






Chapter 2 Part B:

1.4 litre engine in-car repair procedures

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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	
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Specifications

General

Engine code*	182 A3.000
Bore	82.0 mm
Stroke	64.9 mm
Compression ratio	9.85:1
Firing order	1-3-4-2
No 1 cylinder location	Timing (right-hand) end of engine

*Note: See 'Vehicle identification numbers' for the location of code marking on the engine.

Lubrication system

Oil pump type	Bi-rotor driven from front of crankshaft
Outer rotor-to-housing clearance	0.080 to 0.186 mm
Axial clearance	0.025 to 0.061 mm
Oil pressure (at operating temperature)	15 psi at idle, to 58 psi at 4000 rpm

Torque wrench settings

	Nm	lbf ft
Air conditioning compressor mounting bracket-to-block	50	37
Alternator mounting bracket to block:		
M8 bolts	25	18
M10 bolts	70	52
Big-end (connecting rod) bearing cap bolts:		
Stage 1	20	15
Stage 2	Angle-tighten a further 40°	
Camshaft caps	15	11
Camshaft cover	9	7
Camshaft sprocket	120	89
Coolant pipe to block:		
M6 bolts	9	7
M8 bolts	25	18
Crankshaft pulley-to-sprocket bolts	25	18
Crankshaft sensor	9	7
Crankshaft sprocket bolt (left-hand thread)	360	266
Cylinder head:		
Stage 1	20	15
Stage 2	40	30
Stage 3	Angle-tighten a further 90°	
Stage 4	Angle-tighten a further 90°	

Torque wrench settings (continued)	Nm	lbf ft
Engine oil dipstick tube	9	7
Engine/transmission mountings:		
Front mounting through-bolt	38	28
Left-hand mounting bracket to transmission:		
M10 bolts	45	33
M12 bolts	85	63
Mounting nuts	80	59
Mountings to bodyshell	32	24
Right-hand mounting bracket to block	70	52
Exhaust manifold nuts	25	18
Flywheel*	160	118
Inlet manifold nuts	25	18
Knock sensor	25	18
Main bearing cap bolts:		
Stage 1	20	15
Stage 2	Angle-tighten a further 100°	
Oil pressure switch	32	24
Oil pump bolts:		
M6 bolt	9	7
M8 bolt	25	18
Sump bolts:		
M6 bolt	9	7
M8 bolt	25	18
Timing belt covers	9	7
Thermostat housing bolts	25	18

*Although not specifically recommended by FIAT, use new bolts and locking fluid.

1 General information

Using this Chapter

Chapter 2 is divided into five Parts; A to E. Repair operations that can be carried out with the engine in the vehicle are described in Parts A to D. Part E covers the removal of the engine/transmission as a unit, and describes the engine dismantling and overhaul procedures.

In Parts A to D, the assumption is made that the engine is installed in the vehicle, with all ancillaries connected. If the engine has been removed for overhaul, the preliminary dismantling information which precedes each operation may be ignored.

Engine description

The 1.4 litre engine is a water-cooled, single overhead camshaft, in-line four-cylinder unit, with cast-iron cylinder block and aluminium-alloy cylinder head. The engine is a 12-valve unit, with two inlet valves per cylinder. The engine is mounted transversely at the front of the vehicle, with the transmission bolted to the left-hand side of the engine.

The cylinder head carries the camshaft, which is driven by a toothed timing belt and runs in five bearings. It also houses the inlet and exhaust valves, which are closed by single coil springs, and which run in guides pressed into the cylinder head. The camshaft actuates the valves directly via cam followers; the valve clearances are maintained by hydraulic tappets mounted in the cylinder head. The

cylinder head contains integral oilways which supply and lubricate the tappets.

The crankshaft is supported by five main bearings, and endfloat is controlled by thrust washers fitted either side of the centre main bearing.

Engine coolant is circulated by a pump, driven by the timing belt. For details of the cooling system, refer to Chapter 3.

Lubricant is circulated under pressure by a pump, driven from the front of the crankshaft. Oil is drawn from the sump through a strainer, and then forced through an externally-mounted, replaceable screw-on filter. From there, it is distributed to the cylinder head, where it lubricates the camshaft journals and tappets, and also to the crankcase, where it lubricates the main bearings, connecting rod big and small-ends, gudgeon pins and cylinder bores.

Repair operations possible with the engine in the car

The following work can be carried out with the engine in the car:

- Auxiliary drivebelt - removal and refitting (see Chapter 1).*
- Camshaft - removal and refitting*.*
- Camshaft oil seals - renewal.*
- Camshaft sprocket - removal and refitting.*
- Coolant pump - removal and refitting (refer to Chapter 3).*
- Crankshaft oil seals - renewal.*
- Crankshaft sprocket - removal and refitting.*
- Cylinder head - removal and refitting.*
- Engine mountings - inspection and renewal.*
- Oil pump and pickup assembly - removal and refitting.*

k) *Sump.*

l) *Timing belt, sprockets and cover - removal, inspection and refitting.*

*Cylinder head dismantling procedures are detailed in Chapter 2E, Section 4, with details of camshaft and tappet removal.

Note: It is possible to remove the pistons and connecting rods (after removing the cylinder head and sump) without removing the engine. However, this is not recommended. Work of this nature is more easily and thoroughly completed with the engine on the bench, as described in Chapter 2E.

2 Location of TDC on No 1 cylinder

1 With the car parked on a level surface, apply the handbrake and chock the rear wheels. Loosen the right-hand front wheel bolts.

2 Raise the front of the vehicle, rest it securely on axle stands and remove the right-hand front roadwheel.

3 Unscrew and release the fasteners, and remove the wheelarch inner panel, to gain access to the crankshaft pulley.

4 To make the engine easier to turn, remove all four spark plugs, as described in Chapter 1. If preferred, however, it is sufficient to remove just No 1 spark plug (nearest the timing belt end of the engine).

5 Have an assistant turn the engine using a spanner or socket on the crankshaft pulley centre bolt. As this is done, place a finger over No 1 spark plug hole, and feel for pressure build-up.

6 Once pressure is felt, continue turning the engine until the crankshaft pulley timing mark is aligned with the mark on the oil pump cover or timing belt lower cover (see illustration).

7 For further confirmation that the engine is at TDC with No 1 cylinder on compression, remove the camshaft cover as described in Section 6. The camshaft lobes for No 1 cylinder will be just above horizontal (valves closed, cylinder on compression), while those for No 4 cylinder will be pointing downwards, opening the exhaust valve (see illustration).

8 The engine is now set at TDC on No 1 cylinder.

3 Cylinder compression test

1 When engine performance is down, or if misfiring occurs which cannot be attributed to the ignition or fuel systems, 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 engine must be fully warmed-up to normal operating temperature, the battery must be fully charged, and all the spark plugs must be removed (Chapter 1). The aid of an assistant will also be required.

3 Disable the ignition system by disconnecting the LT wiring plug to the ignition coil.

4 To prevent possible damage to the catalytic converter, depressurise and disable the fuel injection system by removing the fuel pump fuse or relay (see Chapter 4A, Section 8).

5 Fit a compression tester to the No 1 cylinder spark plug hole - the type of tester which screws into the plug thread is to be preferred.

