

Chapter 2 Part B:

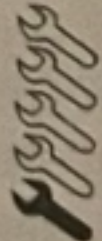
Diesel engine in-car repair procedures

Contents

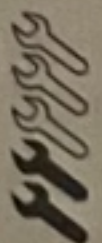
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Degrees of difficulty

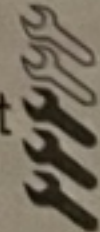
Easy, suitable for novice with little experience



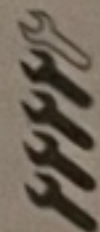
Fairly easy, suitable for beginner with some experience



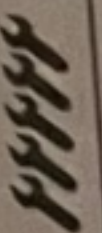
Fairly difficult, suitable for competent DIY mechanic



Difficult, suitable for experienced DIY mechanic



Very difficult, suitable for expert DIY or professional



Specifications

General

Engine type	Four-cylinder, in-line, water-cooled. Double overhead camshaft, belt-driven
Manufacturer's engine code*	Z19DTH
Bore	82.0 mm
Stroke	90.4 mm
Capacity	1910 cc
Compression ratio	17.5:1
Output:	
Torque	320 Nm @ 2000-2700 rpm
Power	110 kW @ 4000 rpm
Firing order	1-3-4-2 (No 1 cylinder at timing belt end of engine)
Direction of crankshaft rotation	Clockwise (viewed from timing belt end of engine)

* For details of engine code location, see 'Vehicle identification' in the Reference Chapter.

Compression pressures

Maximum difference between any two cylinders	1.5 bar
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Lubrication system

Minimum oil pressure at 80°C:	
At idle speed	1.0 bar
At 4000 rpm	4.0 bar
Oil pump type	Rotor-type, driven by crankshaft pulley/vibration damper from crankshaft

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	Nm	lbf ft
Torque wrench settings		
Air conditioning compressor mounting bracket to cylinder block/sump	50	37
Auxiliary drivebelt idler pulley bolt	25	18
Auxiliary drivebelt tensioner assembly bolts	50	37
Camshaft drivegear bolts*	120	89
Camshaft housing bolts	25	18
Camshaft housing closure bolt	16	12
Camshaft sprocket bolt*	120	89
Connecting rod big-end bearing cap bolt:*		
Stage 1	25	18
Stage 2	Angle-tighten a further 60°	7
Crankshaft oil seal housing	9	7
Crankshaft pulley/vibration damper bolts	25	18
Crankshaft sprocket bolt*†	360	266
Cylinder head bolts:*		
Stage 1	20	15
Stage 2	65	48
Stage 3	Angle-tighten a further 90°	
Stage 4	Angle-tighten a further 90°	
Stage 5	Angle-tighten a further 90°	
Driveplate bolts*	160	118
Engine mountings:		
Front mounting/torque link bracket to transmission	80	59
Front mounting/torque link to subframe	80	59
Left-hand:		
Mounting-to-body bolts	20	15
Mounting bracket to transmission bracket	55	41
Transmission bracket to transmission	55	41
Rear mounting/torque link bracket to transmission	80	59
Rear mounting/torque link to subframe	60	44
Rear mounting/torque link to transmission bracket	80	59
Right-hand:		
Engine bracket-to-engine bolts	55	41
Lower bolts (M8)	25	18
Upper bolts (M10)	50	37
Mounting-to-body bolts/nut	55	41
Mounting-to-engine bracket bolts	55	41
Engine-to-transmission unit bolts:		
M10 bolts	40	30
M12 bolts	60	44
Flywheel bolts*	160	118
High-pressure fuel pump sprocket nut*	50	37
Intermediate shaft bearing housing support bracket bolts	55	41
Main bearing cap bolts:*		
Stage 1	25	18
Stage 2	Angle-tighten a further 100°	
Oil filler housing bolts	9	7
Oil filter housing to cylinder block	50	37
Oil pump housing to cylinder block	9	7
Oil pump pick-up/strainer bolts	9	7
Roadwheel bolts	110	81
Sump bolts:		
M6 bolts	9	7
M8 bolts	25	18
M10 bolts	40	30
Sump drain plug	20	15
Timing belt idler pulley bolt	50	37
Timing belt tensioner bolt	25	18
Timing belt upper cover bolts:		
M6 bolts	9	7
M8 bolts	25	18

* Do not re-use

† Left-hand thread

1 General in

How to use

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1 General information

How to use this Chapter

This Part of Chapter 2 describes the repair procedures which can reasonably be carried out, on the engine while it remains in the vehicle. If the engine has been removed from the vehicle and is being dismantled as described in Chapter 2C, any preliminary dismantling procedures can be ignored.

Note that, while it may be possible physically to overhaul items such as the piston/connecting rod assemblies while the engine is in the vehicle, such tasks are not usually carried out as separate operations, and usually require the execution of several additional procedures (not to mention the cleaning of components and of oilways); for this reason, all such tasks are classed as major overhaul procedures, and are described in Chapter 2C.

Chapter 2C describes the removal of the engine/transmission unit from the vehicle, and the full overhaul procedures which can then be carried out.

Engine description

The 1.9 litre DOHC diesel engine is of the sixteen-valve, in-line four-cylinder, double overhead camshaft type, mounted transversely at the front of the car, with the transmission on its left-hand end.

The crankshaft is supported within the cylinder block on five shell-type main bearings. Thrustwashers are fitted to number 3 main bearing, to control crankshaft endfloat.

The connecting rods rotate on horizontally split bearing shells at their big ends. The pistons are attached to the connecting rods by gudgeon pins, which are retained by circlips. The aluminium-alloy pistons are fitted with three piston rings – two compression rings and scraper-type oil control ring.

The camshafts are situated in a separate housing bolted to the top of the cylinder head. The exhaust camshaft is driven by the crankshaft via a toothed composite rubber timing belt (which also drives the high-pressure fuel pump and the coolant pump). The exhaust camshaft drives the intake camshaft via a spur gear. Each cylinder has four valves (two intake and two exhaust), operated via followers, which are supported at their pivot ends by hydraulic self-adjusting tappets. One camshaft operates the intake valves, and the other operates the exhaust valves.

The intake and exhaust valves are each closed by a single valve spring, and operate in guides pressed into the cylinder head.

Lubrication is by pressure-feed from a rotor-type oil pump, which is mounted on the right-hand end of the crankshaft. The pump draws oil through a strainer located in the sump, and then forces it through an externally

mounted full-flow cartridge-type filter. The oil flows into galleries in the cylinder block/crankcase, from where it is distributed to the crankshaft (main bearings) and camshafts. The big-end bearings are supplied with oil via internal drillings in the crankshaft, while the camshaft bearings also receive a pressurised supply. The camshaft lobes and valves are lubricated by splash, as are all other engine components.

A semi-closed crankcase ventilation system is employed; crankcase fumes are drawn from the oil separator attached to the cylinder block via a hose to the camshaft housing. The fumes are then passed via a hose to the intake manifold.

Operations with engine in car

The following operations can be carried out without having to remove the engine from the car.

- Removal and refitting of the cylinder head.
- Removal and refitting of the timing belt, tensioner, idler pulleys and sprockets.
- Renewal of the camshaft oil seal.
- Removal and refitting of the camshaft housing.
- Removal and refitting of the camshafts and followers.
- Removal and refitting of the sump.
- Removal and refitting of the connecting rods and pistons.*
- Removal and refitting of the oil pump.
- Removal and refitting of the oil filter housing.
- Renewal of the crankshaft oil seals.
- Renewal of the engine mountings.
- Removal and refitting of the flywheel/driveplate.

* Although the operation marked with an asterisk can be carried out with the engine in the car (after removal of the sump), it is preferable for the engine to be removed, in the interests of cleanliness and improved access. For this reason, the procedure is described in Chapter 2C.

2 Compression and leakdown tests – description and interpretation

Compression test

Note 1: A compression tester specifically designed for diesel engines must be used for this test because of the higher pressures involved.

Note 2: The battery must be in a good state of charge, the air filter must be clean, and the engine should be at normal operating temperature.

1 When engine performance is down, or if misfiring occurs which cannot be attributed to the fuel system, a compression test can provide diagnostic clues as to the engine's condition. If the test is performed regularly, it

can give warning of trouble before any other symptoms become apparent.

2 The tester is connected to an adapter, which screws into the glow plug holes. It is unlikely to be worthwhile buying such a tester for occasional use, but it may be possible to borrow or hire one – if not, have the test performed by a Saab dealer, or suitably-equipped garage. If the necessary equipment is available, proceed as follows.

3 Remove the glow plugs as described in Chapter 5A.

4 Screw the compression tester adapter in to the glow plug hole of No 1 cylinder.

5 With the help of an assistant, crank the engine on the starter motor; after one or two revolutions, the compression pressure should build-up to a maximum figure, and then stabilise. Record the highest reading obtained.

6 Repeat the test on the remaining cylinders, recording the pressure in each.

7 All cylinders should produce very similar pressures; any difference greater than the maximum figure given in the Specifications indicates the existence of a fault. Note that the compression should build-up quickly in a healthy engine; low compression on the first stroke, followed by gradually increasing pressure on successive strokes, indicates worn piston rings. A low compression reading on the first stroke, which does not build-up during successive strokes, indicates leaking valves or a blown head gasket (a cracked head could also be the cause). **Note:** The cause of poor compression is less easy to establish on a diesel engine than on a petrol engine. The effect of introducing oil into the cylinders ('wet' testing) is not conclusive, because there is a risk that the oil will sit in the recess on the piston crown instead of passing to the rings.

8 On completion of the test refit the glow plugs as described in Chapter 5A.

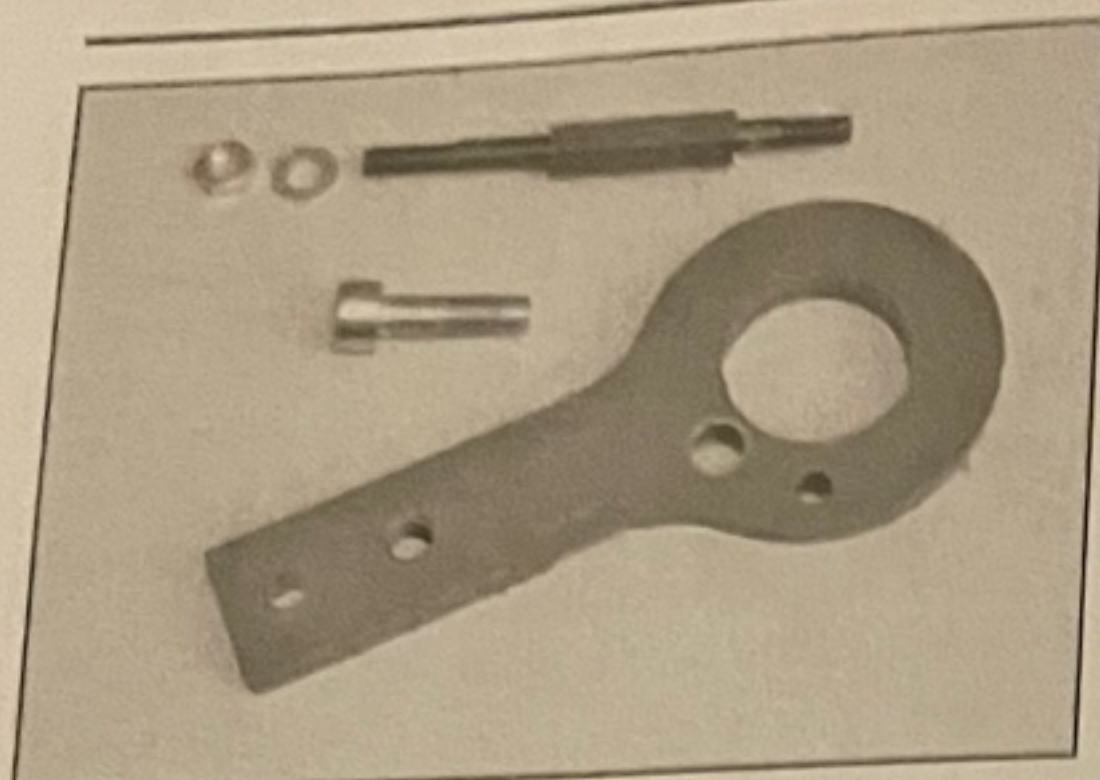
Leakdown test

9 A leakdown test measures the rate at which compressed air fed into the cylinder is lost. It is an alternative to a compression test, and in many ways it is better, since the escaping air provides easy identification of where pressure loss is occurring (piston rings, valves or head gasket).

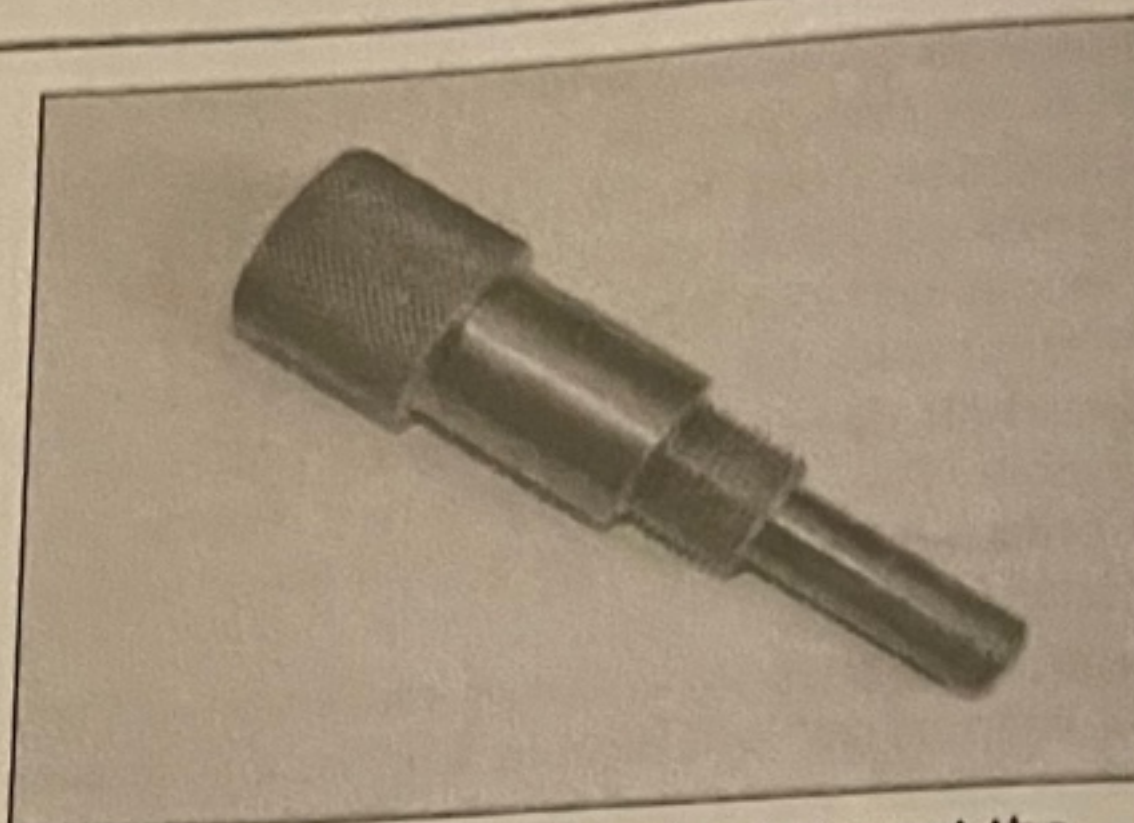
10 The equipment needed for leakdown testing is unlikely to be available to the home mechanic. If poor compression is suspected, have the test performed by a Saab dealer, or suitably-equipped garage.

3 Top dead centre (TDC) for No 1 piston – locating

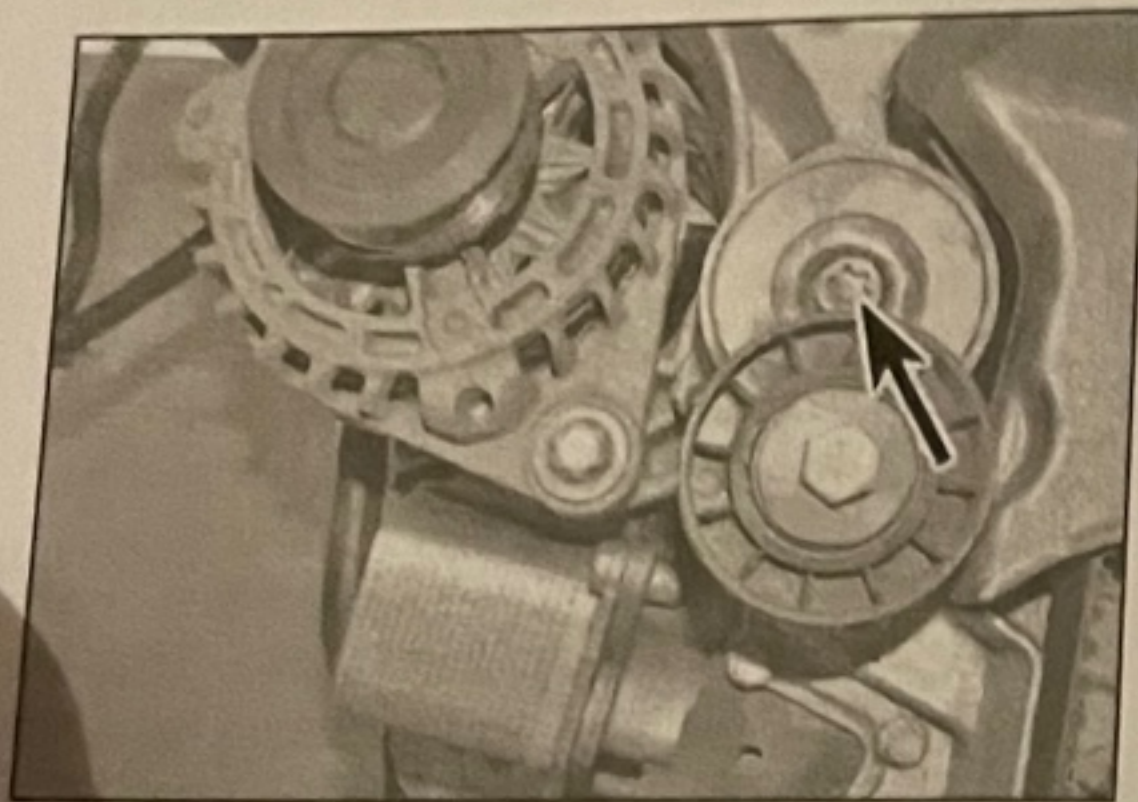
Note: To accurately determine the TDC position for No 1 piston, it will be necessary to use Saab special tool 32 025 009 (or suitable equivalent) to set the crankshaft at the TDC position, together with the camshaft



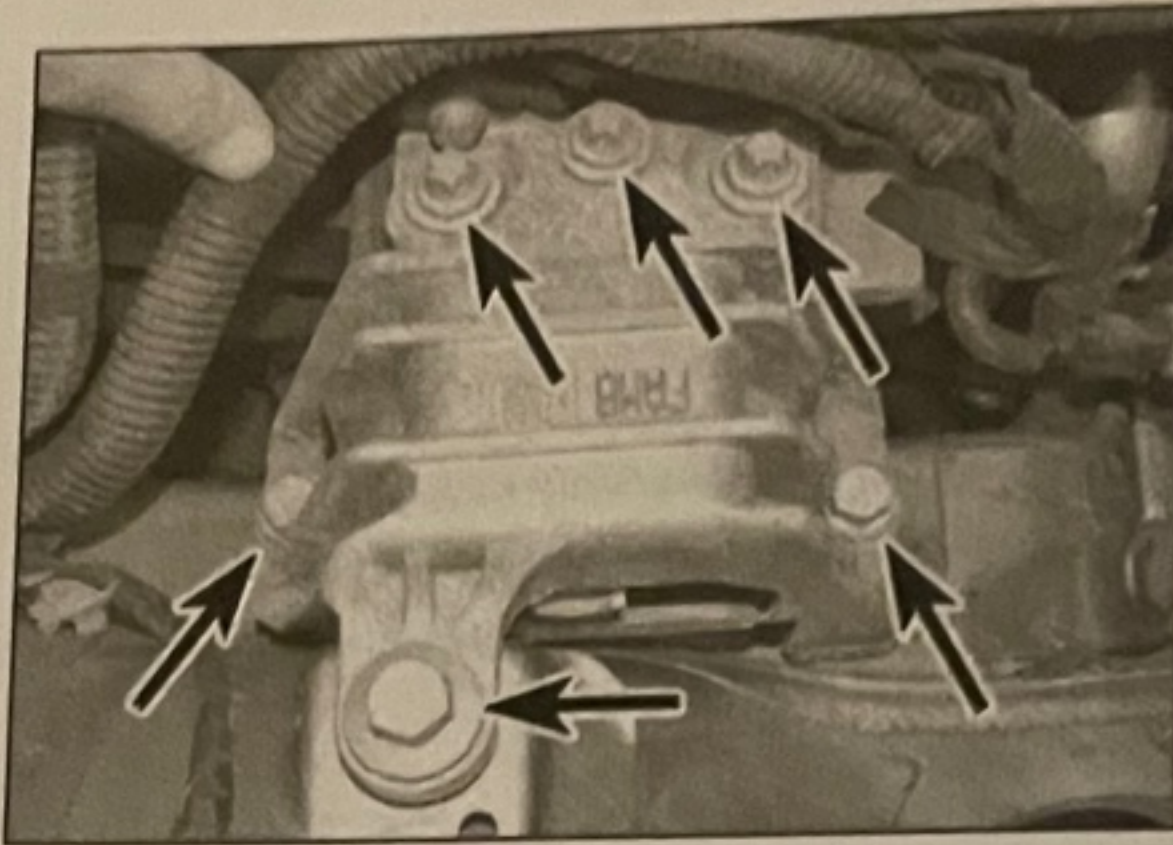
3.0a Saab special tool (or equivalent) is required to set the TDC position for No 1 piston ...



3.0b ... together with tools to set the camshaft position



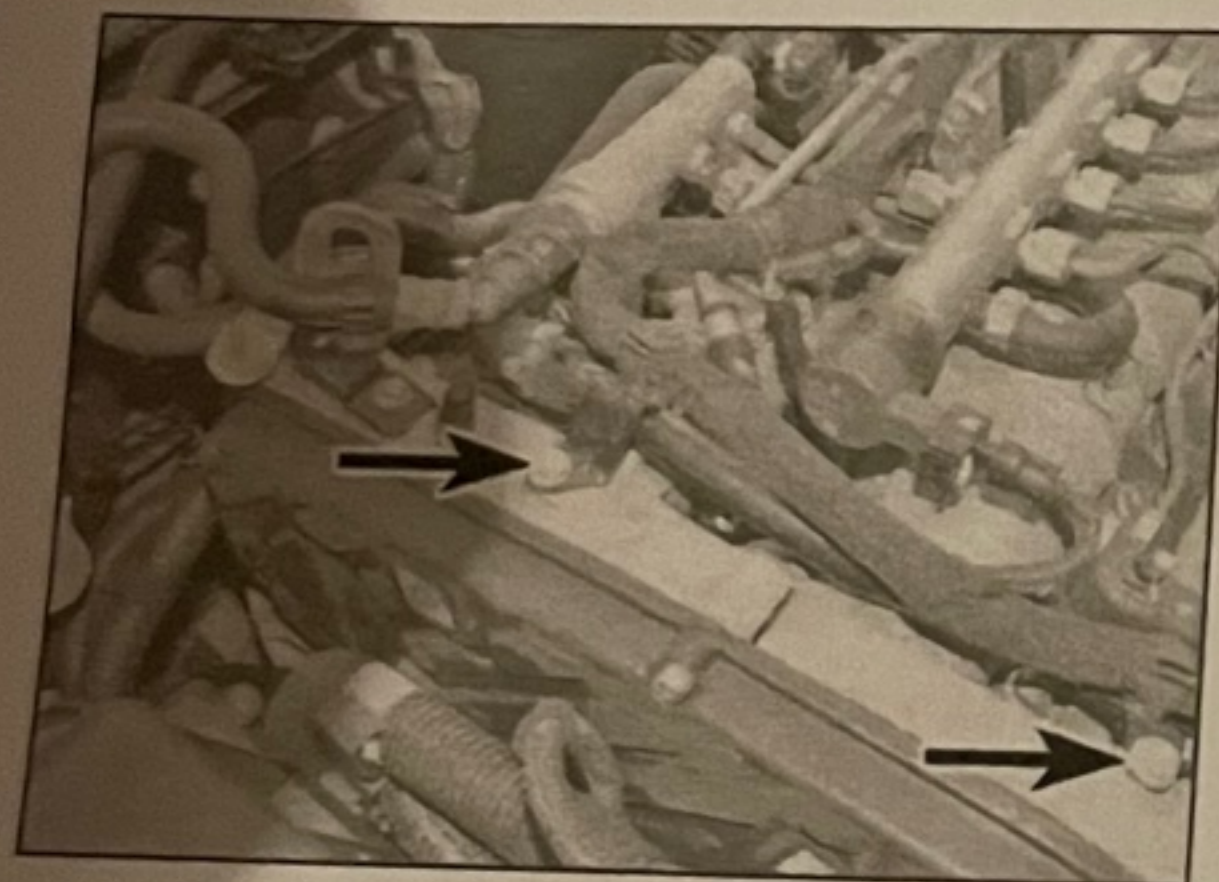
3.5 Undo the central mounting bolt (arrowed), and remove the auxiliary drivebelt tensioner assembly



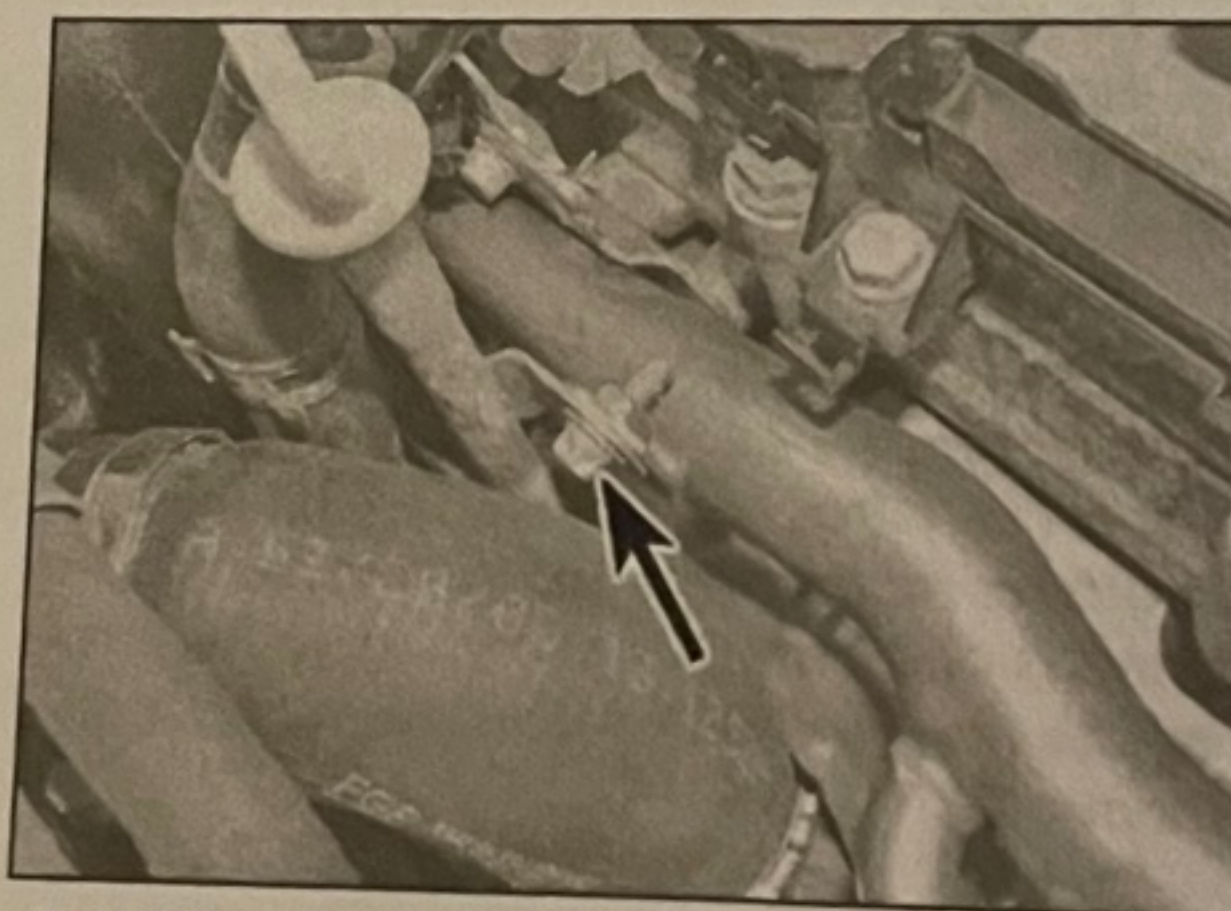
3.8 Undo the 6 bolts (arrowed) securing the engine mounting to the body and engine bracket

positioning tool, Saab special tool 32 025 008 (or suitable equivalent) (see illustrations).

1 In its travel up-and-down its cylinder bore, Top Dead Centre (TDC) is the highest point



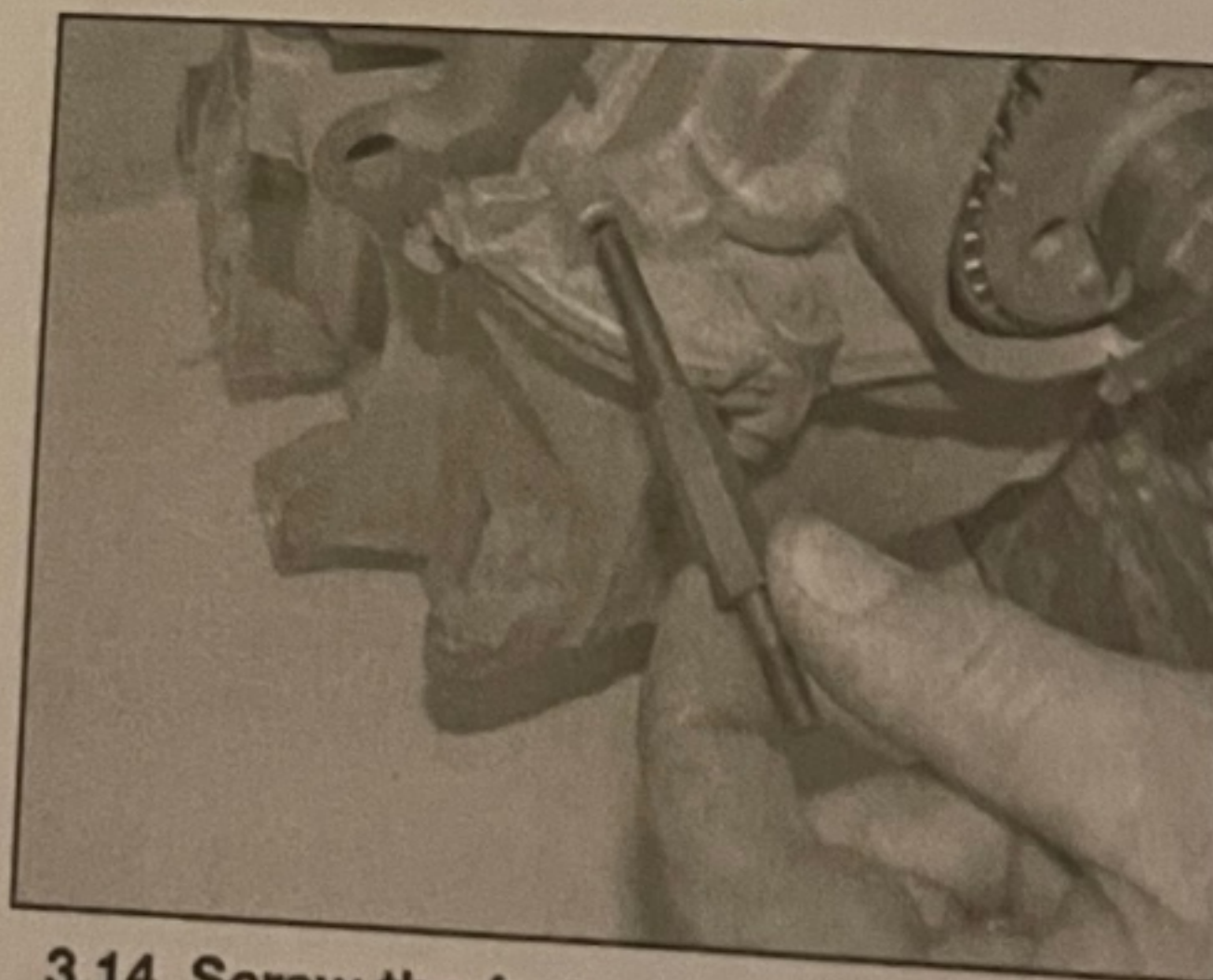
3.9 Engine breather pipe retaining bolts (arrowed)



3.10 Undo the bolt (arrowed) and release the engine oil dipstick guide tube from the coolant pipe



3.11 Unscrew the closure bolt from the valve timing checking hole in the camshaft housing



3.14 Screw the fastening stud of special tool 32 025 009 into the oil pump housing

that each piston reaches as the crankshaft rotates. While each piston reaches TDC at the top of the compression stroke, the piston position of No 1 cylinder is the purpose of timing the engine. TDC of its compression stroke.

2 Number 1 piston (and cylinder) is at right-hand (timing belt) end of the engine and its TDC position is located as follows. Note that the crankshaft rotates clockwise when viewed from the right-hand side of the car.

3 Disconnect the battery negative terminal as described in Chapter 5A, then lift a plastic cover over the top of the engine. 4 Remove the crankshaft pulley/vibration damper as described in Section 5.

5 Undo the central mounting bolt, and remove the auxiliary drivebelt tensioner assembly (see illustration).

6 Remove the air cleaner assembly and intake duct as described in Chapter 4B.

7 Remove the engine undershield, then place a trolley jack beneath the right-hand side of the engine with a block of wood on the head. Raise the jack until it is supporting the weight of the engine.

8 Mark the bolt positions for correct refitting, then undo the three bolts securing the right-hand engine mounting to the engine bracket, and the three bolts securing the mounting to the body. Remove the mounting (see illustration).

9 Release the retaining clip securing the engine breather hose to the breather pipe adjacent to the engine oil dipstick. Undo two bolts securing the breather pipe to the cylinder head, and disconnect the pipe from the hose (see illustration).

10 Undo the bolt and release the engine oil dipstick guide tube from the coolant pipe (see illustration).

11 Unscrew the closure bolt from the valve timing checking hole in the camshaft housing (see illustration).

12 Screw the camshaft positioning tool (Saab special tool 32 025 008) into the valve timing checking hole.

13 Using a socket and extension bar on the crankshaft sprocket bolt, rotate the crankshaft in the normal direction of rotation until the spring-loaded plunger of the positioning tool slides into engagement with the slot in the camshaft. There will be an audible click in the tool when this happens.

14 Unscrew the bolt from the lower left-hand side of the oil pump housing and screw in the fastening stud of Saab special tool 32 025 009 (see illustration).

15 Fit the positioning ring of tool 32 025 009 over the fastening stud and engage it with the crankshaft sprocket. Ensure that the hole in the positioning ring engages with the hole in the sprocket. Secure the tool in position with the retaining bolt and nut (see illustration).

16 With the crankshaft positioning ring in place and the camshaft positioning

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Note: To will be n suitable camshaft

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engaged with the slot in the camshaft, the engine is positioned with No 1 piston at TDC on compression.

4 Valve timing – checking and adjustment

Note: To check and adjust the valve timing, it will be necessary to use Saab special tools (or suitable equivalents) to set the crankshaft and camshafts in the TDC position (see Section 3).

