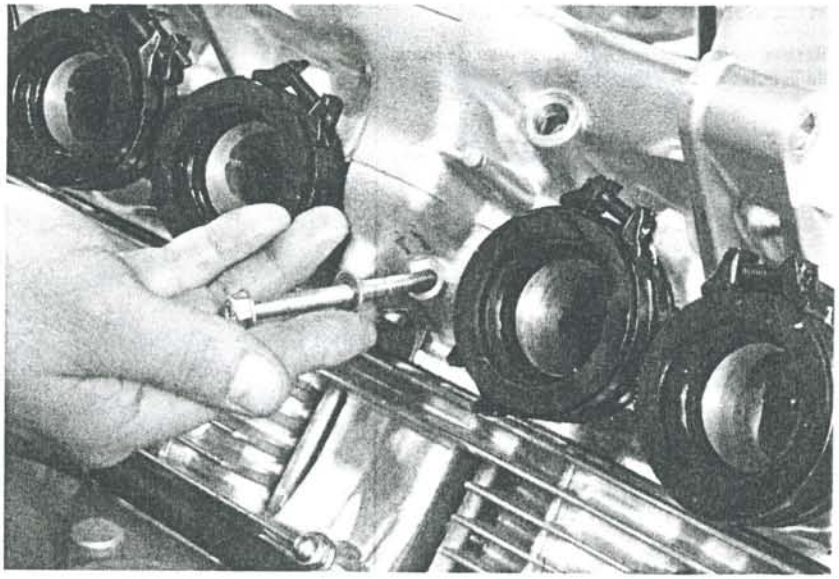
Apply molybdenum disulfide grease to the thread of the cylinder bolts and washers.



TORQUE:
10 mm cap nut: 32–34 N·m
(3.2–3.4 kg-m, 23–25 ft-lb)
8 mm cap nut: 19–21 N·m
(1.9–2.1 kg-m, 14–15 ft-lb)
8 mm bolt: 18–22 N·m
(1.8–2.2 kg-m, 13–16 ft-lb)

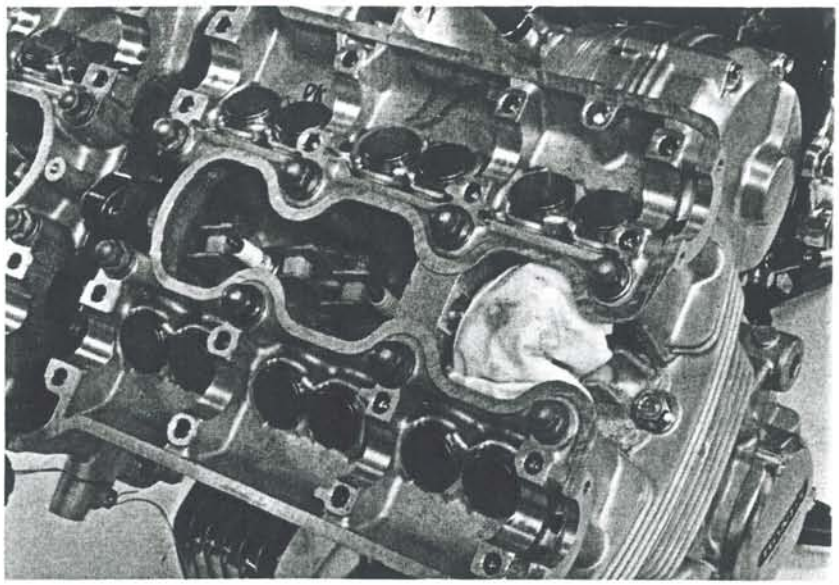
Tighten the cam chain tensioner bolt.

TORQUE: 10–14 N·m
(1.0–1.4 kg-m, 7–10 ft-lb)