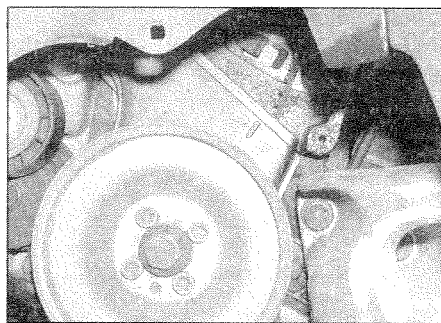
6 Have the assistant hold the throttle wide open, and crank the engine on the starter motor; after one or two revolutions, the compression pressure should build up to a maximum figure, and then stabilise. Record the highest reading obtained.

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

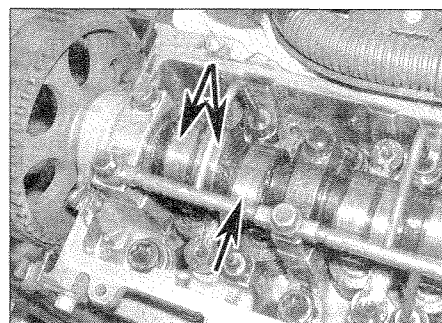
8 All cylinders should produce very similar pressures; any excessive difference indicates the existence of a fault. Note that the compression should build up quickly in a healthy engine; low compression on the first stroke, followed by gradually increasing pressure on successive strokes, indicates worn 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).

9 If the pressure in any cylinder is very low, carry out the following test to isolate the cause. Introduce a teaspoonful of clean oil into that cylinder through its spark plug hole and repeat the test.

10 If the addition of oil temporarily improves



2.6 Notch in crankshaft pulley aligned with rib mark on timing belt lower cover



2.7 Camshaft lobes for No 1 cylinder (arrowed) pointing upwards

the compression pressure, this indicates that bore or piston wear is responsible for the pressure loss. No improvement suggests that leaking or burnt valves, or a blown head gasket, may be to blame.

11 A low reading from two adjacent cylinders is almost certainly due to the head gasket having blown between them; the presence of coolant in the engine oil will confirm this.

12 If one cylinder is about 20 percent lower than the others and the engine has a slightly rough idle, a worn camshaft lobe could be the cause.

13 On completion of the test, refit the spark plugs and restore the ignition and fuel systems.

4 Timing belt and covers - removal and refitting

Note: If the timing belt is being removed, it is a wise precaution to check the condition of the coolant pump at the same time (check for signs of coolant leakage). This may avoid the need to remove the timing belt again at a later stage, should the coolant pump fail.

General information

1 The function of the timing belt is to drive the camshaft and coolant pump. Should the belt slip or break in service, the valve timing will be disturbed and piston-to-valve contact will occur, resulting in serious engine damage.

2 For this reason, it is important that a new timing belt is fitted at or before the specified mileage (see Chapter 1). If the car has been

purchased second-hand, and its history is unknown, renewing the timing belt should be treated as a priority.

3 FIAT garages use a pair of special tools to keep the camshaft and crankshaft sprockets at the TDC position, since it is possible that the sprockets may turn as the old belt is removed and the new one fitted. If they turn independently, the valve timing will be lost, and the engine will not run properly when restarted - worse, piston-to-valve contact may occur.

4 In the absence of the special tools, great care must be taken when removing and refitting the belt that the sprockets do not move. Marks may be found on the sprockets, which align with markings on the cylinder head or oil pump housing. If none are present, take care to make your own, using typists correction fluid or similar, **before** removing the belt.

5 If the special tools are not used, the procedure given below will suffice to change the belt successfully, but if care is not taken and the camshaft timing is slightly out, the engine may not run very well on completion. It is advisable to have a FIAT dealer confirm the camshaft timing after a new belt is fitted, if the special tools are not used.

Removal

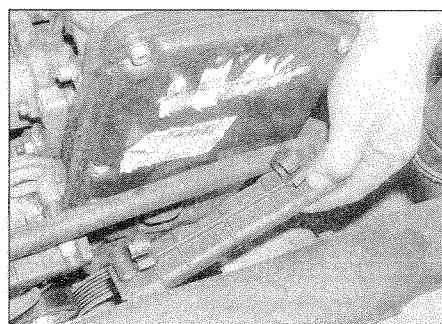
6 To improve access, remove the air cleaner cover and air ducting as described in Chapter 4A.

7 Remove the spark plugs (refer to Chapter 1).

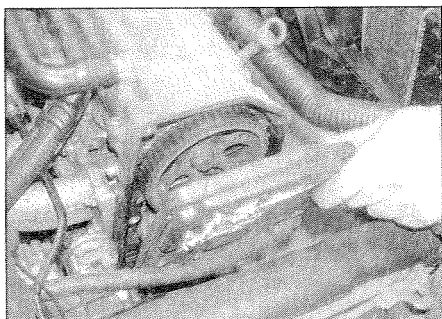
8 Remove the two bolts securing the coolant hose mounting brackets to the timing belt cover, then unclip the hose and move it out of the way (see illustrations).



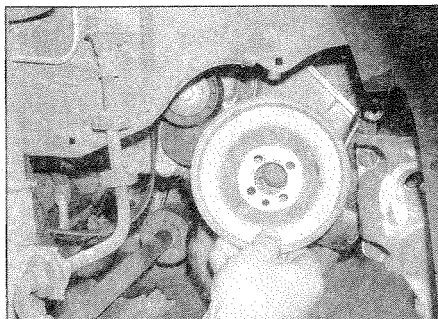
4.8a Unscrew the two mounting bracket bolts ...



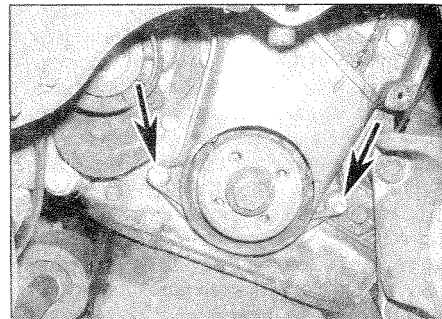
4.8b ... then unclip the hose and remove the mounting bracket



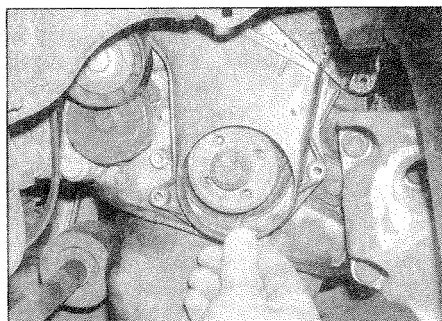
4.9 Removing the timing belt upper cover



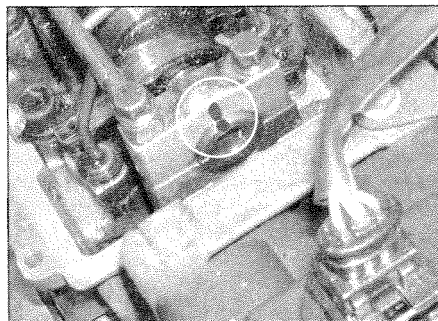
4.13 Removing the crankshaft pulley



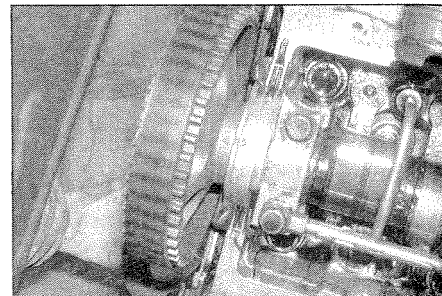
4.14a Remove the two bolts (arrowed) . . .