Checking

- 1 Disconnect the battery negative terminal (refer Chapter 5A), then lift off the plastic cover over the top of the engine.
- 2 Release the retaining clip securing the engine breather hose to the breather pipe adjacent to the engine oil dipstick. Undo the two bolts securing the breather pipe to the cylinder head, and disconnect the pipe from the hose (see illustration 3.9).
- 3 Undo the bolt and release the engine oil dipstick guide tube from the coolant pipe (see illustration 3.10).
- 4 Unscrew the closure bolt from the valve timing checking hole in the exhaust side of camshaft housing (see illustration 3.11).
- 5 Screw the exhaust camshaft positioning tool (Saab special tool 32 025 008) into the valve timing checking hole.
- 6 Unscrew the closure bolt from the valve timing checking hole in the intake side of the camshaft housing. The closure bolt is located below the fuel pressure regulating valve on the fuel rail.
- 7 Screw the intake camshaft positioning tool (Saab special tool 32 025 008) into the valve timing checking hole.
- 8 Using a socket and extension bar on the crankshaft sprocket bolt, rotate the crankshaft in the normal direction of rotation until the spring-loaded plungers of the positioning tools slide into engagement with the slots in the camshafts. There will be an audible click from the tools when this happens.
- 9 Remove the crankshaft pulley/vibration damper as described in Section 5.
- 10 Unscrew the bolt from the lower left-hand side of the oil pump housing and screw in the fastening stud of Saab special tool 32 025 009 (see illustration 3.14).
- 11 Fit the positioning ring of tool 32 025 009 over the fastening stud and engage it with the crankshaft sprocket. Ensure that the hole in the positioning ring engages with the lug on the sprocket. Secure the tool in position with the retaining bolt and nut (see illustration 3.15).
- 12 If it is not possible to fit the positioning ring of tool 32 025 009 as described, or if the camshaft positioning tools did not engage with the camshaft slots, adjust the valve timing as follows.

Adjustment

- 13 Remove the timing belt as described in Section 6.

- 14 Using a socket and extension bar on the crankshaft sprocket bolt, rotate the crankshaft anti-clockwise by 90°. This will position all the pistons halfway down their bores, and prevent any chance of the valves touching the piston crowns during the following procedure.

- 15 Remove the intake and exhaust camshaft positioning tools from the valve timing checking holes.

- 16 Using a suitable tool engaged with the timing belt sprocket on the exhaust camshaft, rotate the sprocket approximately 90° clockwise (see Tool Tip in Section 7). Take care not to damage the camshaft sensor with the tool as the sprocket is rotated.

- 17 Screw the intake camshaft positioning tool (Saab special tool 32 025 008) into the valve timing checking hole.

- 18 Rotate the camshaft sprocket clockwise until the spring-loaded plunger of the positioning tool slides into engagement with the slot in the intake camshaft. There will be an audible click from the tool when this happens.

- 19 Release the two retaining clips and disconnect the charge air hose from the throttle body/housing, and intercooler charge air pipe.

- 20 Release the clip and disconnect the crankcase ventilation hose from the engine oil filler housing.

- 21 Disconnect the wiring connector from the coolant temperature sensor, then undo the three retaining bolts and remove the oil filler housing.

- 22 Remove the braking system vacuum pump as described in Chapter 9.

- 23 Working through the oil filler housing aperture, and using the holding tool to prevent rotation of the camshaft, slacken the intake camshaft drivegear retaining bolt. Working through the vacuum pump aperture, slacken the exhaust camshaft drivegear retaining bolt in the same way.

- 24 Screw the exhaust camshaft positioning tool (Saab special tool 32 025 008) into the valve timing checking hole.

- 25 Rotate the camshaft sprocket clockwise until the spring-loaded plunger of the positioning tool slides into engagement with the slot in the exhaust camshaft. There will be an audible click from the tool when this happens.

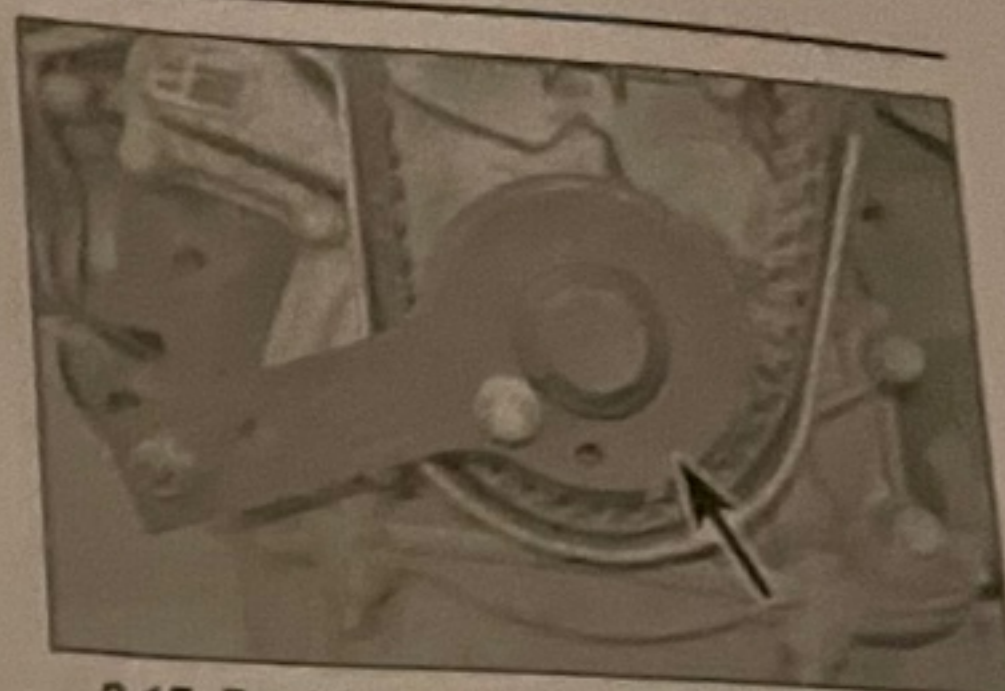
- 26 Hold the camshaft sprocket with the tool and tighten both drivegear retaining bolts to the specified torque.

- 27 Remove the positioning tool from the intake camshaft and refit the closure bolt. Tighten the bolt to the specified torque.

- 28 Refit the oil filler housing to the camshaft housing using a new gasket, refit the retaining bolts and tighten the bolts to the specified torque. Reconnect the coolant temperature sensor wiring connector, and reconnect the crankcase ventilation hose.

- 29 Refit the braking system vacuum pump as described in Chapter 9.

- 30 Refit the charge air hose to the throttle body/housing, and intercooler charge air pipe and secure with the retaining clips.



3.15 Positioning ring of tool 32 025 009 (arrowed) attached to the fastening stud and crankshaft sprocket

- 31 Refit the timing belt as described in Section 6.

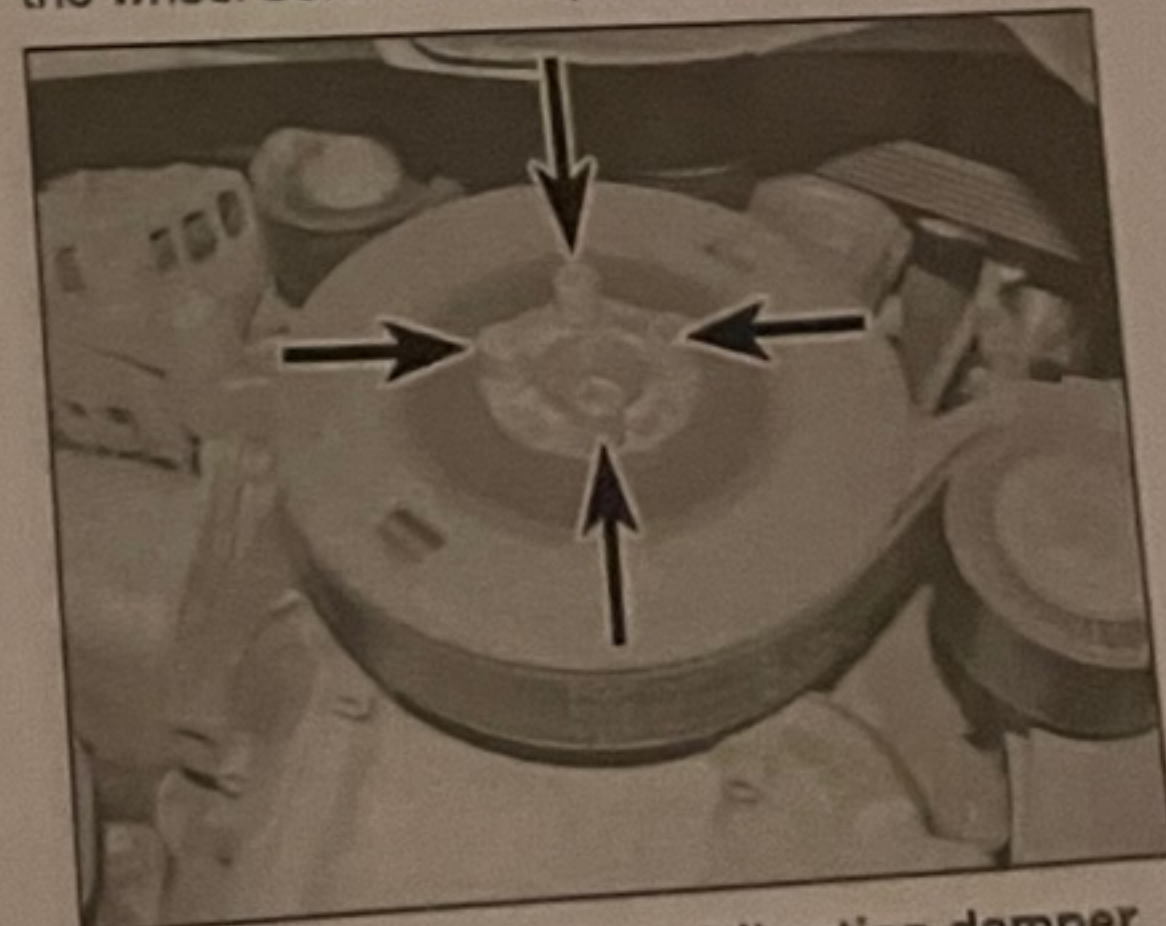
5 Crankshaft pulley/vibration damper – removal and refitting

Removal

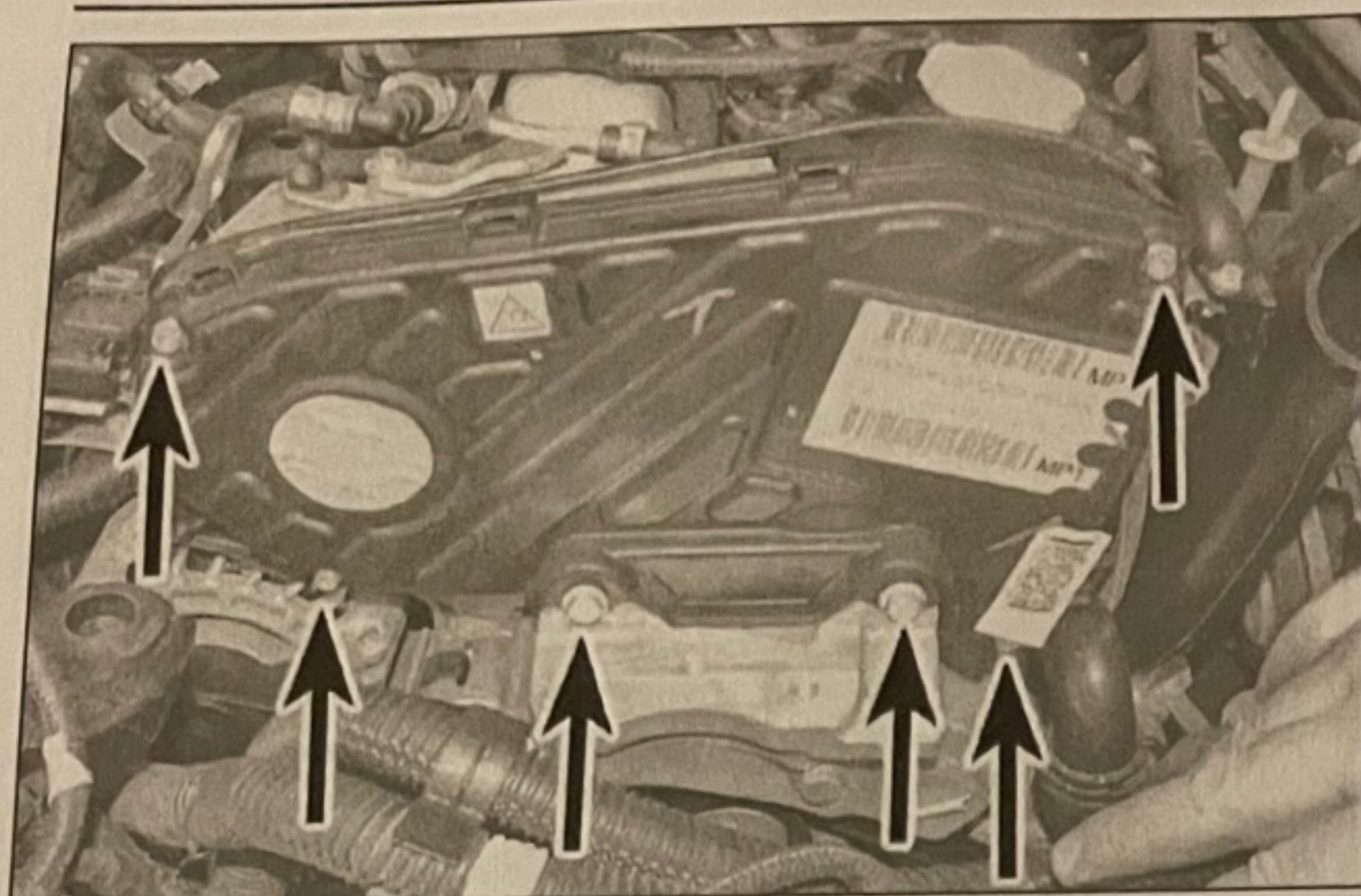
- 1 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove the right-hand front roadwheel, then undo the bolts and remove the engine undershield for access to the crankshaft pulley.
- 2 Remove the auxiliary drivebelt as described in Chapter 1B. Prior to removal, mark the direction of rotation on the belt to ensure the belt is refitted the same way around.
- 3 Undo the four bolts securing the pulley to the crankshaft sprocket and remove the pulley from the sprocket (see illustration).

Refitting

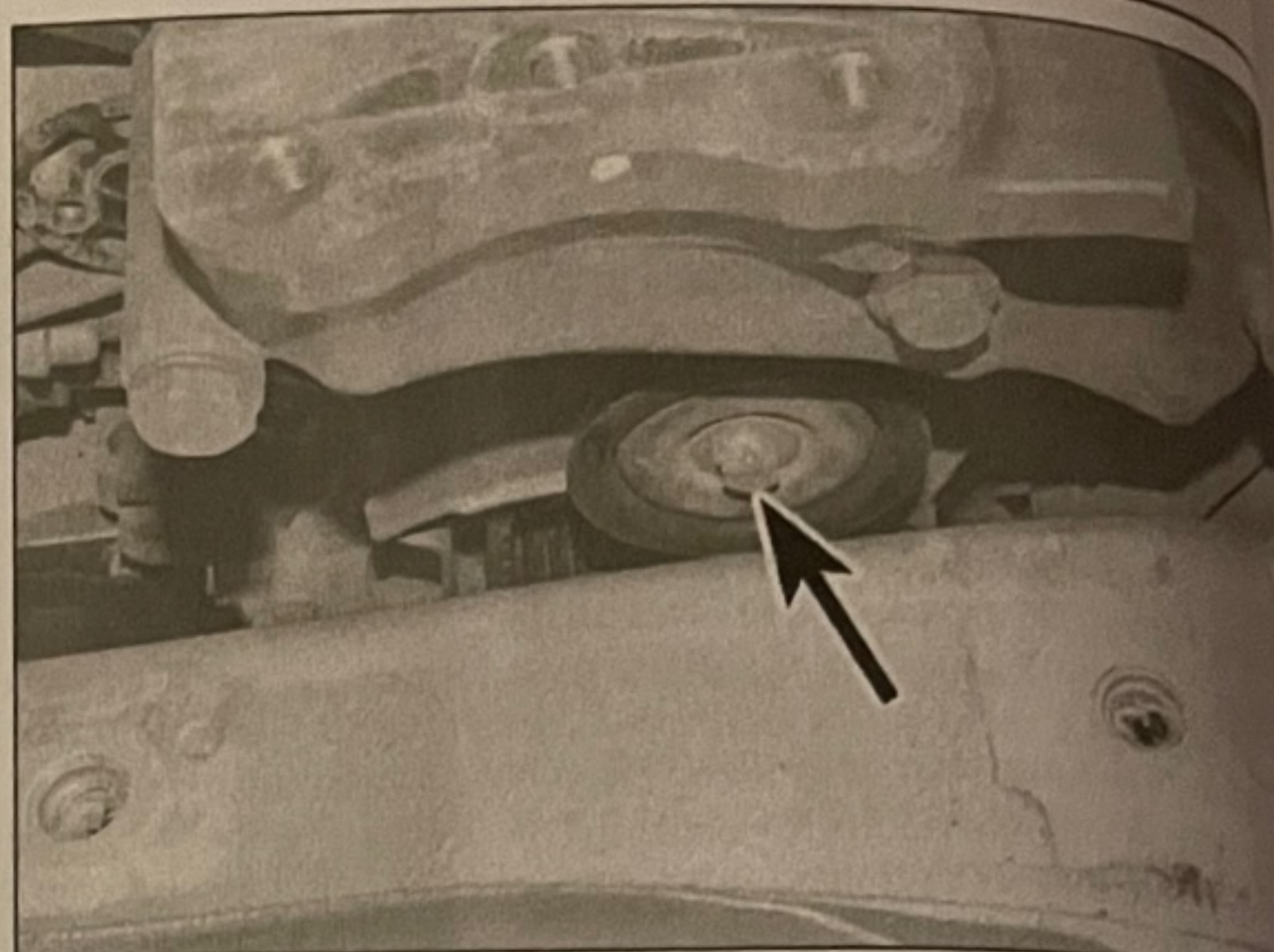
- 4 Locate the crankshaft pulley on the sprocket, ensuring that the hole on the rear face of the pulley engages with the lug on the sprocket.
- 5 Refit the four retaining bolts and tighten them progressively to the specified torque.
- 6 Refit the auxiliary drivebelt as described in Chapter 1B using the mark made prior to removal to ensure the belt is fitted the correct way around.
- 7 Refit the roadwheel and engine undershield, then lower the car to the ground and tighten the wheel bolts to the specified torque.



5.3 Crankshaft pulley/vibration damper retaining bolts (arrowed)

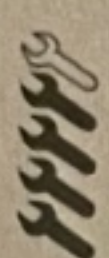


6.2 Upper timing belt cover retaining bolts (arrowed)



6.3 Undo the bolt (arrowed) and remove the auxiliary drivebelt idler pulley from the engine bracket

6 Timing belt – removal and refitting



Note: The timing belt must be removed and refitted with the engine cold.

Removal

- 1 Position No 1 cylinder at TDC on its compression stroke as described in Section 3.
- 2 Unclip the wiring harness from the side of the upper timing belt cover. Unscrew the seven retaining bolts and lift off the upper timing belt cover (see illustration).
- 3 Undo the retaining bolt and remove the auxiliary drivebelt idler pulley from the engine bracket (see illustration).
- 4 Undo the two lower bolts, and the three upper bolts, and remove the engine bracket from the engine (see illustrations).
- 5 Undo the nut and bolt and remove the crankshaft positioning tool (32 025 009) from the crankshaft sprocket.
- 6 Slacken the timing belt tensioner retaining bolt and allow the tensioner to retract, relieving the tension on the timing belt.
- 7 Slide the timing belt from its sprockets and remove it from the engine. If the belt is to be re-used, use white paint or similar to mark the

direction of rotation on the belt. Do not rotate the crankshaft or camshafts until the timing belt has been refitted.

8 Check the timing belt carefully for any signs of uneven wear, splitting or oil contamination, and renew it if there is the slightest doubt about its condition. If the engine is undergoing an overhaul and is approaching the specified interval for belt renewal (see Chapter 1B) renew the belt as a matter of course, regardless of its apparent condition. If signs of oil contamination are found, trace the source of the oil leak and rectify it, then wash down the engine timing belt area and all related components to remove all traces of oil.

Refitting

- 9 On reassembly, thoroughly clean the timing belt sprockets and tensioner/idler pulleys.
- 10 Place the timing belt in position over the crankshaft sprocket. If the original belt is being refitted, ensure that the arrow mark made on removal points in the normal direction of rotation, as before.
- 11 Check that the camshaft and crankshaft are still positioned with No 1 piston at TDC on compression as described in Section 3, and with the camshaft positioning tool still in place. Now refit the crankshaft positioning tool.
- 12 Fit the timing belt over the crankshaft,

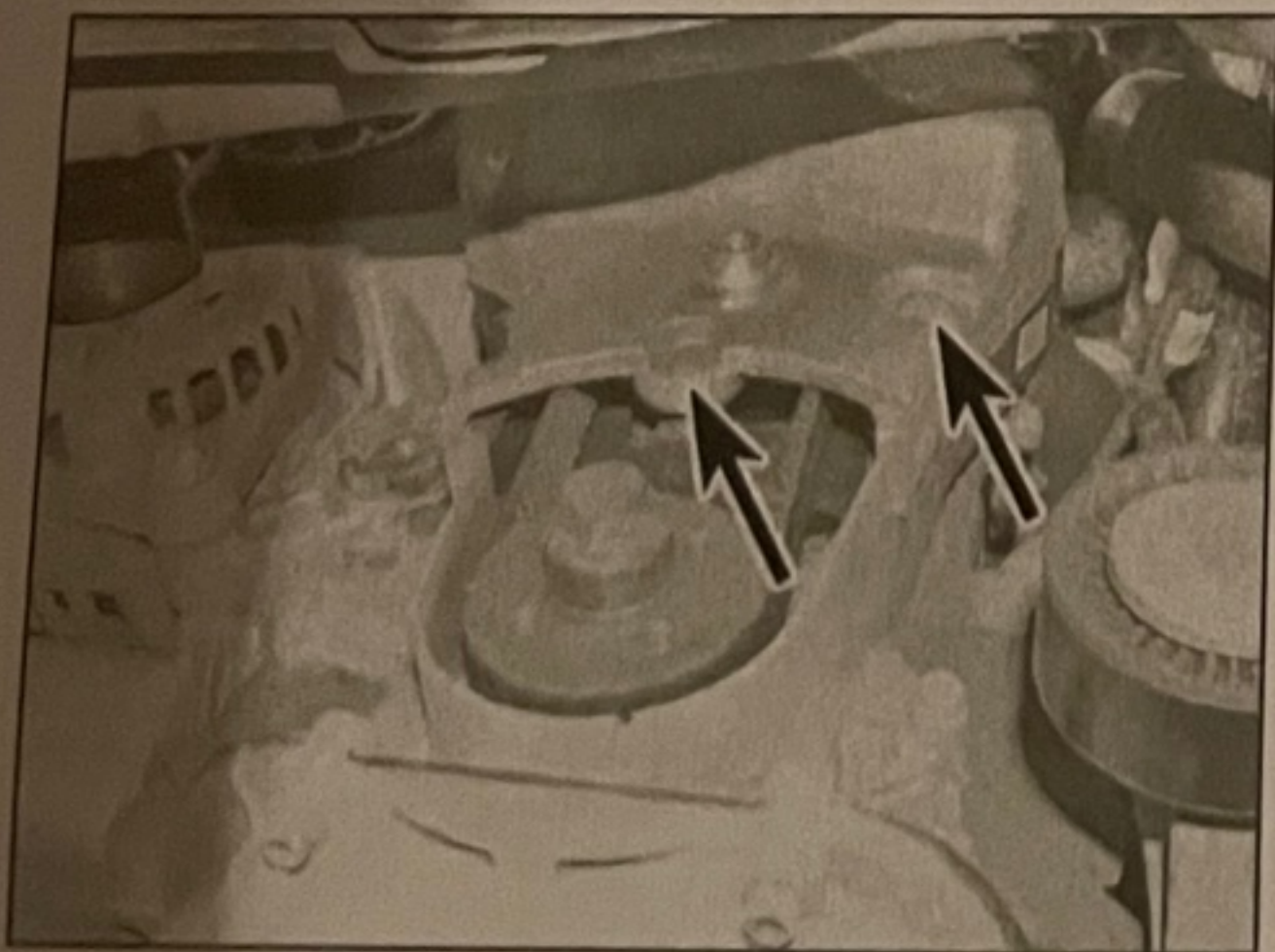
camshaft and fuel pump sprockets, around the idler pulleys, ensuring that the front run is taut (ie, all slack is on the tensioner side of the belt), then fit the belt over the coolant pump sprocket and tensioner pulley. Do not twist the belt sharply while refitting. Ensure that the belt teeth are correctly seated centrally in the sprockets. Note that the marks on the new belt correspond to the marks on the crankshaft and camshaft sprockets.

13 Screw in a suitable bolt, approximately 50 mm in length, into the threaded hole directly below the timing belt tensioner. Use a screwdriver resting on the bolt as a pivot to move the adjusting lever on the tensioner until the tensioner pointer is aligned with the mark on the backplate. Hold the tensioner in this position and tighten the tensioner retaining bolt (see illustrations).

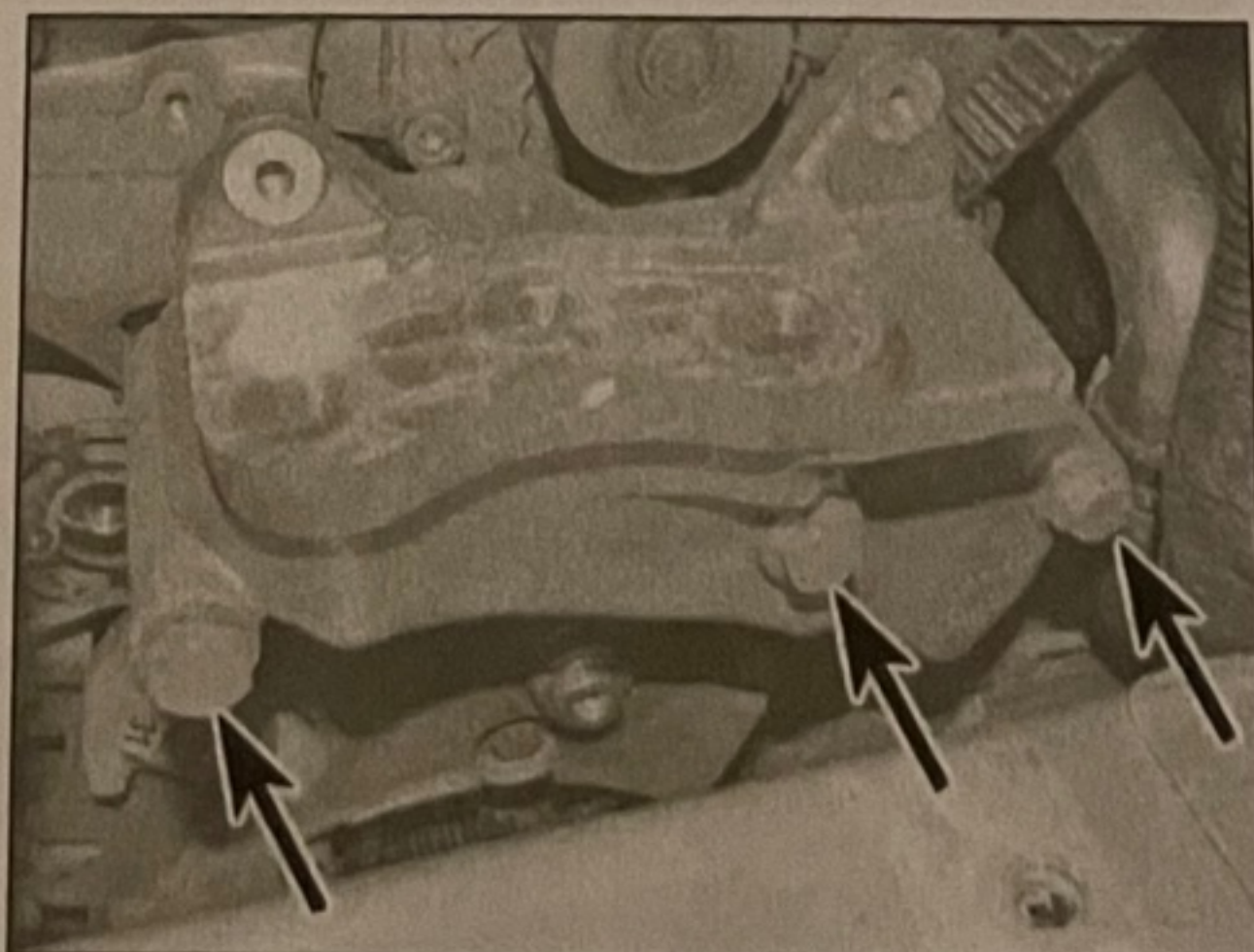
14 Remove the crankshaft and camshaft positioning tools.

15 Using a socket on the crankshaft sprocket bolt, rotate the crankshaft smoothly through two complete turns (720°) in the normal direction of rotation to settle the timing belt in position. Stop rotating the crankshaft before completing the second turn.

16 Refit the camshaft positioning tool and continue turning the crankshaft until the camshaft positioning tool engages.



6.4a Undo the two lower bolts (arrowed) ...



6.4b ... and the three upper bolts (arrowed) ...



6.4c ... and remove the bracket from engine

17 Refit the p
over the faste
crankshaft sp
positioning ri
sprocket. Se
retaining bolt
18 Slacken
bolt and, u
pivot bolt as
on the tens
is once ag
backplate.
and tighten
specified to
19 Remov
again rotat
two comp
direction o
tensioner
on the ba
described
20 When
position
from the
specified
camshaft
torque.
21 Plac
refit the
bolts. T
Refit th
engine
to the s
22 Re
the ret
the w
23 Pl
assem
secur
the b
the m
tighte
spec
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24 R
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3

17 Refit the positioning ring of tool 32 025 009 over the fastening stud and engage it with the crankshaft sprocket. Ensure that the hole in the positioning ring engages with the lug on the sprocket. Secure the tool in position with the retaining bolt and nut.

18 Slacken the timing belt tensioner retaining bolt and, using a screwdriver resting on the pivot bolt as before, move the adjusting lever on the tensioner until the tensioner pointer is once again aligned with the mark on the backplate. Hold the tensioner in this position and tighten the tensioner retaining bolt to the specified torque.

19 Remove all the positioning tools and again rotate the crankshaft smoothly through two complete turns (720°) in the normal direction of rotation. Check that the timing belt tensioner pointer is still aligned with the mark on the backplate. If not, repeat the procedure described in paragraph 18.

20 When all is correct, remove the tensioner position pivot bolt. Refit the bolt removed from the oil pump housing and tighten it to the specified torque. Refit the closure plug to the camshaft housing and tighten to the specified torque.

21 Place the engine bracket in position and refit the two lower bolts, and the three upper bolts. Tighten the bolts to the specified torque. Refit the auxiliary drivebelt idler pulley to the engine bracket and tighten the retaining bolt to the specified torque.

22 Refit the upper timing belt cover and tighten the retaining bolts to the specified torque. Clip the wiring harness back into position.

23 Place the right-hand engine mounting assembly in position and refit the three bolts securing the mounting to the body. Tighten the bolts/nut to the specified torque. Align the mounting in its original position, and then tighten the three mounting bracket bolts to the specified torque. Remove the jack from under the engine.

24 Refit the air cleaner assembly and air intake duct as described in Chapter 4B.

25 Place the auxiliary drivebelt tensioner assembly in position ensuring that the locating peg on the tensioner mounting surface engages correctly with the corresponding hole in the mounting bracket. Tighten the tensioner central mounting bolt to the specified torque.

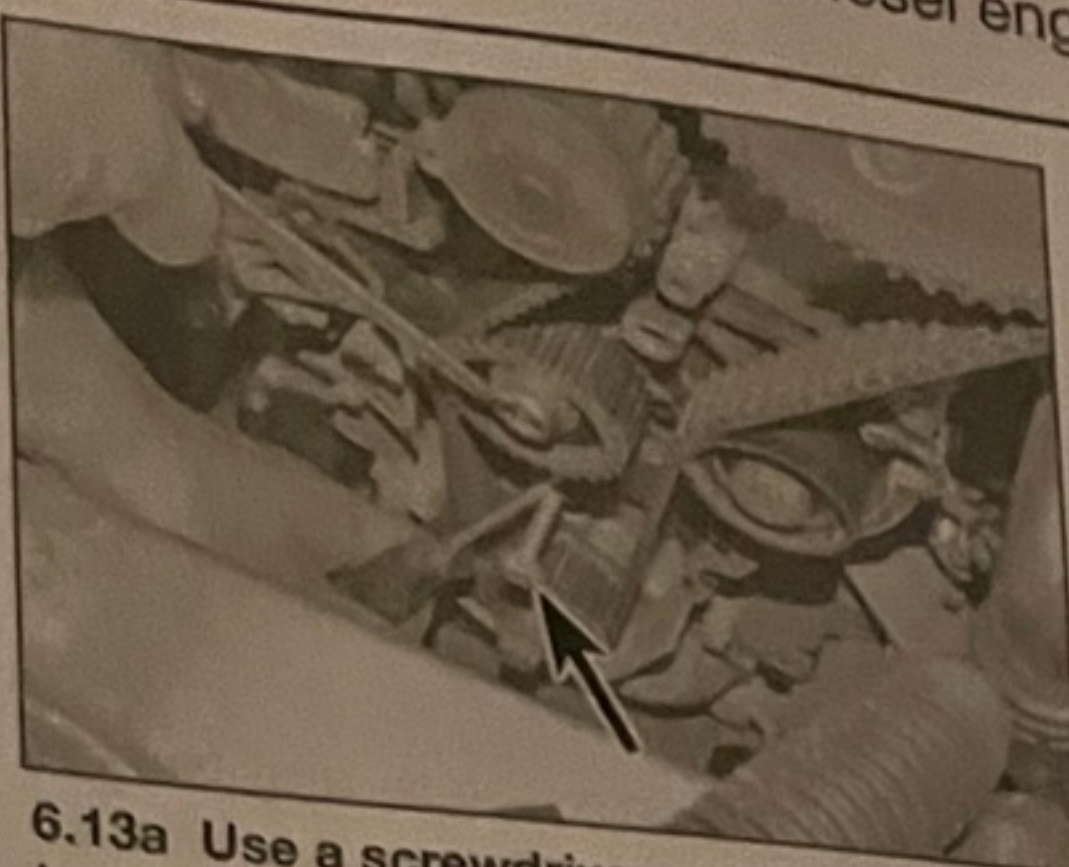
26 Refit the crankshaft pulley/vibration damper as described in Section 5, then refit the auxiliary drivebelt as described in Chapter 1B.

27 Move the engine oil dipstick guide tube back into position. Refit the bolt securing the guide tube to the coolant pipe and tighten the bolt securely.

28 Attach the engine breather hose to the breather pipe and secure with the retaining clip. Secure the breather pipe to the cylinder head with the two bolts securely tightened.

29 Refit the plastic cover to the top of the engine.

30 Refit the roadwheel and engine under shield, then lower the car to the ground and tighten the wheel bolts to the specified torque.



6.13a Use a screwdriver resting on a pivot bolt (arrowed), to move the adjusting lever on the tensioner . . .



6.13b . . . until the tensioner pointer (arrowed) is aligned with the mark on the backplate

7 Timing belt sprockets, tensioner and idler pulley – removal and refitting

Note: Certain special tools will be required for the removal and refitting of the sprockets. Read through the entire procedure to familiarise yourself with the work involved, then either obtain the manufacturer's special tools, or use the alternatives described.

Camshaft sprocket

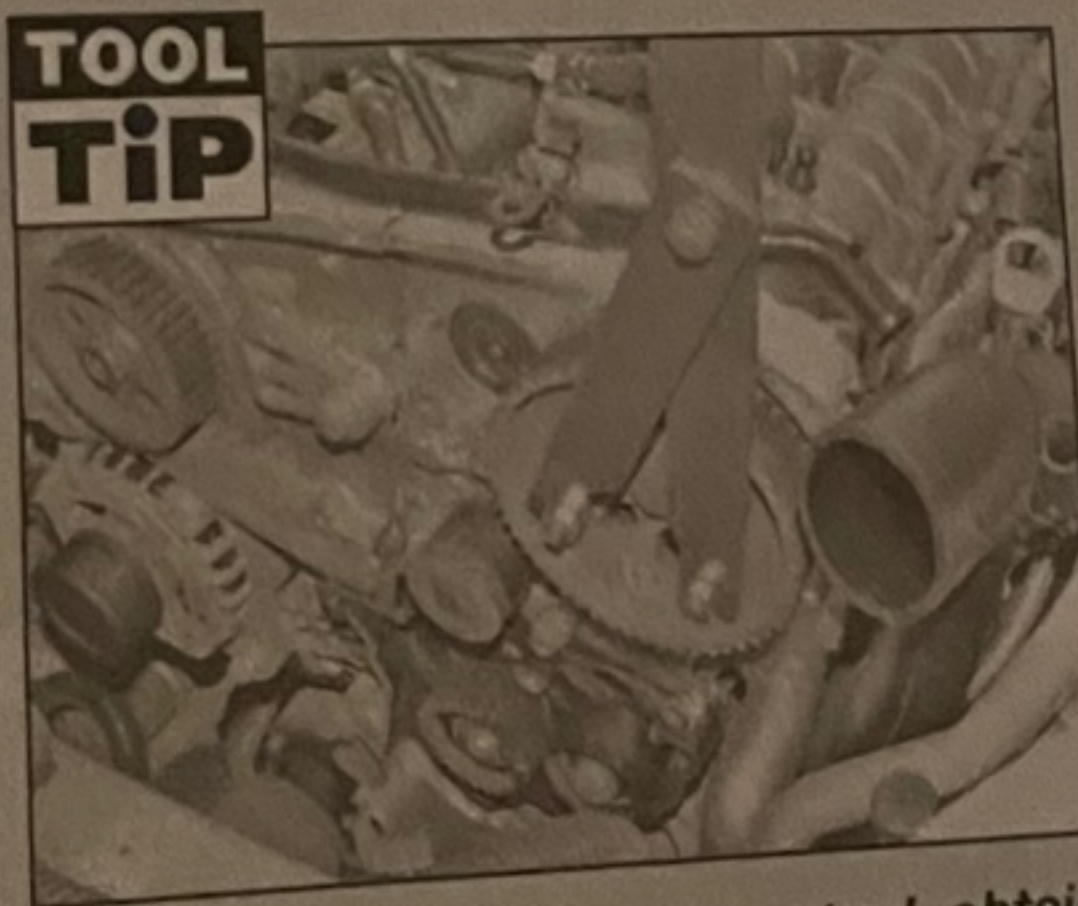
Note: A new sprocket retaining bolt will be required for refitting.

