

117 Camshaft Timing Chain

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GENERAL

This repair group covers timing chain repair information for the M30, M60 and M70 engines.

The timing chains are lubricated by engine oil and do not require maintenance. A worn timing chain and sprockets can lead to noisy operation and erratic valve timing. A faulty timing chain tensioner can also cause noise in the timing chain.

M30 TIMING CHAIN

- ◀ The M30 engine uses a single row chain to drive the single overhead camshaft. The chain is tensioned by a hydraulic chain tensioner supplied with engine oil.

Camshaft timing chain, removing (M30 engine)

- Disconnect negative (–) battery cable. See **020 Maintenance**.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- With engine cold, drain engine coolant from radiator and from cylinder block. See **170 Radiator and Cooling System**.

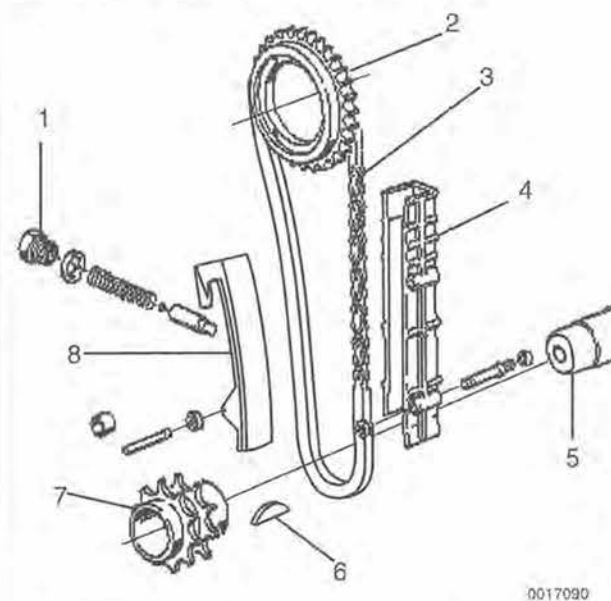
WARNING—

Allow the cooling system to cool before opening or draining the system. Hot coolant can scald and burn.

NOTE—

The cylinder block drain is on the exhaust side of the engine, near cylinder no. 5.

M30 engine timing chain components



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- | | |
|------------------------------|-------------------------|
| 1. Hydraulic chain tensioner | 5. Crankshaft |
| 2. Cam sprocket | 6. Woodruff key |
| 3. Camshaft timing chain | 7. Crankshaft sprocket |
| 4. Chain guide | 8. Chain tensioner rail |

117-2 CAMSHAFT TIMING CHAIN

- Remove radiator cooling fan and radiator fan shroud. See **170 Radiator and Cooling System**.

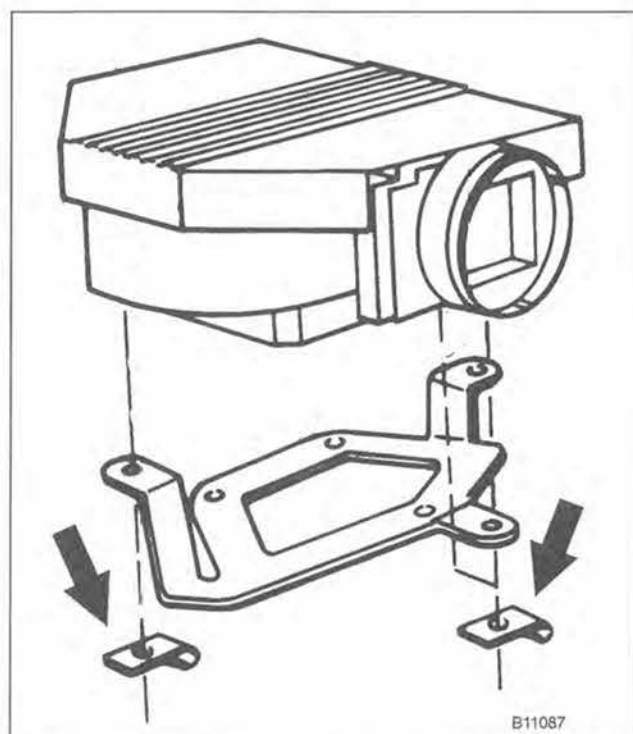
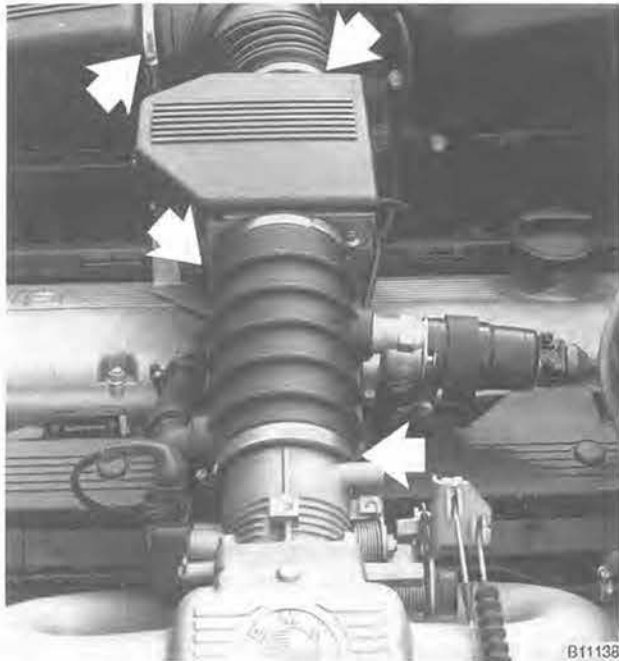
NOTE—

The radiator cooling fan nut (32 mm wrench) has left-hand threads.

- Loosen intake air boot hose clamps at intake manifold, air flow sensor, and air cleaner (**arrows**). Remove boots while disconnecting any hoses or fittings in boots.

NOTE—

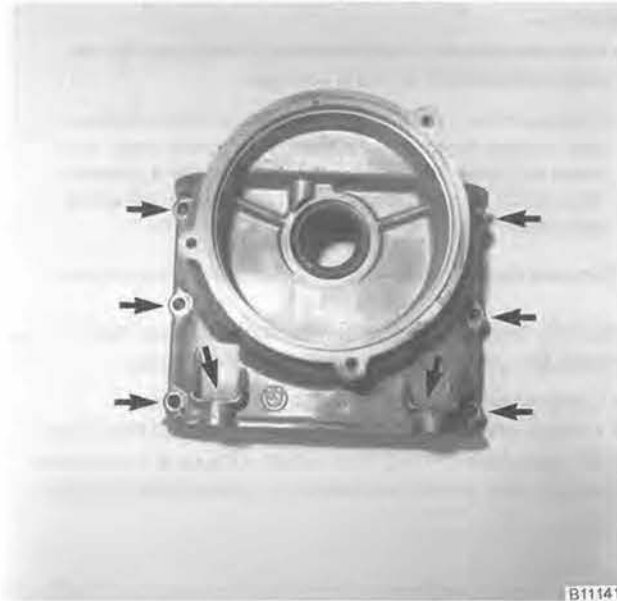
Some hoses may be secured with one-time crimp-type hose clamps. The clamps may be pried loose with a small screwdriver. Replace the clamps with standard screw-type clamps.