4.14b . . . and take off the timing belt lower cover



4.15a Alignment mark made between the camshaft and the end bearing cap . . .



4.15b . . . and between the camshaft and sprocket - useful if the sprocket is to be removed

9 Unbolt and remove the timing belt upper cover, which is secured by six bolts (see illustration).

10 Remove the camshaft cover as described in Section 6. With the cover removed, the camshaft can be marked for position (or the special FIAT locking tool can be fitted). In addition, removing the cover enables confirmation that the engine is at TDC on No 1 cylinder, as the camshaft lobes for No 1 cylinder will be just above horizontal (valves closed, cylinder on compression).

11 Set the engine to TDC as described in Section 2, then engage top gear; if the handbrake is firmly applied, this should prevent the crankshaft from moving.

12 Remove the auxiliary drivebelt from the crankshaft pulley as described in Chapter 1.

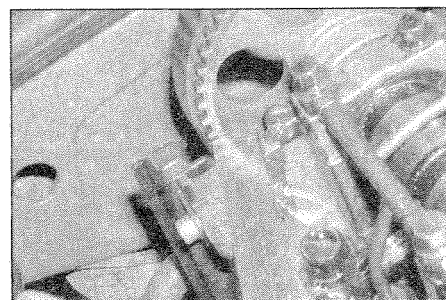
13 Remove the four small bolts and take off the crankshaft pulley (see illustration).

14 Remove the two bolts securing the timing

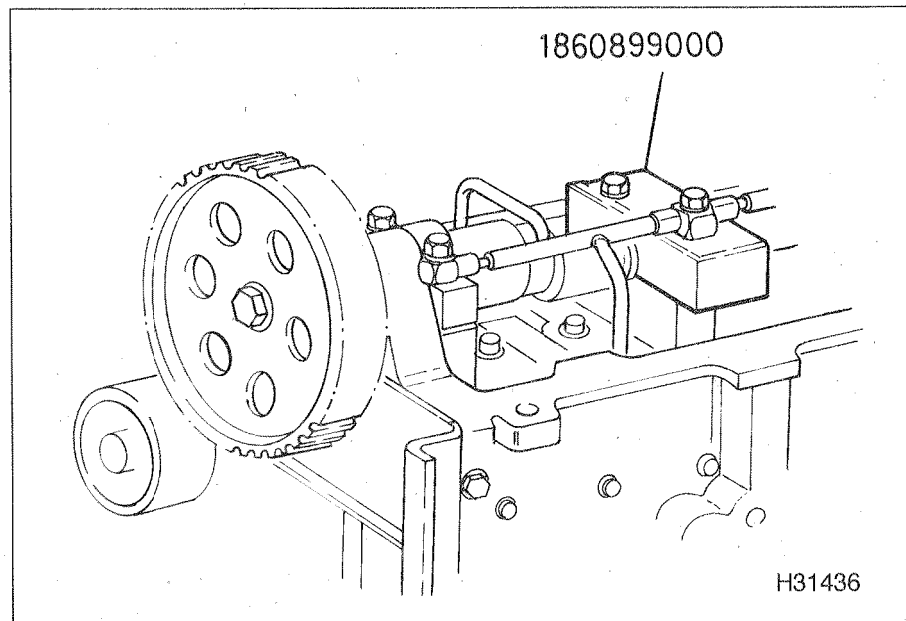
belt lower cover, and remove the cover (see illustrations).

15 If the special holding tools are not available, make your own sprocket alignment marks as necessary before removing the belt (see paragraph 4). If the camshaft cover is removed, an accurate mark can be made across the left-hand end of the camshaft and the left-hand bearing cap (left as seen from the driver's seat) (see illustrations).

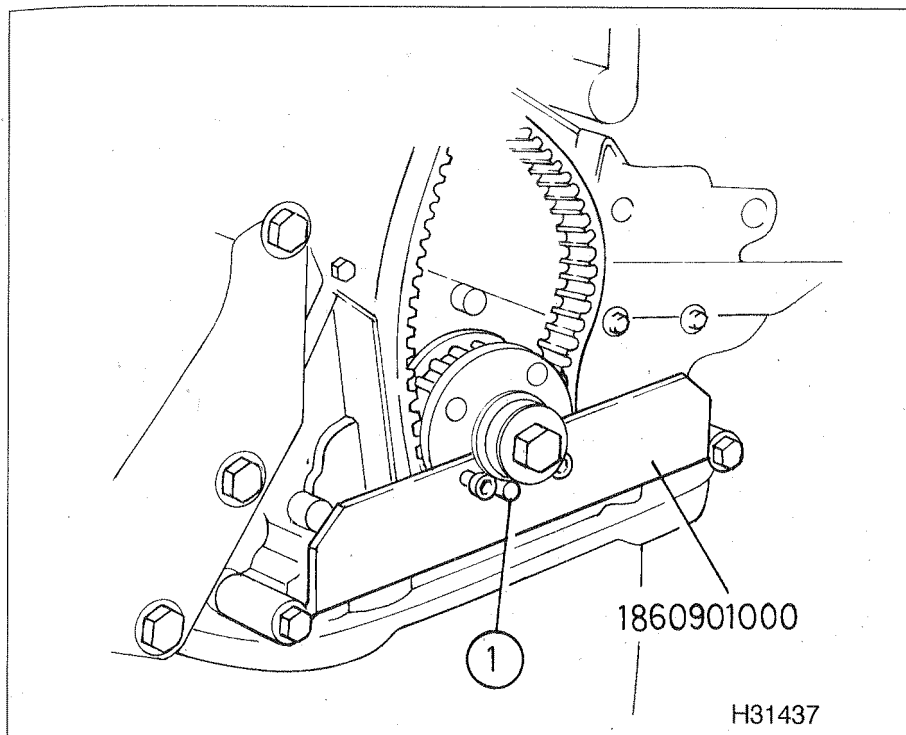
16 The FIAT tool (1860899000) for holding the camshaft stationary is a modified No 2 camshaft bearing cap which locates over one of the camshaft lobes, preventing rotation and maintaining the camshaft timing (see illustration). It is fitted after removing the camshaft cover, and loosening the other bearing cap bolts securing the camshaft oil feed pipe assembly. When the tool has been fitted, tighten all the bearing cap bolts to 10 Nm (7 lbf ft).



4.15c Use a ruler to mark the inside of the sprocket relative to the top of the cylinder head



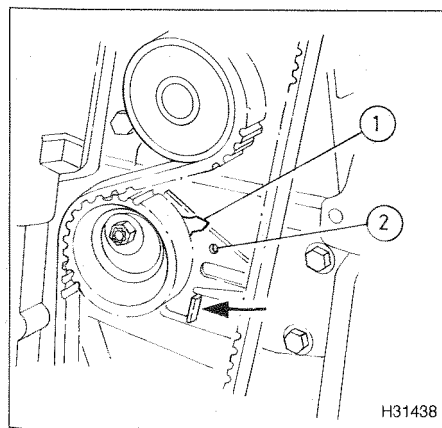
4.16 FIAT special tool used to lock the camshaft



4.17 FIAT special tool used to lock the crankshaft sprocket and locating peg (1)

17 The tool used to lock and time the crankshaft sprocket (1869901000) is a metal plate which bolts across the lower half of the sprocket, secured using the oil pump lower bolt holes (see illustration). The plate has two holes through which two of the crankshaft pulley bolts can be screwed into the crankshaft sprocket, and a smaller hole between the bolt holes, through which a locating peg can be inserted into a corresponding recess in the sprocket face, for timing.