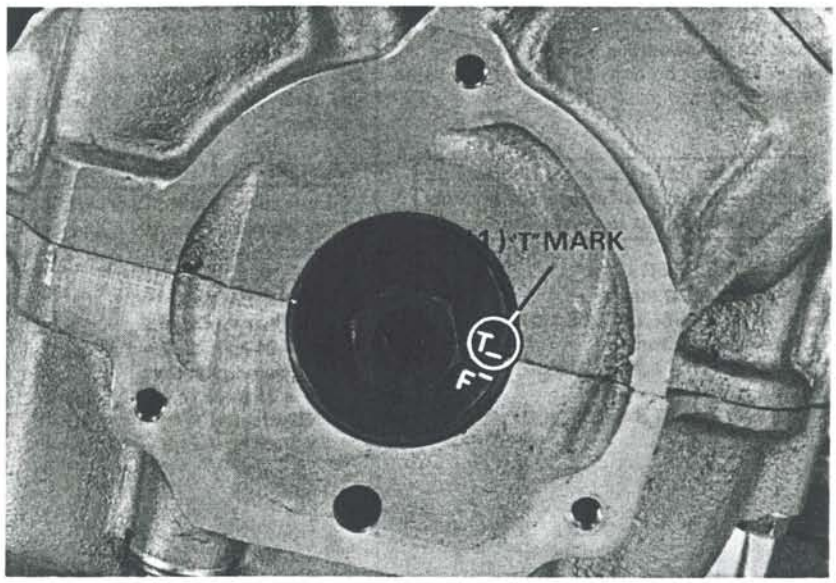


CAMSHAFT INSTALLATION

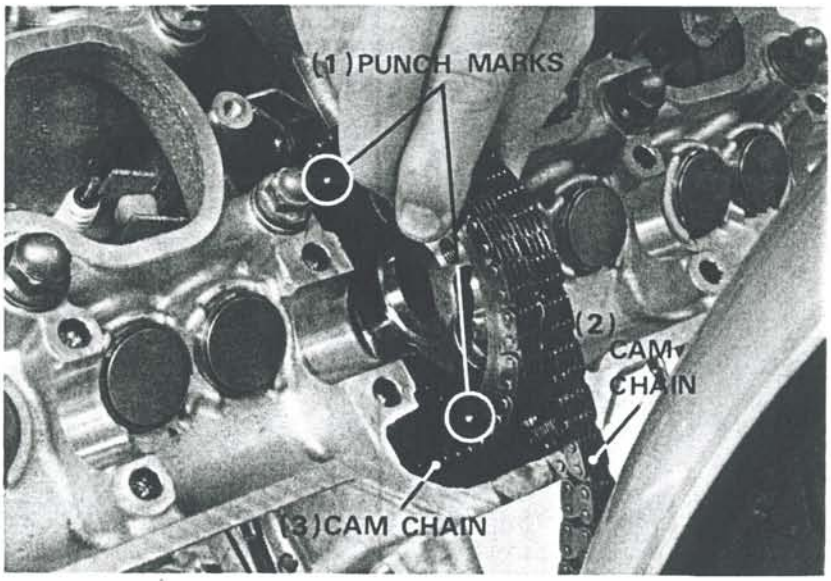
Lubricate the camshaft bearings with molybdenum disulfide grease.



Turn the crankshaft clockwise until the "T" mark is aligned with the crankcase front mating surface.



Place the cam chain over the sprocket, making sure that the punch marks on the sprocket are aligned with the head cover mating surface.
Position No. 6 exhaust cam lobe toward the spark plug.
Tighten the cam sprocket bolt loosely.



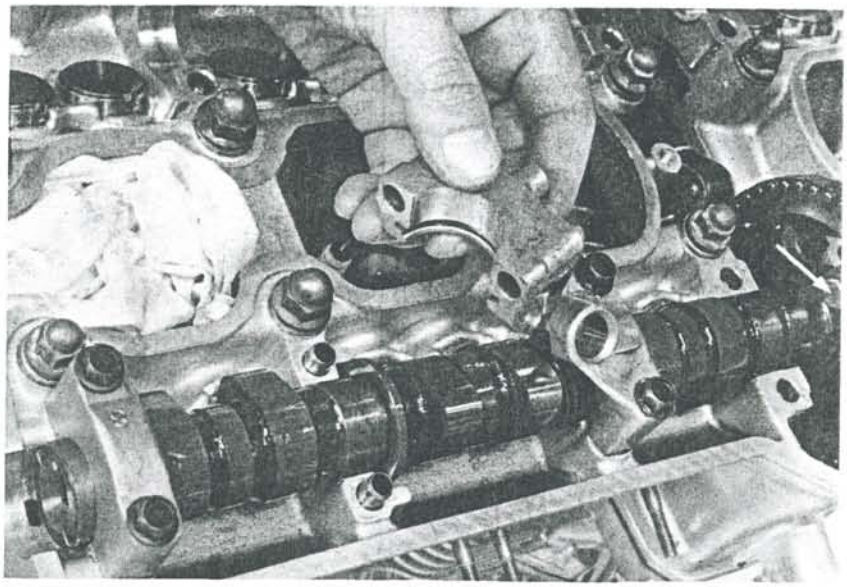
Install the No. 6 and 8 camshaft holders loosely to place the camshaft horizontally.
Move the camshaft to position the flange on the camshaft between the slot in the No. 7 camshaft holder.
Install the No. 7 camshaft holder.
Tighten the camshaft holder bolts in a criss cross pattern.