- Remove air flow sensor by disconnecting harness connector and removing retaining clips (**arrows**) from underside of meter.
- Remove cylinder head cover mounting nuts. Disconnect crankcase breather hose and remove cover.
- Remove distributor cap and rotor from front of camshaft. Remove rotor adaptor from camshaft.

M30 TIMING CHAIN

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- Remove bolts (**arrows**) from upper timing chain cover. Carefully separate cover from cylinder head.

CAUTION—

Use care when removing the cover from the cylinder head gasket. If the cover is stuck, use a sharp knife to separate it from the head gasket.

- Remove all V-belts. See **020 Maintenance**.
- Remove coolant pump pulley from pump. Remove reference/speed sensor mounting bolt and pull sensor from its mount on lower timing chain cover.
- Remove power steering pump and its brackets. Hang power steering pump from chassis using a stiff wire. See **320 Steering and Wheel Alignment**.
- Secure crankshaft hub/vibration damper to prevent crankshaft from turning. Using a 36 mm socket, loosen but do not remove crankshaft hub center nut.

NOTE—

The crankshaft hub center nut is tightened to a torque of 440 Nm (316 ft-lb). A heavy duty holding device, such as BMW special tool no. 11 2 220, should be used to hold the crankshaft hub stationary. Use a heavy duty 3/4-inch drive socket and breaker bar to break the nut free.

- Remove holding device and rotate crankshaft clockwise until engine is at TDC on compression stroke of no.1 cylinder.



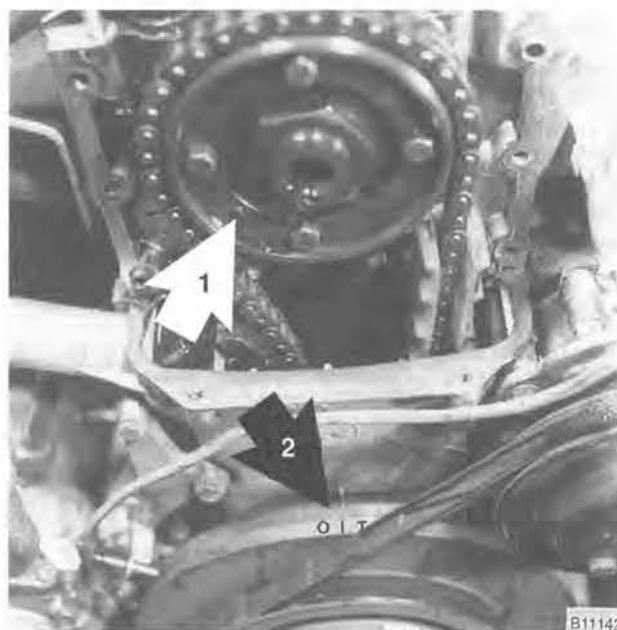
- Set crankshaft and camshaft to TDC position.

- Position sprocket bolts straight up and down with locating dowel (1) in lower left corner.
- Check that O/T mark on vibration damper aligns with mark on timing chain cover (2).
- Remove timing chain tensioner from side of upper timing chain cover. Be ready to catch piston spring as tensioner is removed. Pull tensioner piston from its bore.

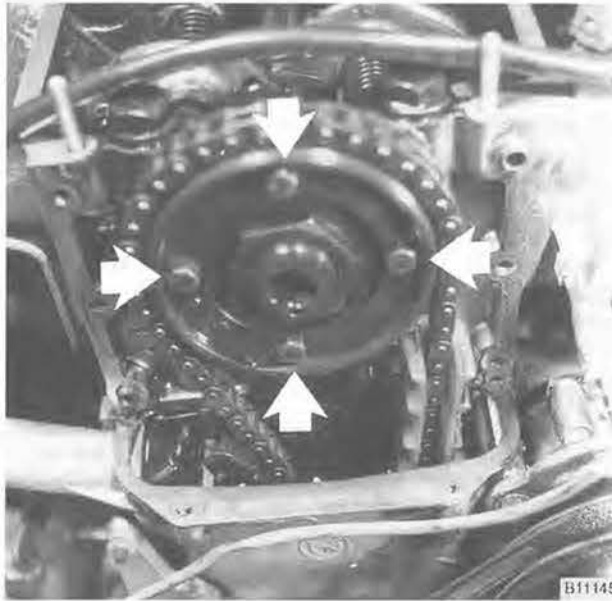
NOTE—

Check the removed piston for free movement of the check ball by shaking the piston. The ball should rattle freely. Blow air into the closed end of the piston. No air should pass. Blow air into the slotted guide end of the piston. Air should pass freely. If any faults are found, try disassembling and cleaning the piston. If the piston cannot be made to operate correctly, it should be replaced.

- Without disturbing position of crankshaft, remove hub/vibration damper mounting nut and hub/damper assembly from front of crankshaft. Remove woodruff key from crankshaft.



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NOTE—

- Note the orientation of the woodruff key in the keyway. Replace the woodruff key if it is damaged.
- If the hub/vibration damper assembly is difficult to remove, first remove the pulley and damper mounting bolts. Remove the pulley and the damper and then use a puller on the hub. Do not try to lever the vibration damper off, as this may distort the harmonic balance of the damper.

- Remove mounting bolts from lower timing chain cover.

- ◀ Working beneath engine, remove oil pan mounting bolts (arrows) that are threaded into timing chain cover.

- Loosen remainder of oil pan mounting bolts.
- Using a sharp knife, separate oil pan gasket from cover.
- Remove lower timing chain cover. Use care to not damage oil pan gasket on bottom, nor head gasket on top.

- ◀ Camshaft sprocket mounting bolts (arrows).

- Remove bolts from camshaft sprocket and remove sprocket. Carefully remove chain from sprockets and tensioning rails.