18 Release the nut on the timing belt tensioner, move the pulley away from the belt and retighten the nut to hold the pulley in the retracted position (see illustration).



4.23a Timing belt tensioner details - vertical rib (arrowed), tensioner pointer (1) and alignment hole (2)

19 Slide the timing belt from the sprockets, taking great care not to turn them if locking tools have not been used (see illustration).

Refitting

20 When refitting the new belt, first make sure that the sprocket timing marks are still in alignment.

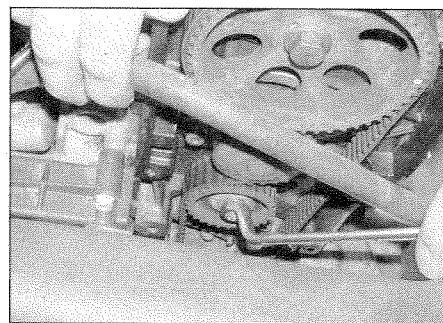
21 If the special locking tools are being used, the camshaft sprocket bolt should be loosened to allow the sprocket to move slightly as the timing belt is refitted and tensioned. To hold the sprocket stationary while the retaining bolt is loosened, make up a tool as described in Section 5.

22 If the special locking tools are not being used, it is not advisable to loosen the camshaft sprocket bolt unless absolutely necessary. If the timing belt teeth will not engage the camshaft sprocket satisfactorily, it is permissible to loosen the bolt and turn the sprocket *very slightly*.

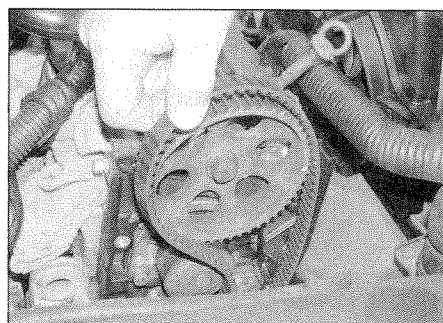
23 Fit the belt so that the arrows on the belt (where applicable) point in the direction of engine rotation. Also where applicable, the lines painted on the belt should coincide with marks on the sprockets.

22 Engage the timing belt with the crankshaft sprocket first, then place it around the camshaft sprocket and the coolant pump pulley. Finally, slip the belt around the tensioner sprocket. Ensure that any slack in the belt is on the tensioner side of the belt run.

23 Release the tensioner nut and push the pulley anti-clockwise against the belt, using



4.18 Release the timing belt tensioner nut



4.19 Removing the timing belt

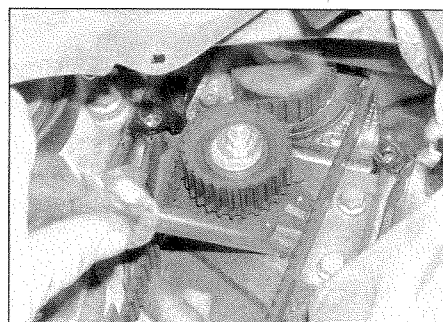
the small vertical rib on the tensioner backplate (see illustrations).

24 Initially, the belt should be set to the maximum tension possible using reasonable force, indicated by the tensioner pointer moving past the alignment hole in the tensioner backplate. Tighten the tensioner nut securely.

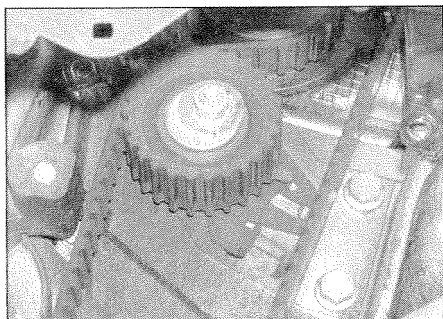
25 If the camshaft sprocket bolt was loosened, tighten it to the specified torque, holding the sprocket in the same way as when it was loosened.

26 Remove any locking tools used, and/or select neutral. Using a spanner or socket on the crankshaft pulley bolt, turn the engine through two complete turns in the normal direction of rotation. Check (as far as possible) that the sprocket timing marks come back into alignment.

27 Loosen the tensioner nut, and align the



4.23b Using a screwdriver to set the belt tensioner



4.27 Belt tensioner correctly set - pointer aligned with hole

tensioner pointer with the small hole on the tensioner backplate. Hold the tensioner in this position, and tighten the tensioner nut securely (see illustration).

28 Refit the timing belt lower cover, and secure with the two bolts.

29 Refit the crankshaft pulley, locating the pulley over the peg on the crankshaft sprocket and tightening the four bolts to the specified torque.

30 If the crankshaft has not turned, check that the mark on the crankshaft pulley aligns with the mark on the belt lower cover.

31 Further refitting is a reversal of removal. Refit and tension the auxiliary drivebelt as described in Chapter 1.

5 Timing belt sprockets and tensioner - removal and refitting



Timing belt tensioner

Removal

1 Remove the air cleaner and air ducting as described in Chapter 4A.

2 Remove the auxiliary drivebelt as described in Chapter 1.

3 Remove the two bolts securing the coolant hose mounting bracket to the timing belt cover, and move the hose out of the way.

4 Unbolt and remove the timing belt upper cover, which is secured by six bolts.

Caution: Provided the timing belt is kept fully engaged with the camshaft, crankshaft and coolant pump sprockets during the

following procedure, it is not necessary to align the timing TDC marks. However if any doubt exists, read through the full procedure given in Section 4, noting the advice on setting to TDC, and ensuring that the timing is not lost. The timing belt does not have to be removed for this procedure, but if the belt slips from the sprockets, the timing could be lost.

5 Loosen the nut on the timing belt tensioner and move the pulley away from the belt. If necessary, keep the belt engaged with the sprockets using cable-ties, elastic bands or string.

6 Completely unscrew the nut, and slide the tensioner off the mounting stud.

Inspection

7 Wipe the tensioner clean, but do not use excessive amounts of solvent, as these may contaminate the bearings. Spin the tensioner pulley on its hub by hand. Stiff movement or excessive freeplay is an indication of severe wear; the tensioner is not a serviceable component, and should be renewed if its condition is suspect, or as a precaution at the time of a major engine overhaul.

Refitting

8 Hold the timing belt aside, then slide the tensioner over the mounting stud and secure loosely with the nut. Ensuring that all slack is taken out of the belt, engage the timing belt with tensioner sprocket.

9 Set the belt tension with reference to Section 4, paragraphs 20 to 23.

10 Refit the timing belt cover and tighten the bolts. Refit the bolts securing the coolant hose to the timing belt cover.