TORQUE: 12–14 N·m
(1.2–1.4 kg-m, 9–10 ft-lb)

Tighten the cam sprocket bolt to the specified torque.

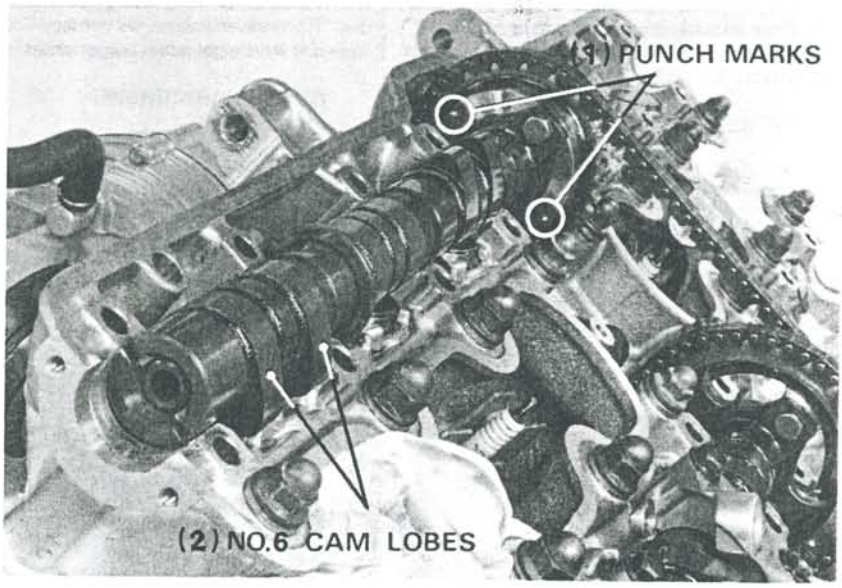
TORQUE: 14–18 N·m
(1.4–1.8 kg-m, 10–13 ft-lb)

Adjust the cam chain tension by loosening the tensioner lock nut.
Recheck the cam sprocket position.
Turn the crankshaft clockwise to install the other cam sprocket bolt.
Tighten the bolt securely.



Turn the crankshaft clockwise (approximately 540 degrees) until the "T" mark is aligned with the mating surface and the No. 6 exhaust cam lobe of the right exhaust camshaft faces the spark plug.

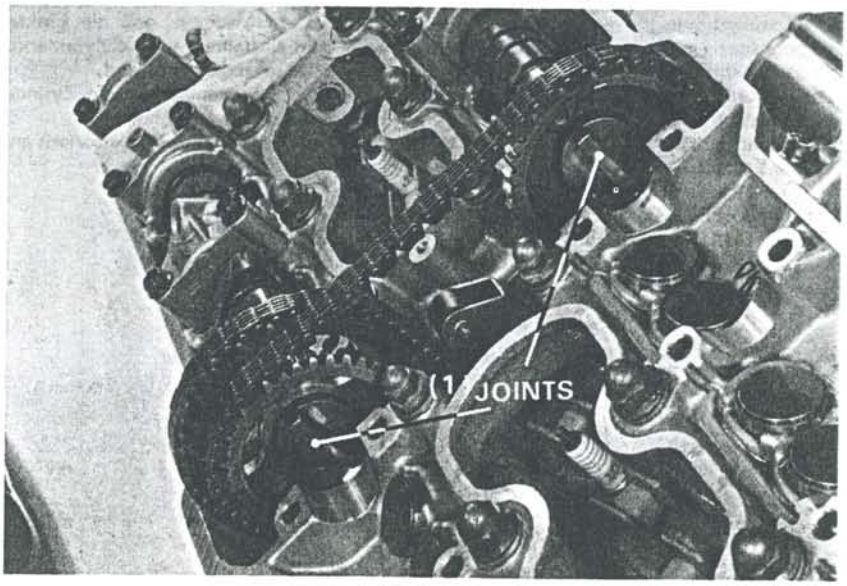
Place the cam chain over the sprocket, making sure that the punch marks on the sprocket are aligned with the head cover mating surface and the No. 6 intake cam lobes face the spark plug.