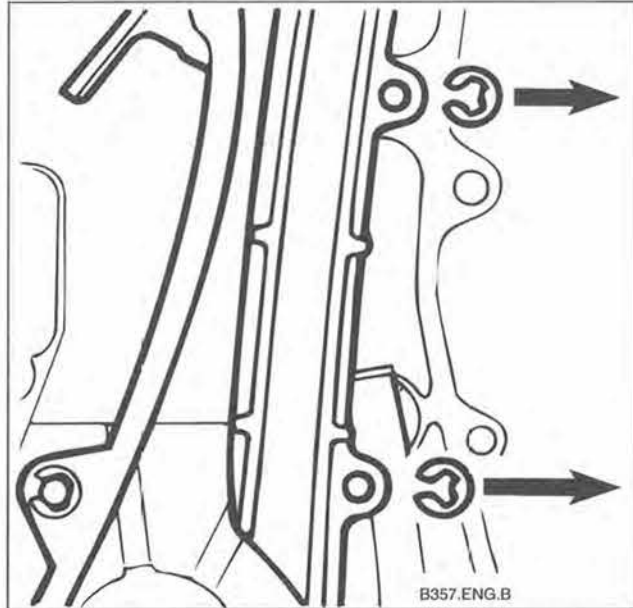
CAUTION—

Do not rotate the crankshaft or the camshaft while the timing chain is removed. The pistons can contact the open valves

- Inspect timing chain sprockets. Sprockets that have worn or missing teeth should be replaced.

NOTE—

- If any of the sprockets are being replaced due to wear, the chain should also be replaced.
- If the crankshaft sprocket requires replacement, the oil pan and the oil pump drive sprocket must be removed as described in 119 Lubrication System. The crankshaft sprocket can be removed from the crankshaft using a puller. Prior to installing the replacement sprocket, it must first be heated in an oil bath to a maximum temperature of 390°F (200°C). At this temperature, the sprocket can be driven onto the crankshaft while aligning the woodruff keyway.



Guide rail mounting circlips (arrows).

- Inspect guide rail and tensioner rail for deep grooves caused by chain contact. Rails can be replaced after removing circlips from mounting pins. Always use new circlips.

Camshaft timing chain, installing (M30 engine)

- Install timing chain, guiding it up through guide rails and cylinder head gasket. Make sure chain is properly engaged on crankshaft sprocket.

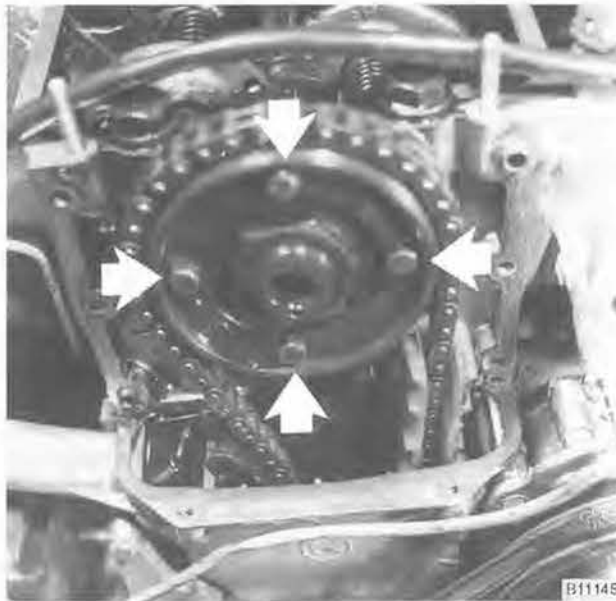
Camshaft sprocket mounting bolts (arrows).

- Temporarily install lower cover.
- Temporarily install crankshaft woodruff key together with crankshaft hub/vibration damper.
- Check that both camshaft and crankshaft are set at TDC.

- Install camshaft sprocket with chain to camshaft so that all chain slack is on tensioner side of chain. Tighten sprocket mounting bolts.

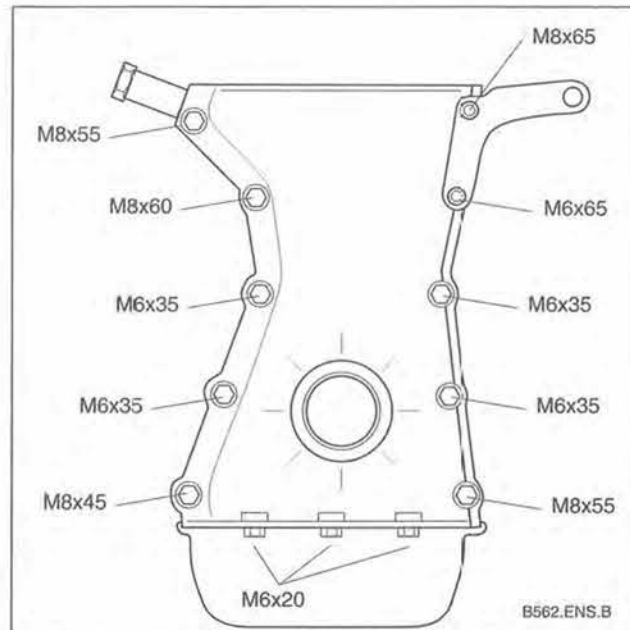
Tightening Torque

- Camshaft sprocket to camshaft 10 ± 1 Nm (89 $\pm$ 9 in-lb)



- Remove hub/vibration damper and lower timing chain cover.
- Apply a light coat of gasket sealer to lower camshaft timing chain cover gaskets. Install gaskets on cylinder block. Apply a light coating of sealant to exposed portion of oil pan gasket. Apply extra amount of sealer (3-Bond®1207 or equivalent) to each corner of oil pan/cylinder block surface area.
- Install a new crankshaft oil seal in lower timing chain cover and apply a light coat of engine oil to seal.

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- Apply a light coat of engine oil to lip of crankshaft oil seal in lower cover. Install cover and loosely install its mounting bolts.

Lower timing chain cover mounting bolt locations.

- Various sizes of bolts are used in the lower timing chain cover.