Removal

1 Remove the timing belt as described in Section 6, then remove camshaft positioning tool from the valve timing checking hole.

2 It will now be necessary to hold the camshaft sprocket to enable the retaining bolt to be removed. Saab special tool 32 025 035 is available for this purpose, however, a home-made tool can easily be fabricated (see Tool Tip).

TOOL TIP



To make a sprocket holding tool, obtain two lengths of steel strip about 6 mm thick by about 30 mm wide or similar, one 600 mm long, the other 200 mm long (all dimensions are approximate). Bolt the two strips together to form a forked end, leaving the bolt slack so the shorter strip can pivot freely. At the other end of each 'prong' of the fork, fit a nut and bolt to allow the tool to engage with the spokes in the sprocket.

3 Engage the tool with the holes in the camshaft sprocket, taking care not to damage the camshaft sensor located behind the sprocket

4 Unscrew the retaining bolt and remove the sprocket from the end of the camshaft.

Refitting

5 Prior to refitting check the oil seal for signs of damage or leakage. If necessary, renew as described in Section 8.

6 Refit the sprocket to the camshaft end, aligning its cutout with the locating peg, and fit the new retaining bolt finger-tight only at this stage. Final tightening is carried out after the timing belt has been fitted and tensioned.

7 Refit the camshaft positioning tool to the valve timing checking hole. If necessary, rotate the camshaft slightly, by means of the sprocket, until the tool audibly engages.

8 Proceed with the timing belt refitting procedure as described in Section 6, paragraphs 9 to 14.

9 Retain the camshaft sprocket using the holding tool, and tighten the retaining bolt to the specified torque.

10 Continue with the timing belt refitting procedure as described in Section 6, paragraphs 15 to 30.

Crankshaft sprocket

Note 1: The crankshaft sprocket retaining bolt is extremely tight. Ensure that the holding tool used to prevent rotation as the bolt is slackened is of sturdy construction and securely attached.

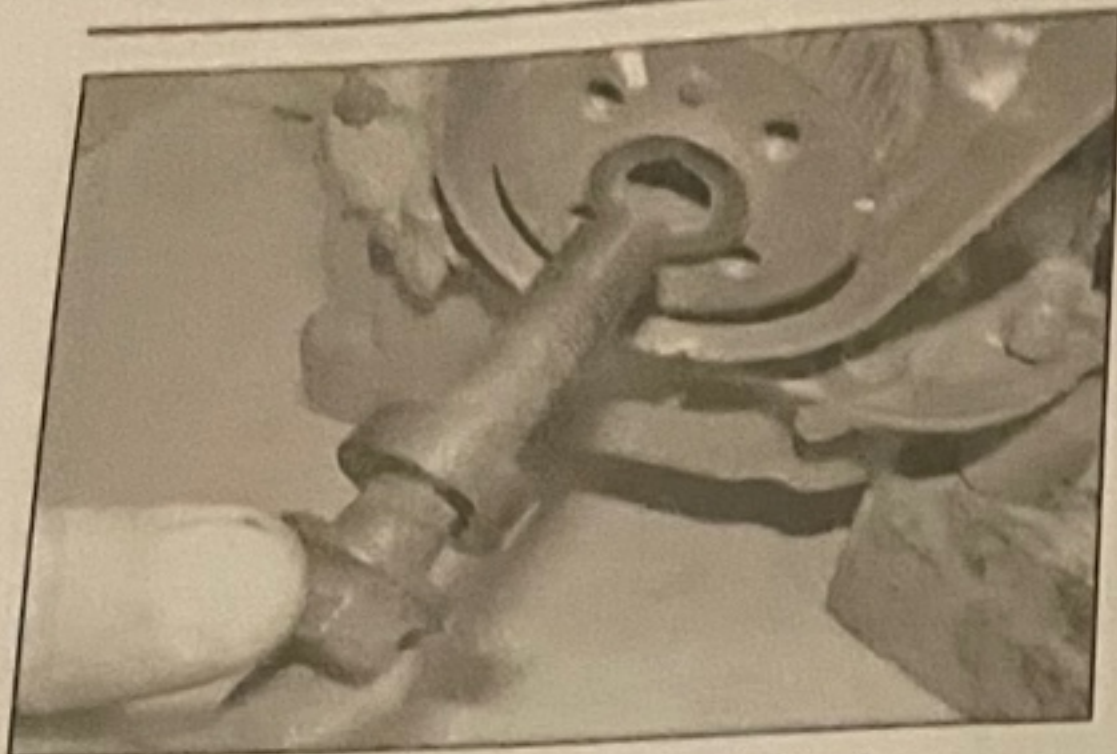
Note 2: A new sprocket retaining bolt will be required for refitting.

Removal

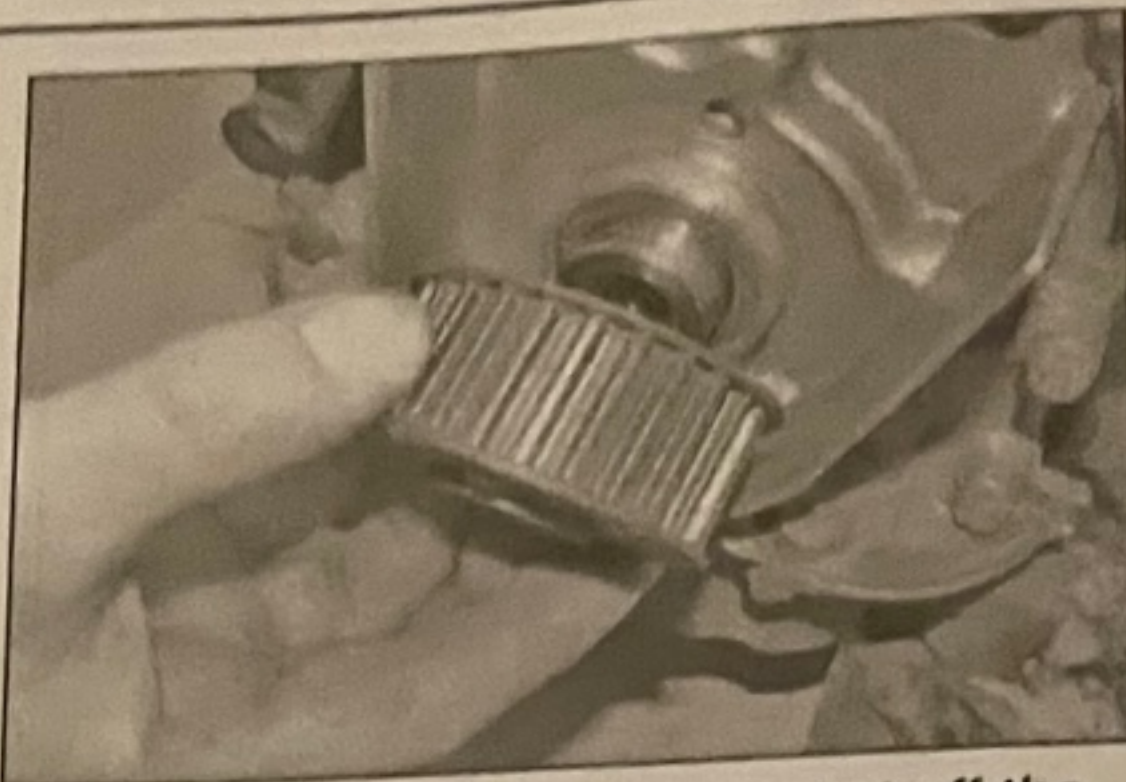
11 Remove the timing belt as described in Section 6.

12 It will now be necessary to hold the crankshaft sprocket to enable the retaining bolt to be removed. Saab special tools 32 025 006 and 83 95 360 are available for this purpose, however, a home-made tool similar to that described in paragraph 2, can easily be fabricated.

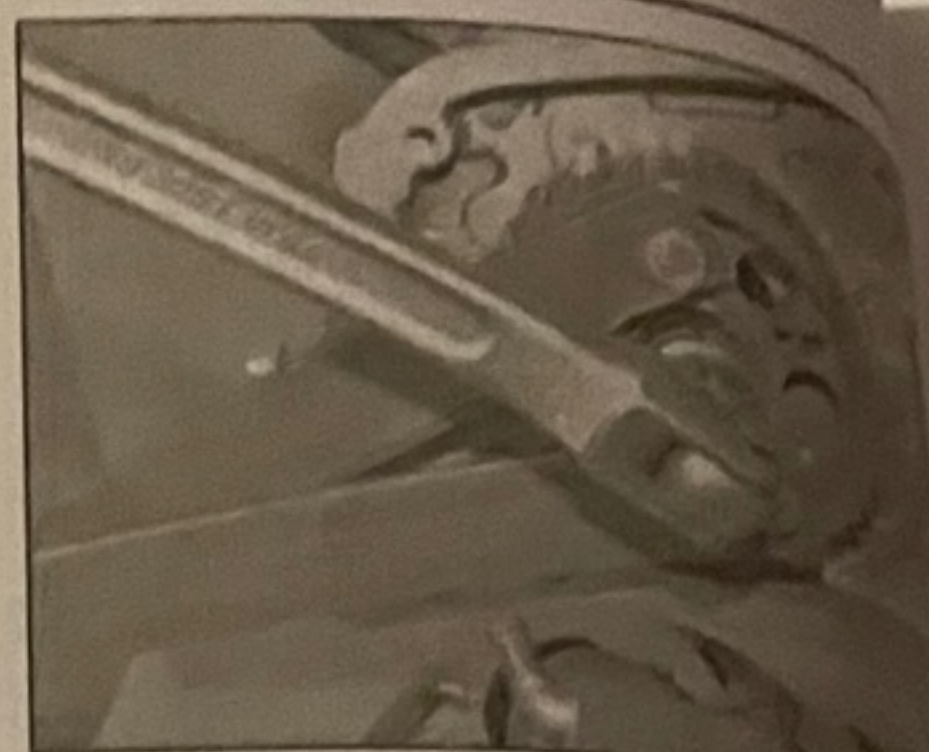
13 Using the crankshaft pulley retaining bolts, securely attach the tool to the crankshaft sprocket. With the help of an assistant, hold



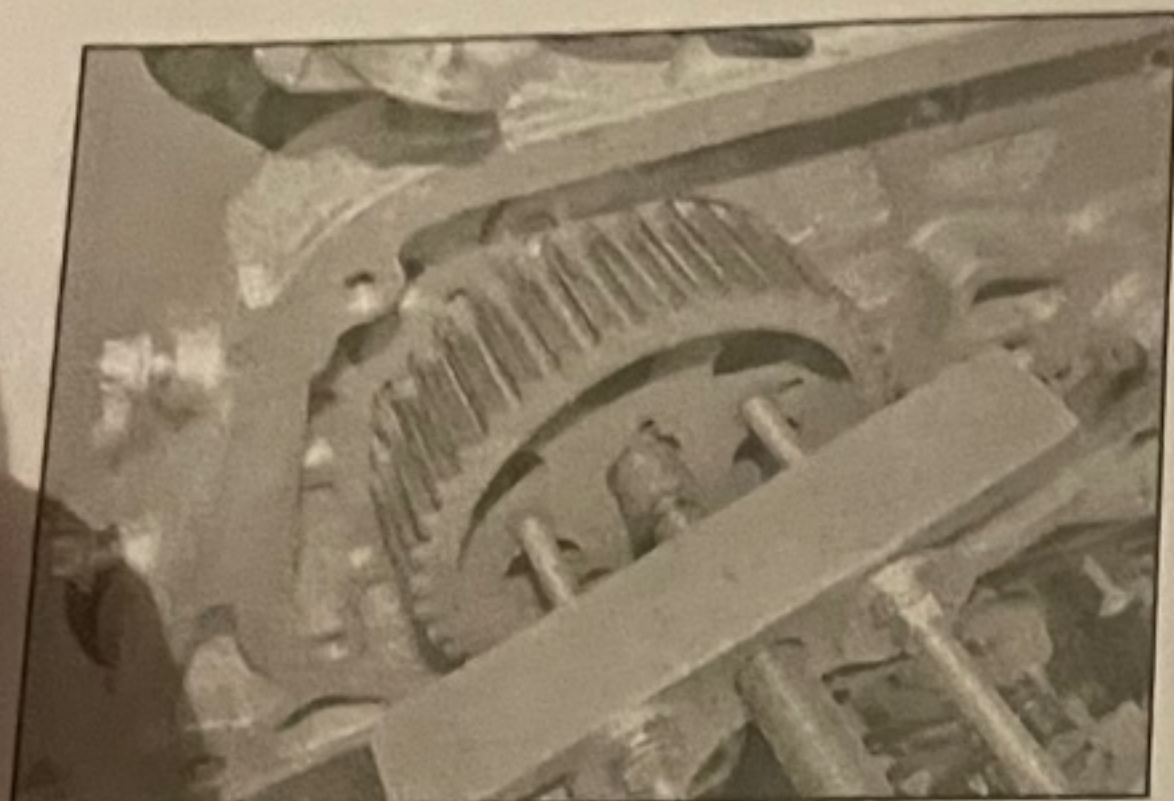
7.14a Remove the bolt and washer ...



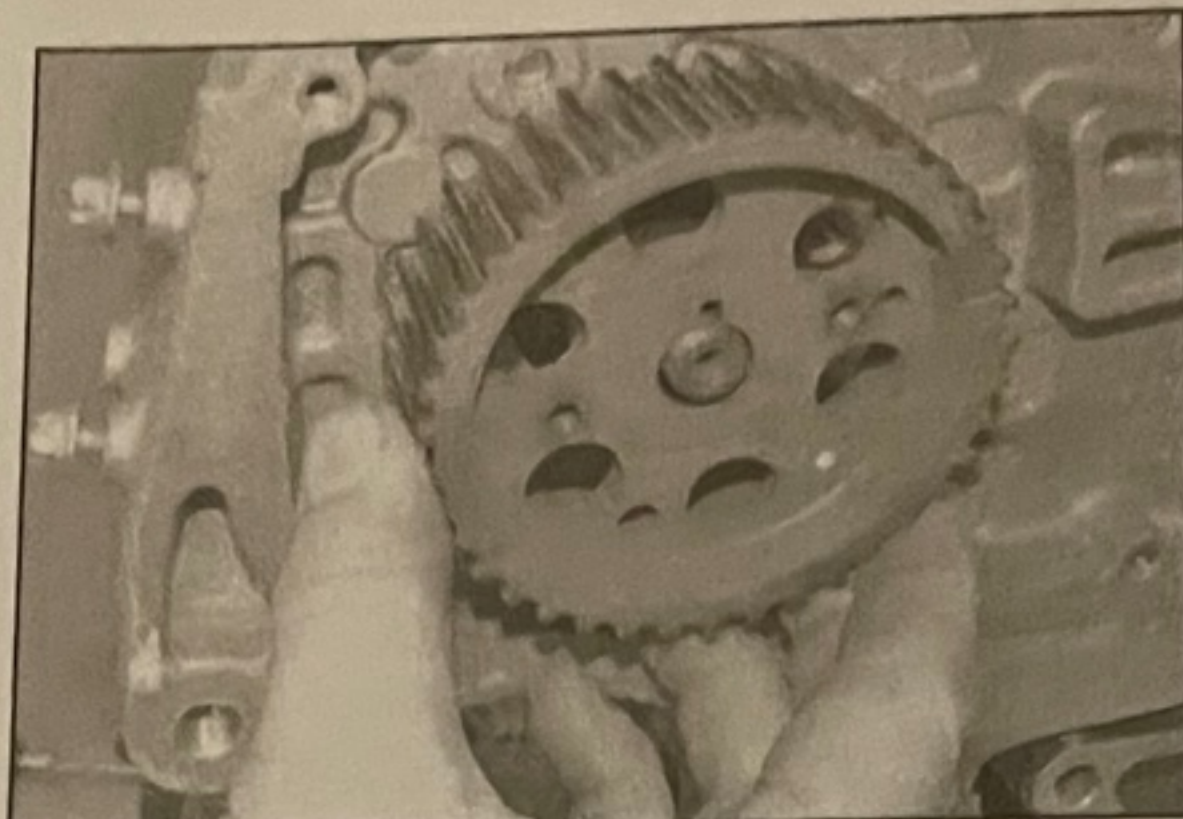
7.14b ... and slide the sprocket off the end of the crankshaft



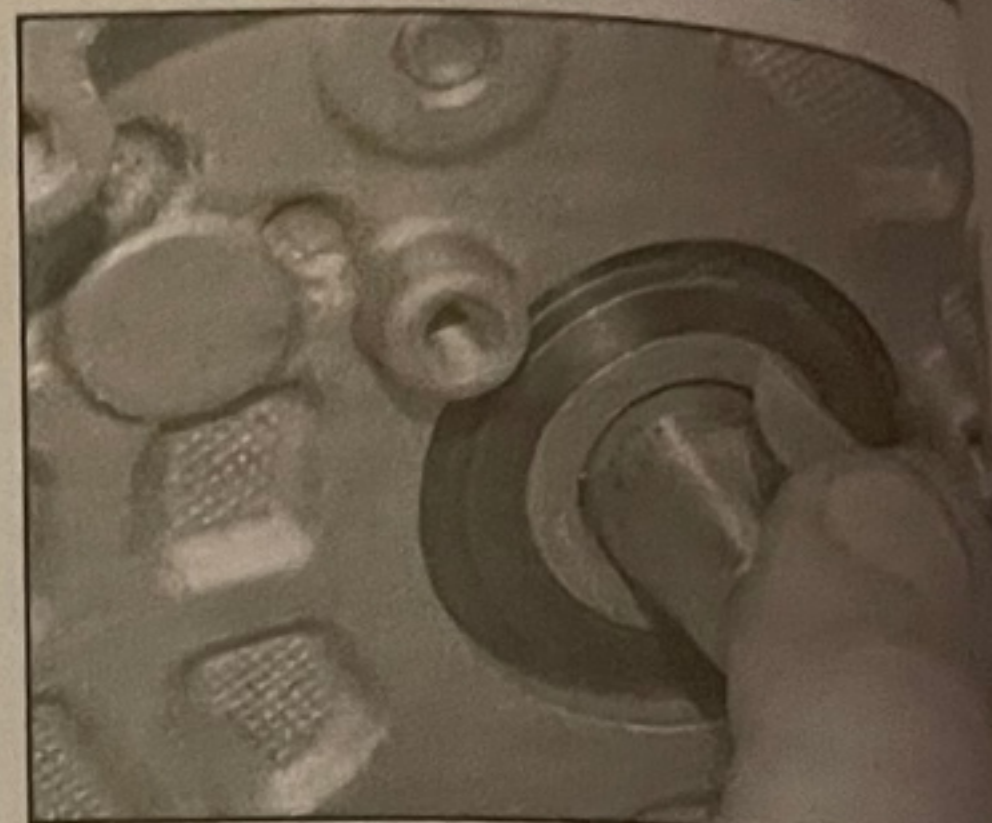
7.20 Engage the holding tool with the holes in the fuel pump sprocket and the retaining nut



7.21 Use a suitable puller to release the fuel pump sprocket taper



7.22a Once the taper releases, withdraw the sprocket ...



7.22b ... and collect the Woodruff key from the pump shaft

the sprocket stationary and unscrew the retaining bolt. **Note:** The sprocket retaining bolt has a **left-hand thread** and is unscrewed by turning it clockwise.

14 Remove the bolt and washer and slide the sprocket off the end of the crankshaft (see illustrations). Note that a new bolt will be required for refitting.

Refitting

15 Align the sprocket location key with the crankshaft groove and slide the sprocket into position. Fit the new retaining bolt and washer.

16 Hold the sprocket stationary using the holding tool and tighten the retaining bolt to the specified torque, remembering it has a **left-hand thread**. Remove the holding tool.

17 Refit the timing belt as described in Section 6.

High-pressure pump sprocket

Note: A new sprocket retaining nut will be required for refitting.

Removal

18 Remove the timing belt as described in Section 6.

19 It will now be necessary to hold the fuel pump sprocket to enable the retaining nut to be removed. Saab special tools 32 025 019 and 83 95 360 are available for this purpose, however, a home-made tool similar to that described in paragraph 2, can easily be fabricated.

20 Engage the tool with the holes in the fuel pump sprocket and undo the sprocket retaining nut (see illustration). Note that a new nut will be required for refitting.

21 Attach a suitable puller to the threaded holes in the fuel pump sprocket using bolts

and washers similar to the arrangement shown (see illustration).

22 Tighten the puller centre bolt to release the sprocket from the taper on the pump shaft. Once the taper releases, remove the puller and withdraw the sprocket. Collect the Woodruff key from the pump shaft (see illustrations).

Refitting

23 Clean the fuel pump shaft and sprocket hub ensuring that all traces of old grease are removed.

24 Refit the Woodruff key to the pump shaft and then locate the sprocket in position. Tighten the new retaining nut.

25 Hold the sprocket stationary using the holding tool and tighten the retaining nut to the specified torque. Remove the holding tool.

26 Refit the timing belt as described in Section 6.

Tensioner assembly

Removal

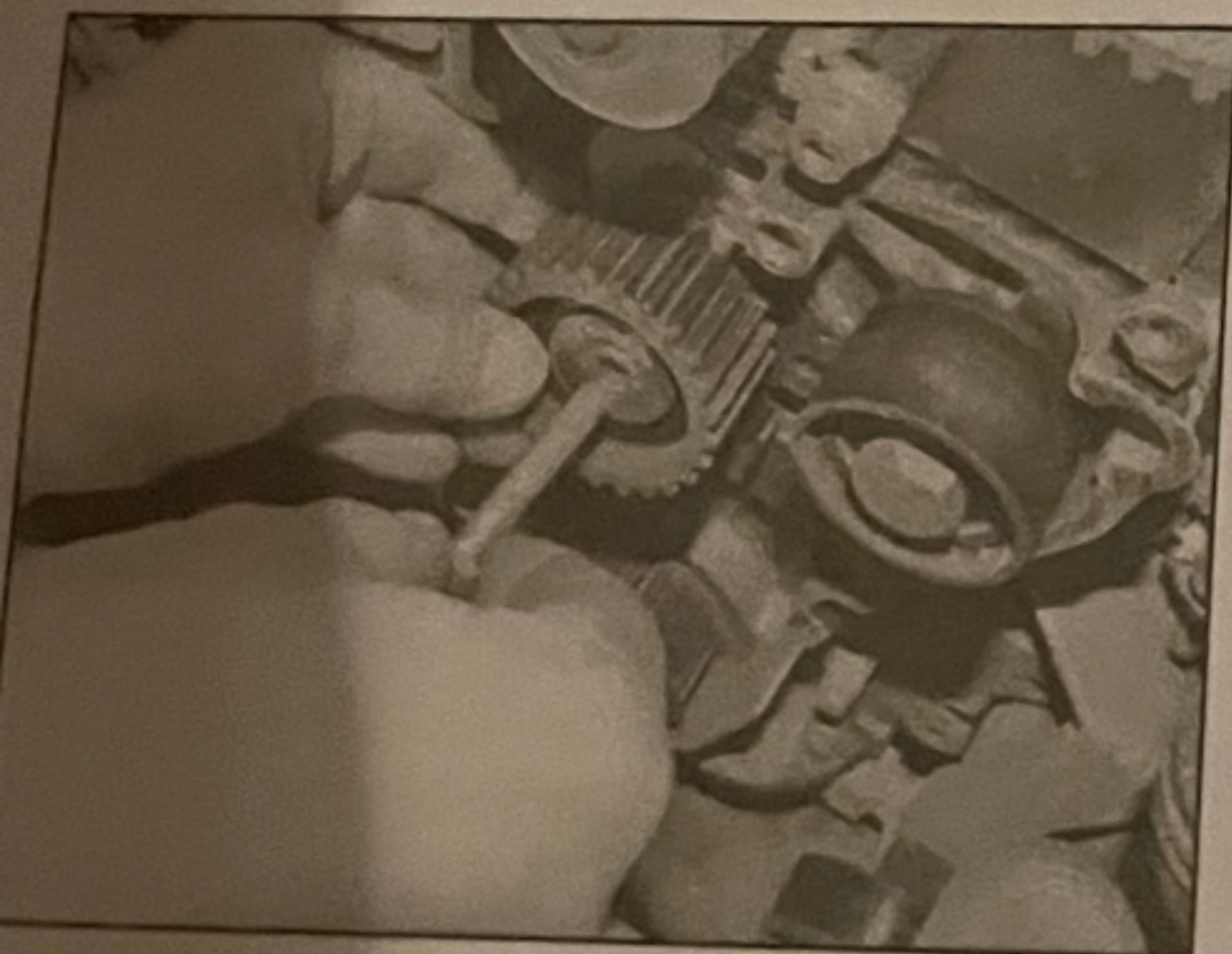
27 Remove the timing belt as described in Section 6.

28 Slacken and remove the retaining bolt and remove the tensioner assembly from the engine (see illustrations).

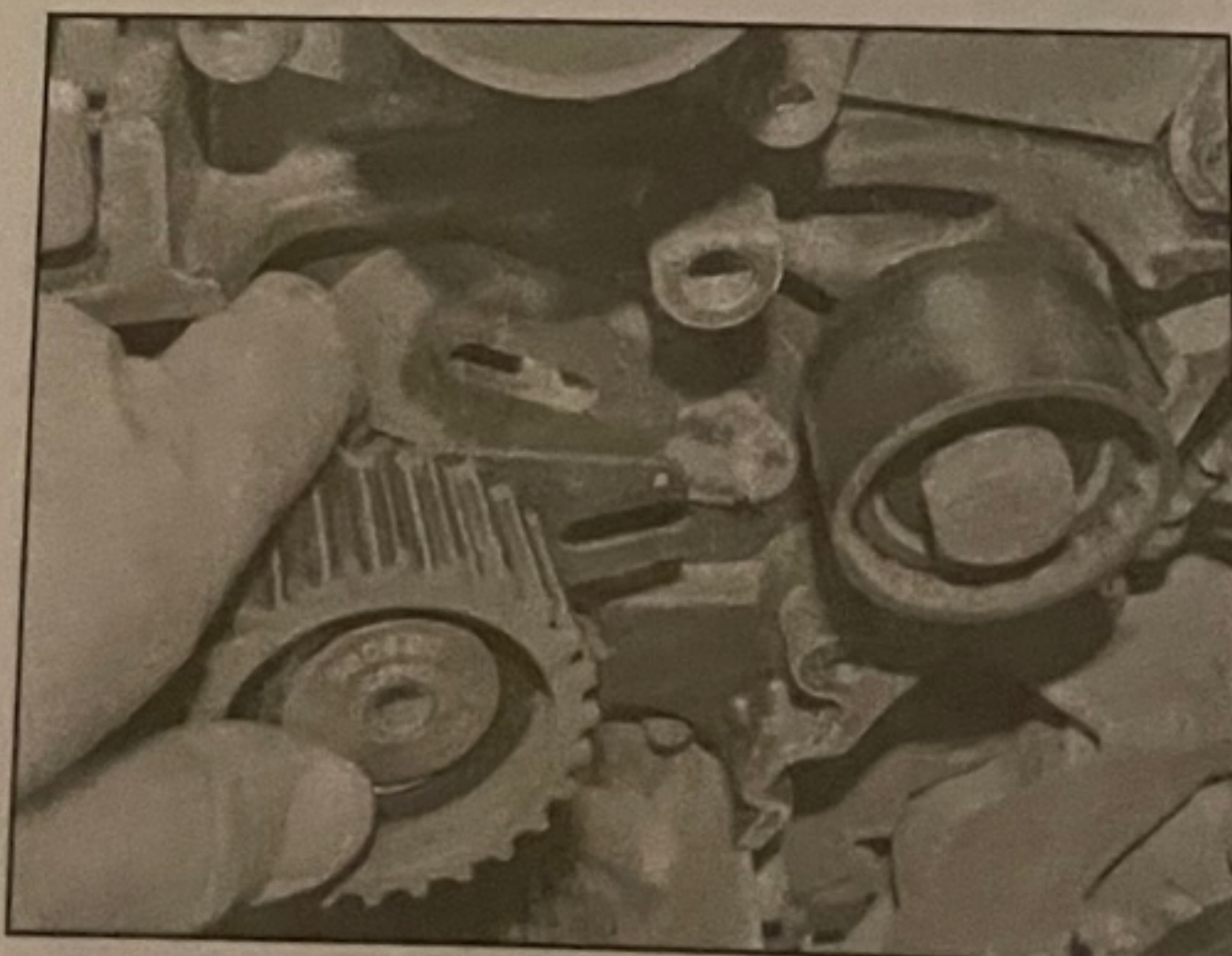
Refitting

29 Fit the tensioner to the engine, making sure that the slot on the tensioner backplate is correctly located over the peg on the engine bracket (see illustration).

30 Clean the threads of the retaining bolt



7.28a Slacken and remove the retaining bolt ...



7.28b ... and remove the timing belt tensioner assembly

apply thread-
locking compound to the
tensioner in the
the retaining bolt
31 Refit the
Section 6.

Idler pulley

Removal

32 Remove the
Section 6.

33 Slacken and
remove the
illustration).

Refitting

34 Refit the
retaining bolt

35 Refit the
tion 6.

8 Can
rene

1 Remove
in Section

2 Carefully
seal. Sc

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4 Lubri

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apply thread-locking compound to the bolt threads. Screw in the retaining bolt, set the tensioner in the retracted position and tighten the retaining bolt.

31 Refit the timing belt as described in Section 6.

Idler pulley

Removal

32 Remove the timing belt as described in Section 6.

33 Slacken and remove the retaining bolt and remove the idler pulley from the engine (see illustration).

Refitting

34 Refit the idler pulley and tighten the retaining bolt to the specified torque.

35 Refit the timing belt as described in Section 6.

8 Camshaft oil seal – renewal

1 Remove the camshaft sprocket as described in Section 7.

2 Carefully punch or drill a small hole in the oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal.

3 Clean the seal housing, and polish off any burrs or raised edges, which may have caused the seal to fail in the first place.

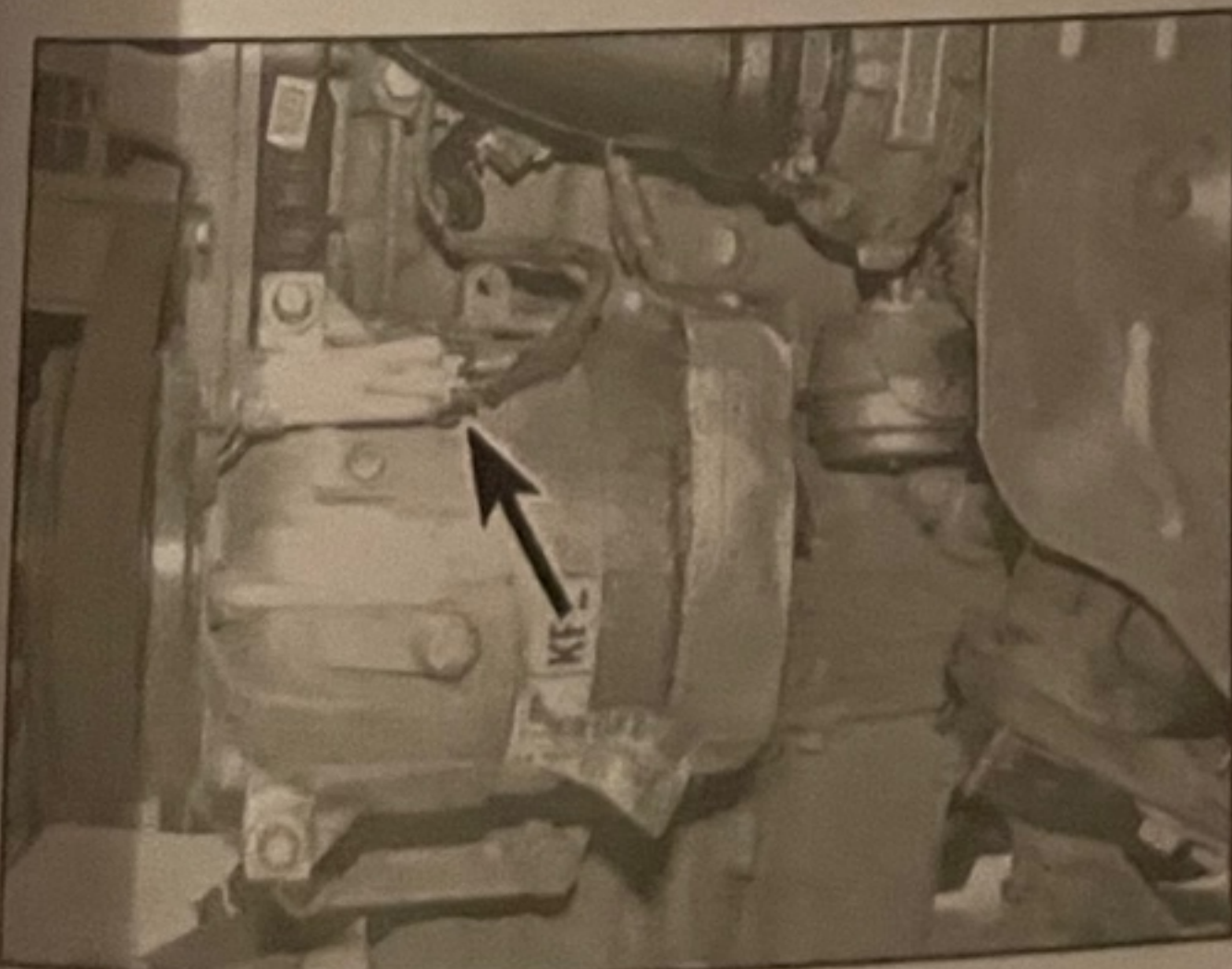
4 Lubricate the lips of the new seal with clean engine oil, and press it into position using a suitable tubular drift (such as a socket) which bears only on the hard outer edge of the seal. Take care not to damage the seal lips during fitting; note that the seal lips should face inwards.