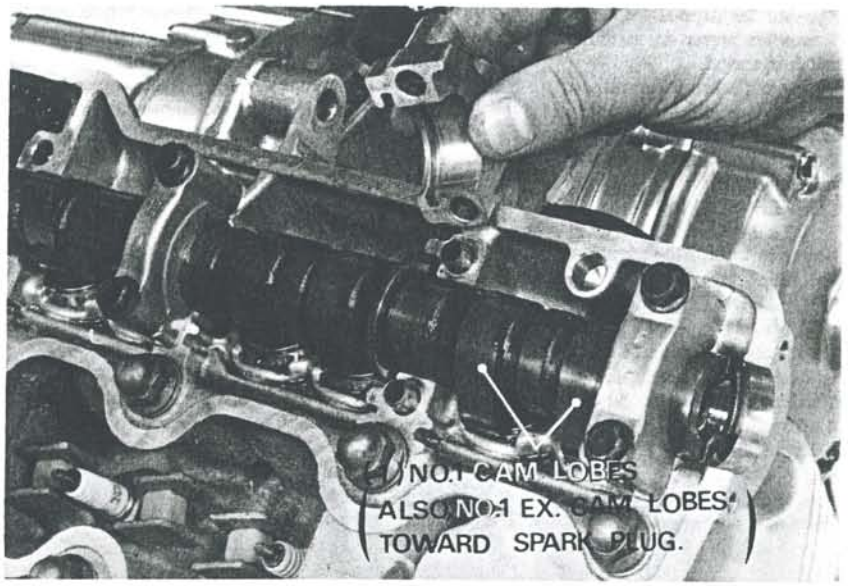
Install the No. 14 and 16 camshaft holders loosely, then install the No. 15 holder.
Tighten the bolts to the specified torque in a criss cross pattern.

Adjust the cam chain tension by loosening the tensioner lock nut and bolt.
Recheck the cam sprocket position.

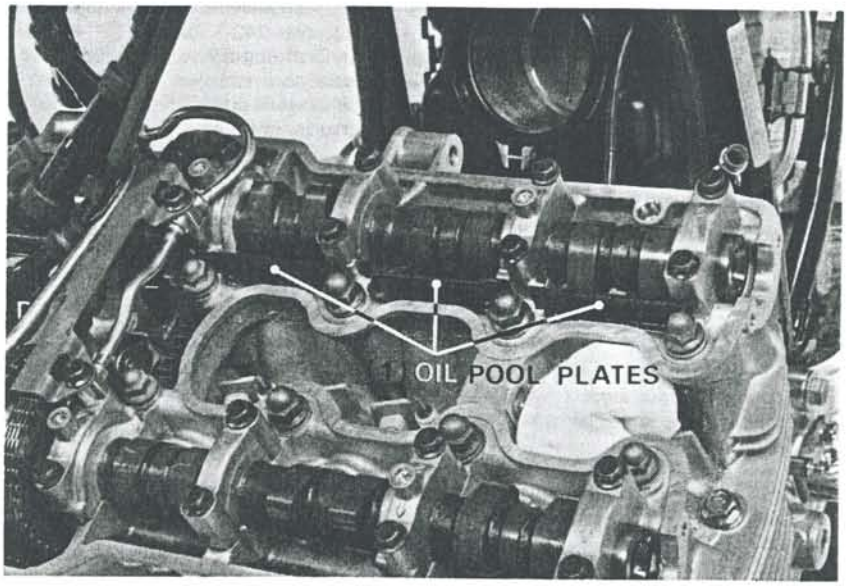
Turn the crankshaft 360 degrees until the "T" mark is realigned with the front crankcase mating surface.
Insert the camshaft joints into the right camshaft end.



Connect the left camshafts to the joints with No. 1 cam lobes toward the spark plug.
Install No. 1, No. 3 and No. 9 and 11 holders loosely.
Install the No. 2 and No. 10 holders.
Tighten the bolts to the specified torque in a crisscross pattern.