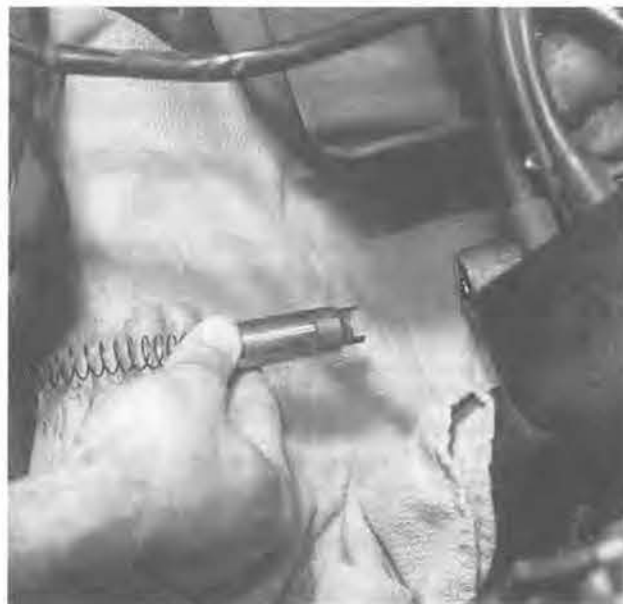
- Loosely install power steering pump bracket.

- When all brackets and bolts are installed, tighten front cover and oil pan bolts in an alternating pattern.

Tightening Torques

- Lower timing chain cover to cylinder block
 - M6 bolts 10 ± 1 Nm (89 ± 9 in-lb)
 - M8 bolts 22 ± 2 Nm (16 ± 1 ft-lb)
- Oil pan to cylinder block 10 ± 1 Nm (89 ± 9 in-lb)

- Install camshaft timing chain tensioner piston, spring, a new seal, and chain tensioner plug. Tapered end of spring should face plug. Leave plug a little loose.



Timing chain tensioner with cutout positioned to properly engage chain rail.

- Install the camshaft timing chain tensioner piston so that the cutout in the piston engages the chain rail.

- Pour a small amount of oil down side of camshaft timing chain cover. Move tensioner rail back and forth slowly until oil runs out past plug and resistance can be felt at rail. Tighten plug.

Tightening Torque

- Camshaft timing chain tensioner to front timing chain cover. 40 Nm (30 ft-lb)

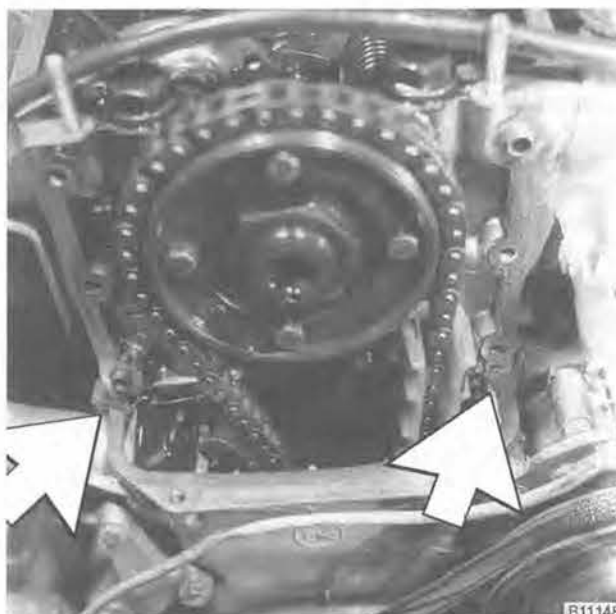
- Install crankshaft hub/vibration damper to crankshaft, while aligning keyway with key. Hold hub stationary and tighten nut.

Tightening Torques

- Crankshaft hub to crankshaft 440 ± 10 Nm (317 ± 7 ft-lb)
- Vibration damper and pulley to crankshaft hub 22 ± 2 Nm (16 ± 1 ft-lb)

- Turn engine over two complete revolutions and recheck timing marks.

CAMSHAFT TIMING CHAIN 117-7



- Apply a light coat of sealer to two upper camshaft timing chain cover gaskets.

- Set gaskets into position on cover.
- Apply a sealer (3-Bond®1207 or equivalent) to each corner of cylinder head/upper timing chain cover surface area (**arrows**).

- Apply a light coat of engine oil to lip of camshaft oil seal in upper timing chain cover. Install cover and hand-tighten mounting bolts. Tighten bolts in stages.
- Upper timing chain cover mounting bolts vary in size.

Tightening Torque

- Front timing chain cover to cylinder head and lower timing chain cover 10 Nm (89 in-lb)

- Install cylinder head cover.

Tightening Torque

- Cylinder head cover to cylinder head 10 Nm (89 in-lb)

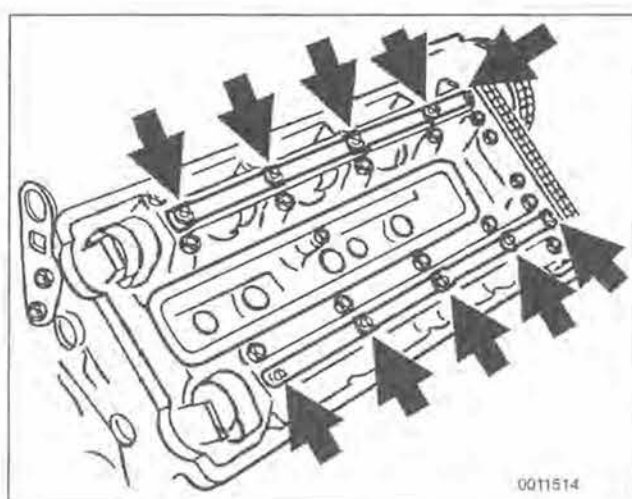
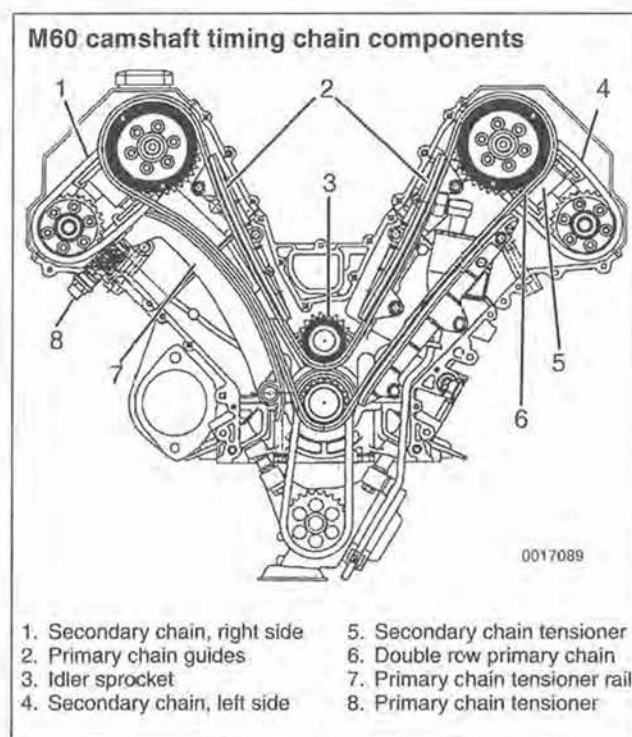
- Install coolant pump pulley.
- Install all engine drive belts. See **020 Maintenance**.
- Install radiator fan, fan shroud and thermostat housing. Re-fill cooling system. See **170 Radiator and Cooling System**.
- Install ignition components.