11 Refit and tension the auxiliary drivebelt as described in Chapter 1.

12 Refit the air cleaner and air ducting as described in Chapter 4A.

Camshaft sprocket

Removal

13 Remove the timing belt as described in Section 4. It is essential that an alignment mark is made between the sprocket and the cylinder head, to preserve the camshaft timing - make your own if none are present, particularly if the camshaft holding tool described in Section 4 is not available.

14 The camshaft sprocket must now be held stationary while the retaining bolt is loosened; if the sprocket turns very far, there is a risk that the valves will hit the pistons. Make up a tool as follows and engage it with the holes in the sprocket (see illustration).

TOOL TIP

To make a camshaft sprocket holding tool, obtain two lengths of steel strip about 6 mm thick by 30 mm wide or similar, one 600 mm long, the other 200 mm long (all dimensions approximate). Bolt the two strips together to form a forked end, leaving the bolt slack so that the shorter strip can pivot freely. At the end of each 'prong' of the fork, secure a bolt with a nut and a locknut, to act as the fulcrums; these will engage with the cut-outs in the sprocket, and should protrude by about 30 mm.

15 Alternatively, pass a rod through one of the holes in the camshaft sprocket to prevent it rotating. Position a pad of rag or a piece of wood under the rod to avoid damaging the cylinder head.

16 Unscrew the bolt, and slide the sprocket from the end of the camshaft. Note the integral location key on the inner face of the sprocket (see illustrations).

Inspection

17 With the sprocket removed, examine the camshaft oil seal for signs of leaking. If necessary, refer to Section 7 and renew it.

18 Check the sprocket teeth for damage.

19 Wipe clean the sprocket and camshaft mating surfaces.

Refitting

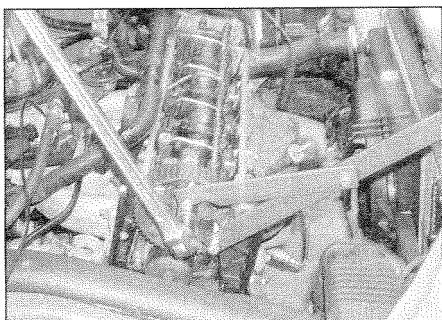
20 Locate the sprocket on the end of the camshaft. Refit the bolt and tighten to the specified torque while holding the camshaft stationary using the method described previously.

21 Align the marks made between the camshaft sprocket and cylinder head, then refit the timing belt as described in Section 4.

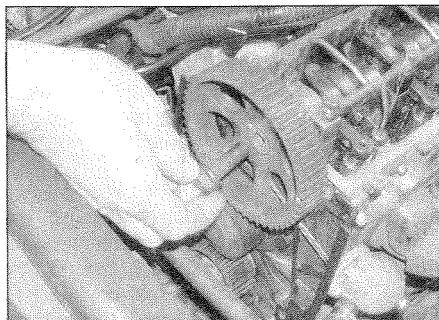
Crankshaft sprocket

Removal

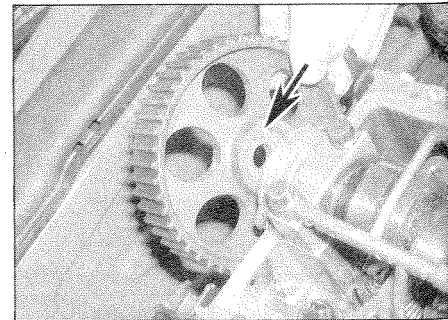
22 Remove the timing belt as described in



5.14 Hold the camshaft sprocket as the bolt is loosened



5.16a Remove the camshaft sprocket bolt ...



5.16b ... and remove the sprocket - note keyway (arrowed)

Section 4. It is essential that an alignment mark is made between the sprocket and the oil pump housing, to preserve the timing - make your own if none are present, particularly if the sprocket holding tool described in Section 4 is not available.

23 Working beneath the engine, unbolt and remove the flywheel lower cover, then hold the flywheel stationary, preferably using a tool which engages the flywheel starter ring gear (see Section 10). Alternatively, have an assistant engage a wide-bladed screwdriver with the starter ring gear.

24 Unscrew the crankshaft sprocket retaining bolt - this is tightened to a particularly high torque, so ensure that the car is adequately supported. Use only good-quality, close-fitting tools, and take precautions against personal injury, especially when the bolt eventually loosens (wear gloves to protect your hands). The bolt has a **left-hand thread** - ie it unscrews **clockwise**.

25 Slide the sprocket off the end of the crankshaft. If it is tight, remove it using a puller or a pair of suitable screwdrivers. The sprocket may have an integral location key on its inner face, or a separate key which locates in a groove in the crankshaft nose.

Inspection

26 With the sprocket removed, examine the crankshaft oil seal for signs of leaking. If necessary, refer to Section 8 and renew it.

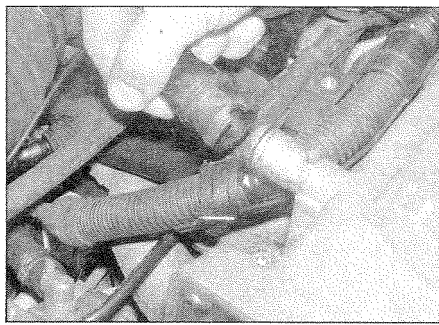
27 Wipe clean the sprocket and crankshaft mating surfaces. Check the sprocket teeth for damage.

Refitting

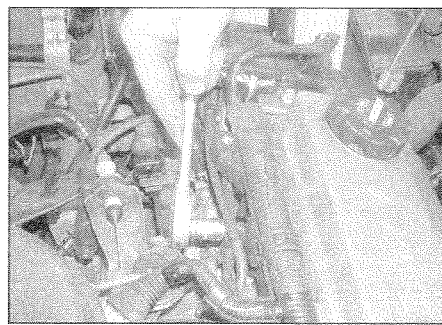
28 Slide the sprocket onto the crankshaft, making sure it engages the integral key or separate key. Fit the washer to a new bolt - do not lubricate the threads. It is not advisable to re-use the old bolt, given the extremely high torque to which it is tightened.

29 Fit the new bolt and washer, tightening the bolt to the specified torque while holding the crankshaft stationary using the method described in paragraph 23. Also bear in mind the advice in paragraph 24.

30 Refit the timing belt as described in Section 4.



6.1 Disconnecting the breather hose from the camshaft cover



6.3 Remove the two wiring harness brackets from the rear of the head

6 Camshaft cover - removal and refitting

Note: The camshaft cover is secured by *Ribe* bolts, which are similar in appearance to *Torx* types, but require different tools. A set of *Ribe* sockets can be obtained from good tool stockists - larger *Ribe* bolts are used to secure the cylinder head.

Removal

1 Remove the air cleaner top cover and inlet duct as described in Chapter 4A (see illustration).

2 Remove the three bolts securing the engine top cover, and loosen the fourth bolt at the rear of the engine, behind the timing belt cover. Remove the top cover from the engine compartment.

3 Loosen and remove the two bolts securing the wiring harness brackets to the rear of the cylinder head, and move the harness back out of the way (see illustration).



If the spark plugs have been removed as part of another procedure, place rags over the spark plug holes, to prevent the bolts falling into the engine.

4 Remove the two top Allen bolts securing the timing belt upper cover to the camshaft cover - there is no need to remove the timing belt upper cover completely.