5 Refit the camshaft sprocket as described in Section 7.

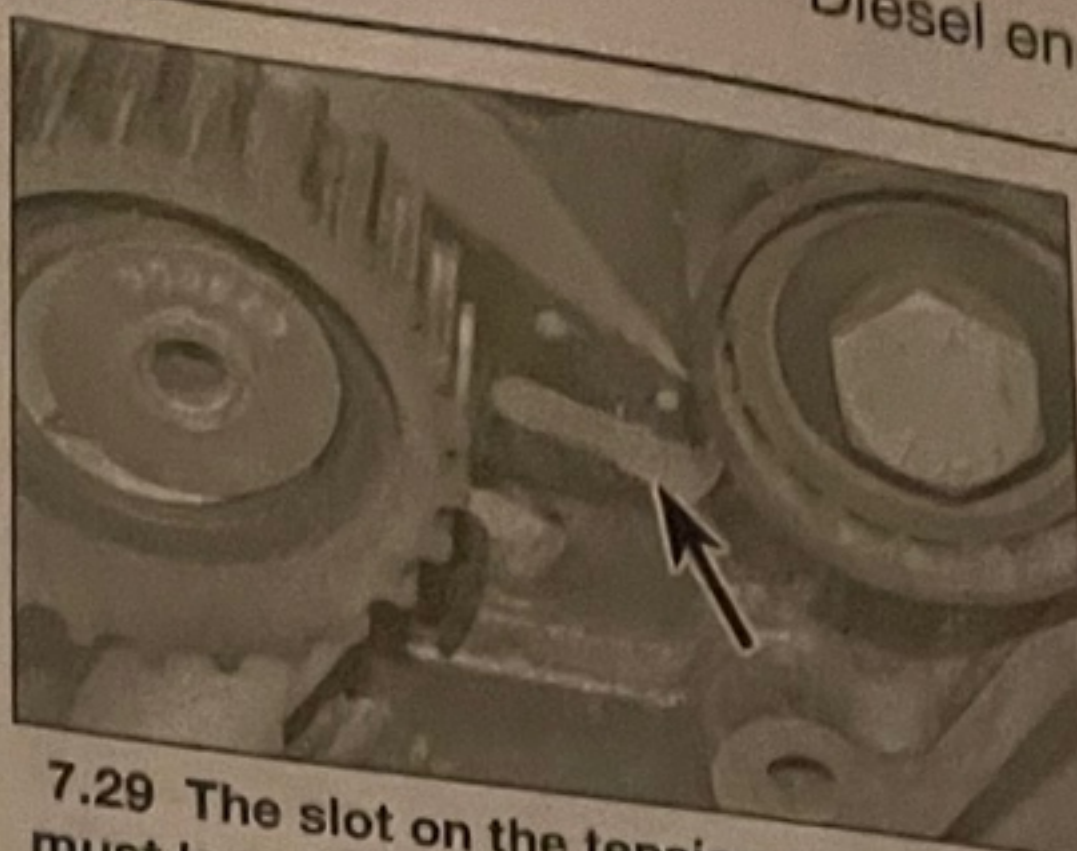
9 Camshaft housing – removal and refitting

Removal

1 Remove the timing belt as described in Section 6.



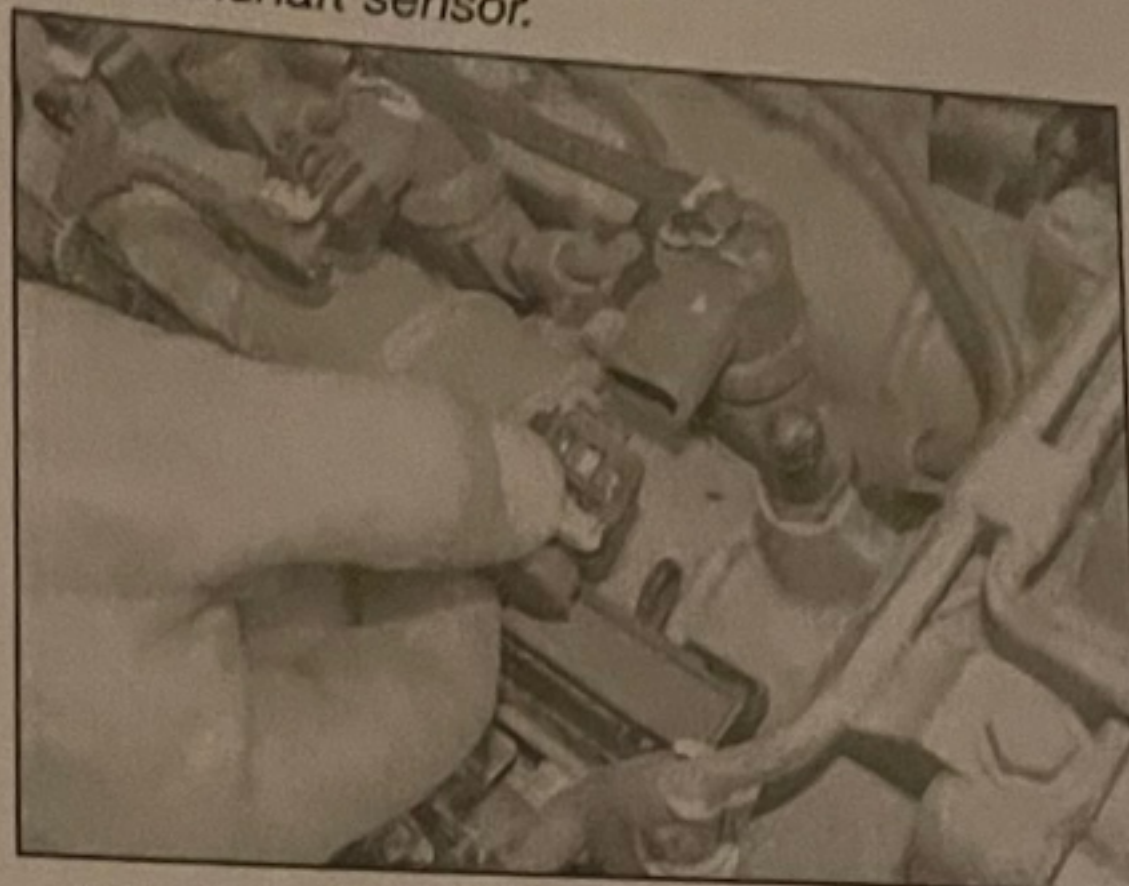
9.2e ... and air conditioning compressor (arrowed)



7.29 The slot on the tensioner backplate must locate over the peg (arrowed) on the engine bracket

2 Disconnect the wiring harness connectors from the following components (see illustrations):

- Fuel injectors.
- Fuel pressure regulating valve.
- Fuel pressure sensor.
- Camshaft sensor.



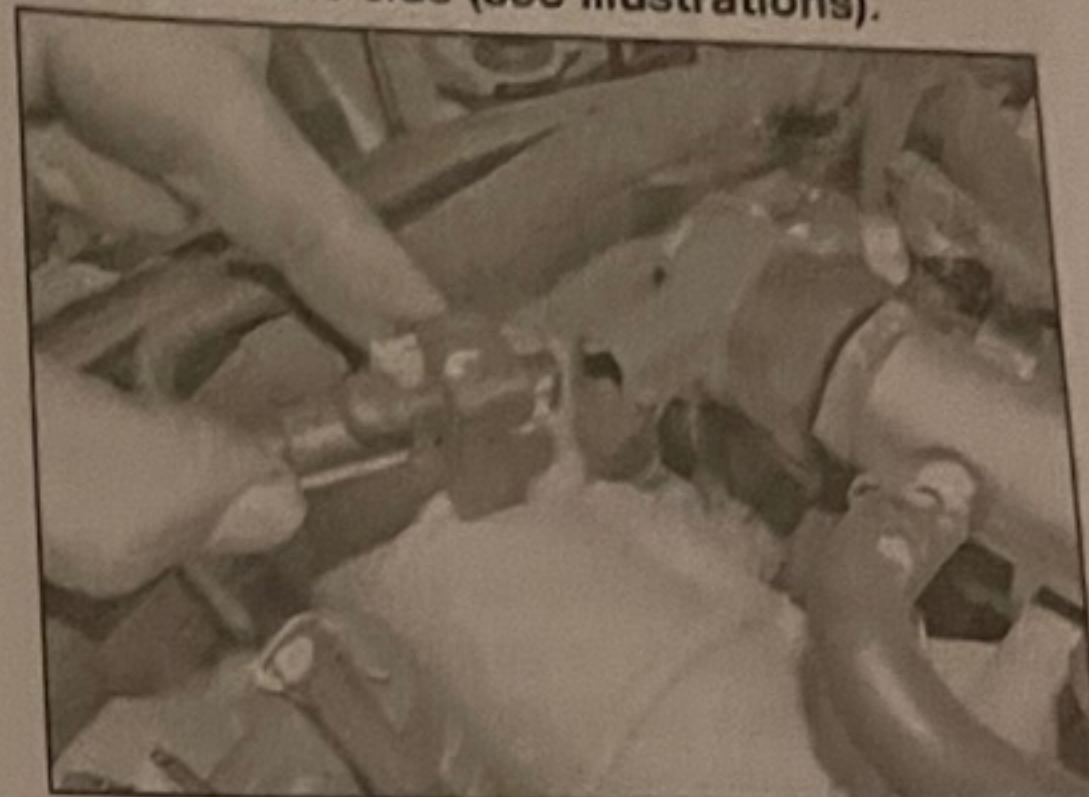
9.2a Disconnect the wiring plugs at the fuel injectors ...



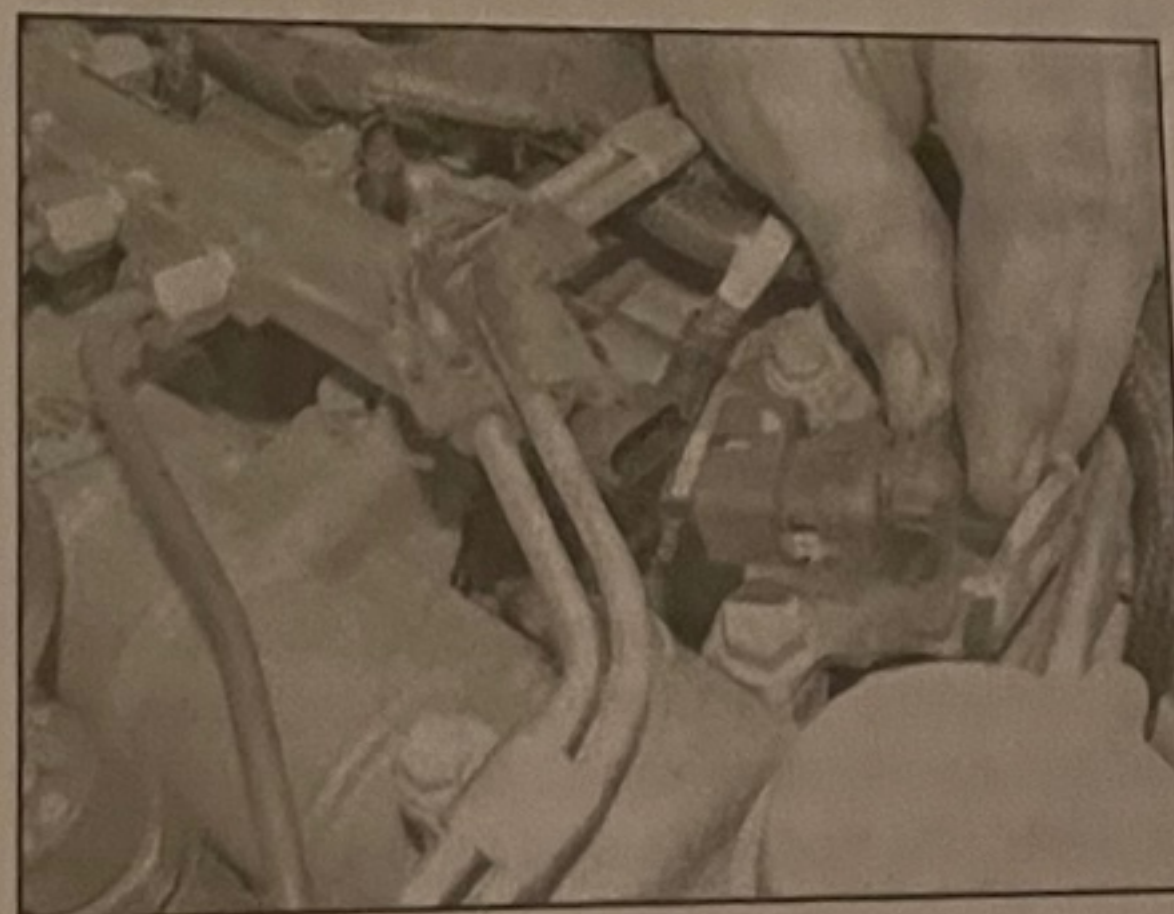
7.33 Slacken and remove the retaining bolt and remove the idler pulley from the engine

e) Air conditioning compressor.

3 Release the air conditioning compressor wiring harness from the clip on the oil dipstick guide tube. Undo the two bolts securing the plastic wiring harness guide to the camshaft housing and move the disconnected wiring harness to one side (see illustrations).



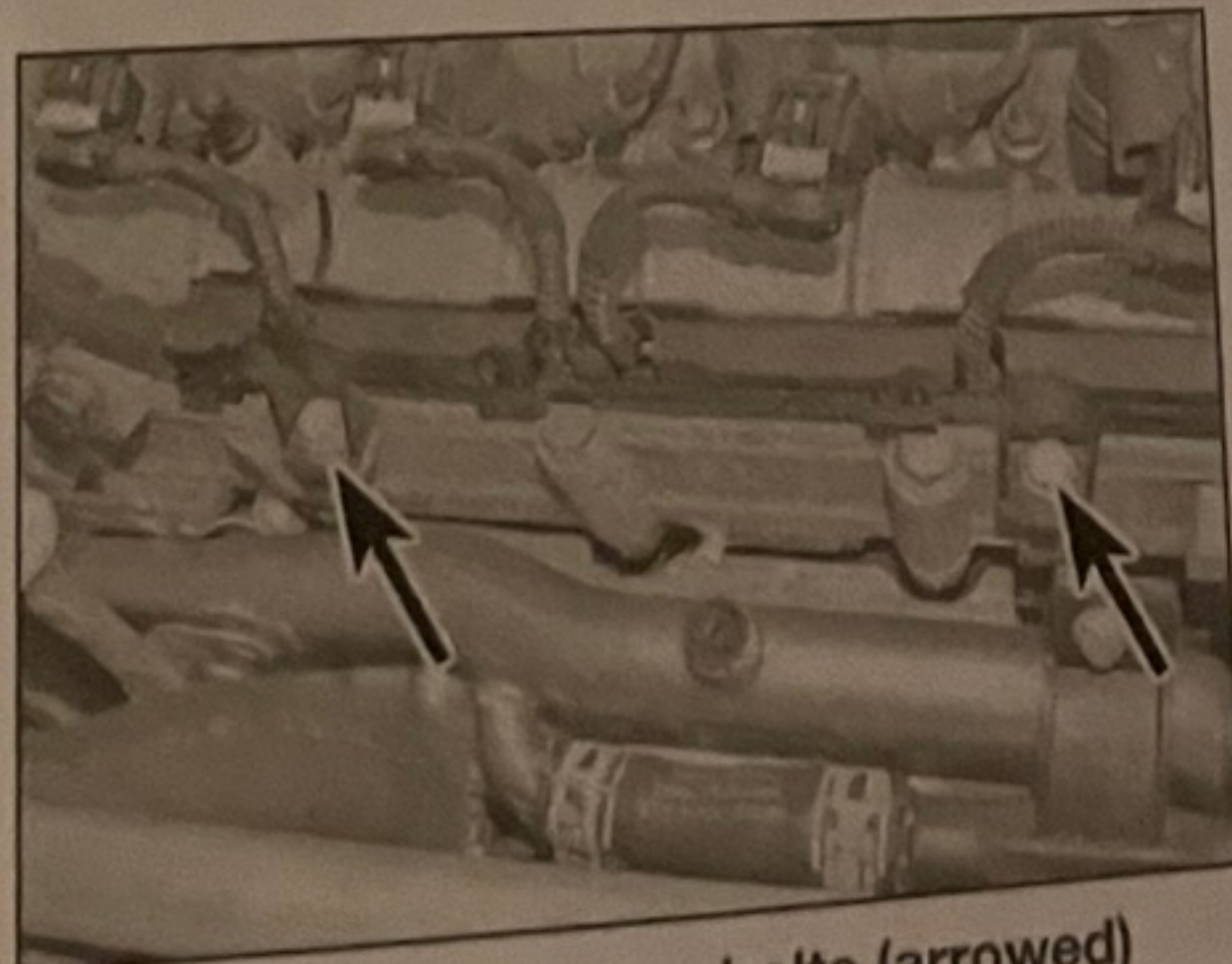
9.2b ... fuel pressure regulating valve ...



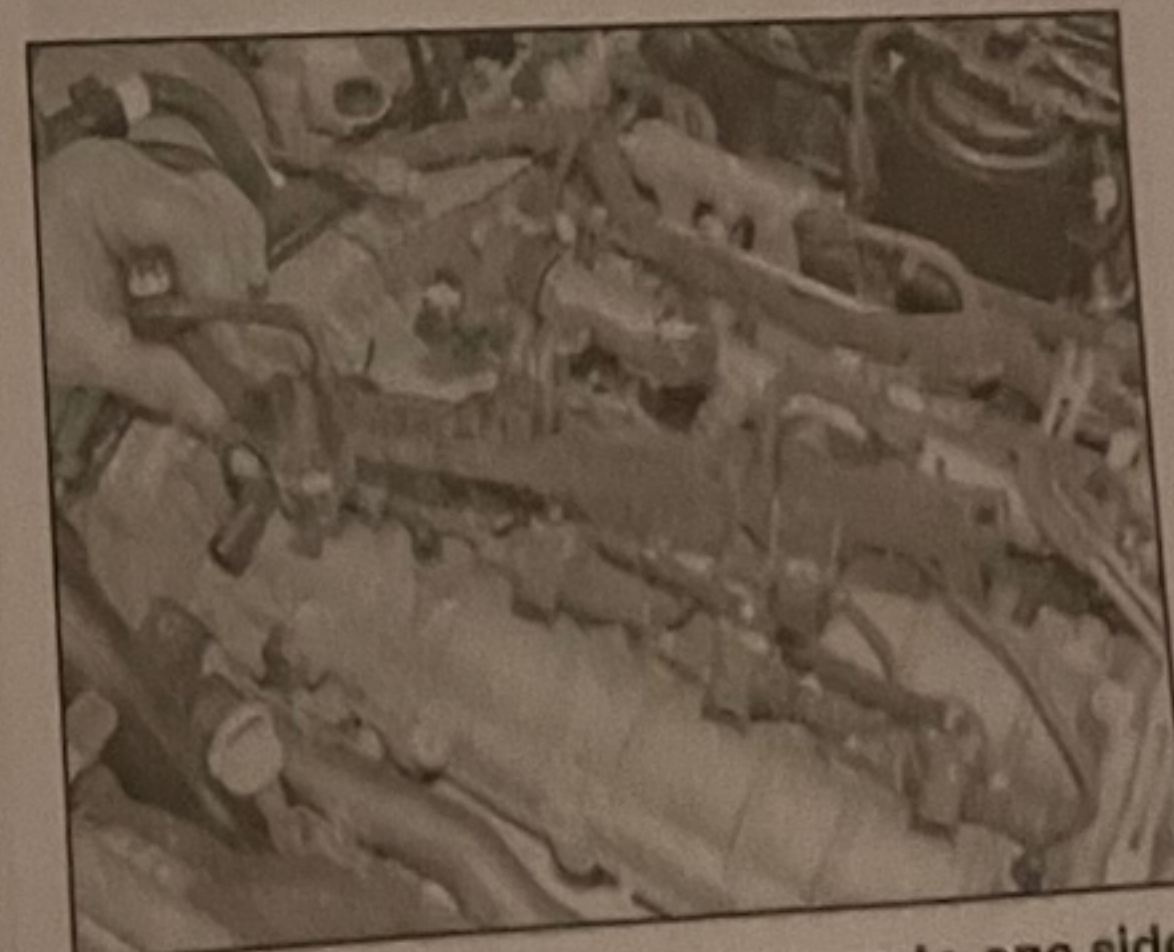
9.2c ... fuel pressure sensor ...



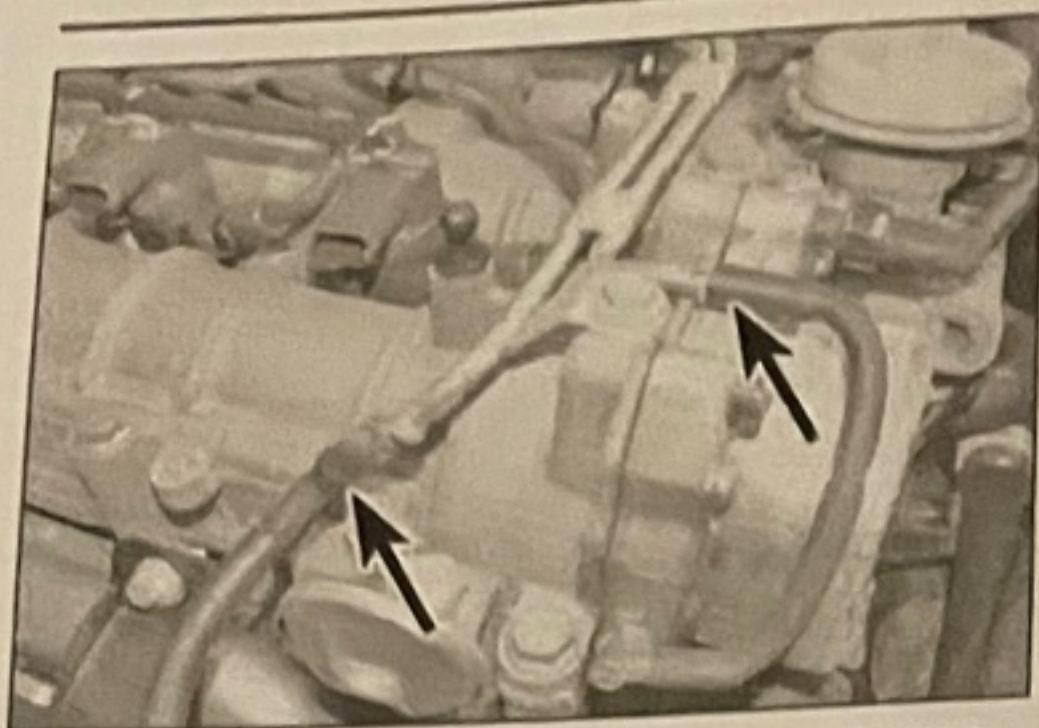
9.2d ... camshaft sensor ...



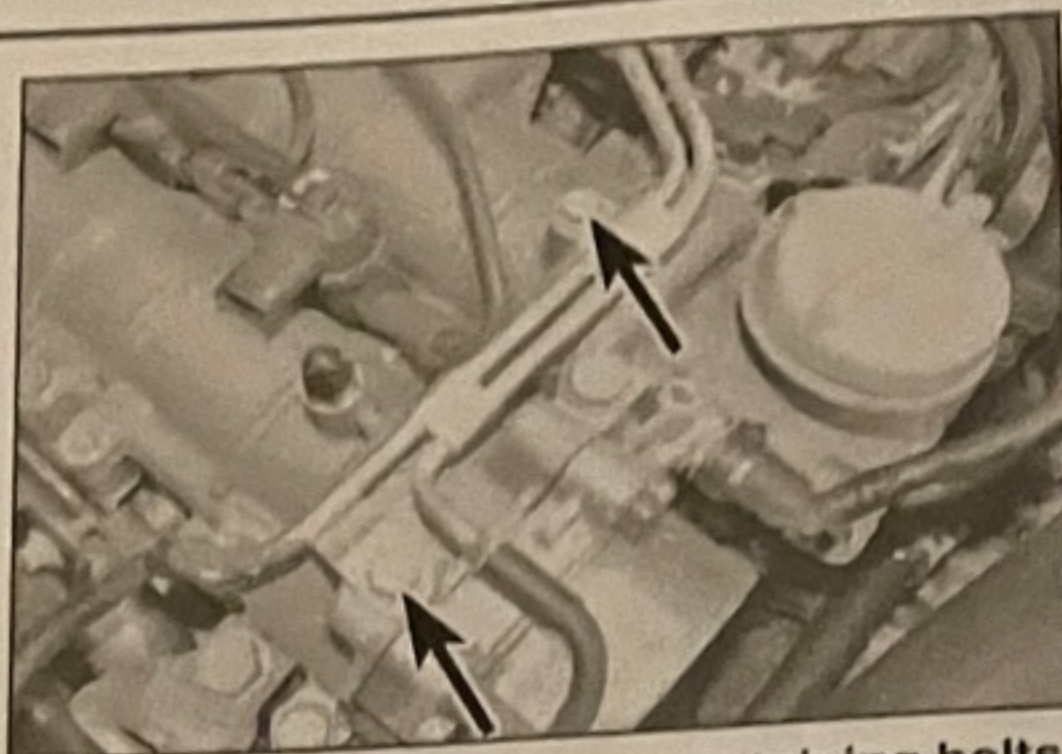
9.3a Undo the two bolts (arrowed) securing the wiring harness guide to the camshaft housing ...



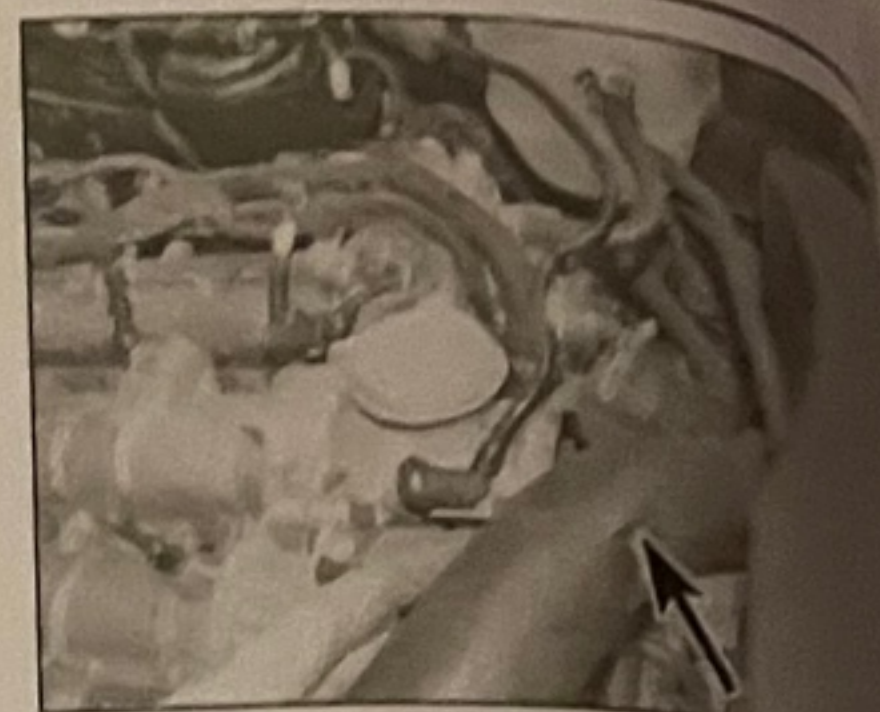
9.3b ... and move the harness to one side



9.4a Disconnect the two vacuum hoses (arrowed) from the pipe assembly . . .



9.4b . . . then undo the two retaining bolts (arrowed) and move the pipe assembly to one side



9.6 Release the retaining clips and disconnect the charge air hose (arrowed)

4 Disconnect the two vacuum hoses from the vacuum pipe assembly on top of the camshaft housing. Undo the two retaining bolts and move the pipe assembly to one side (see illustrations).

5 Remove the fuel injectors and the fuel rail as described in Chapter 4B.

6 Release the two retaining clips and disconnect the charge air hose from the throttle body/housing, and intercooler charge air pipe (see illustration).

7 Disconnect the vacuum hose quick-release fitting from the braking system vacuum pump (see illustration).

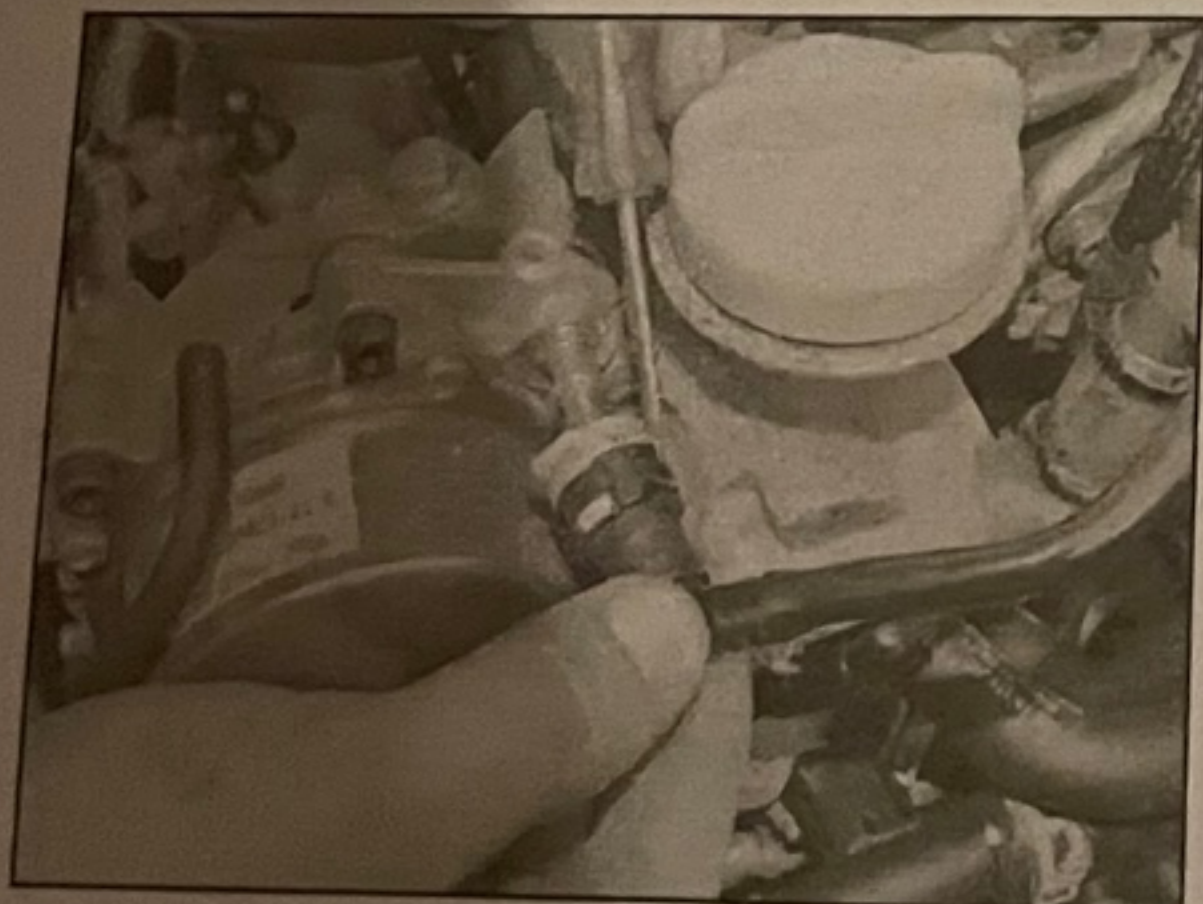
8 Release the clip and disconnect the crankcase ventilation hose from the engine oil filler housing (see illustration).

9 Undo the retaining bolts and remove the two engine lifting brackets from the left-hand end of the camshaft housing. Undo the bolt securing the turbocharger charge air pipe to the right-hand end of the camshaft housing

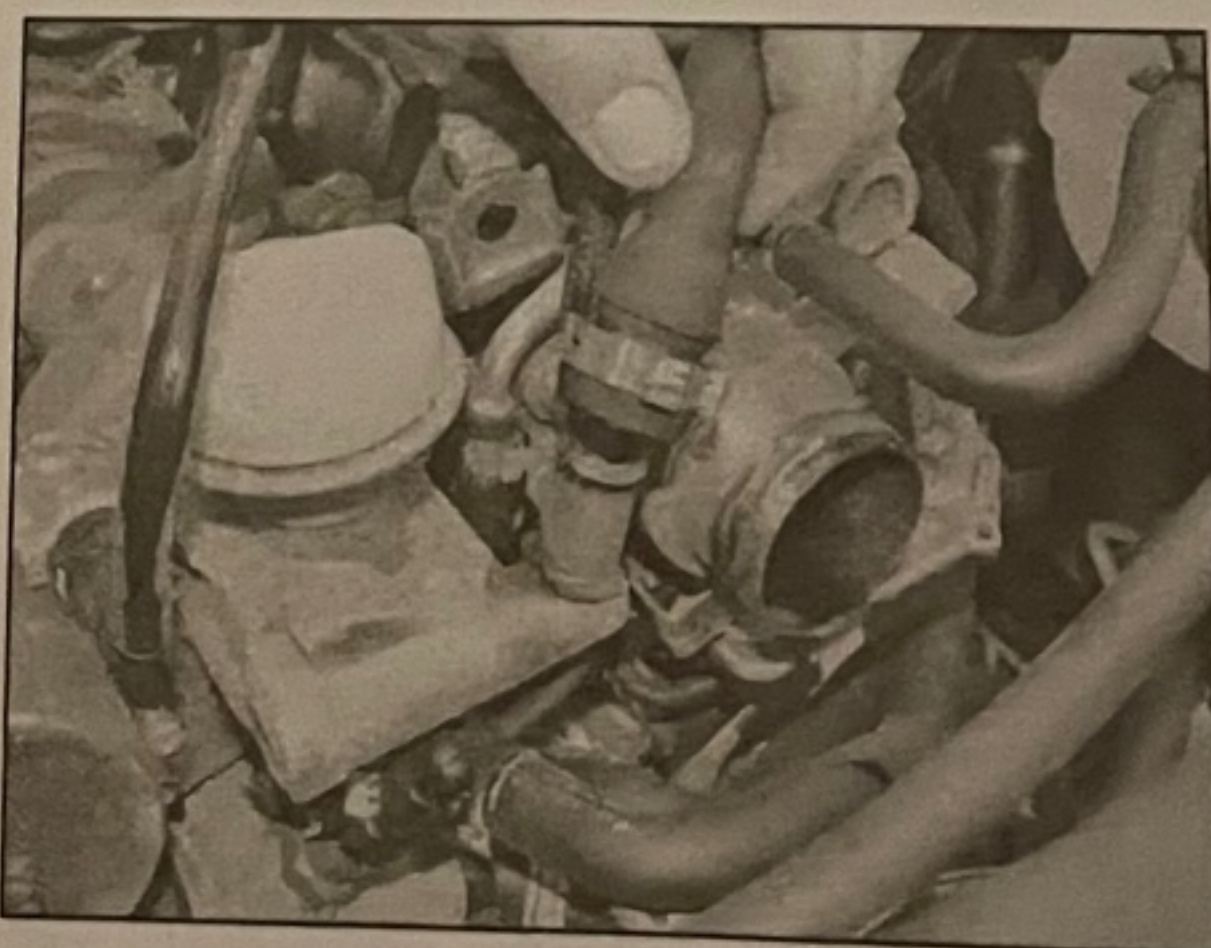
10 Working in a spiral pattern from the outside inwards, progressively slacken, then remove, the sixteen bolts securing the camshaft housing to the cylinder head. Ensure that the housing releases evenly from the cylinder block.

11 Lift the camshaft housing off the cylinder head and recover the gasket (see illustration).

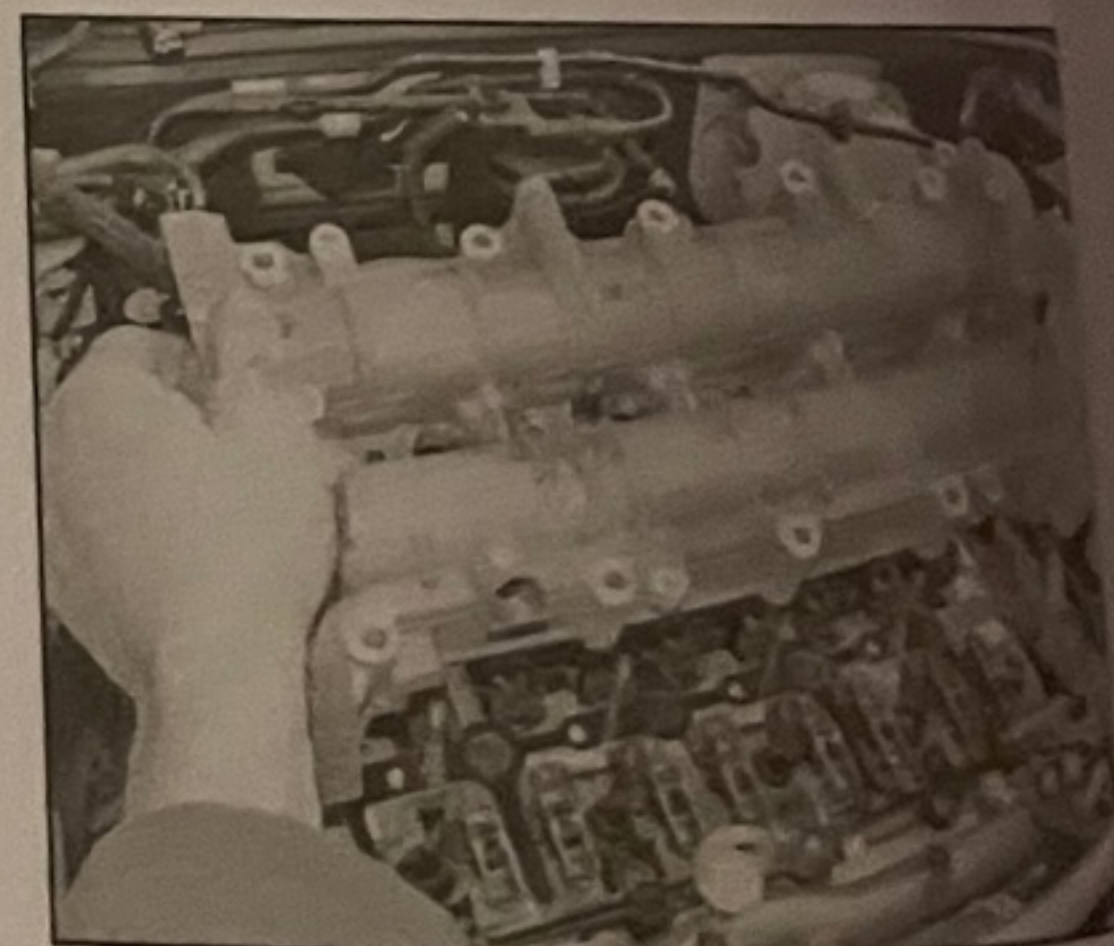
12 Thoroughly clean the mating faces of the cylinder head, camshaft housing and vacuum pump and obtain a new gasket for refitting.