Tightening Torque

- Ignition rotor adaptor to camshaft (install with thread locking compound). 23 ± 1 Nm (17 ± 1 ft-lb)

- Reconnect battery. Check all fluid levels.

117-8 CAMSHAFT TIMING CHAIN



M60 TIMING CHAIN

M60 TIMING CHAIN

The M60 engine uses a double-row primary chain to drive the intake camshaft sprockets on each cylinder bank. The exhaust camshaft sprockets are driven by the secondary chains off the intake camshaft sprockets. The chains are tensioned by three hydraulic chain tensioners, one for each chain.

NOTE—

The engine must be removed for M60 timing chain replacement. See 110 Engine Removal and Installation.

Camshaft timing, checking and adjusting (M60 engine)

CAUTION—

Special BMW service tools are needed for this procedure. Read the procedure through before beginning the job. If the camshafts are not properly timed, the pistons can contact the valves.

- Disconnect negative cable (–) from battery under rear seat.

CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove radiator cooling fan and fan shroud. See 170 Radiator and Cooling System.

NOTE—

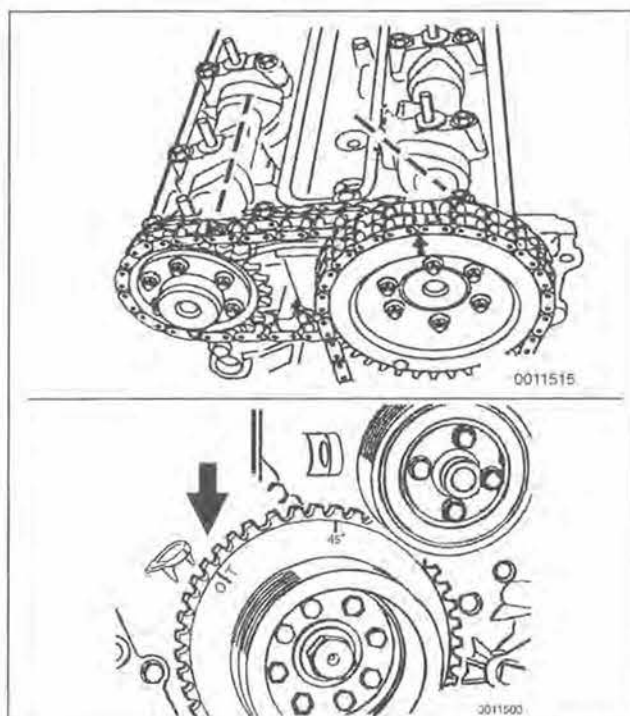
The radiator cooling fan nut (32 mm wrench) has left-hand threads.

- Remove spark plugs. See 020 Maintenance.
- Remove cylinder head covers from left and right cylinder heads. See 117 Cylinder Head Removal and Installation.
- Unbolt oil pipes from both cylinder heads.
- Remove timing chain tensioner from side of right timing chain cover. Install in its place BMW special tool no. 11 3 390. Thread special tool in until no slack is present in chain, tightening to 1.3 Nm (12 in-lb).

NOTE—

- BMW special tool no. 11 3 390 is a dummy primary chain tensioner and simulates the function of the hydraulic tensioner.
- Assume left/right orientation sitting in driver seat.

CAMSHAFT TIMING CHAIN 117-9



- Set cylinder no. 1 to TDC by rotating engine in normal operating direction.

- Arrows on intake camshaft sprockets point up.
- Camshaft lobes at cylinder no. 1 face in.
- O/T mark on vibration damper aligns with pointer on front timing chain cover.

- Loosen 3 accessible bolts on camshaft sprockets at left and right cylinder heads.

NOTE—

Hold the camshaft stationary (at hex on camshaft) when loosening or tightening the camshaft sprocket mounting bolts.

- Turn engine over one complete revolution. Loosen remaining bolts on camshaft sprockets.

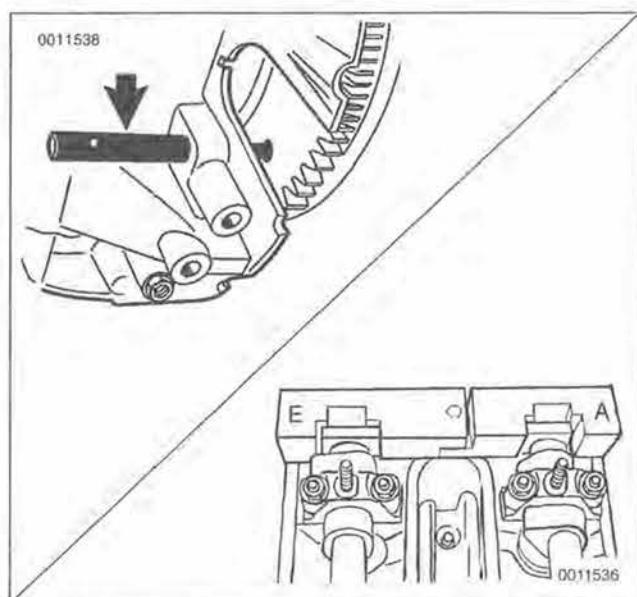
- Turn engine over to TDC and lock crankshaft at TDC using BMW special tool no. 11 2 300 (arrow).

- Lock camshafts at TDC using BMW special tools 11 2 442/446 (cyl. 5-8) and tools 11 2 445/441 (cyl. 1-4). Install camshaft tools with letter **A** on exhaust side and letter **E** on intake side.

- Using hex casting on camshafts, turn camshafts slightly from side to side to ensure proper fit of camshaft locking tools.

CAUTION—

The camshafts must be locked in the TDC position using BMW special tools at the rear of the camshafts. The arrows on the sprockets should not be used to set the engine at TDC.



117-10 CAMSHAFT TIMING CHAIN

- Tighten top three camshaft sprocket bolts using sequence listed.

Tightening Torques

- Camshaft sprocket tightening sequence
 1. exhaust, left cylinder head 15 Nm (11 ft-lb)
 2. exhaust, right cylinder head 15 Nm (11 ft-lb)
 3. intake, left cylinder head 15 Nm (11 ft-lb)
 4. intake, right cylinder head 15 Nm (11 ft-lb)

- Remove crankshaft and camshaft locking tools. Turn engine over in normal operating direction one complete revolution. Tighten remaining sprocket mounting bolts using sequence and torques listed earlier.
- Remove dummy chain tensioner and install chain tensioner.
- The remainder of installation is reverse of removal.