5 Progressively unscrew the six *Ribe* bolts from the top of the camshaft cover and lift off the cover - note the location of any supports on the bolts (see illustrations). If it sticks, do not attempt to lever it off - instead free it by working around the cover and tapping it lightly with a soft-faced mallet.

6 Recover the camshaft cover gasket. Inspect the gasket carefully, and renew it if damage or deterioration is evident.

7 Clean the mating surfaces of the cylinder head and camshaft cover thoroughly, removing all traces of oil and old gasket - take care to avoid damaging the surfaces as you do this.

Refitting

8 Before refitting the cover, pull out the breather filter from the breather hose connection stub (see illustration). Clean the filter using suitable solvent, then refit it.

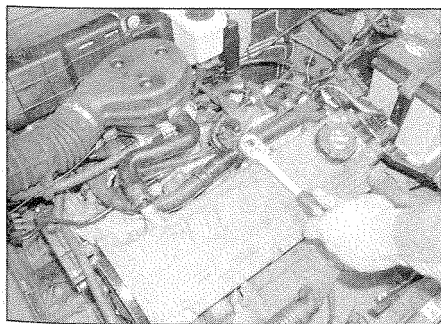
9 Locate a new gasket on the cylinder head and make sure it is correctly seated.

10 Lower the cover onto the gasket, making sure the gasket is not displaced.

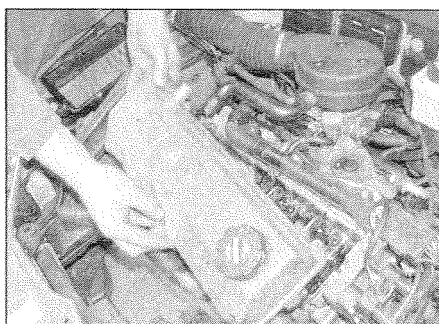
11 Insert the mounting bolts and tighten them progressively to the specified torque.

12 Refit the components removed for access using a reversal of the relevant removal procedure.

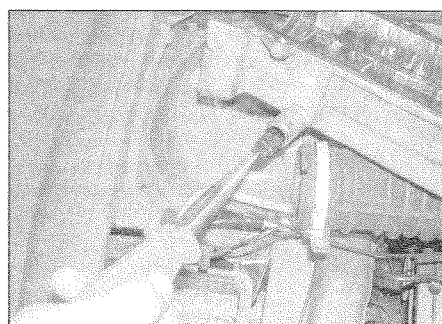
2B



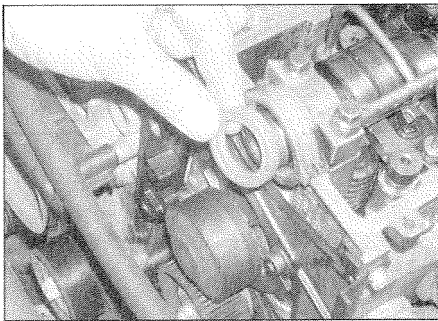
6.5a Unscrew the camshaft cover bolts ...



6.5b ... and lift off the cover



6.8 Removing the breather filter from the camshaft cover



7.4 Lubricate the new seal, then fit over the camshaft

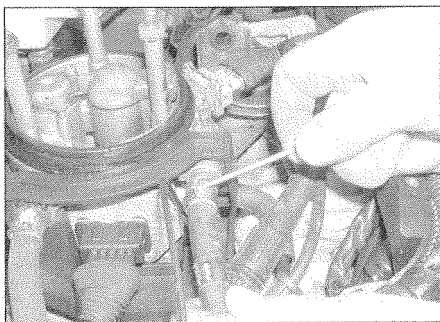
7 Camshaft oil seal - renewal

- 1 Remove the timing belt and camshaft sprocket as described in Sections 4 and 5.
- 2 Using a suitable hooked instrument, remove the oil seal from the cylinder head, taking care not to damage the surface of the camshaft.
- 3 Clean the seating in the cylinder head and the end of the camshaft. To prevent damage to the new oil seal as it is being fitted, wrap some adhesive tape around the end of the camshaft and lightly oil it.
- 4 Dip the new oil seal in oil then locate it over the camshaft, making sure that the sealing lips are facing inwards (see illustration).
- 5 Using a suitable tubular drift, drive the oil seal squarely into the cylinder head (see illustration). Remove the adhesive tape from the camshaft.
- 6 Refit the camshaft sprocket and timing belt with reference to Sections 5 and 4.

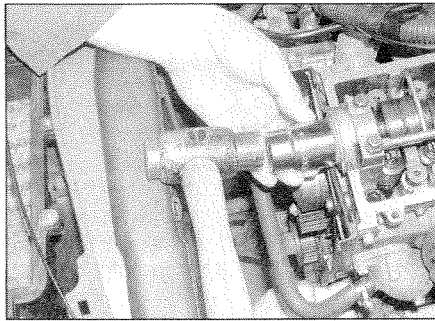
8 Crankshaft oil seals - renewal

Front (right-hand side) oil seal

- 1 The front oil seal is located in the oil pump on the front of the crankshaft. Remove the timing belt as described in Section 4 and the crankshaft sprocket as described in Section 5.



9.8a Release the hose clips ...



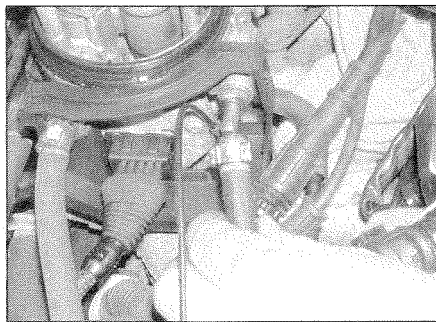
7.5 Tap the camshaft seal home using a large socket

- 2 Using a hooked instrument, remove the oil seal from the oil pump housing, taking care not to damage the surface of the crankshaft.
- 3 Clean the seating in the housing and the surface of the crankshaft. To prevent damage to the new oil seal as it is being fitted, wrap some adhesive tape around the end of the crankshaft and lightly oil it.
- 4 Dip the new oil seal in oil then offer it up to the oil pump casing making sure that the sealing lips are facing inwards.
- 5 Using a suitable tubular drift, drive the oil seal squarely into the casing. Remove the adhesive tape.
- 6 Refit the crankshaft sprocket and timing belt with reference to Sections 5 and 4.

Rear (left-hand side) oil seal

Note: The following paragraphs describe renewal of the rear oil seal leaving the housing in position. Refer to Chapter 2E for details of removing the housing.

- 7 Remove the flywheel as described in Section 10.
- 8 Using a suitable hooked instrument, remove the oil seal from the rear oil seal housing, taking care not to damage the surface of the crankshaft.
- 9 Clean the seating in the housing and the surface of the crankshaft. Check the crankshaft for burrs which may damage the oil seal lip of the new seal, and if necessary use a fine file to remove them.
- 10 Dip the new seal in clean engine oil and carefully locate it over the crankshaft rear flange, making sure that it is the correct way round (lips facing inwards). Take care not to



9.8b ... and disconnect the fuel supply ...

damage the oil seal lips as it passes over the crankshaft flange.

11 Progressively tap the oil seal into the housing, keeping it square to prevent distortion. A block of wood is useful for this purpose.