9.7 Depress the clip and disconnect the vacuum hose quick-release fitting from the braking system vacuum pump



9.8 Disconnect the crankshaft ventilation hose from the engine oil filler housing



9.11 Lift the camshaft housing off the cylinder head and recover the gasket

Refitting

13 Check that all the hydraulic tappets and rocker arms are correctly positioned in the cylinder head and none have been disturbed.

14 Commence refitting by turning the crankshaft anti-clockwise by 90°. This will position all the pistons half-way down their bores, and prevent any chance of the valves touching the piston crowns as the camshaft housing is being fitted.

15 Place a new gasket on the cylinder head, then locate the camshaft housing in position aligning it with the locating dowels.

16 Refit the sixteen camshaft housing retaining bolts. Progressively screw in the bolts to gradually draw the housing down and into contact with the cylinder head.

17 Working in a spiral pattern from the inside outwards, progressively tighten the sixteen bolts to the specified torque.

18 Refit the two engine lifting brackets to the left-hand end of the camshaft housing and tighten the retaining bolts securely. Refit and tighten the charge air pipe retaining bolt.

19 Reconnect the crankcase ventilation hose to the engine oil filler housing.

20 Reconnect the vacuum hose quick-release fitting to the braking system vacuum pump ensuring that the fitting engages audibly.

21 Refit the charge air hose to the throttle body/housing, and intercooler charge air pipe and secure with the retaining clips.

22 Refit the fuel rail and fuel injectors as described in Chapter 4B.

23 Place the vacuum pipe assembly in position on the top of the camshaft housing and refit the two retaining bolts. Tighten the bolts securely and then reconnect the two vacuum hoses.

24 Lay the plastic wiring harness over the position on the camshaft housing, then reconnect the wiring harness connectors and tighten the two retaining bolts.

25 Reconnect the wiring harness connectors to the components listed in paragraph 24, ensuring that the harness is secured by all relevant retaining clips.

26 Turn the crankshaft clockwise by 90° to bring No 1 and 4 pistons to approximately TDC position.

27 Refit the timing belt as described in Section 6.

10 Camshafts – removal, inspection and refitting

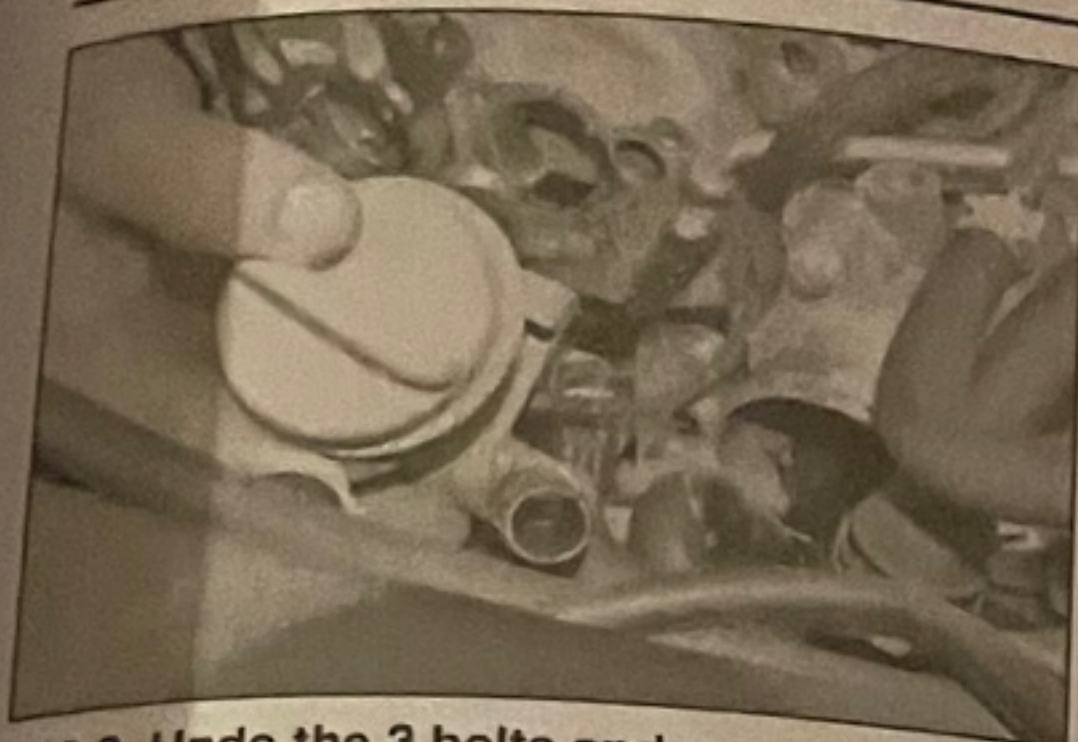
Note: Additional camshaft positioning tool will be required for this operation – two in total (see Section 3).

Removal

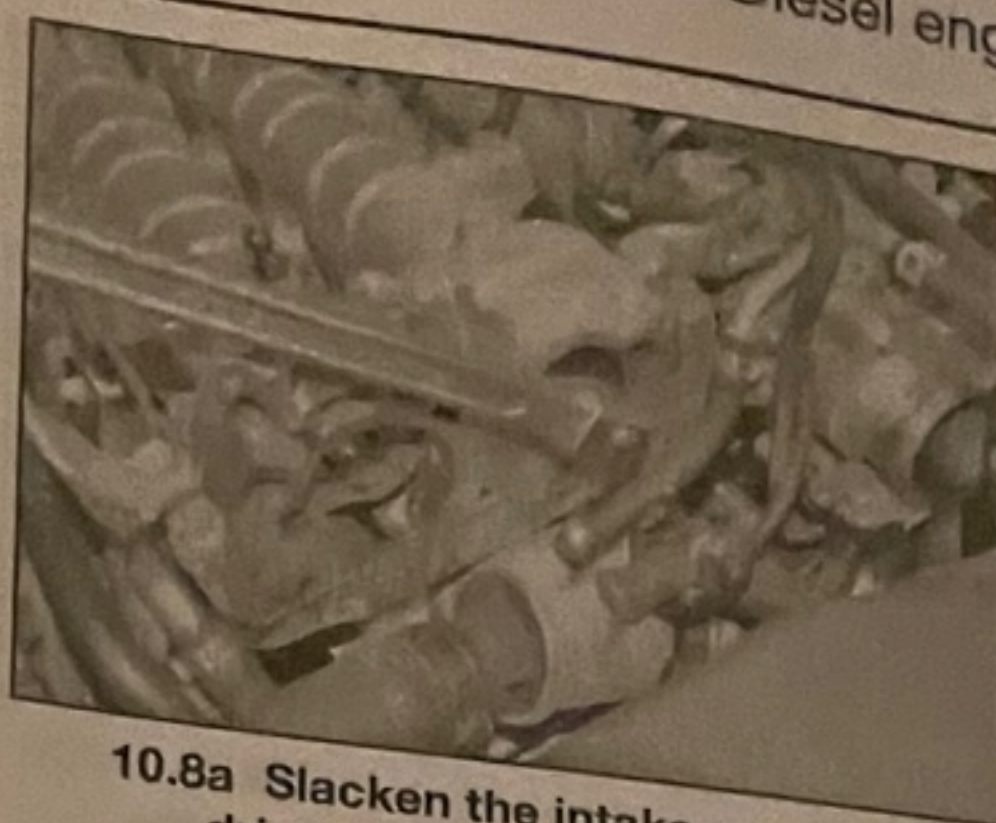
1 Carry out the operations described in Section 9, paragraphs 1 to 8.

2 Remove the braking system vacuum pump as described in Chapter 9.

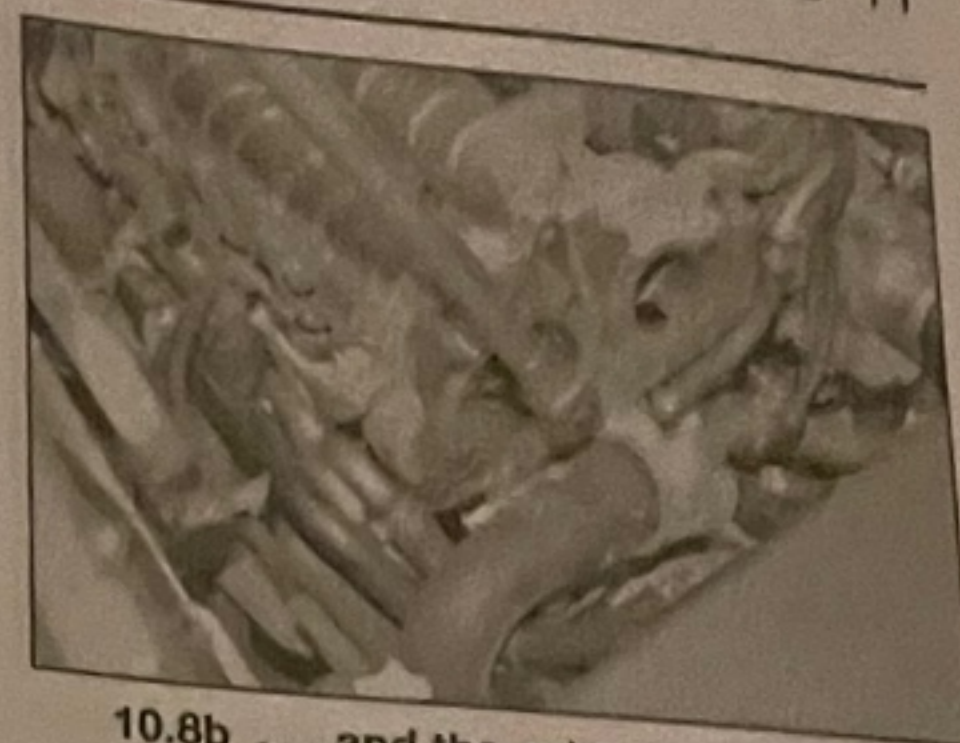
3 Disconnect the wiring connector from the coolant temperature sensor, then undo the three retaining bolts and remove the oil filler housing (see illustration).



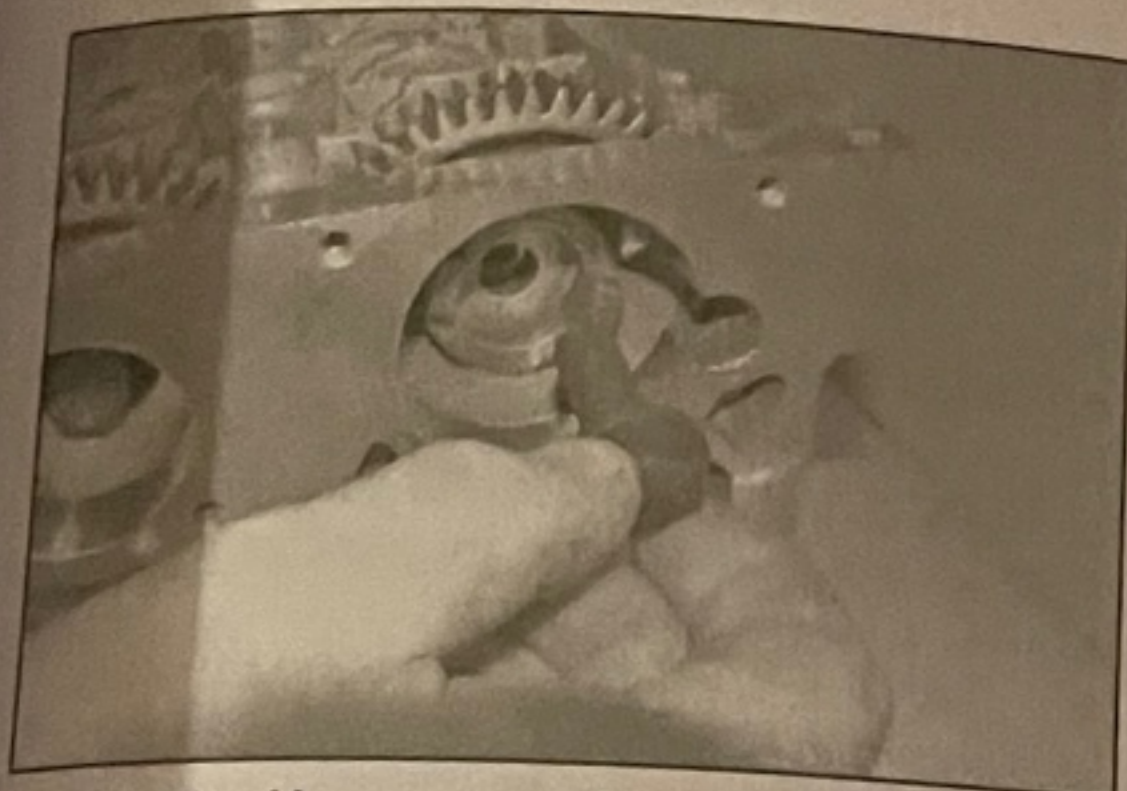
10.3 Undo the 3 bolts and remove the oil filler housing



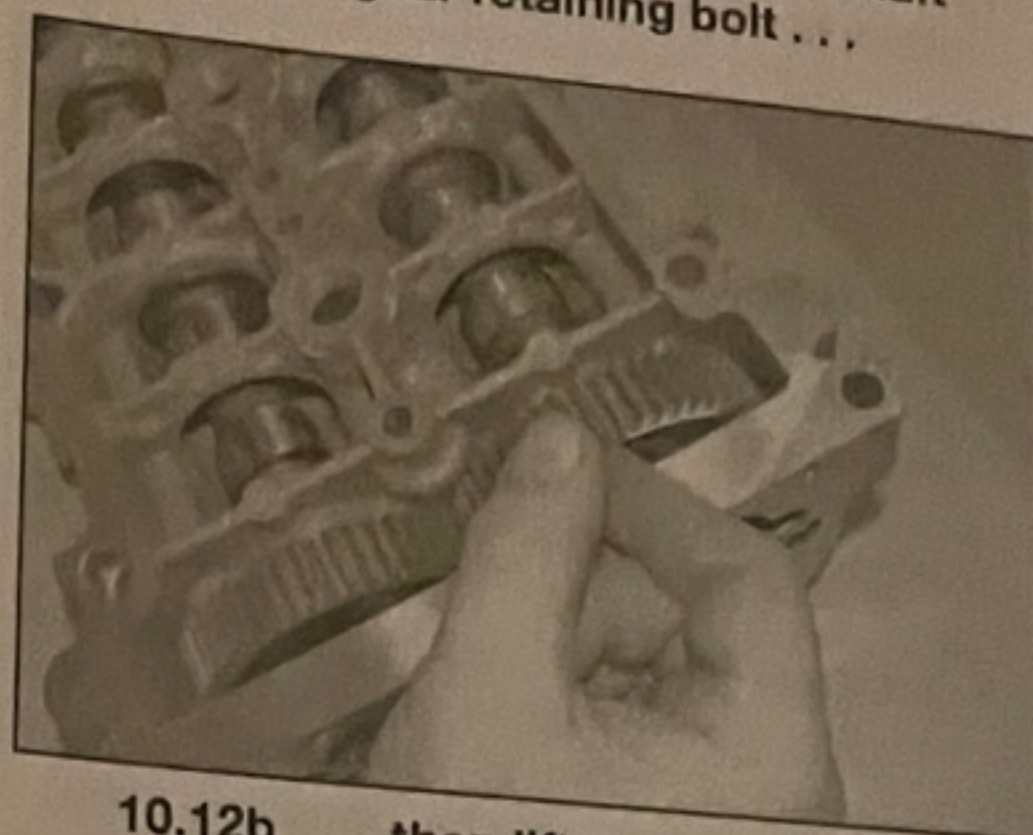
10.8a Slacken the intake camshaft drivegear retaining bolt . . .



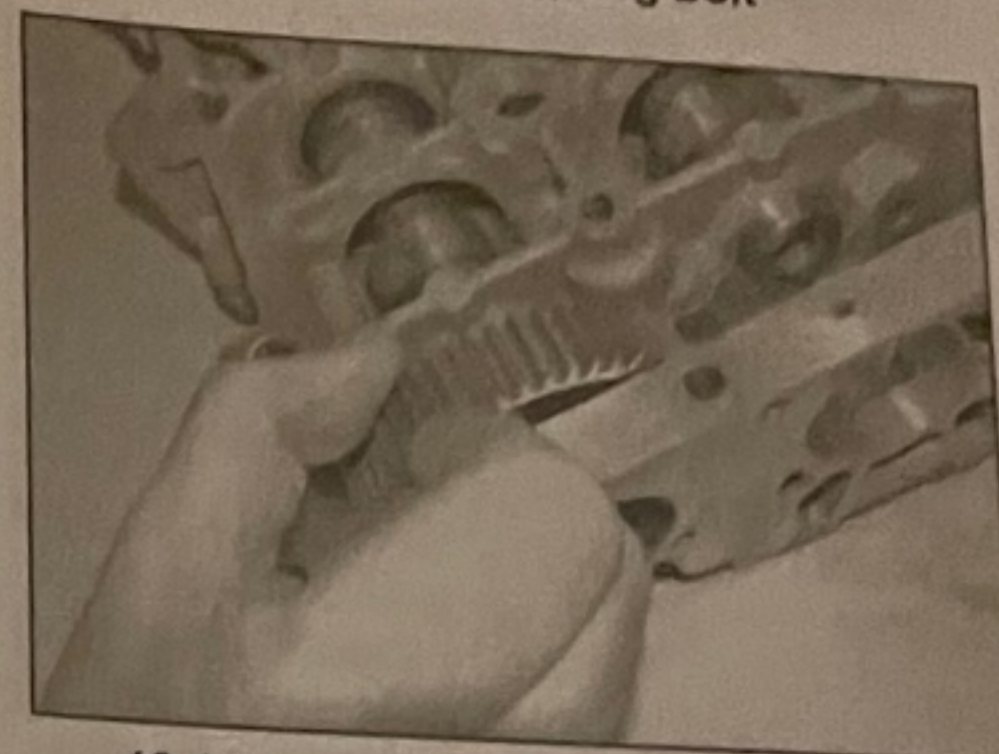
10.8b . . . and the exhaust camshaft drivegear retaining bolt



10.12a Unscrew and remove the two previously-slackened retaining bolts . . .



10.12b . . . then lift out the exhaust camshaft drivegear . . .



10.12c . . . and the intake camshaft drivegear

4 Undo the retaining bolt and remove the camshaft sensor from the right-hand end of the camshaft housing.

5 Before removing the camshaft housing completely, the retaining bolts for the camshaft drivegears and sprocket should be slackened as follows.

6 Remove the exhaust camshaft positioning tool from the valve timing checking hole.

7 It will be necessary to hold the camshaft sprocket to enable the drivegear and sprocket retaining bolts to be slackened. A home-made tool can easily be fabricated (see **Tool Tip in Section 7**).

8 Working through the oil filler housing aperture, and using the holding tool to prevent rotation of the camshaft, slacken the intake camshaft drivegear retaining bolt. Working through the vacuum pump aperture, slacken the exhaust camshaft drivegear retaining bolt in the same way (see **illustrations**).

9 Again, using the holding tool, slacken the camshaft sprocket retaining bolt.

10 Continue with the camshaft housing removal procedure as described in Section 9, paragraphs 9 to 11.

11 With the camshaft housing placed upside-down on the bench, unscrew and remove the previously-slackened retaining bolt, and remove the timing belt sprocket from the exhaust camshaft.

12 At the other end of the housing, unscrew and remove the two previously-slackened retaining bolts, and lift off the drivegears from the intake and exhaust camshafts (see **illustrations**).

13 Carefully prise out the exhaust camshaft

oil seal with a screwdriver or similar hooked tool. Carefully withdraw the exhaust camshaft out from the timing belt end of the camshaft housing (see **illustration**).

14 Using a wooden dowel or similar, carefully tap the end of the intake camshaft toward the timing belt end of the housing, to release the blanking cap. Remove the cap, and then carefully withdraw the intake camshaft from the housing (see **illustration**).

Inspection

15 Examine the camshaft bearing surfaces and cam lobes for signs of wear ridges and scoring. Renew the camshaft(s) if any of these conditions are apparent. Examine the condition of the bearing surfaces in the camshaft housing. If the any wear or scoring is evident, the camshaft housing will need to be renewed.

16 If either camshaft is being renewed, it will be necessary to renew all the rocker arms and

tappets for that particular camshaft also (see Section 11).

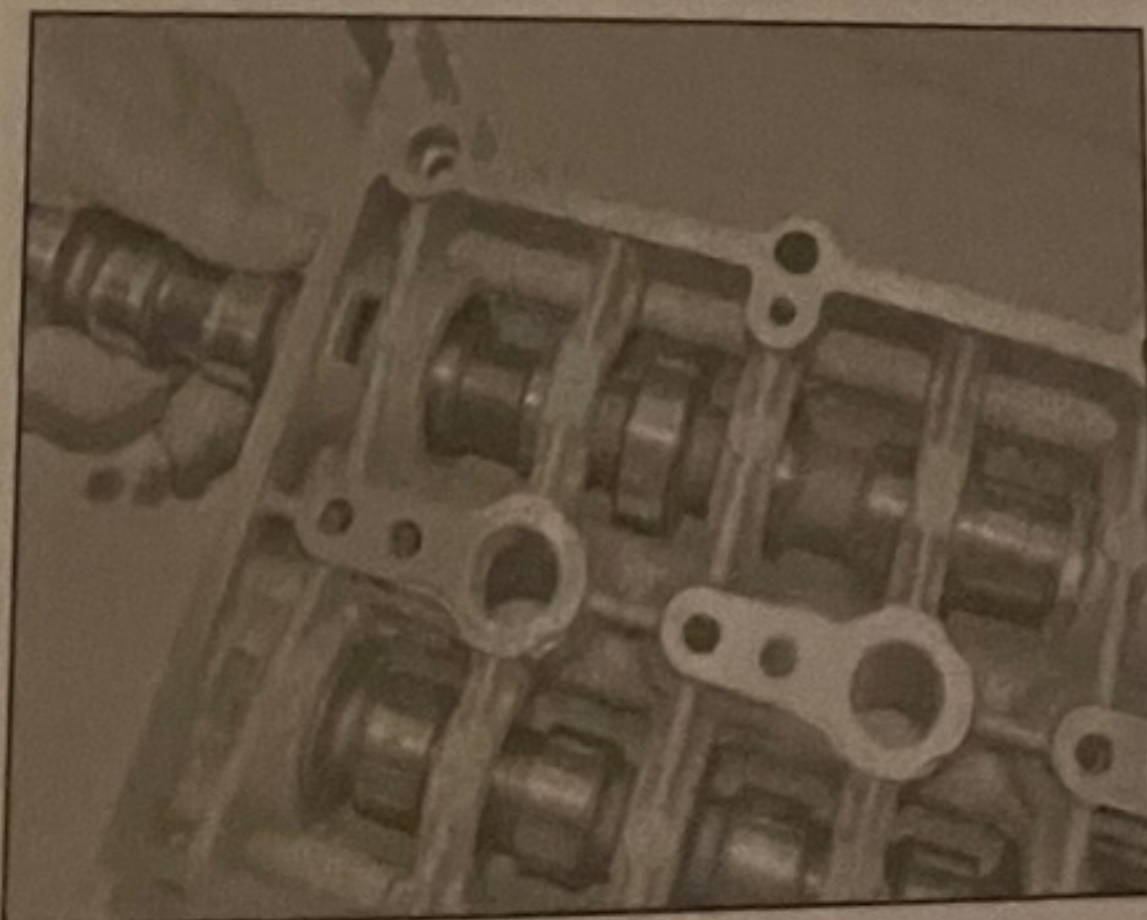
17 Check the condition of the camshaft drivegears and sprocket for chipped or damaged teeth, wear ridges and scoring. Renew any components as necessary.

Refitting

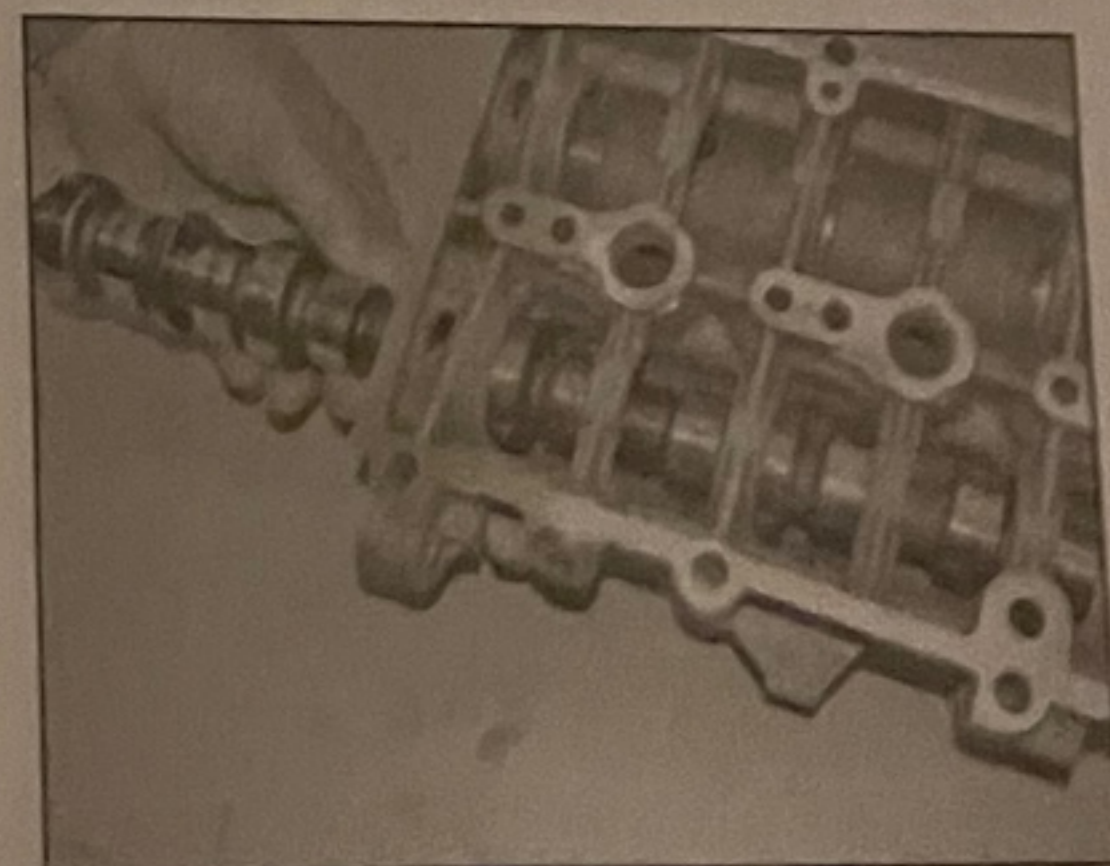
18 Prior to refitting, thoroughly clean all components and dry with a lint-free cloth. Ensure that all traces of oil and grease are removed from the contact faces of the drivegears, sprocket and camshafts.

19 Lubricate the camshaft bearing journals in the camshaft housing and carefully insert the intake and exhaust camshafts.

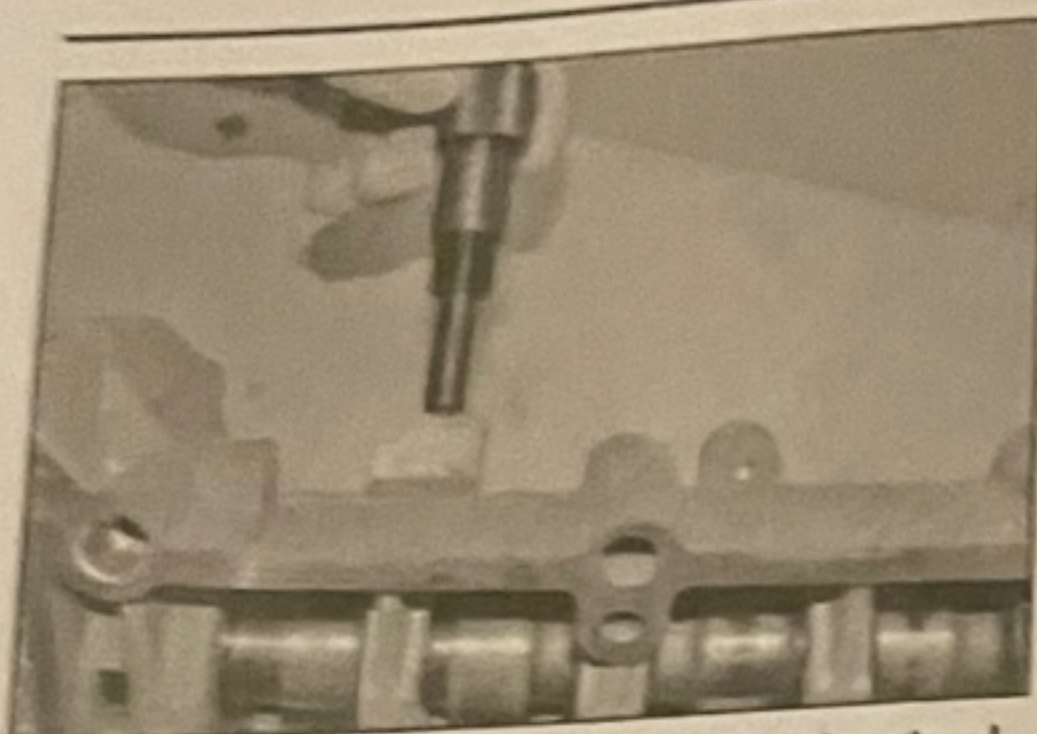
20 Ensuring that the contact faces are clean and dry, refit the drivegear to each camshaft. Note that the gear with the vacuum pump drive dogs is fitted to the exhaust camshaft, and the plain gear is fitted to the intake camshaft.



10.13 Withdraw the exhaust camshaft . . .



10.14 . . . and intake camshaft from the housing



10.22 Refit the camshaft positioning tool to the valve timing checking hole of the exhaust camshaft

21 Screw in a new drivegear retaining bolt for each camshaft and tighten both bolts finger-tight only at this stage.

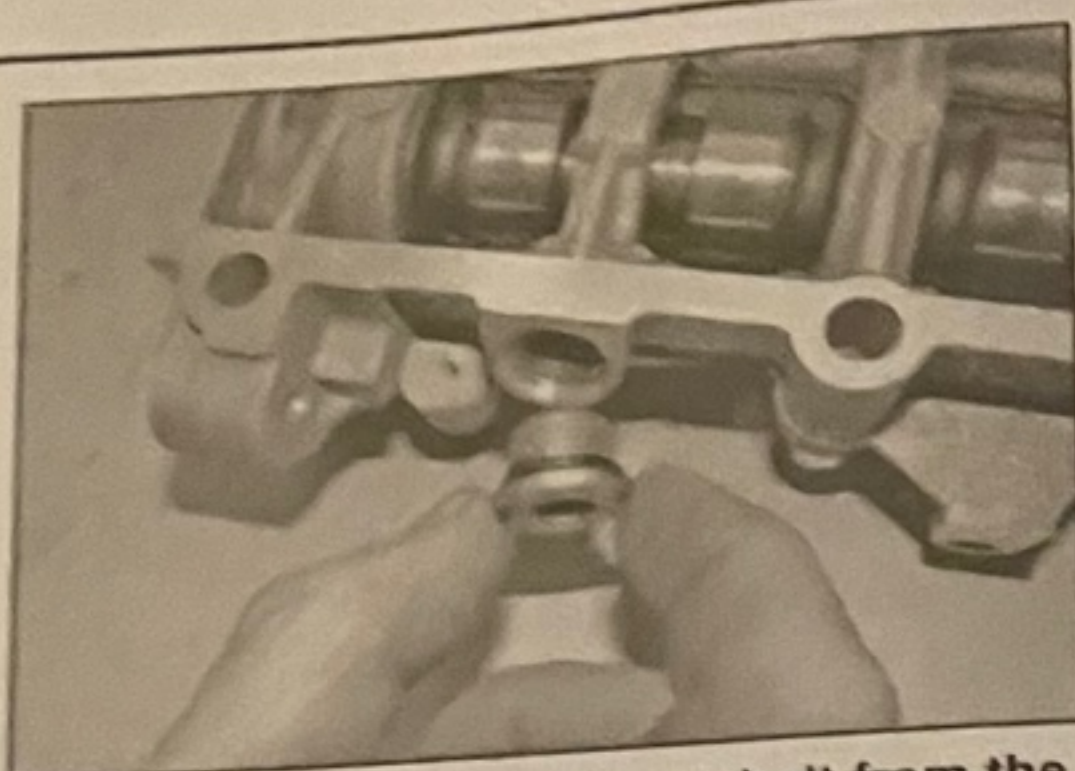
22 Refit the camshaft positioning tool to the valve timing checking hole of the exhaust camshaft. If necessary, rotate the exhaust camshaft slightly, until the tool engages audibly (see illustration).

23 Unscrew and remove the closure bolt from the intake camshaft side of the camshaft housing and fit a second camshaft positioning tool (see illustrations). If necessary, rotate the camshaft slightly, until the tool engages audibly.

24 With both camshafts locked by means of the positioning tools, tighten both drivegear retaining bolts to the specified torque (see illustration). It may be beneficial to have an assistant securely support the camshaft housing as the bolts are tightened.



10.24 With both camshafts locked, tighten both drivegear retaining bolts to the specified torque



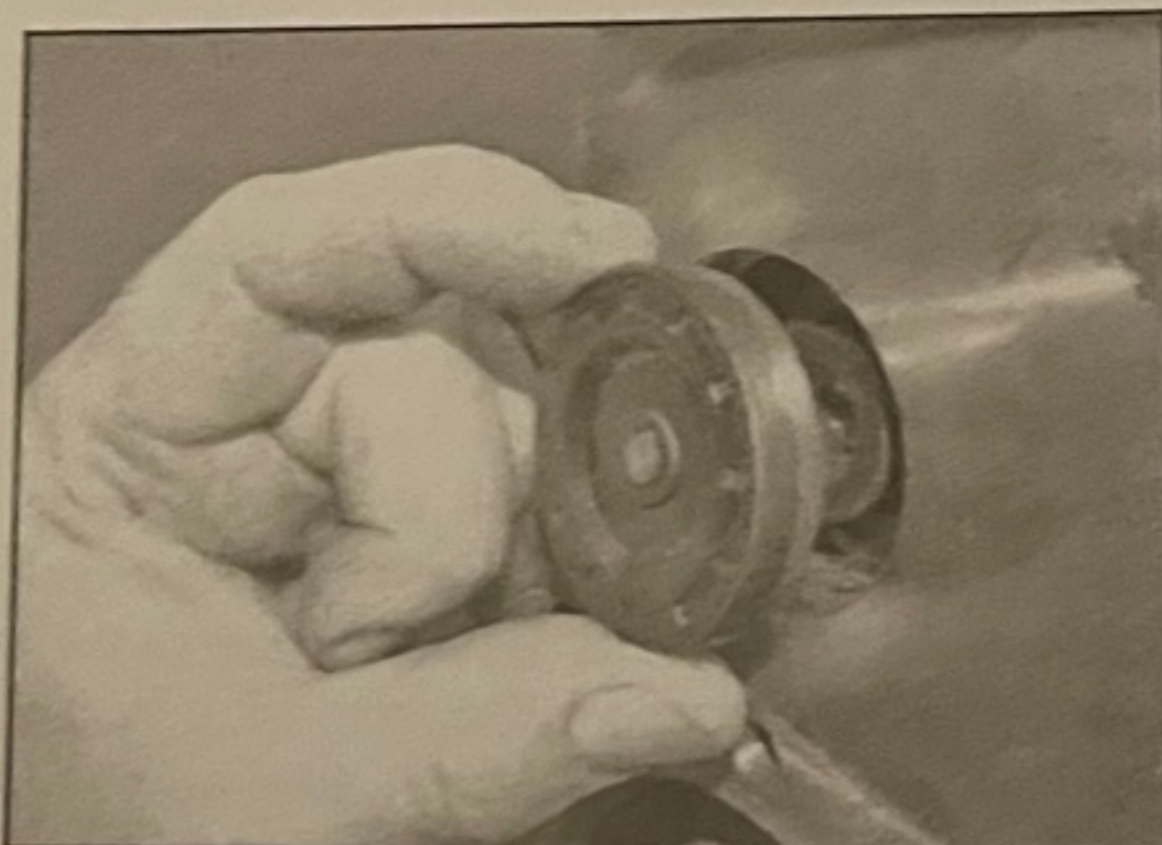
10.23a Unscrew the closure bolt from the intake camshaft side of the housing . . .