Tightening Torques

- Timing chain tensioner to timing chain cover 40 Nm (30 ft-lb)
- Camshaft lubrication pipe to camshaft bearing caps 10 Nm (89 in-lb)
- Cylinder head cover to cylinder head/ timing chain cover
 - M6. 10 Nm (89 in-lb)
 - M7. 15 Nm (11 ft-lb)
- Radiator cooling fan to coolant pump 40 Nm (30 ft-lb)
- Spark plug to cylinder head 23±3 Nm (17±2 ft-lb)

M70 TIMING CHAIN

The M70 engine uses one single-row chain to drive the single camshaft on each bank of cylinders. Two stationary guide rails and one pivoting guide rail with a spring-loaded tensioner are used to keep the chain tensioned.

NOTE—

To replace the M70 timing chain, the engine must be lifted and the oil pan removed. See 119 Lubrication System.

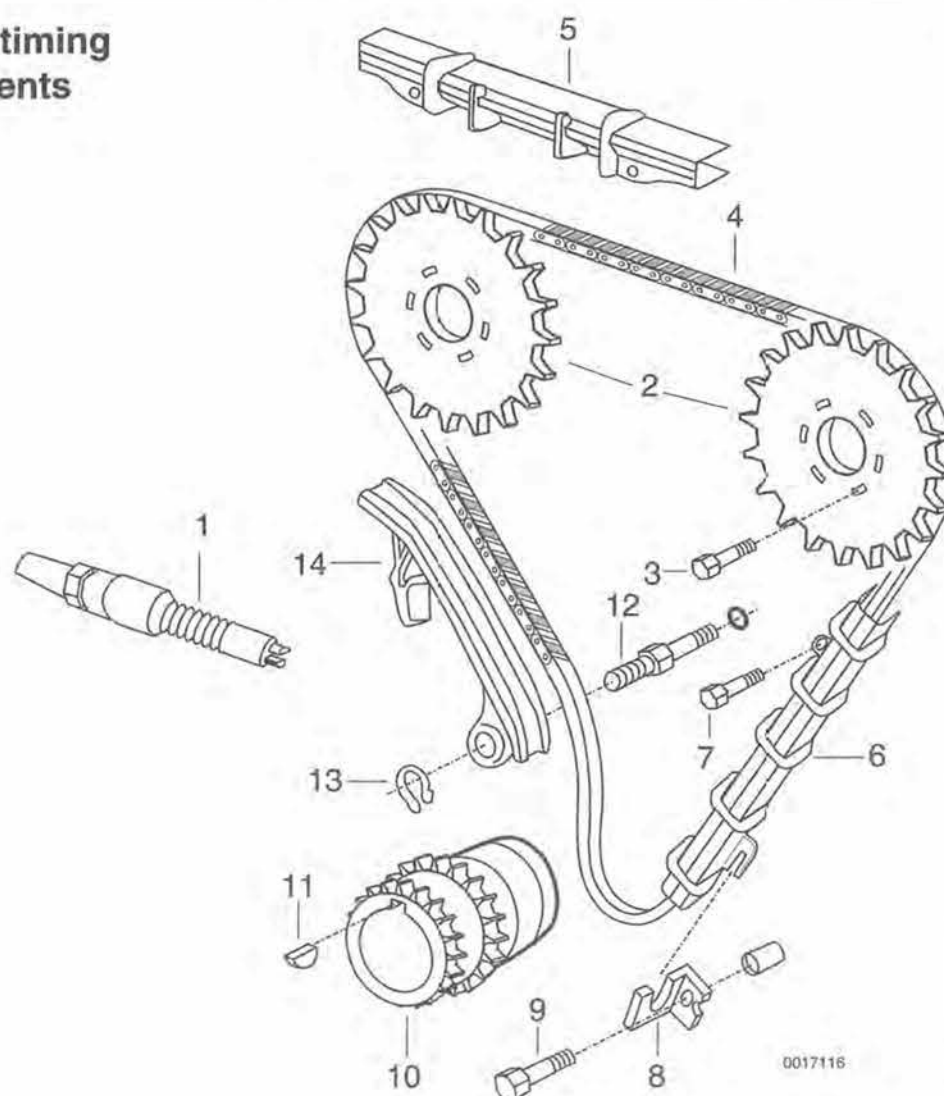
Camshaft timing, checking and adjusting (M70 engine)

CAUTION—

Special BMW service tools are needed for this procedure. Read the procedure through before beginning the job. If the camshafts are not properly timed, the pistons can contact the valves.

M70 camshaft timing chain components

1. Chain tensioner
2. Camshaft sprocket
3. Sprocket bolt
4. Timing chain
5. Top guide rail
6. Left guide rail (will slip up off lower bracket after top bolt is removed)
7. Left guide rail top bolt
8. Left guide rail lower bracket (hidden behind lower timing cover)
9. Left guide rail bracket bolt
10. Crankshaft sprocket
11. Woodruff key
12. Pivoting guide mounting stud
13. Pivoting guide retaining circlip
14. Right pivoting guide rail (with sprocket wheel as of 4/90)



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M70 TIMING CHAIN

117-12 CAMSHAFT TIMING CHAIN

NOTE—

If the upper timing case cover is removed to check/adjust timing chain, the inner case must also be removed to replace the lower gaskets.

- Disconnect negative (–) battery cable. See **020 Maintenance**.