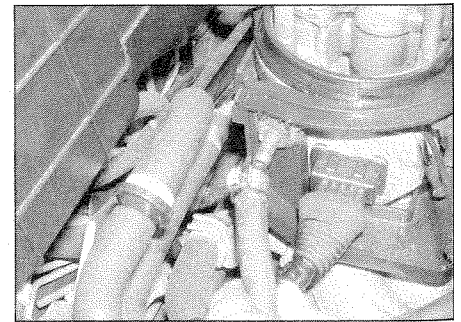
12 Refit the flywheel with reference to Section 10.

9 Cylinder head - removal and refitting

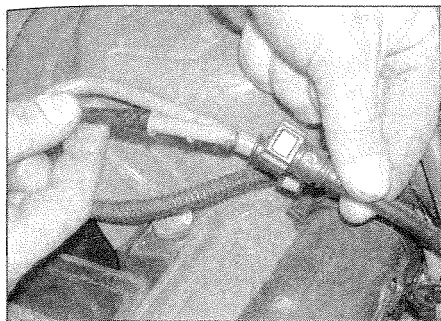
Note: The cylinder head is secured by Ribe bolts, which are similar in appearance to Torx types, but require different tools. A set of Ribe sockets can be obtained from good tool stockists - Ribe bolts are also used on other parts of the engine.

Removal

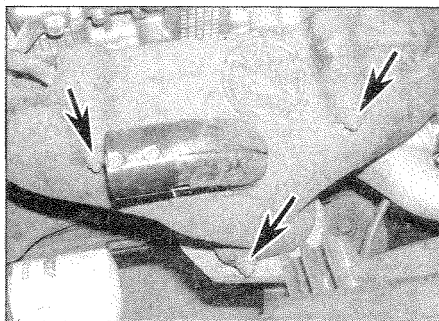
- 1 Depressurise the fuel system, and remove the air cleaner cover, air inlet duct and airbox as described in Chapter 4A.
- 2 Disconnect the battery negative terminal (refer to *Disconnecting the battery*).
- 3 Drain the cooling system as described in Chapter 1.
- 4 Remove the auxiliary drivebelt as described in Chapter 1.
- 5 Remove the spark plugs as described in Chapter 1.
- 6 Remove the timing belt from the camshaft sprocket, using the information in Section 4. Unless the belt has been changed recently, remove it completely and fit a new one on reassembly.
- 7 Disconnect the accelerator cable from the throttle body as described in Chapter 4A.
- 8 Taking precautions against fuel spillage, disconnect the fuel supply and return hoses from the throttle body (the fuel supply hose is at the front, and has an arrow indicating direction of fuel flow) (see illustrations).
- 9 Disconnect the charcoal canister hose, either at the throttle body, or at the connection above the inner wing (see illustration).
- 10 Disconnect the warm-air supply duct from the heat shield over the exhaust manifold. If the manifold is to be removed from the head (see



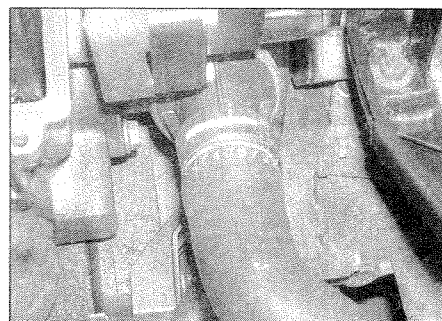
9.8c ... and return hoses from the throttle body



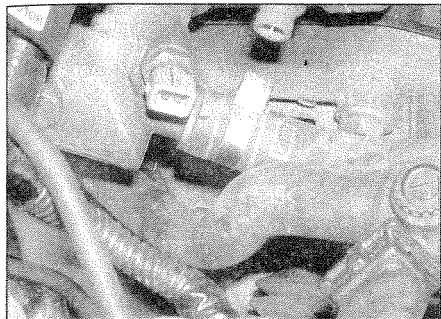
9.9 Disconnecting the charcoal canister hose at the inner wing



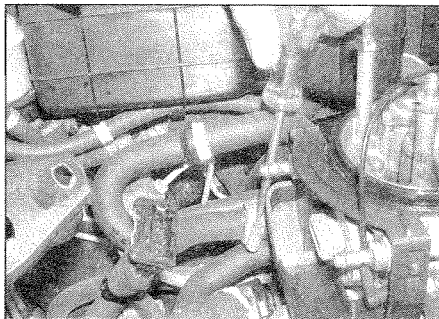
9.10 Exhaust manifold heat shield securing nuts (arrowed)



9.11a Disconnect the hoses at the front ...



9.11b ... and rear of the thermostat housing



9.12a Unscrew the hose clip ...



9.12b ... and disconnect the brake servo hose

paragraph 17), then remove the heat shield itself, which is secured by three nuts (see illustration).

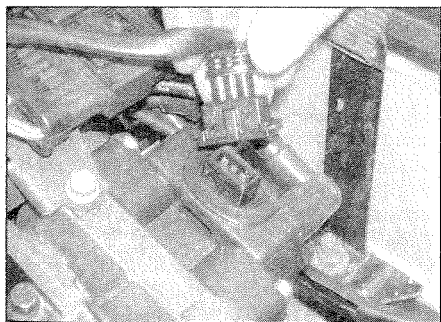
11 Disconnect the coolant hoses from the

front and rear of the thermostat housing (see illustrations).

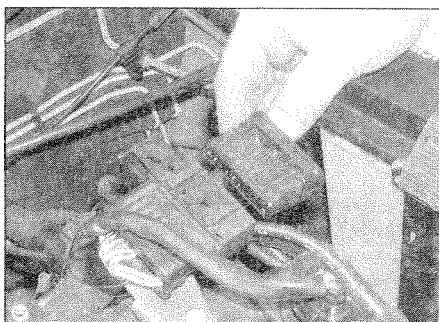
12 Unscrew the hose clip and disconnect the brake servo vacuum pipe (see illustrations).

13 Disconnect the following wiring:

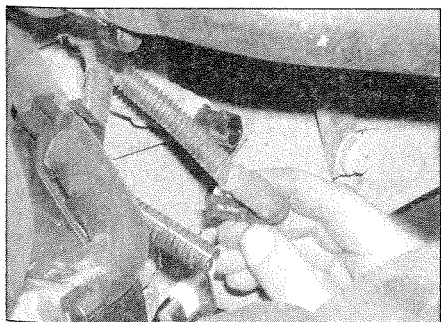
- a) Ignition coil (small wiring plug). Also disconnect the large fuel injection system wiring plug just behind the ignition coil (see illustrations).
- b) Reversing light switch - on the front of the transmission (see illustration).
- c) Detach the HT leads from the clip behind the ignition coil (see illustration).
- d) Three wiring plugs on the throttle housing (see illustration).
- e) Coolant temperature senders - on the left-hand end of the cylinder head (left as seen from the driver's seat) (see illustrations).
- f) Oxygen sensor wiring plug - clipped to a bracket at the front of the engine, below the thermostat housing (see illustration).



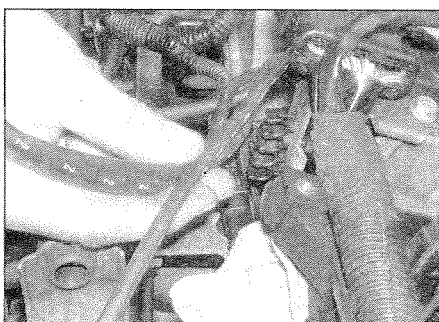
9.13a Disconnect the ignition coil LT wiring plug ...