25 Remove the positioning tool from the intake camshaft and refit the closure bolt. Tighten the bolt to the specified torque.

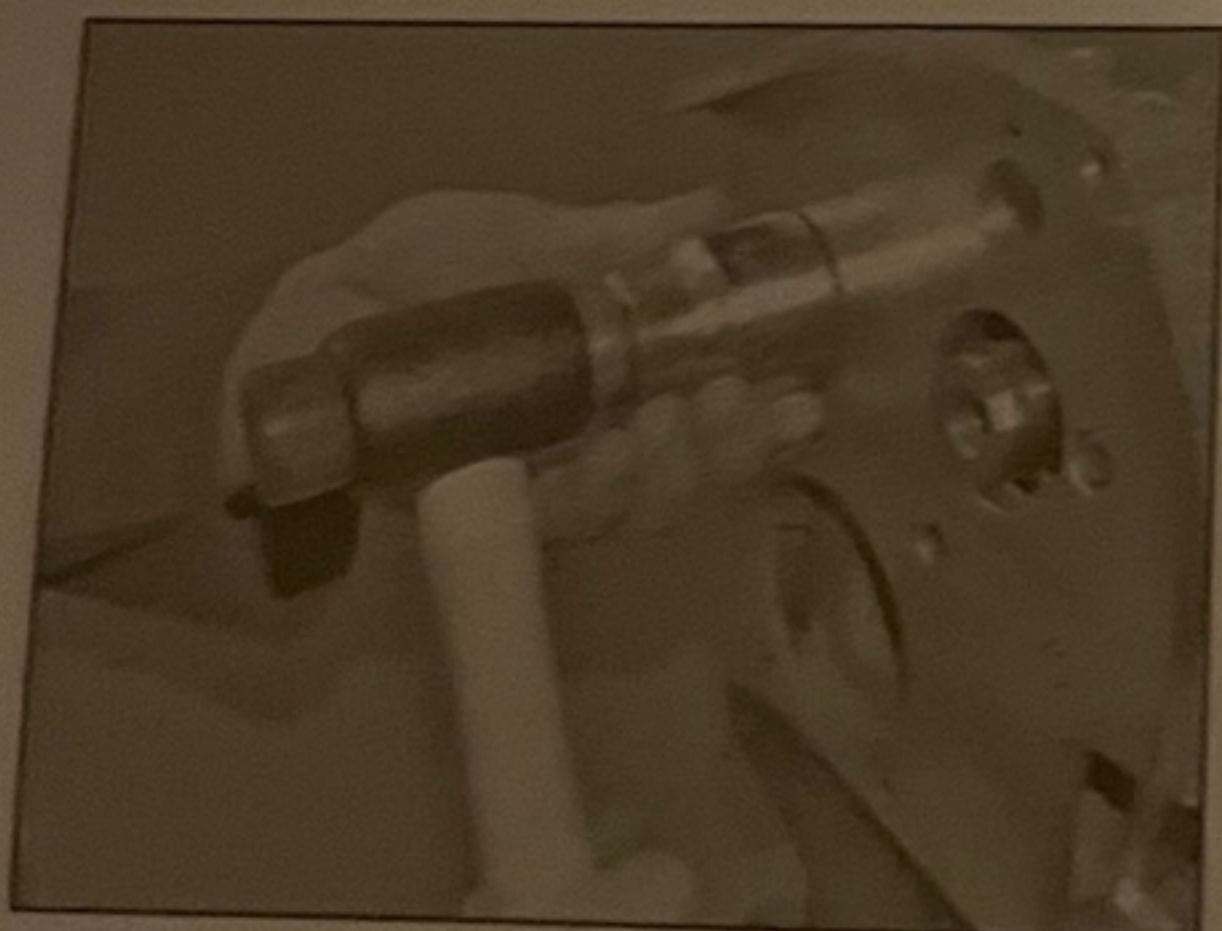
26 Fit a new intake camshaft blanking cap to the timing belt end of the camshaft housing and tap it into position until it is flush with the outer face of the housing, using a suitable socket or tube, or a wooden block (see illustrations).

27 Similarly, fit a new exhaust camshaft oil seal to the timing belt end of the camshaft housing and tap it into position until it is flush with the outer face of the housing, using a suitable socket or tube, or a wooden block (see illustration).

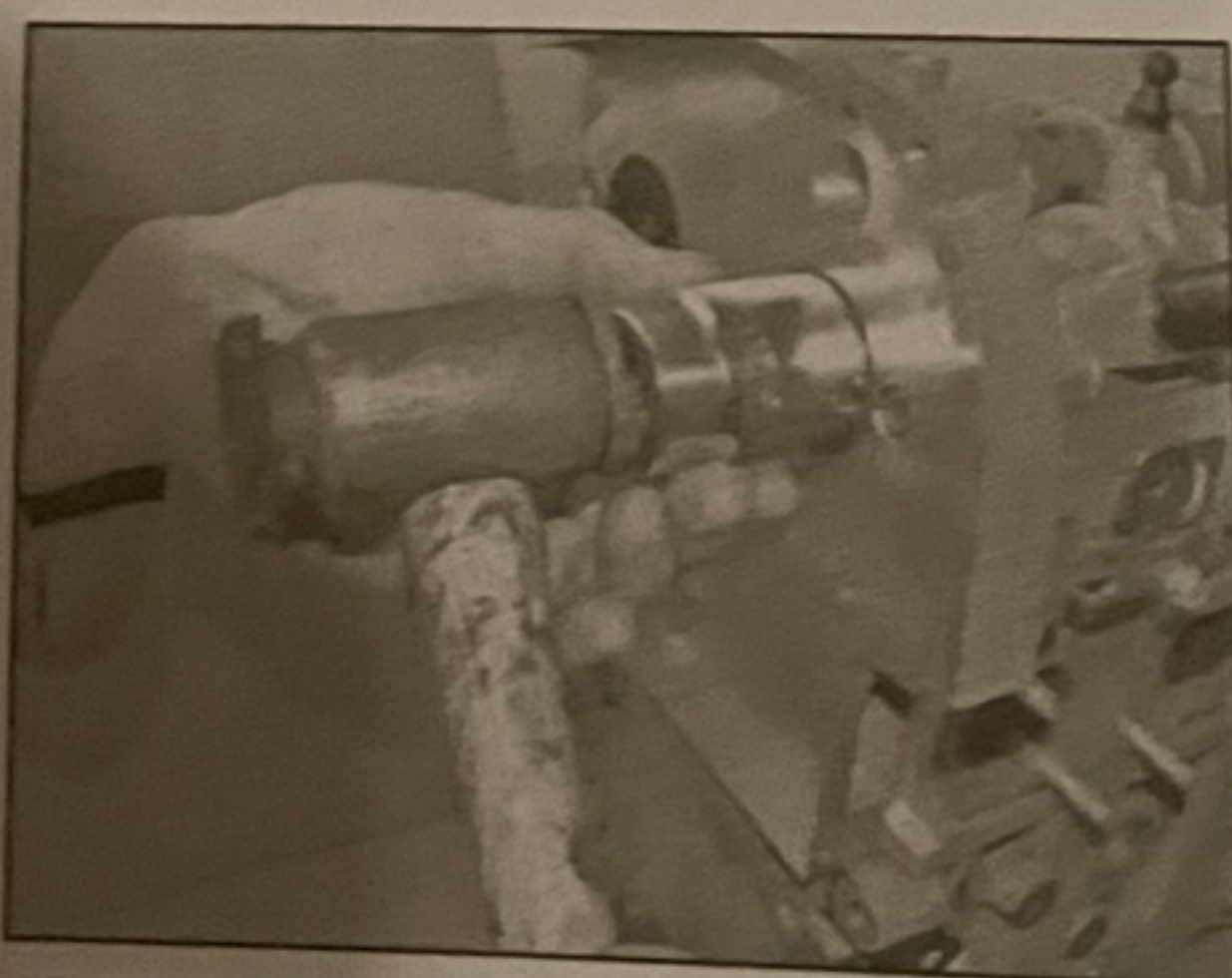
28 Refit the timing belt sprocket to the exhaust camshaft, aligning its cut-out with the locating peg, and fit the new retaining bolt finger-tight only at this stage. Final tightening



10.26a Fit a new intake camshaft blanking cap to the camshaft housing . . .



10.26b . . . and tap it into position until it is flush with the outer face of the housing



10.27 Similarly, fit a new exhaust camshaft oil seal to the camshaft housing



10.23b . . . and fit a camshaft positioning tool for the intake camshaft

is carried out after the timing belt has been fitted and tensioned.

29 Refit the camshaft sensor to the camshaft housing and tighten the retaining bolt securely.

30 Refit the oil filler housing to the camshaft housing using a new gasket, refit the retaining bolts and tighten the bolts to the specified torque. Reconnect the coolant temperature sensor wiring connector.

31 Refit the braking system vacuum pump to the engine as described in Chapter 9.

32 Thoroughly clean the mating faces of the cylinder head and camshaft housing.

33 Refit the camshaft housing to the cylinder head as described in Section 9, paragraph 26.

34 Commence refitting of the timing belt as described in Section 6, paragraphs 9 to 14.

35 Retain the camshaft sprocket using the holding tool, and tighten the retaining bolt to the specified torque.

36 Continue refitting of the timing belt as described in Section 6, paragraphs 15 to 18.

11 Camshaft followers and hydraulic tappets – removal, inspection and refitting

Removal

1 Remove the camshaft housing as described in Section 9.

2 Obtain sixteen small, oil-tight clean plastic containers, and number them intake 1 to 8 and exhaust 1 to 8; alternatively, divide a larger container into sixteen compartments and number each compartment accordingly.

3 Withdraw each camshaft follower and hydraulic tappet in turn, unclip the follower from the tappet, and place them in their respective container (see illustrations). Do not interchange the followers and tappets or the rate of wear will be much increased. Fill each container with clean engine oil to ensure that the tappet is submerged.

Inspection

4 Examine the followers and hydraulic tappets for wear ridges and scoring.

Renew any followers or tappets in poor condition. If any new followers or tappets are fitted, they should be run in on clean engine oil.

Refitting

6 Liberally lubricate the tappet body and assembly with oil. Fit the tappet to the head, ensuring it is seated in the bore. Lay the follower on the tappet (see illustration). Refit the timing belt as described in the same section. 8 With all components refitted, refit the timing belt as described in Section 9.

12 Cy . . .

Note: . . . for refitting.

Removal

1 Discard the old followers and tappets. 2 Drain the oil from the engine. 3 Remove the camshaft housing as described in Section 9, paragraph 33. 4 Refit the camshaft housing to the cylinder head as described in Section 9, paragraph 34. 5 Refit the camshaft sprocket using the holding tool, and tighten the retaining bolt to the specified torque. 6 Continue refitting of the timing belt as described in Section 6, paragraphs 15 to 18.

Renew any follower or tappet on which these conditions are apparent.
5 If any new hydraulic tappets are obtained, they should be immersed in a container of clean engine oil prior to refitting.

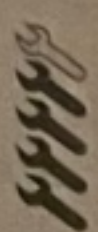
Refitting

6 Liberally oil the cylinder head hydraulic tappet bores and the tappets. Working on one assembly at a time, clip the follower back onto the tappet, then refit the tappet to the cylinder head, ensuring that it is refitted to its original bore. Lay the follower over its respective valve (see illustrations).

7 Refit the remaining tappets and followers in the same way.

8 With all the tappets and followers in place, refit the camshaft housing as described in Section 9.

12 Cylinder head – removal and refitting



Note: New cylinder head bolts will be required for refitting.

Removal

1 Disconnect the battery negative terminal as described in Chapter 5A.

2 Drain the cooling system as described in Chapter 1B.

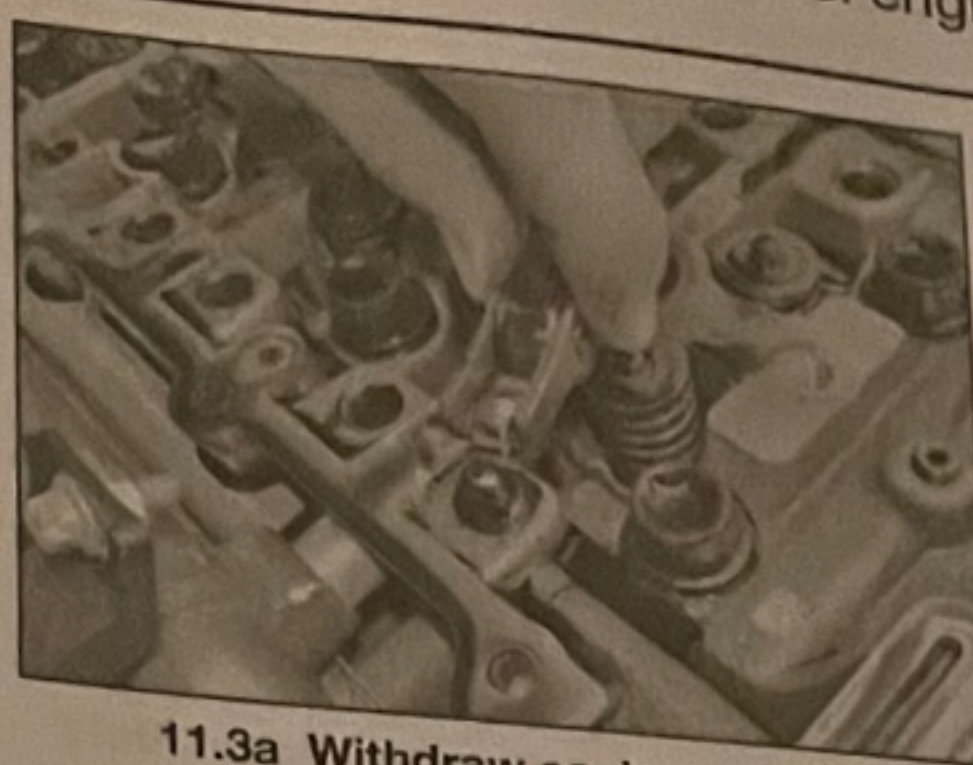
3 Remove the camshaft housing as described in Section 9.

4 Remove the camshaft followers and hydraulic tappets as described in Section 11.

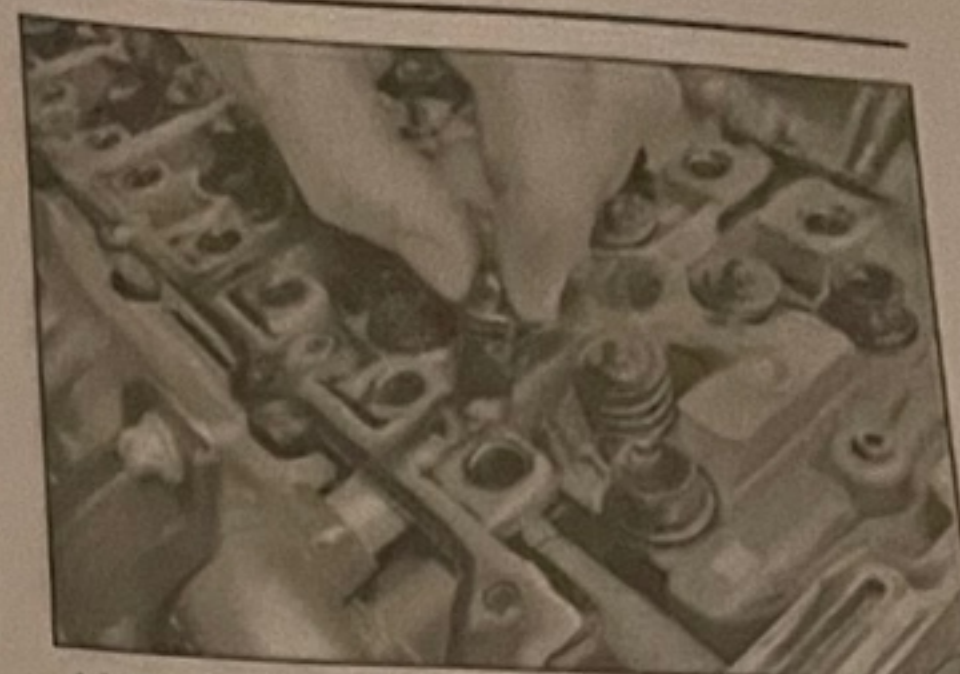
5 Remove the intake and exhaust manifolds as described in Chapter 4B.

6 Release the clips and disconnect the remaining two coolant hoses at the thermostat housing, and the coolant hose at the EGR valve heat exchanger (see illustration).

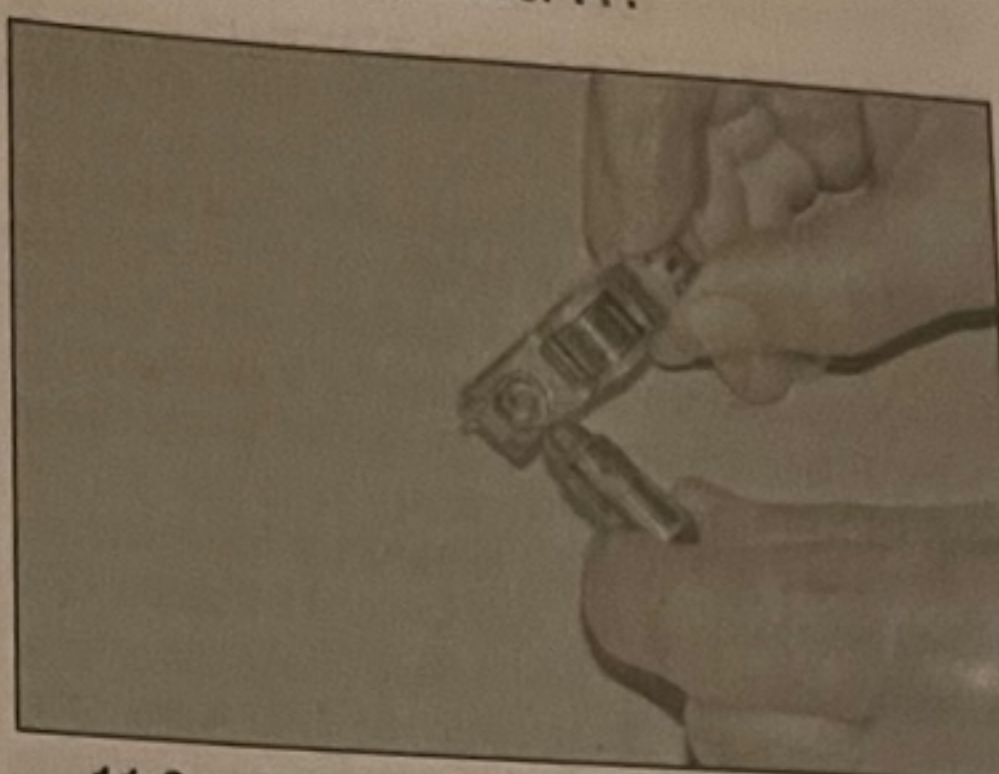
7 Release the coolant pipe from the stud at the base of the thermostat housing (see illustration).



11.3a Withdraw each camshaft follower ...



11.3b ... and hydraulic tappet in turn, then place them in their respective container



11.6a Clip the follower back onto the tappet ...



11.6b ... then refit the tappet to its original bore, and lay the follower over its respective valve

8 Undo the bolt securing the high-pressure fuel pump mounting bracket to the cylinder head (see illustration).

9 Make a final check to ensure that all relevant hoses, pipes and wires have been disconnected.

10 Working in the reverse of the tightening sequence (see illustration 12.27), progressively slacken the cylinder head bolts by half a turn at a time, until all bolts can be unscrewed by hand. Note that an M14 RIBE socket bit will be required to unscrew the bolts. Remove the cylinder head bolts and recover the washers.

11 Engage the help of an assistant, if necessary, and lift the cylinder head from the cylinder block (see illustration).

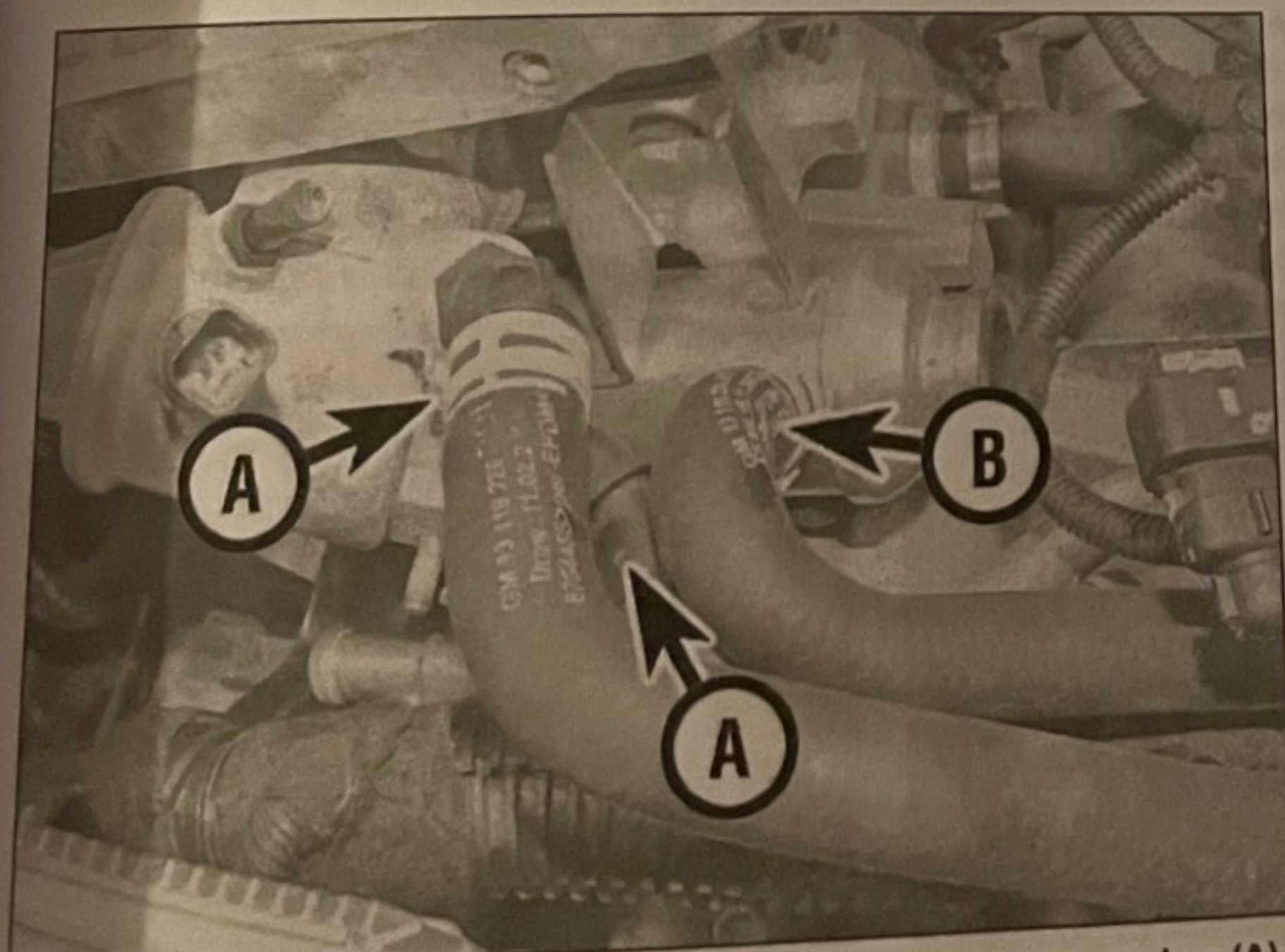
Caution: Do not lay the head on its lower mating surface; support the head on wooden blocks, ensuring each block only contacts the head mating surface.

12 Remove the gasket and keep it for identification purposes (see paragraph 19).

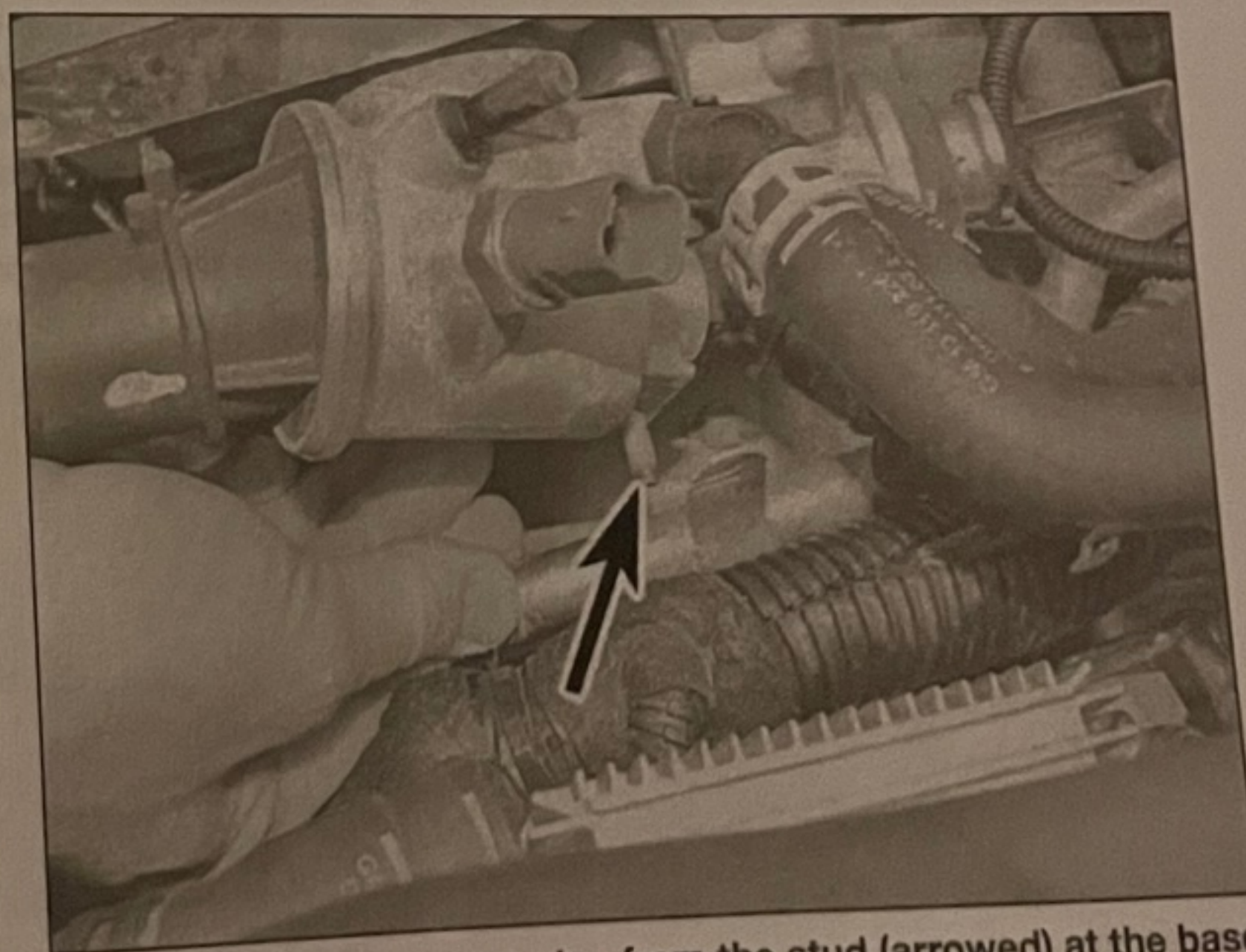
13 If the cylinder head is to be dismantled for overhaul, then refer to Part C of this Chapter.

Preparation for refitting

14 The mating faces of the cylinder head and



12.6 Disconnect the coolant hoses at the thermostat housing (A), and at the EGR valve heat exchanger (B)



12.7 Release the coolant pipe from the stud (arrowed) at the base of the thermostat housing



FIGURE 10.1 The piston and connecting rod assembly, showing the high-pressure fuel pump mounting bracket on the cylinder head.

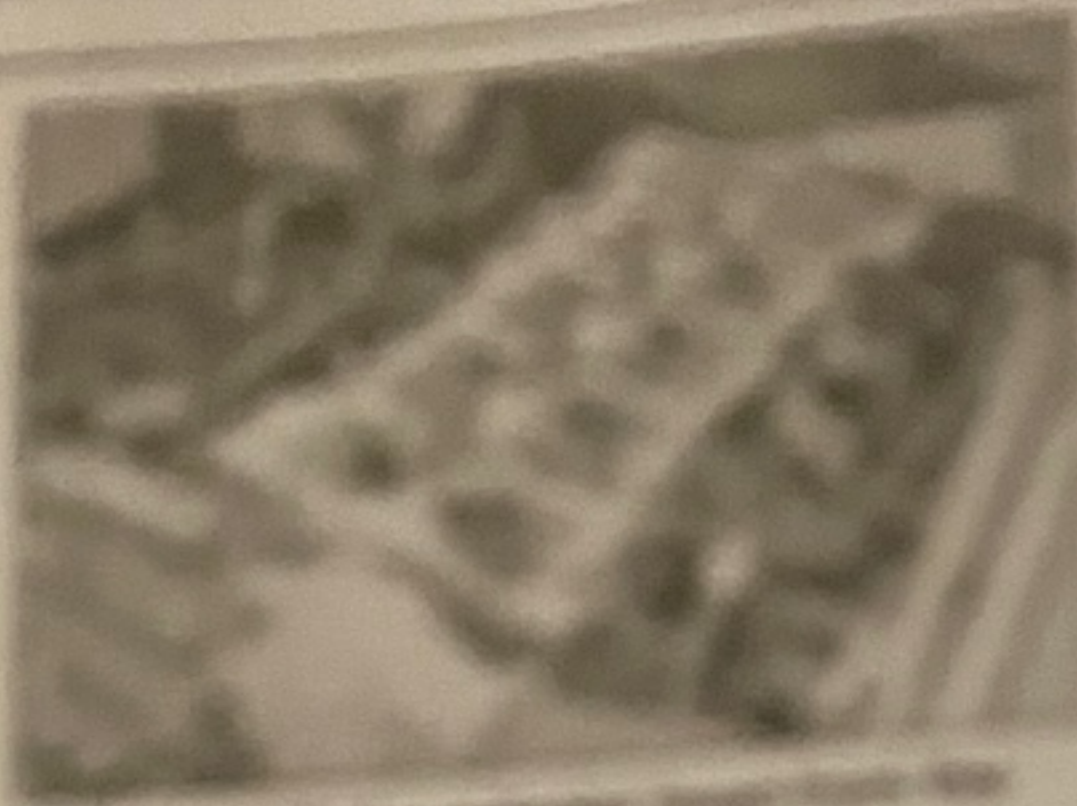


FIGURE 10.2 The timing belt and its associated pulleys.

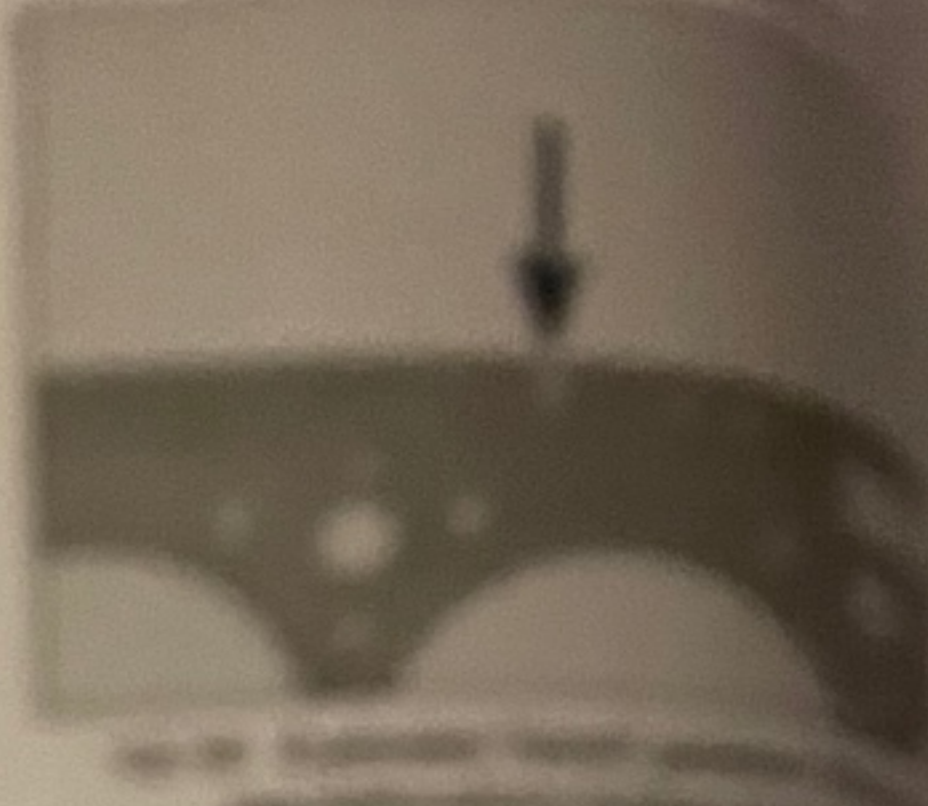


FIGURE 10.3 The timing belt and its associated pulleys.

The timing belt is a critical component of the engine, responsible for synchronizing the rotation of the crankshaft and the camshaft. It is typically made of a durable material like rubber or plastic, reinforced with fibers. The belt is driven by the crankshaft and passes over several pulleys, including the camshaft pulley. Proper timing is essential for the engine to run smoothly and efficiently. If the timing belt is out of sync, it can lead to poor performance, increased fuel consumption, and even engine damage. Regular inspection and replacement of the timing belt are recommended to prevent these issues.

The high-pressure fuel pump is another vital part of the engine, responsible for delivering fuel at the correct pressure to the injectors. It is usually mounted on the side of the cylinder head. The pump is driven by the engine's camshaft and uses a series of plungers to draw fuel from the tank and pump it into the injectors. Maintaining the fuel pump is crucial for ensuring the engine receives the right amount of fuel at the right time.

The connecting rod is a long, slender component that links the piston to the crankshaft. It is typically made of steel or aluminum and is designed to withstand the high forces generated during combustion. The rod is attached to the piston at one end and the crankshaft at the other. It plays a key role in converting the linear motion of the piston into the rotational motion of the crankshaft.

The piston is the component that moves up and down in the cylinder, compressing the fuel-air mixture and transferring the force of combustion to the connecting rod. It is usually made of aluminum and has several rings to scrape excess oil from the cylinder walls and to seal the combustion chamber. The piston is a critical part of the engine's internal mechanism and its proper function is essential for the engine to operate correctly.

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FIGURE 10.4 The timing belt and its associated pulleys.