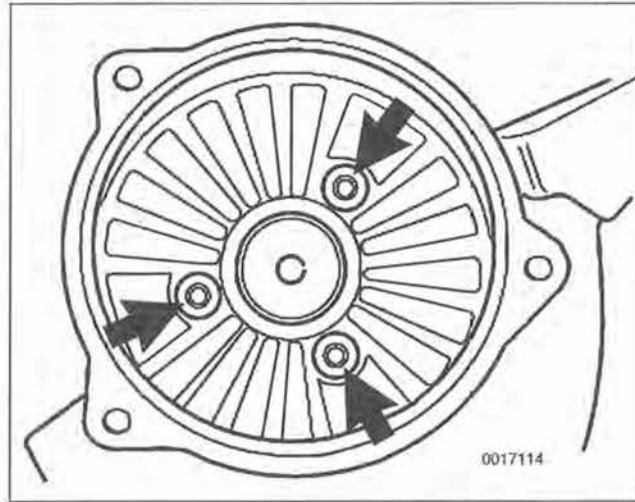
CAUTION—

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

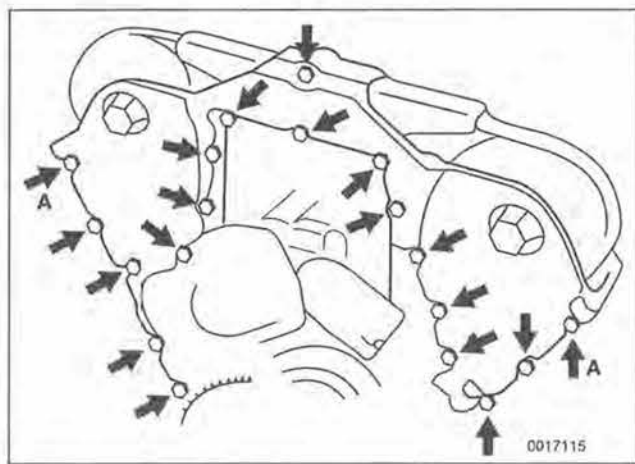
- Remove both intake manifolds and cylinder head covers as described in **113 Cylinder Head Removal and Installation**.
- Remove radiator cooling fan and radiator fan shroud. See **170 Radiator and Cooling System**.

NOTE—

The radiator cooling fan nut (32 mm wrench) has left-hand threads.



- Remove both distributor caps, ignition rotors and rotor adaptors. Remove distributor housing mounting screws (arrows) and remove both distributor housings.
- Remove alternator drive belt and tensioner.



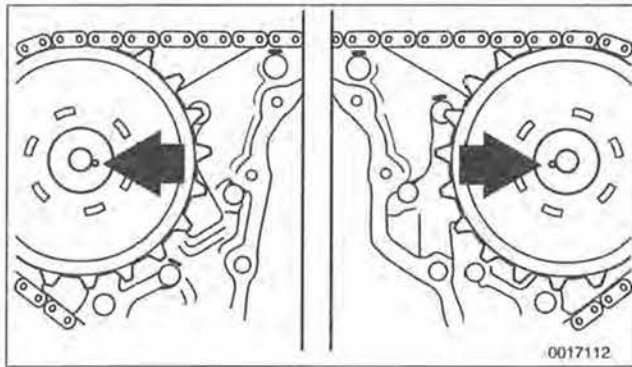
- Remove upper timing case cover bolts (arrows) and lift off cover.

CAUTION—

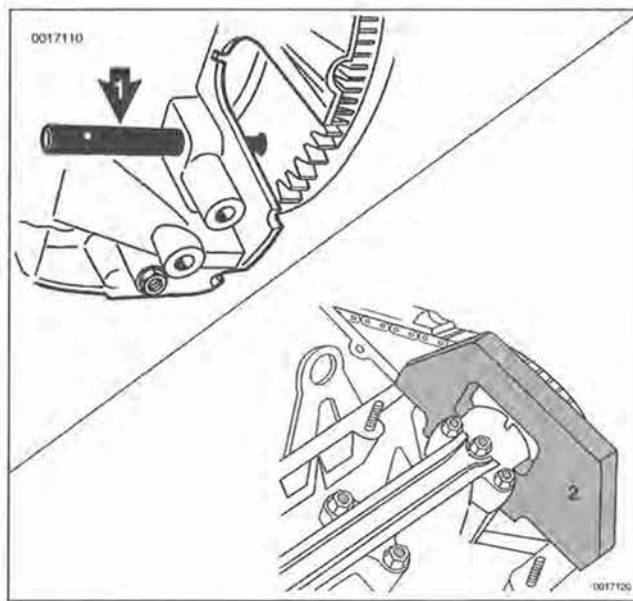
Ensure that locating dowel sleeves at A do not fall into timing case.

M70 TIMING CHAIN

CAMSHAFT TIMING CHAIN 117-13



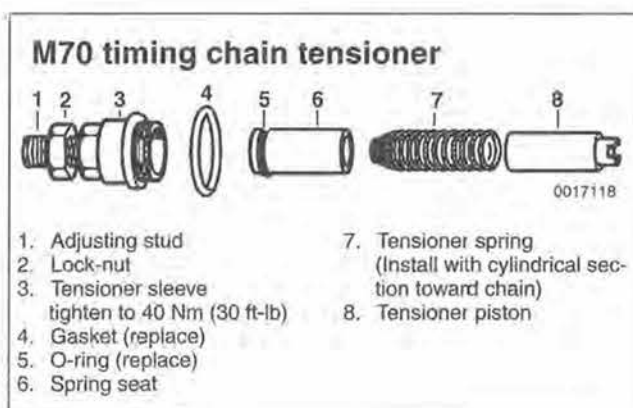
- Using crankshaft pulley bolt, turn engine over until left and right camshaft sprocket dowel pins (arrows) face in with cylinder no. 1 approximately at TDC.



- Lock crankshaft at TDC using BMW special tool no. 11 2 300 (1).
- Lock camshafts at TDC using BMW special tool 11 3 190 (2, one tool per cylinder head).

CAUTION—

The camshafts must be locked in the TDC position using BMW special tools. The marks on the sprockets should not be used to set the engine at TDC.



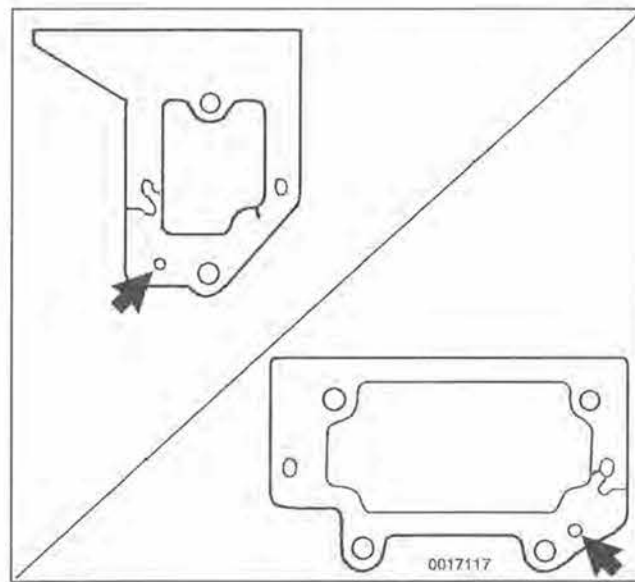
- Loosen all camshaft sprocket bolts.
- Remove top and left chain guide rails and main chain tensioner.
 - To reduce spring tension before removing main chain tensioner, remove plastic anti-tamper cap, loosen lock nut, and back off adjusting stud.