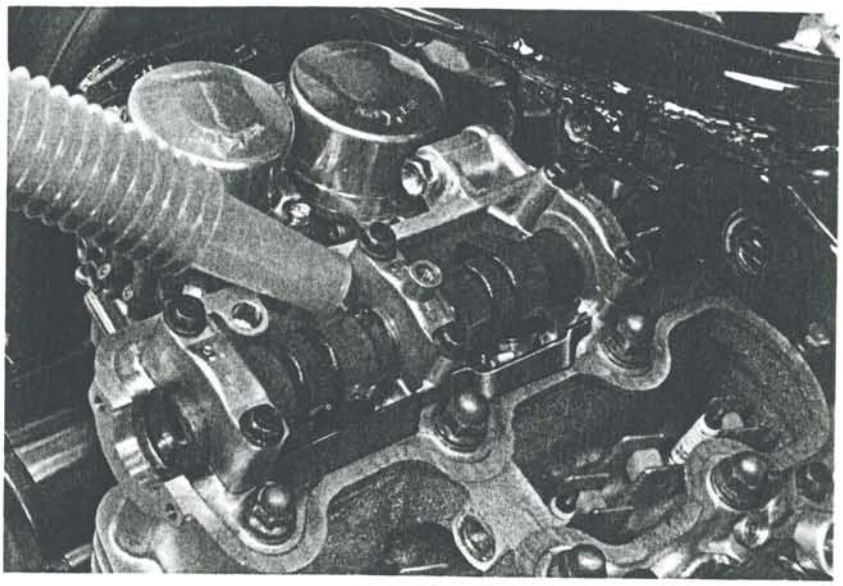


Install the oil pipes and cam chain guide with the No. 4, 5, 12 and 13 holders.
Tighten in a crisscross pattern to the specified torque.



Install the engine to the original position.
Fill the oil pockets in the head with oil so that the cam lobes are submerged.

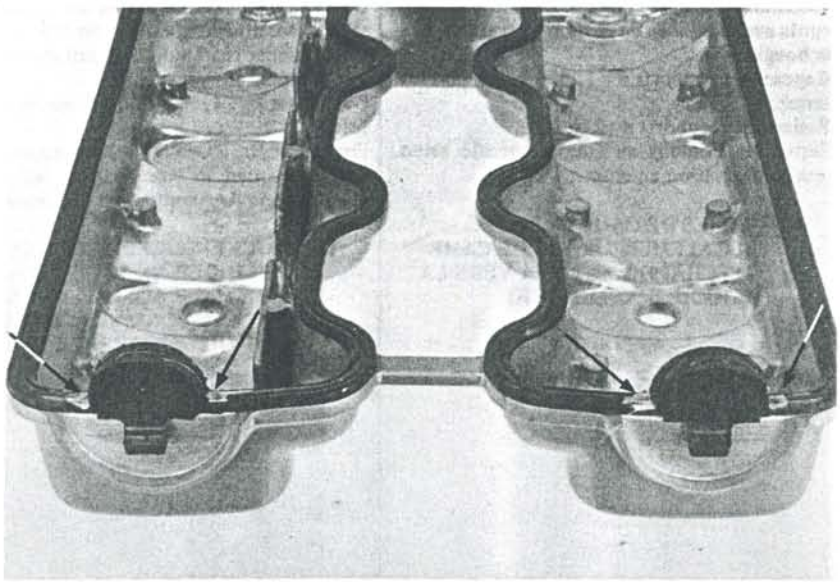
Adjust valve tappet clearance (Section 3).



Inspect the cylinder head cover gasket for damage or deterioration.
Apply a sealant on the cylinder gasket as shown, adjacent to each side cover.

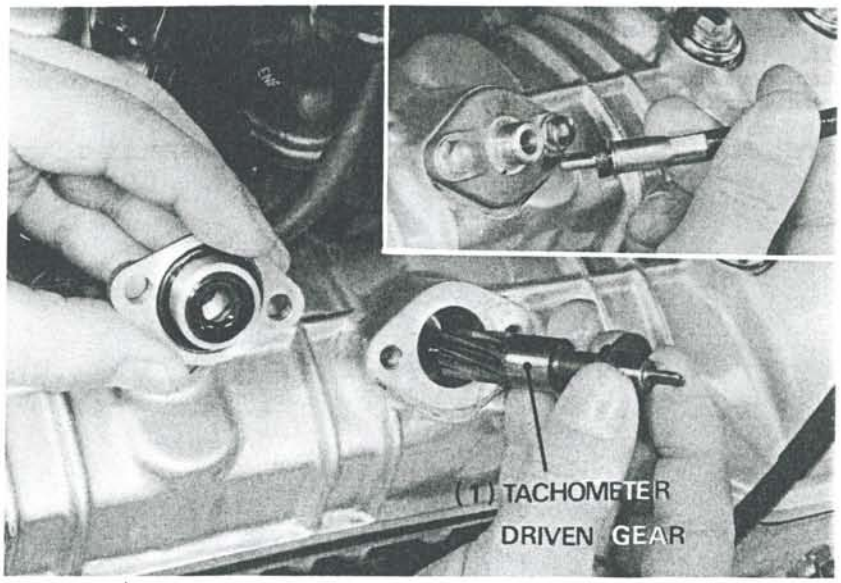
NOTE

Before applying sealant, clean the gasket.



nstall the cylinder head cover and cylinder head side covers.

Insert the tachometer drive gear.
Install the tachometer gear cover.
Connect the tachometer cable.



Install the right crankshaft side cover and gasket with bead printed surface toward the crankcase.

nstall a new O-ring on the upper screw only.

Adjust the cam chain (page 3–14).