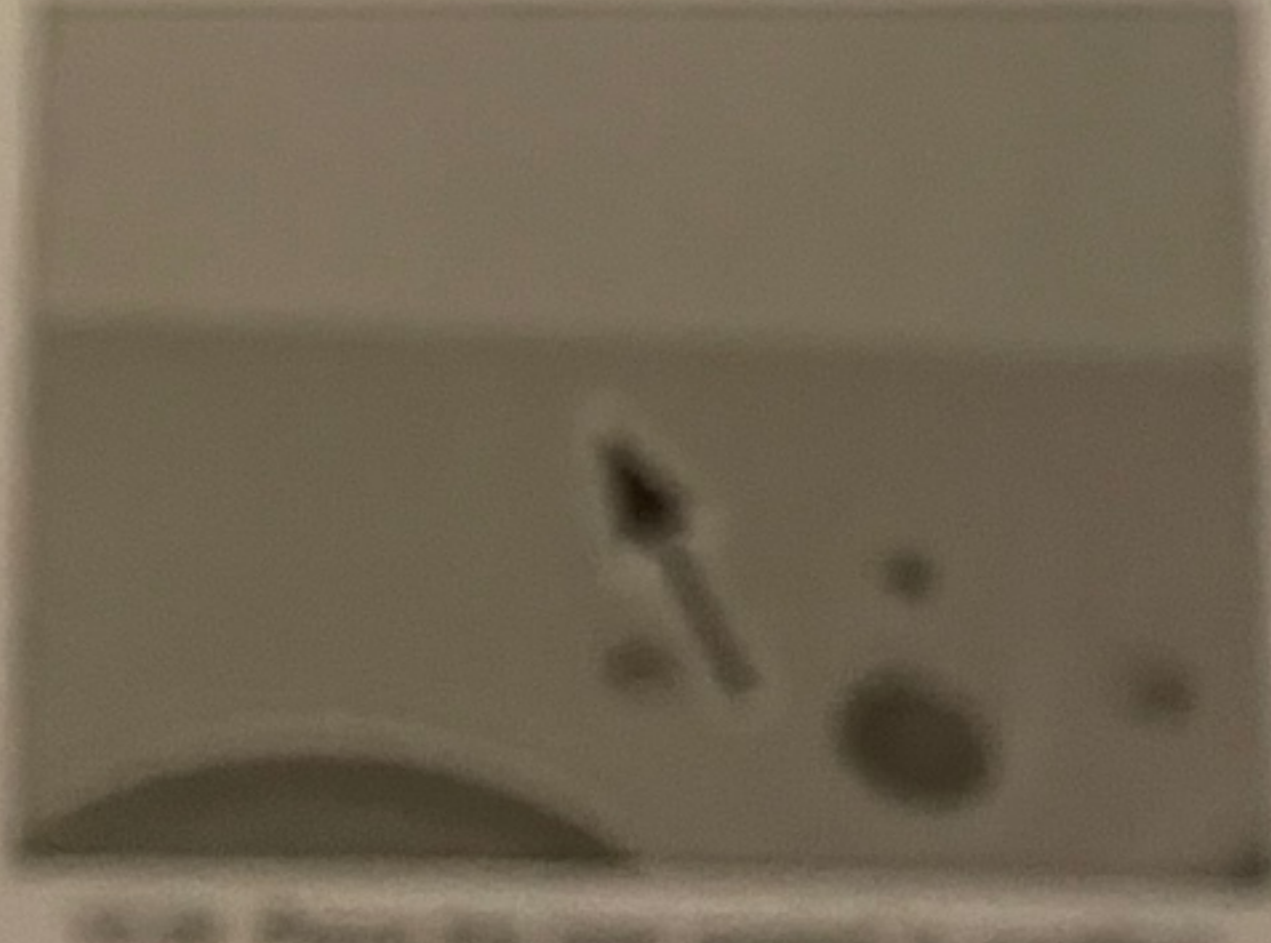


FIGURE 10.5 The timing belt and its associated pulleys.

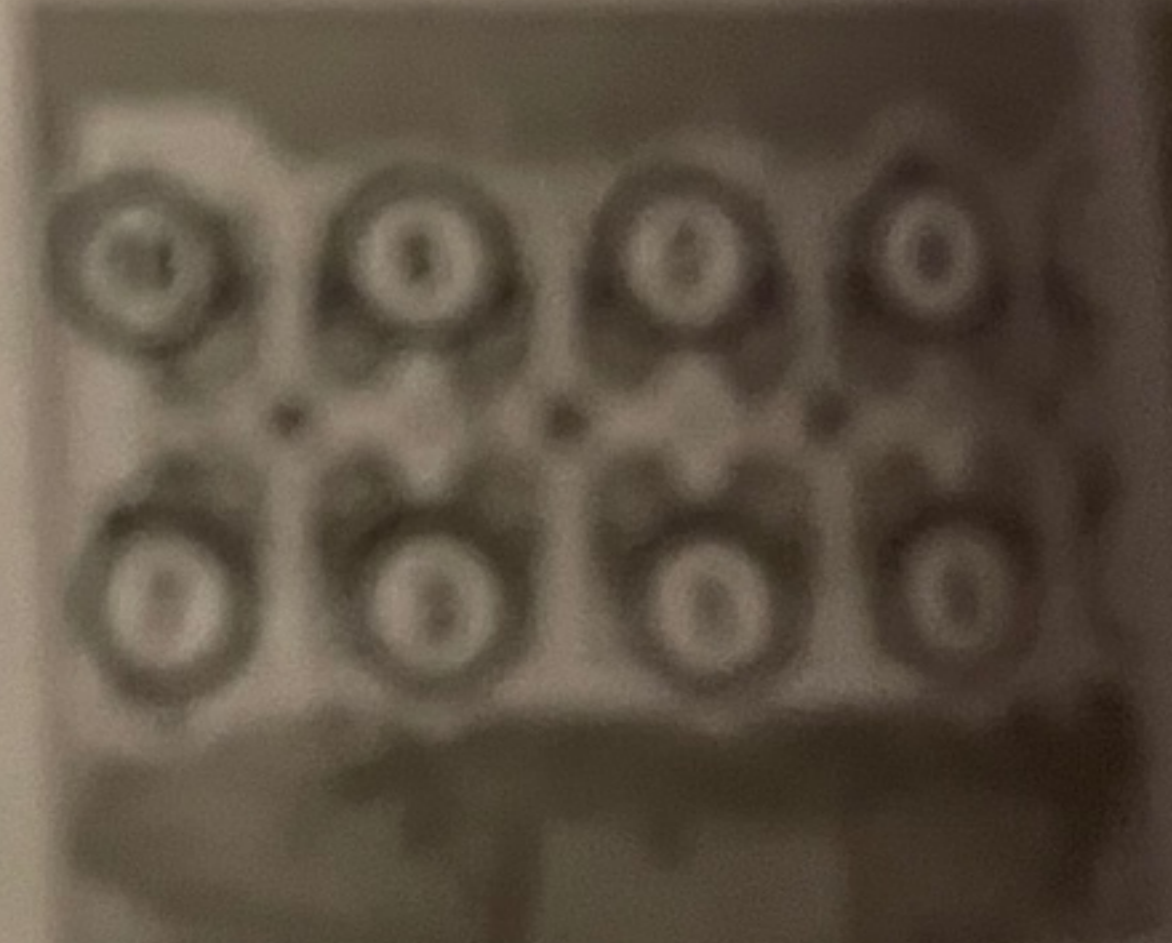
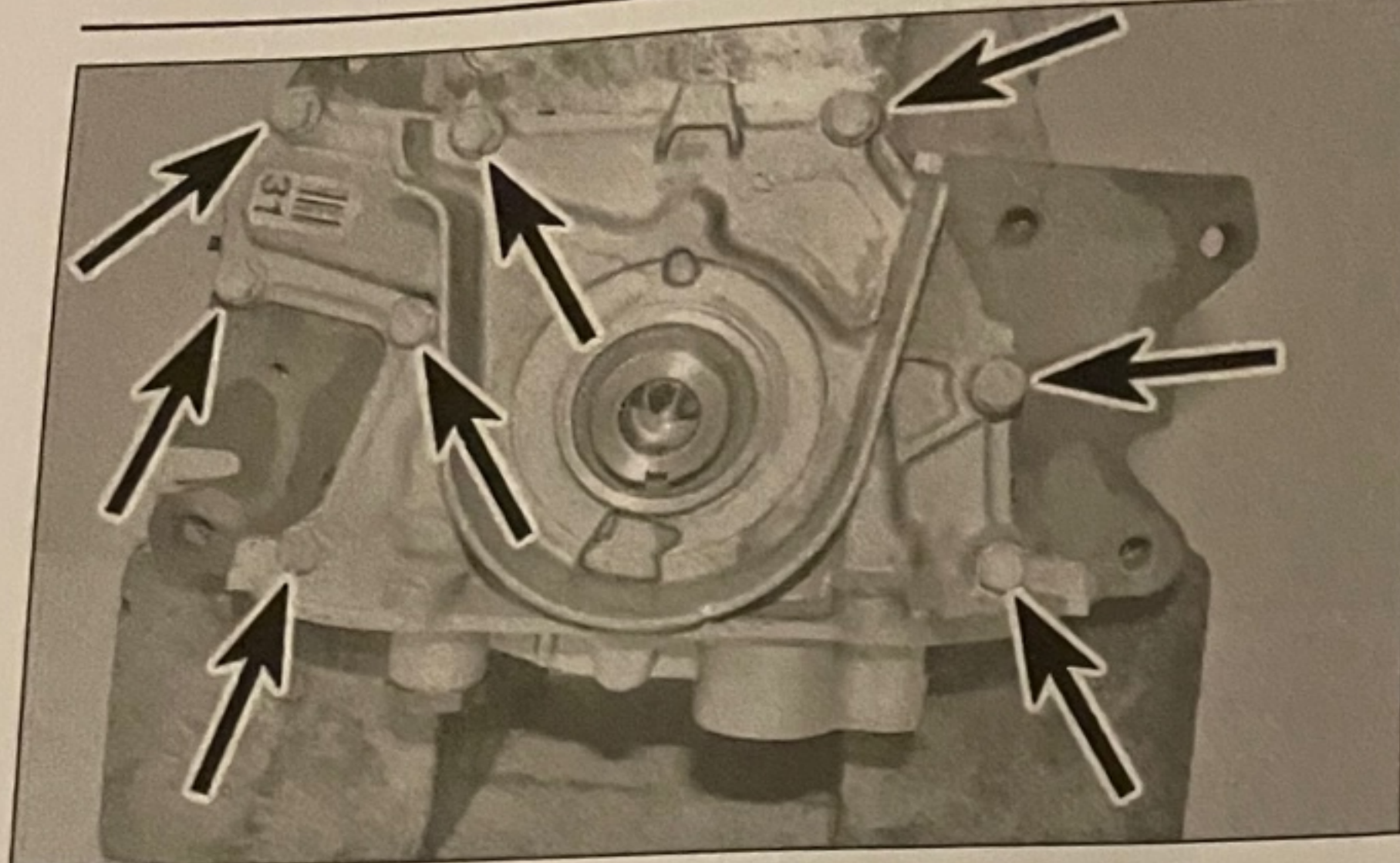


FIGURE 10.6 The timing belt and its associated pulleys.



14.4 Oil pump housing retaining bolts (arrowed)

bead of sealant should be between 2.0 and 2.5 mm in diameter.

22 Locate the sump over the pick-up/strainer then, where applicable, fit the forward end of the pick-up/strainer to the oil pump housing and fit the retaining bolt. Tighten both retaining bolts securely.

23 Engage the sump with the cylinder block and loosely refit all the retaining bolts.

24 Working out from the centre in a diagonal sequence, progressively tighten the bolts securing the sump to the cylinder block and oil pump housing. Tighten all the bolts to their specified torque setting.

25 Tighten the two bolts securing the sump flange to the transmission bellhousing to their specified torque settings.

26 Reconnect the wiring connector to the oil

level sensor, then refit the oil return hose and secure with the retaining clip.

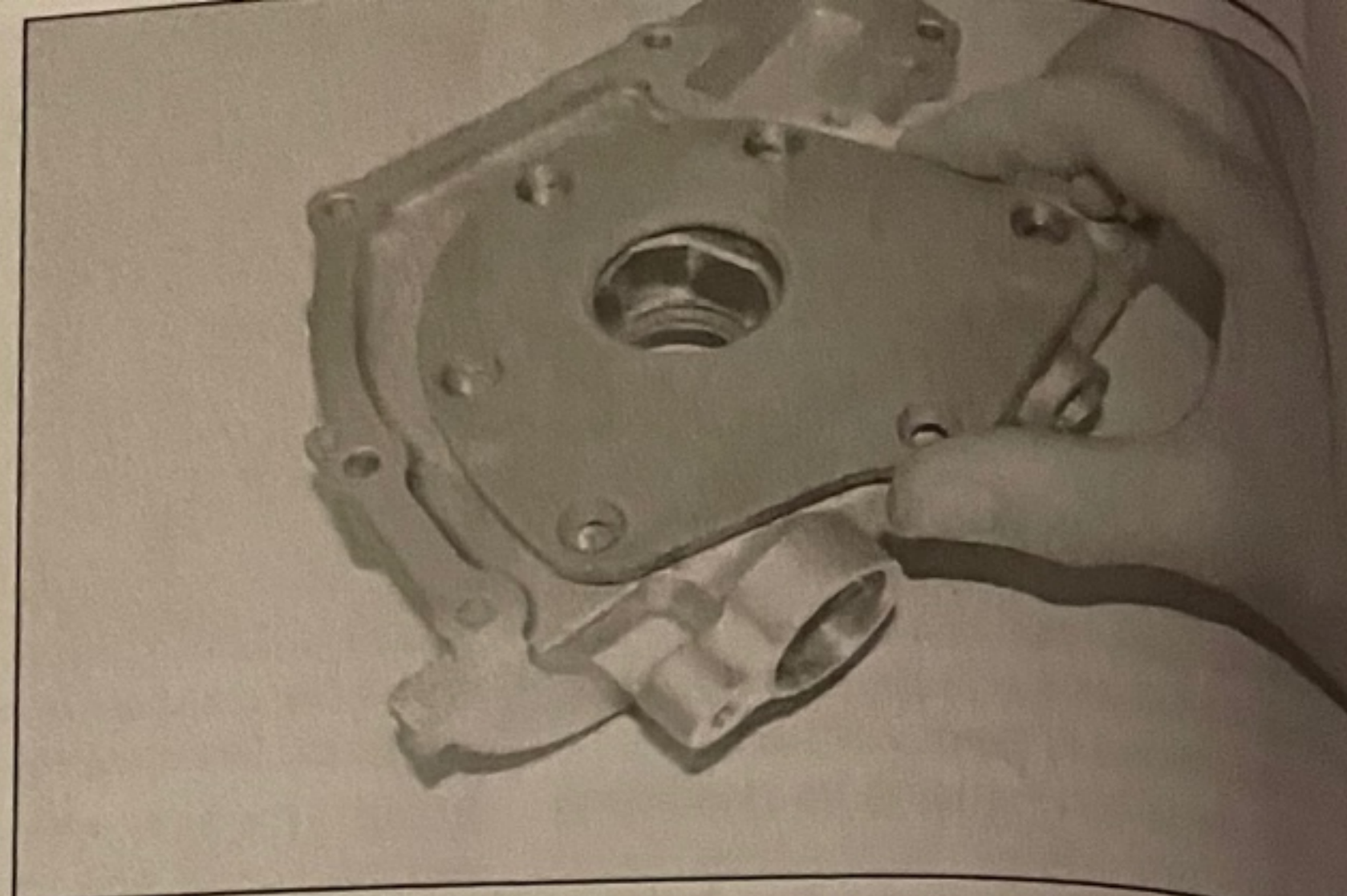
27 Refit the oil dipstick guide tube and secure with the two bolts tightened securely.

28 Locate the air conditioning compressor mounting bracket in position and refit the four retaining bolts. Tighten the bolts to the specified torque. Clip the wiring harness back into position on the bracket.

29 Position the air conditioning compressor on the mounting bracket. Fit and tighten the three retaining bolts to the specified torque (see Chapter 3), then reconnect the compressor wiring connector.

30 Refit the crankshaft pulley/vibration damper as described in Section 5.

31 Refit the catalytic converter support bracket and securely tighten the three bolts.



14.5 Undo the retaining screws and lift off the oil pump cover

32 Refit the exhaust system as described in Chapter 4B.

33 Position the intermediate shaft bearing housing support bracket on the cylinder block and secure with the three retaining bolts tightened to the specified torque.

34 Refit the intermediate shaft and right-hand driveshaft as described in Chapter 8.

35 Refit the roadwheel and engine under shield, then lower the car to the ground and tighten the wheel bolts to the specified torque.

36 Fill the engine with fresh engine oil as described in Chapter 1B.

37 On completion, reconnect the battery negative terminal as described in Chapter 1.

14 Oil pump - removal, overhaul and refitting

Removal

1 Remove the timing belt as described in Section 6.

2 Remove the crankshaft sprocket as described in Section 7.

3 Remove the sump and oil pump pick-up/strainer as described in Section 13.

4 Slacken and remove the seven retaining bolts then slide the oil pump housing assembly off of the end of the crankshaft (see illustration). Remove the housing gasket and discard it.

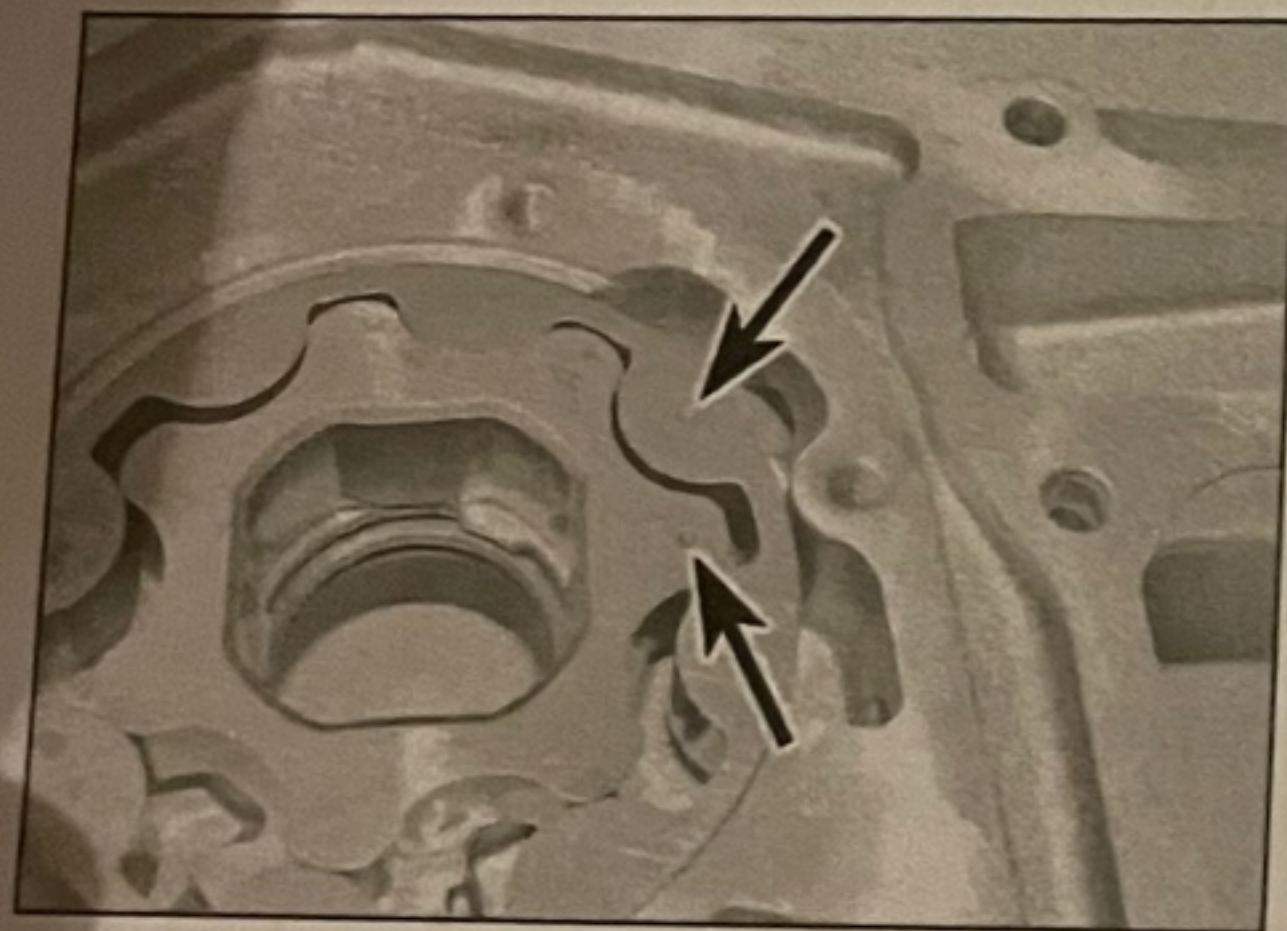
Overhaul

5 Undo the retaining screws and lift off the oil pump cover from the rear of the housing (see illustration).

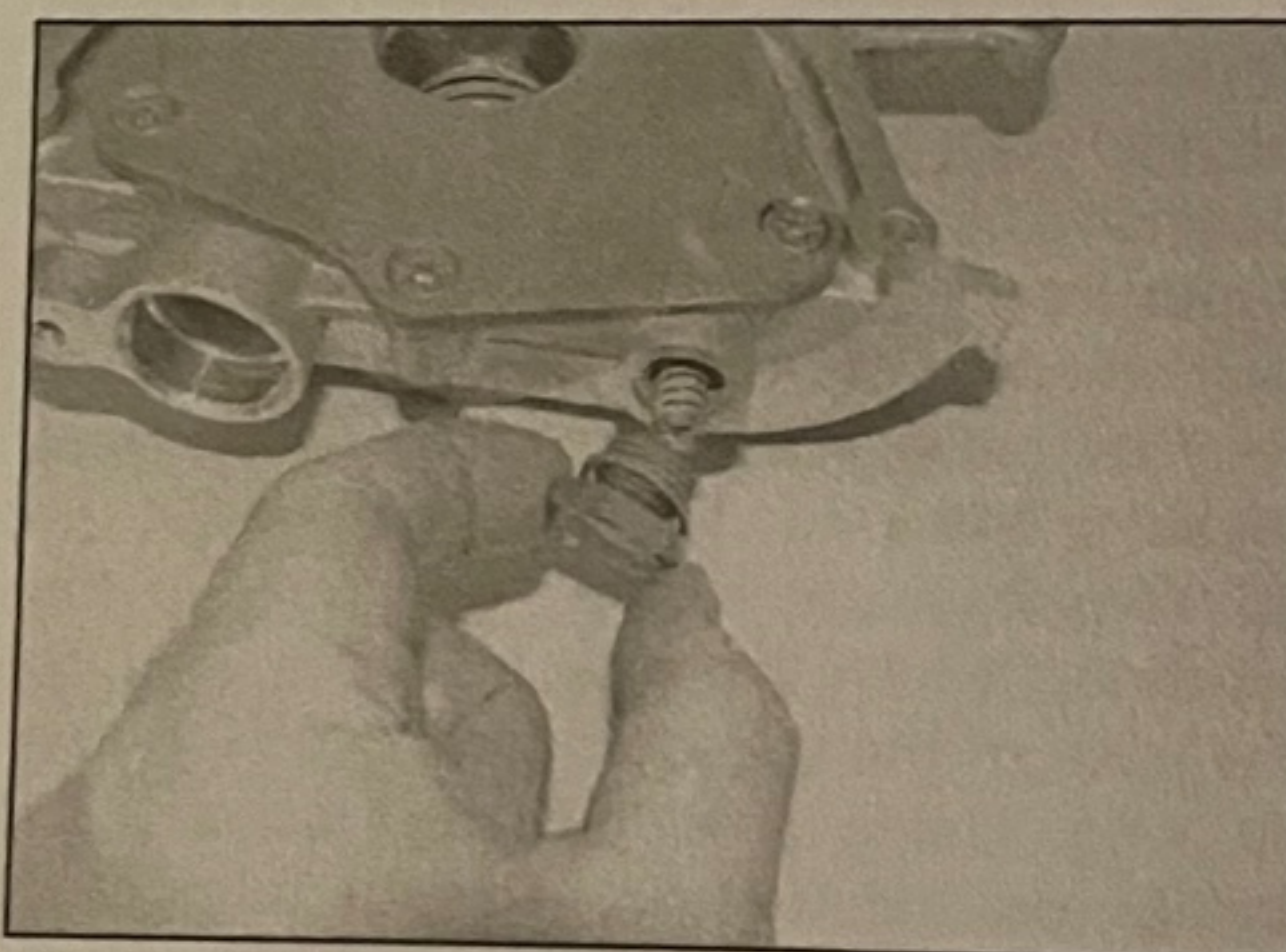
6 Check the inner and outer rotors for identification dots indicating which way round they are fitted (see illustration). If no marks are visible use a suitable marker pen to mark the surface of both the pump inner and outer rotors.

7 Lift out the inner and outer rotors from the pump housing.

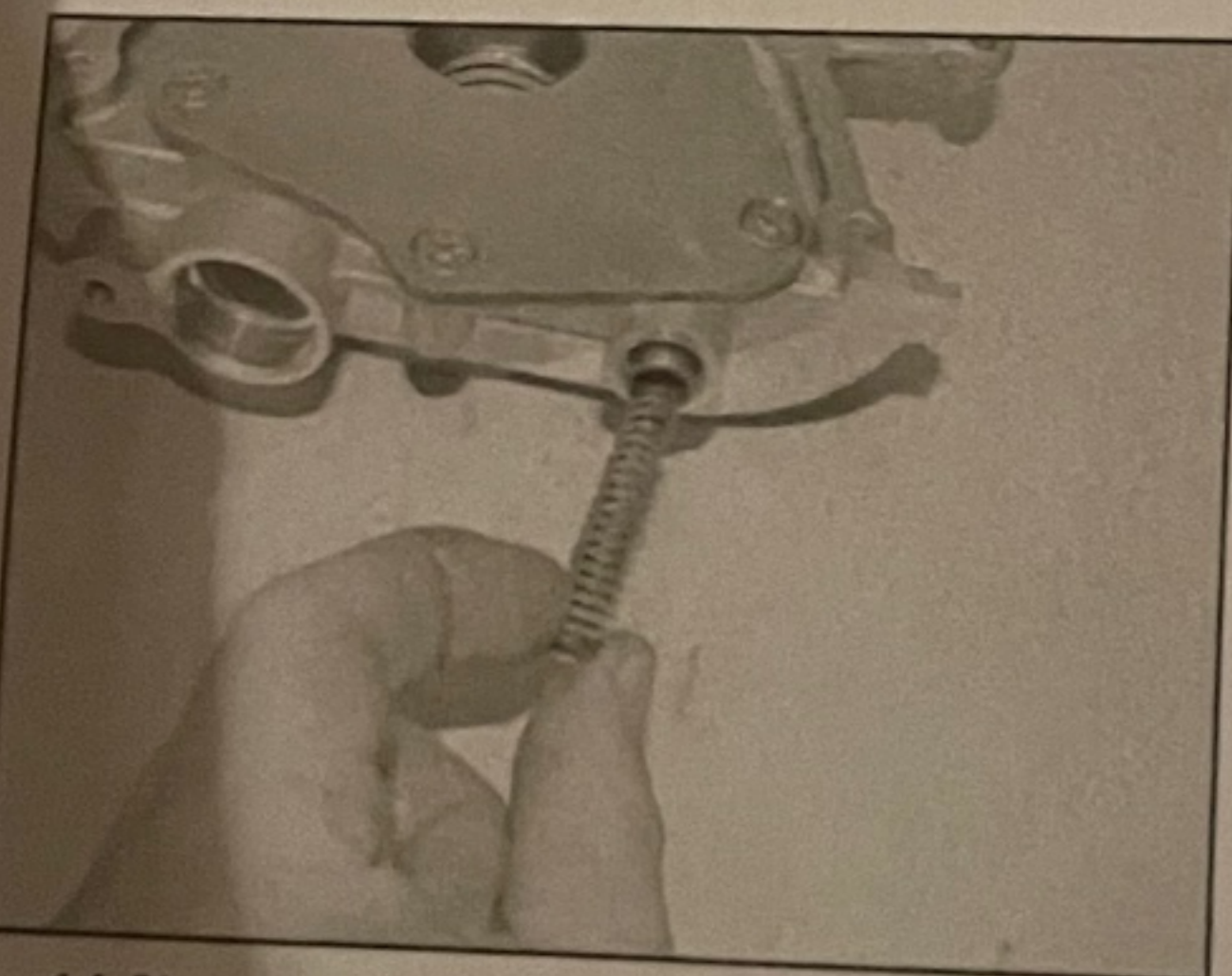
8 Unscrew the oil pressure relief valve from the base of the housing and withdraw the spring and plunger, noting which way round the plunger is fitted (see illustration).



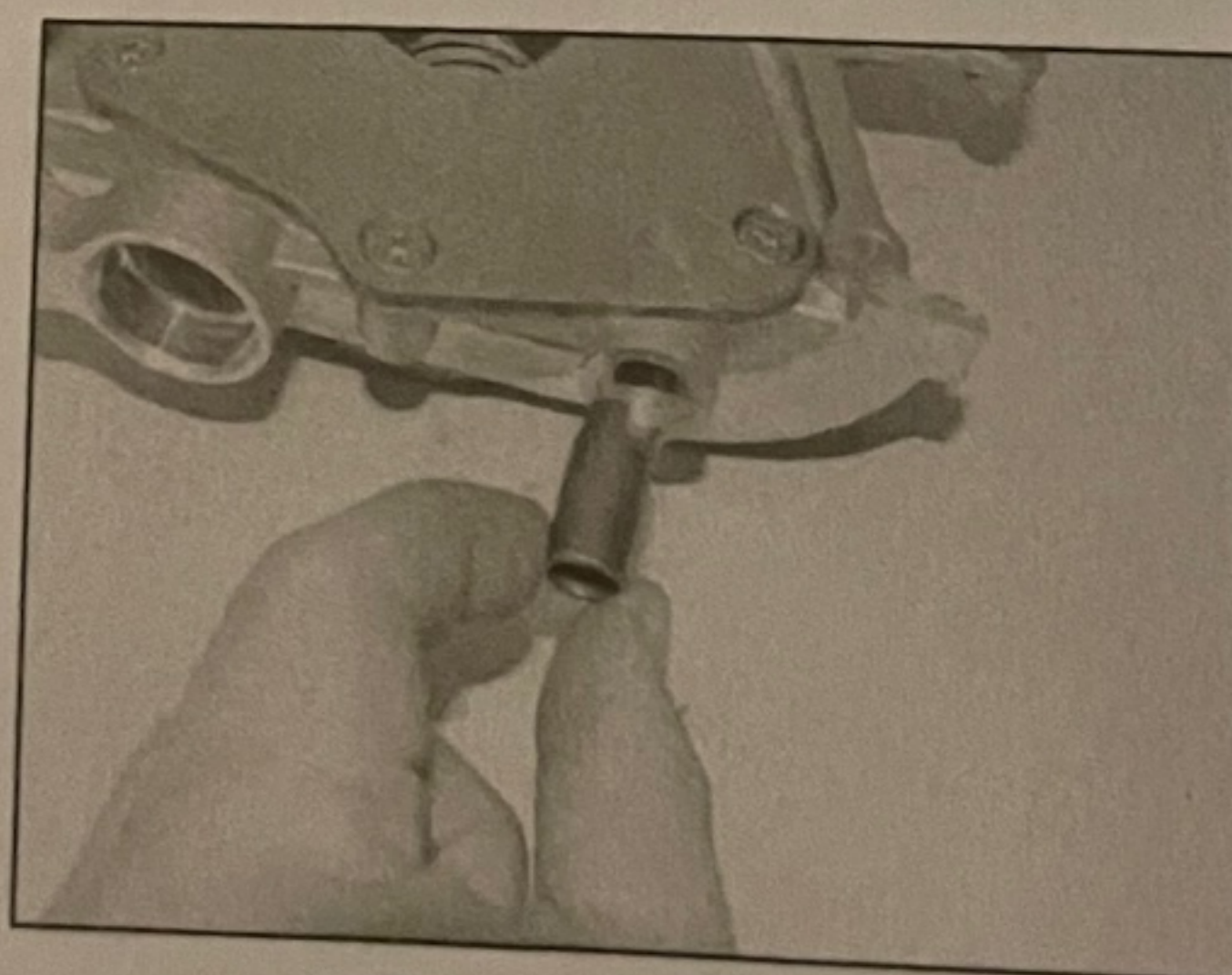
14.6 Oil pump inner and outer rotor identification dots (arrowed)



14.8a Unscrew the oil pressure relief valve bolt . . .



14.8b . . . then withdraw the spring . . .



14.8c . . . and plunger

Remove the sealing washer from the valve bolt.

9 Clean the components, and carefully examine the rotors, pump body and relief valve plunger for any signs of scoring or wear. If any damage or wear is noticed, it will be necessary to renew the complete pump assembly.

10 If the pump is satisfactory, reassemble the components in the reverse order of removal, noting the following.

- Ensure both rotors are fitted the correct way around.
- Fit a new sealing ring to the pressure relief valve bolt and securely tighten the bolt.
- Apply a little locking compound to the threads, and securely tighten the pump cover screws.
- On completion prime the oil pump by filling it with clean engine oil whilst rotating the inner rotor (see illustration).

Refitting

11 Prior to refitting, carefully lever out the crankshaft oil seal using a flat-bladed screwdriver. Fit the new oil seal, ensuring its sealing lip is facing inwards, and press it squarely into the housing using a tubular drift which bears only on the hard outer edge of the seal. Press the seal into position so that it is flush with the housing and lubricate the oil seal lip with clean engine oil.

12 Ensure the mating surfaces of the oil pump and cylinder block are clean and dry.

13 Fit a new gasket to the oil pump housing and bend down the tabs on the edge of the gasket to retain it on the pump housing (see illustration).

14 Locate the pump housing over the end of the crankshaft and into position on the cylinder block.

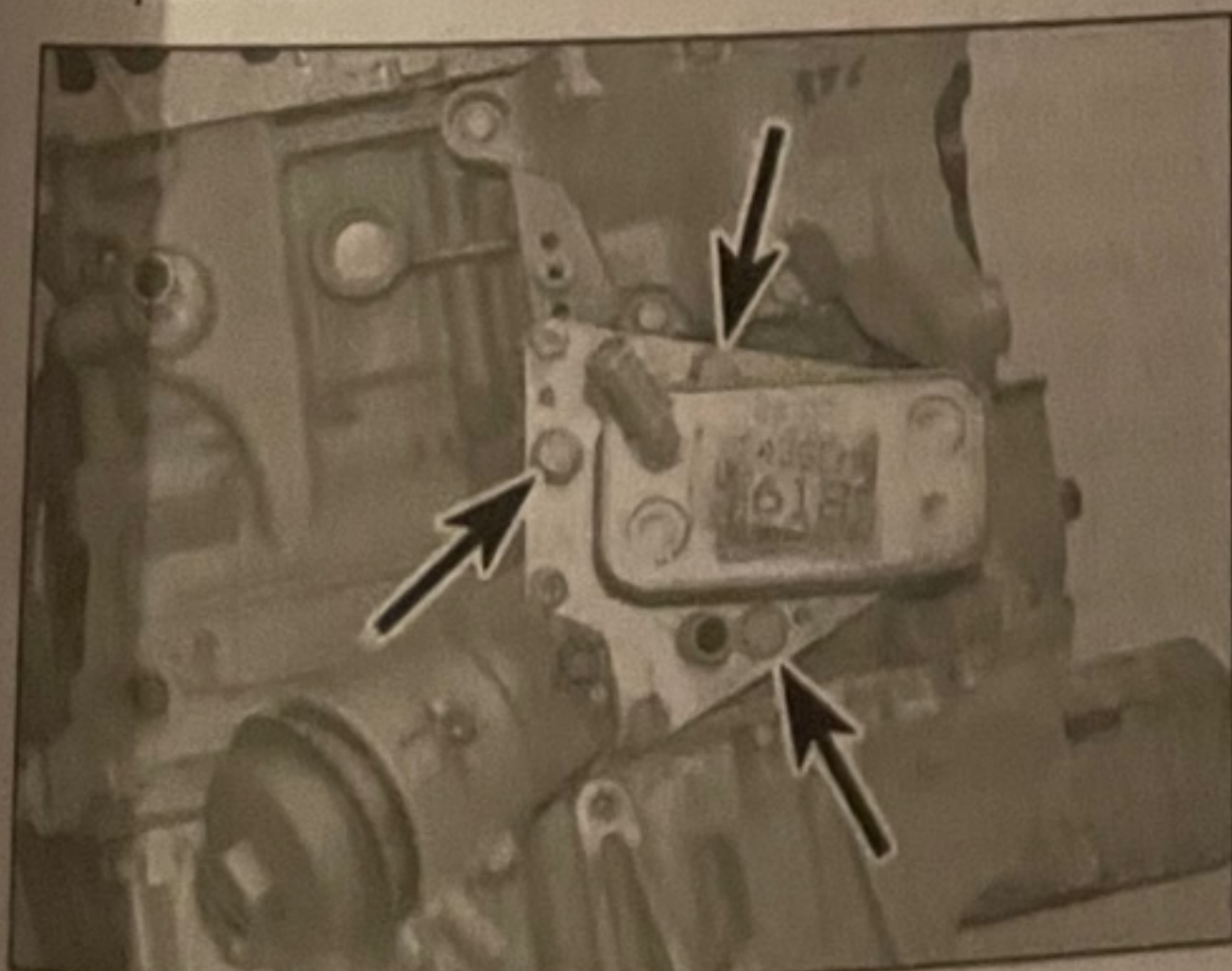
15 Refit the pump housing retaining bolts and tighten them to the specified torque.