117-14 CAMSHAFT TIMING CHAIN

- Tie chain to camshaft sprockets with wire. Unbolt camshaft chain sprockets and pull forward, keeping chain under tension.
- Unbolt upper timing case and remove.

NOTE—

On M70 engines built up to 8/88, the right camshaft must be removed before the upper timing case can be removed. See 116 Cylinder Head and Valve Train.



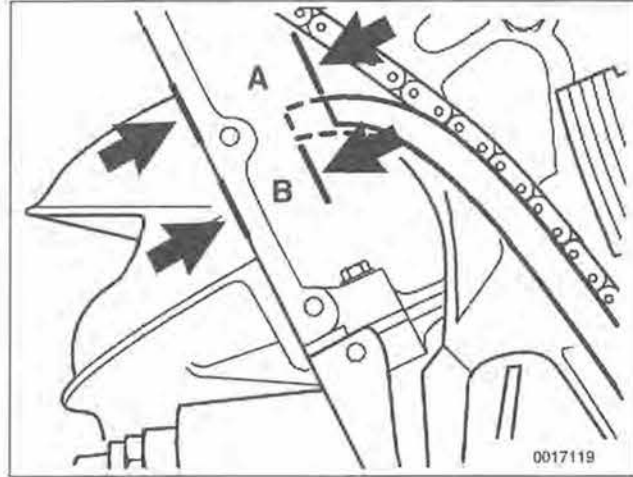
- To reinstall, use new gaskets between upper and lower timing case. Match gasket thickness to original using thickness identifying holes in timing case gaskets (arrows)
- Use 3-Bond®1207 or equivalent sealing compound to seal corners of mating surfaces.

- Hold timing case in position by tightening bolts to cylinder heads finger tight at first. Tighten bolts to lower timing case first, then bolts to cylinder heads.
- With all chain slack at tensioner side, install camshaft sprockets. Tighten bolt finger tight only. Before installing upper timing case cover or cylinder head covers, set camshaft timing as described below.
- Reinstall chain guides and tensioner. Back off chain tensioner adjusting stud.

NOTE—

- When reinstalling chain tensioner, make sure slot at end of tensioning piston engages pivoting guide rail correctly.
- Drain oil from chamber between sleeve and piston to make tensioner assembly and installation easier.

CAMSHAFT TIMING CHAIN 117-15



With crankshaft and camshafts locked in TDC position, camshaft sprocket bolts loose, and chain tensioner adjusting stud backed off fully, measure chain slack at pivoting rail.

- Push pivoting tensioner rail toward chain and measure dimension **A**.
- Push rail back firmly against spring tension and measure dimension **B**.
- Subtract **B** from **A** and compare to nominal value in table below.
- Screw in tensioner adjusting stud by distance derived from chain slack measurement and tighten lock nut.

Timing Chain Slack Nominal Values (M70 Engine)

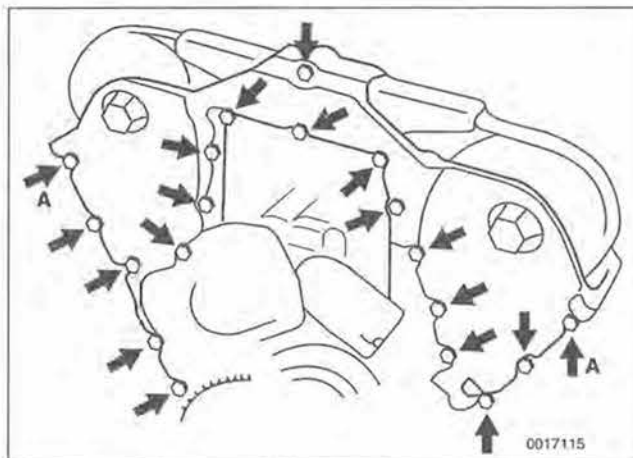
- Pivoting rail without sprocket (to 4/90) 6.0 ± 0.5 mm (0.236 ± 0.020 in)
- Pivoting rail with sprocket (from 4/90) 5.0 ± 0.5 mm (0.197 ± 0.020 in)

NOTE—

If measured slack exceeds nominal value, inspect timing chain assembly for wear.

- Tighten all camshaft sprocket bolts, then remove special BMW tools.

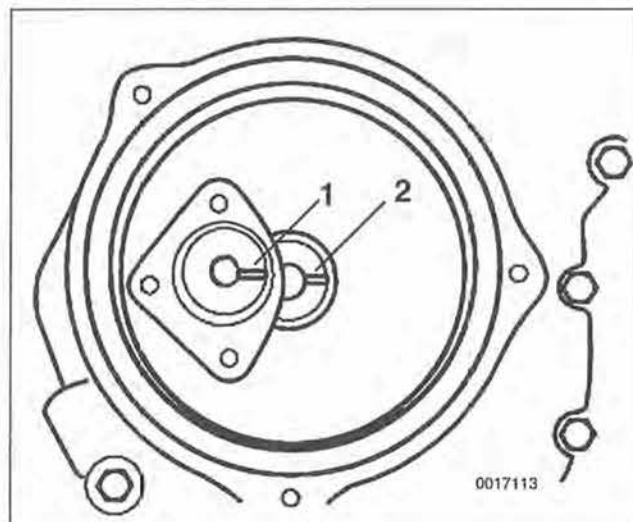
Reinstall upper timing case cover and tighten bolts (arrows).



CAUTION—

Ensure that dowel sleeves at **A** do not fall into timing case.

117-16 CAMSHAFT TIMING CHAIN



- Be sure to install ignition rotor adaptors correctly.
- Ignition rotor adaptor spline (1) should fit recess in camshaft (2).

NOTE—

- Always replace seal at base of distributor housing.
 - Install distributor housing screws using new copper gaskets.
- Remainder of reassembly is reverse of disassembly.

Tightening Torques

- Camshaft sprocket to camshaft (M6) . . . 15 Nm (11 ft-lb)
- Distributor cap to distributor housing . . . 4 Nm (35 in-lb)
- Ignition rotor to rotor flange. 2.8 Nm (25 in-lb)
- Ignition rotor adaptor to camshaft (install with thread locking compound). 23 ± 1 Nm (17 ± 1 ft-lb)
- Timing chain tensioner to cylinder head 40 Nm (30 ft-lb)
- Timing case/cover fasteners
 - M6. 10 Nm (89 in-lb)
 - M8. 22 Nm (17 ft-lb)
 - M10. 47 Nm (35 ft-lb)