16 Refit the oil pump pick-up/strainer and sump as described in Section 13.

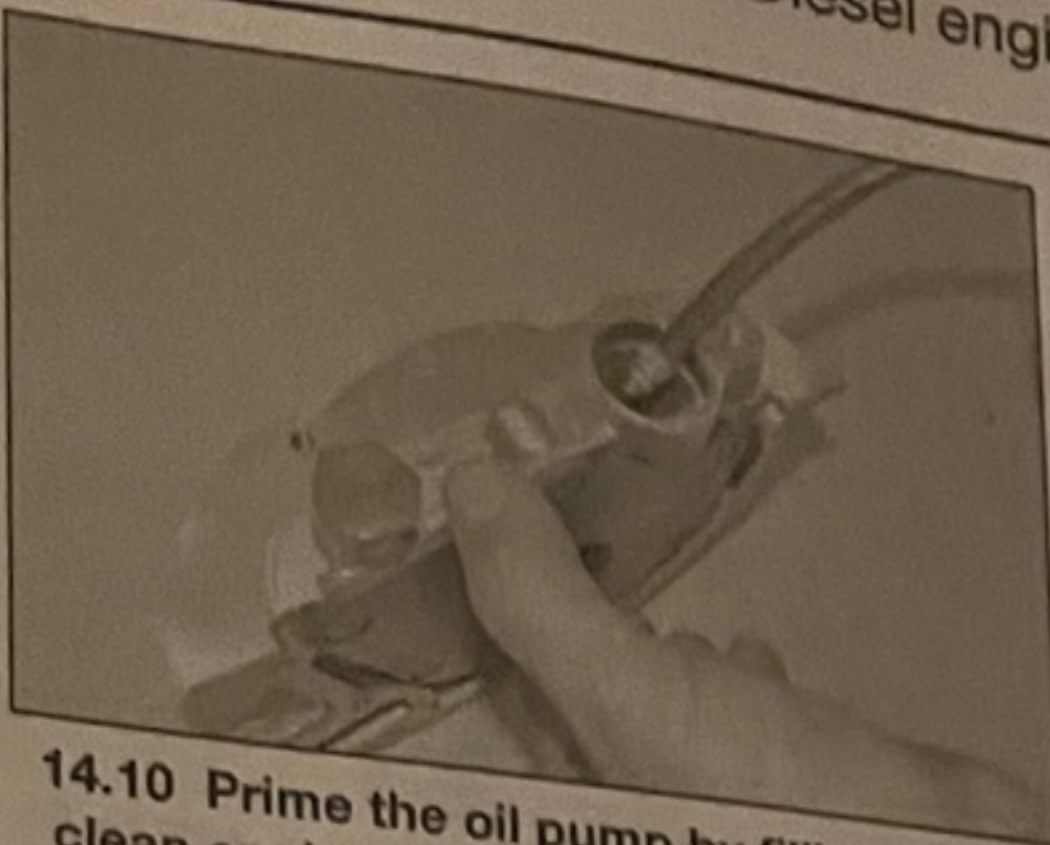
17 Refit the crankshaft sprocket as described in Section 7.

18 Refit the timing belt as described in Section 6.

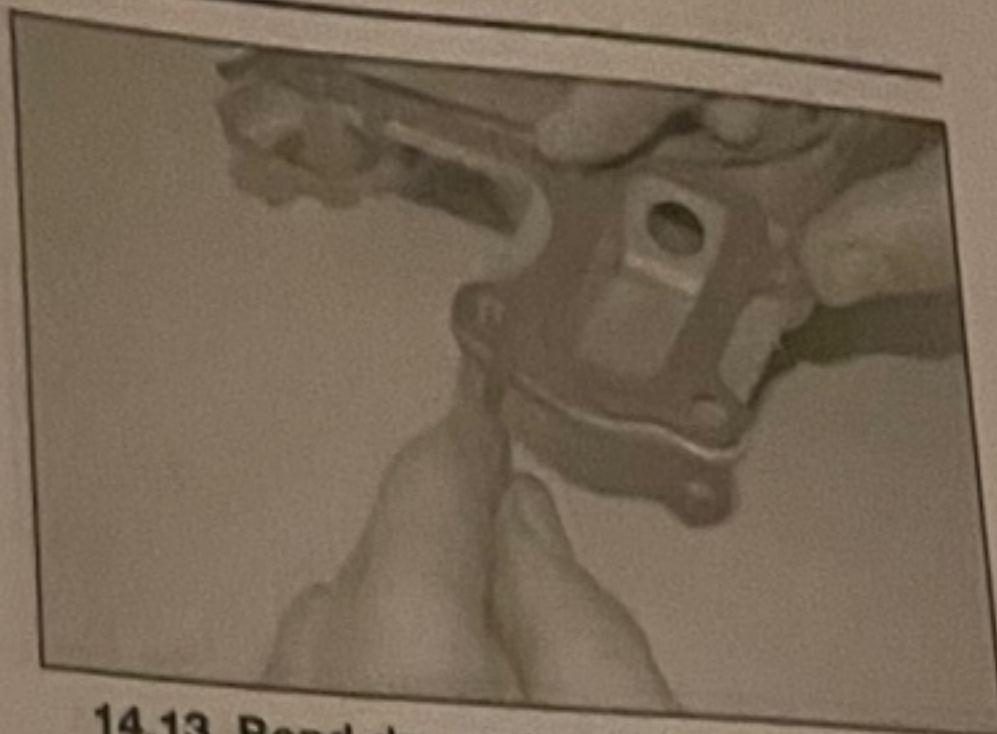
19 On completion, fit a new oil filter and fill the engine with clean oil as described in Chapter 1B.



15.10 Oil filter housing retaining bolts (arrowed)



14.10 Prime the oil pump by filling it with clean engine oil whilst rotating the inner rotor



14.13 Bend down the tabs on the edge of the gasket to retain it on the oil pump housing

15 Oil filter housing – removal and refitting

Removal

1 The oil filter housing with integral oil cooler is located at the rear of the cylinder block, above the right-hand driveshaft.

2 Disconnect the battery negative terminal as described in Chapter 5A.

3 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *Jacking and vehicle support*). Remove the right-hand front roadwheel, then undo the bolts and remove the engine undershield.

4 Drain the cooling system as described in Chapter 1B.

5 Remove the engine oil filter element as described in Chapter 1B.

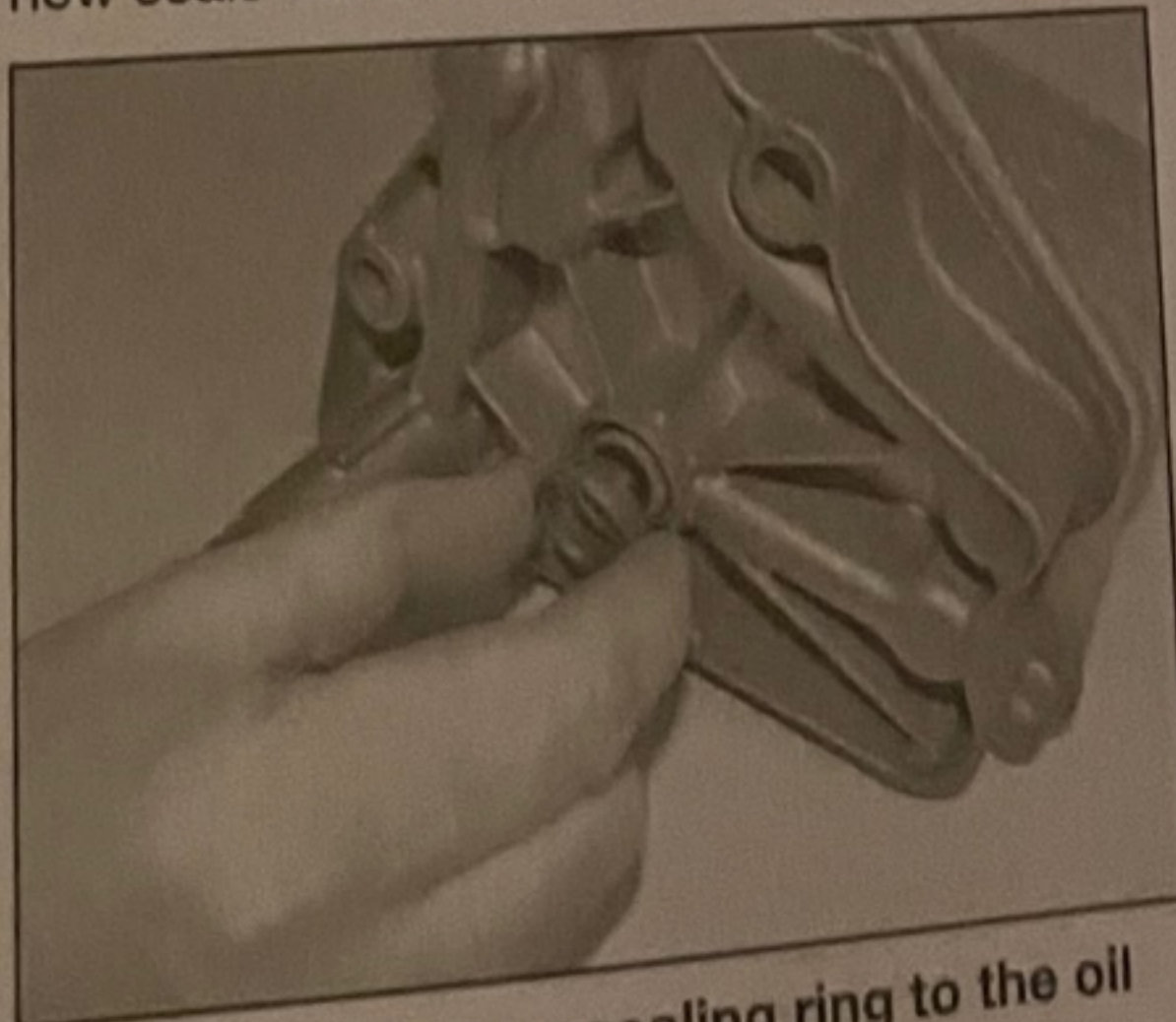
6 Remove the right-hand driveshaft and the intermediate shaft as described in Chapter 8.

7 Undo the three bolts securing the intermediate shaft bearing housing support bracket to the cylinder block and remove the support bracket (see illustration 13.4).

8 Disconnect the wiring connector from the oil pressure switch.

9 Release the retaining clips and disconnect the two coolant hoses from the oil cooler on the oil filter housing.

10 Undo the three retaining bolts and remove the oil filter housing from the cylinder block (see illustration). Recover the two rubber seals from the rear of the housing. Note that new seals will be required for refitting.

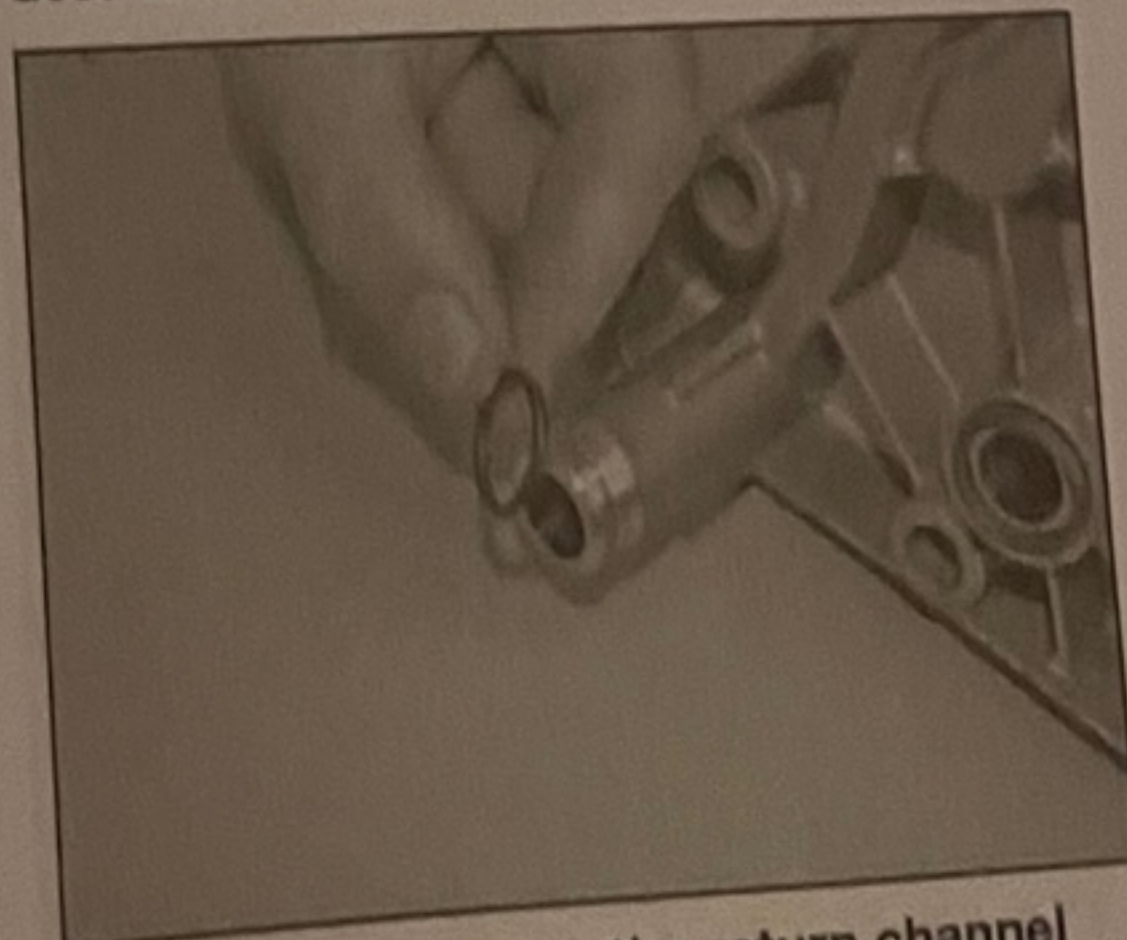


15.11a Fit a new sealing ring to the oil filter housing supply channel ...

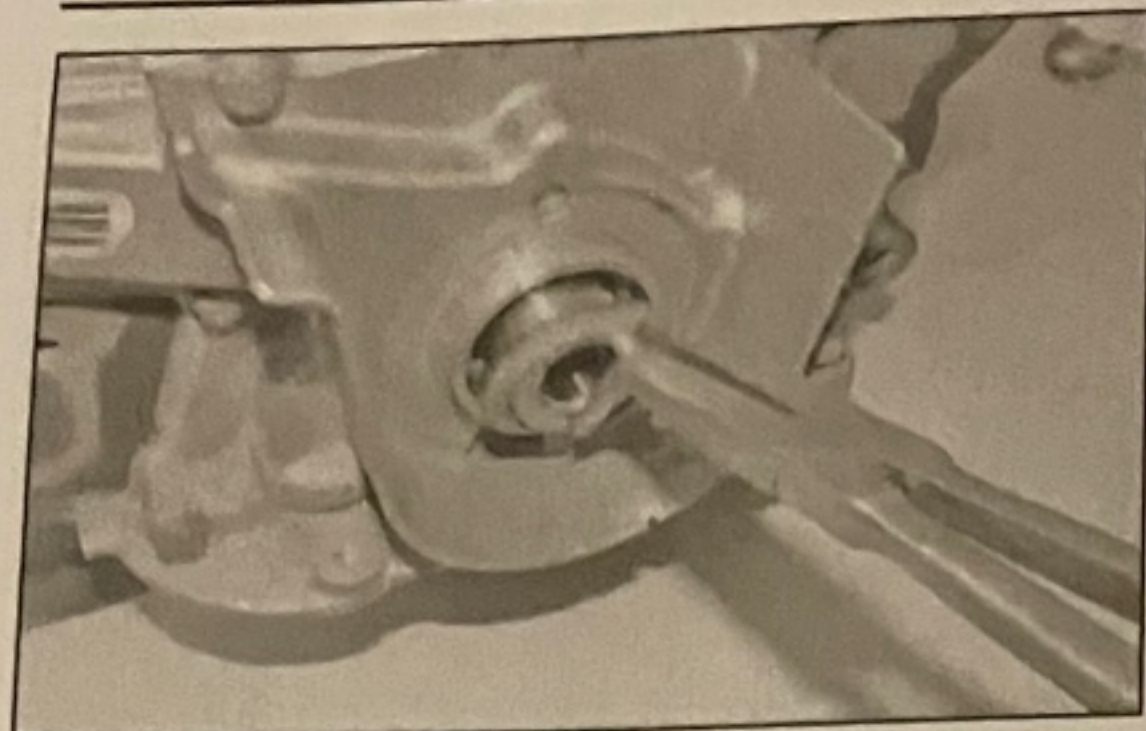
16 Crankshaft oil seals – renewal

Right-hand oil seal

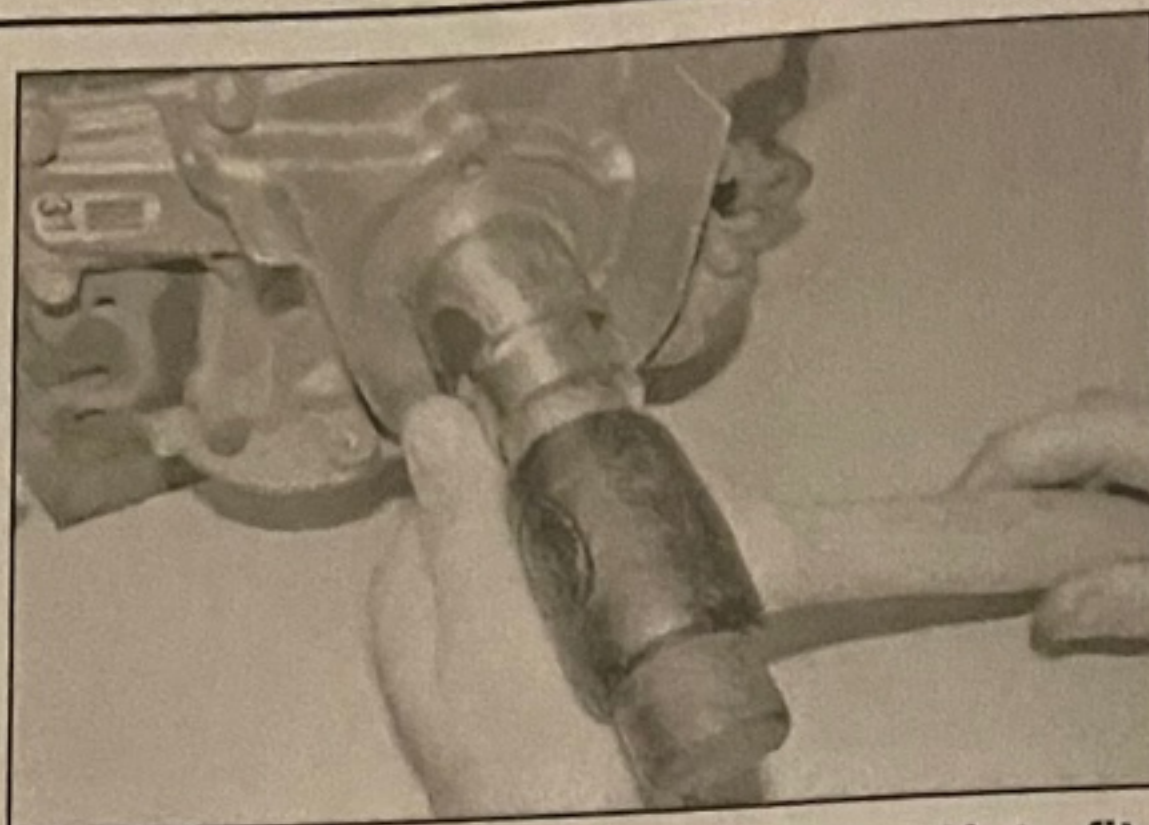
1 Remove the crankshaft sprocket as described in Section 7.



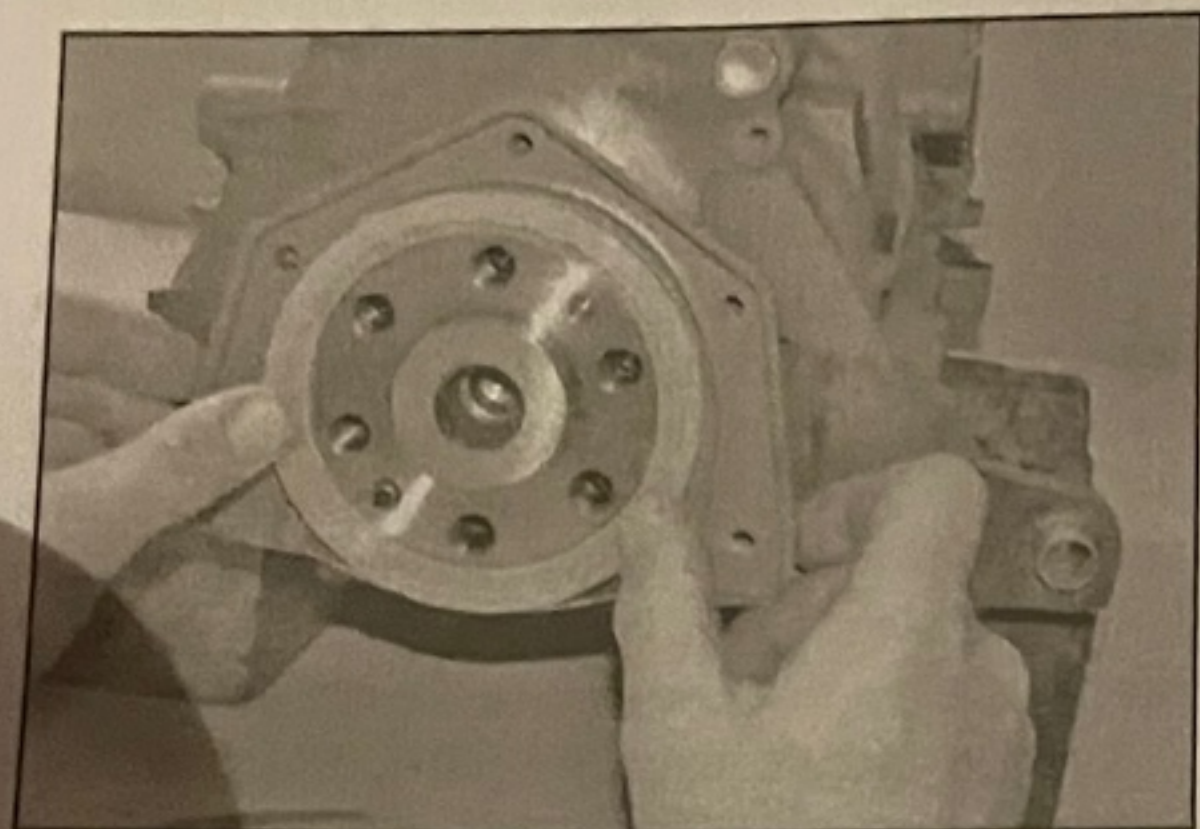
15.11b ... and to the return channel



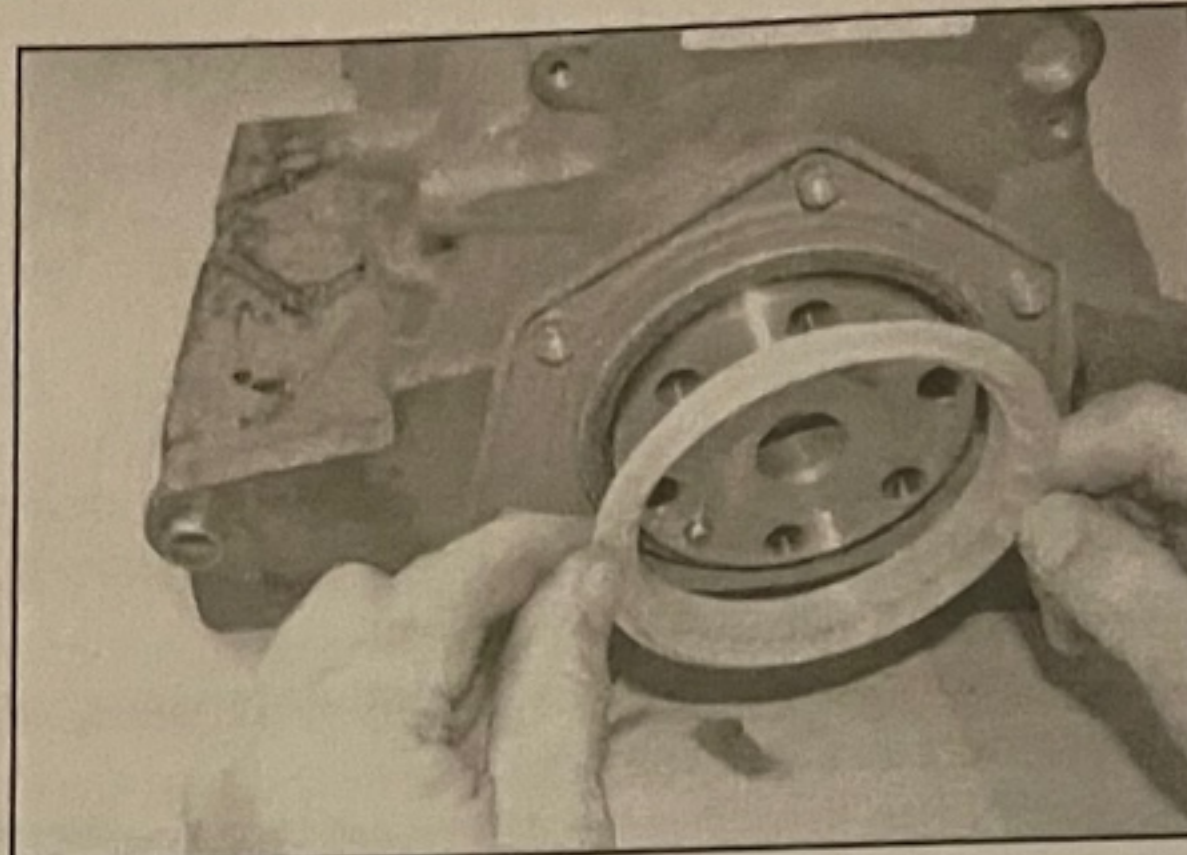
16.2 Screw in a self-tapping screw and pull on the screw with pliers to extract the oil seal



16.4 Use a socket as a tubular drift to fit the new oil seal



16.10 Fit the new housing with integral oil seal over the crankshaft



16.12 After fitting, remove the protector sleeve from the housing

2 Carefully punch or drill a small hole in the oil seal. Screw in a self-tapping screw and pull on the screw with pliers to extract the seal (see illustration).

3 Clean the seal housing and polish off any burrs or raised edges which may have caused the seal to fail in the first place.

4 Lubricate the lips of the new seal with clean engine oil and ease it into position on the end of the shaft. Press the seal squarely into position until it is flush with the housing. If necessary, a suitable tubular drift, which bears only on the hard outer edge of the seal, can be used to tap the seal into position (see illustration). Take great care not to damage the seal lips during fitting and ensure that the seal lips face inwards.

5 Wash off any traces of oil, then refit the crankshaft sprocket as described in Section 7.

Left-hand oil seal

6 Remove the flywheel/driveplate as described in Section 17.

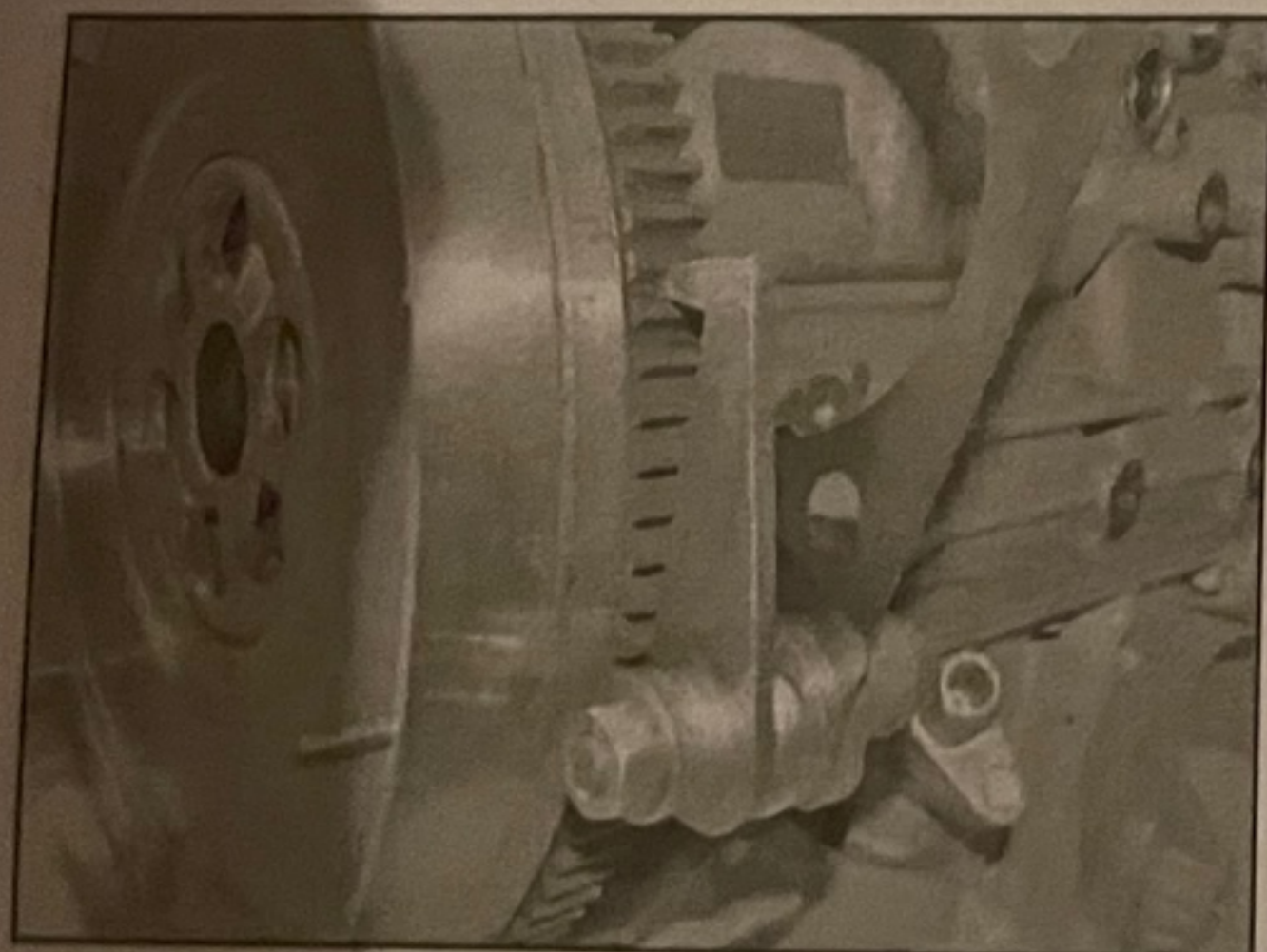
7 Remove the sump as described in Section 13.

8 Undo the five bolts and remove the oil seal housing. Note that the oil seal and the housing are a single assembly.

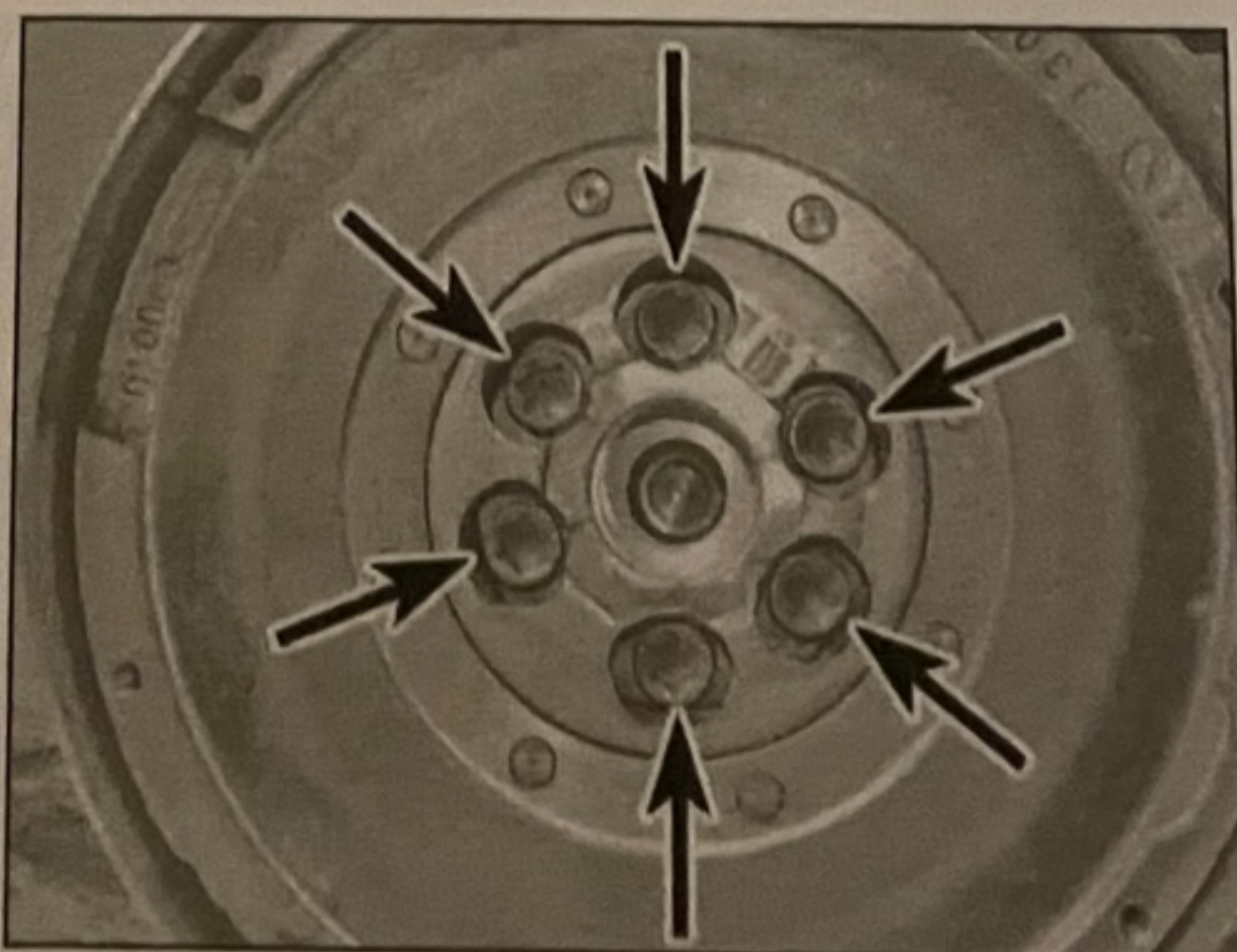
9 Clean the crankshaft and polish off any burrs or raised edges which may have caused the seal to fail in the first place.

10 Position the new oil seal housing, complete with seal, over the crankshaft and into position on the cylinder block (see illustration). Note that the new oil seal housing is supplied with a protector sleeve over the oil seal. Leave the sleeve in position as the housing is fitted.

11 Refit the five retaining bolts and tighten to the specified torque.



17.2 Prevent the flywheel from turning by locking the ring gear teeth



17.3 Flywheel retaining bolts (arrowed)

12 Remove the protector sleeve from the housing (see illustration).

13 Refit the sump as described in Section 13.

14 Refit the flywheel/drive plate as described in Section 17.

17 Flywheel/driveplate - removal, inspection and refitting

Note: New flywheel/driveplate retaining bolts will be required on refitting.

Removal

Manual transmission models

1 Remove the transmission as described in Chapter 7A, then remove the clutch assembly as described in Chapter 6.

2 Prevent the flywheel from turning by locking the ring gear teeth with a similar arrangement to that shown (see illustration).

3 Slacken and remove the retaining bolts, then remove the flywheel (see illustration). Drop it, as it is very heavy.

Automatic transmission models

4 Remove the transmission as described in Chapter 7B then remove the driveplate as described in paragraphs 2 and 3.

Inspection

5 If there is any doubt about the condition of the flywheel/driveplate, seek the advice of a Saab dealer or engine reconditioning specialist. They will be able to advise if it is possible to recondition it or whether replacement is necessary.

Refitting

Manual transmission models

6 Clean the mating surfaces of the flywheel and crankshaft.

7 Offer up the flywheel and engage it over the positioning dowel on the crankshaft. Apply a drop of locking compound to the threads of each new flywheel retaining bolt (unless they are pre-coated) and install the new bolts.

8 Lock the flywheel by the method used on removal then, working in a diagonal sequence, evenly and progressively tighten the retaining bolts to the specified torque.

9 Refit the clutch as described in Chapter 7A then remove the locking tool, and refit the transmission as described in Chapter 7A.

Automatic transmission models

10 Refit the driveplate as described in paragraphs 6 to 8.

11 Remove the locking tool, and refit the transmission as described in Chapter 7A.

18 Engine/transmission mountings - inspection and renewal

Refer to Chapter 2A, Section 13.