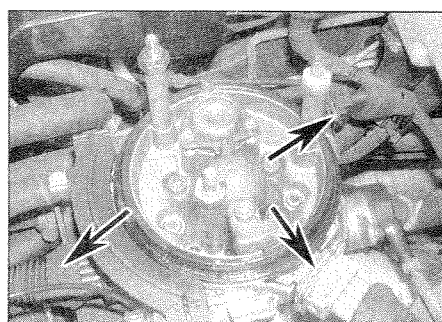
9.13b ... and the fuel injection wiring connector



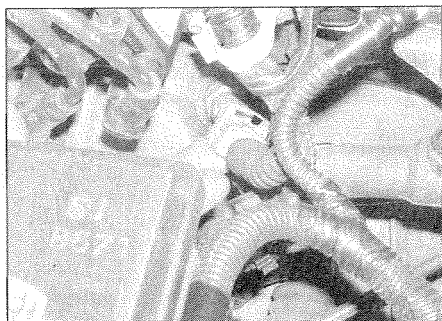
9.13c Disconnect the reversing light switch ...



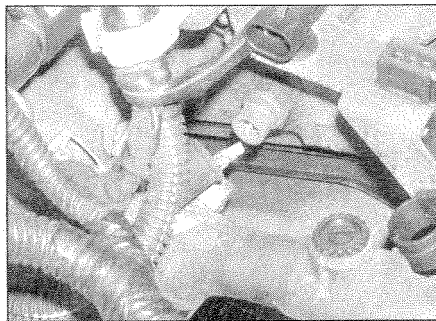
9.13d ... unclip the HT leads ...



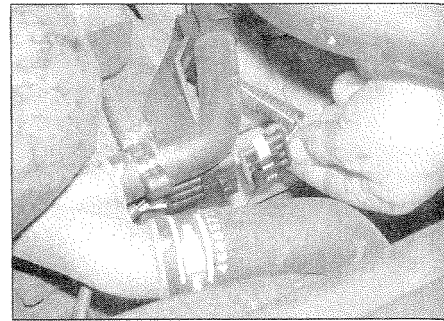
9.13e ... and unplug the wiring connectors at the throttle body



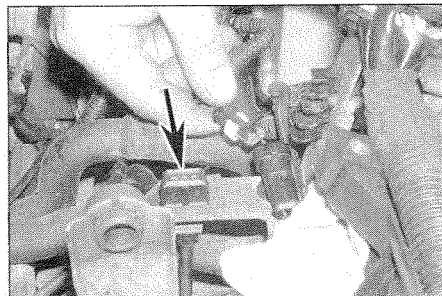
9.13f Unplug the fuel system coolant temperature sender ...



9.13g ... and the temperature gauge sender



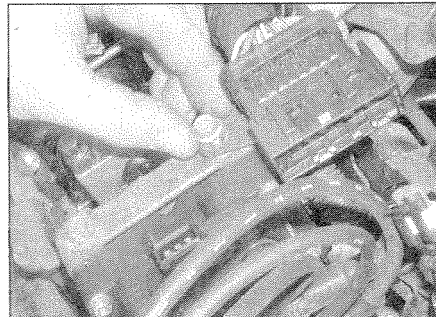
9.13h Disconnecting the oxygen sensor wiring plug



9.13i Disconnect the two wiring plugs behind the ignition coil - one seen disconnected (arrowed)

g) Two wiring plugs on the bracket at the rear of the ignition coil (see illustration).

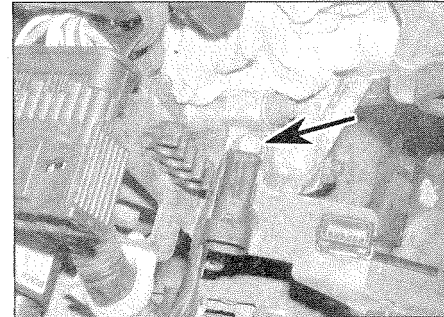
14 Remove the two bolts securing the wiring bracket at the rear of the ignition coil (see illustrations). Move the bracket clear of the



9.14a Unscrew the top bolt (which also secures the injection wiring connector) ...

cylinder head, unclipping the connector plug halves from it as necessary.

15 If not already done, working along the wiring harness at the rear of the cylinder head, unscrew the harness clip mounting bolts and

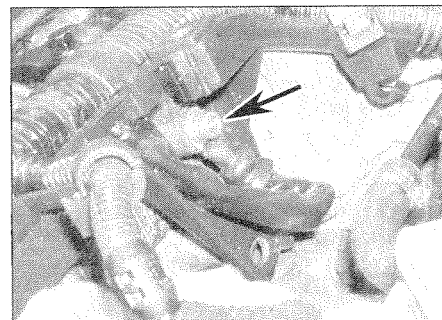


9.14b ... and the lower bolt securing the ignition coil wiring bracket

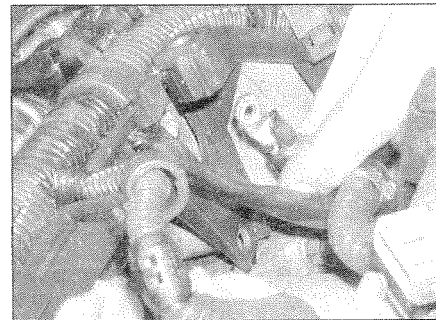
release the harness from the head. A further bolt secures the engine earth lead, which must also be disconnected. When the harness is free, lift it from the rear of the head, and move it to the right of the engine compartment (see illustrations).

16 Free the wiring harness which runs along the base of the inlet manifold by prising open the plastic guide channel (some models may have a cable-tie holding the channel together) (see illustrations). Work along the harness towards the timing belt end of the engine. The fluid pipe(s) from the power steering pump hamper removal of the harness, but we found that disconnecting the pipes was unnecessary.

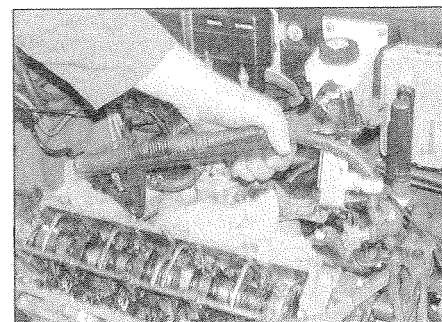
17 There are various potential options concerning the exhaust manifold. It is possible to remove the head with the exhaust manifold attached; alternatively, unbolt the manifold from the head and leave the manifold attached



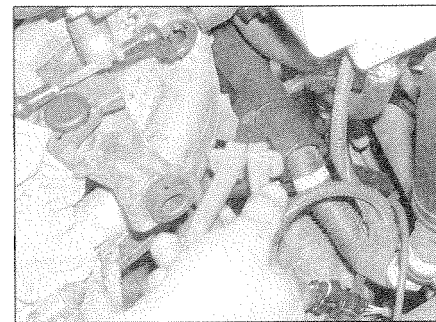
9.15a Unscrew the bolt below the wiring harness mounting bracket (arrowed) ...



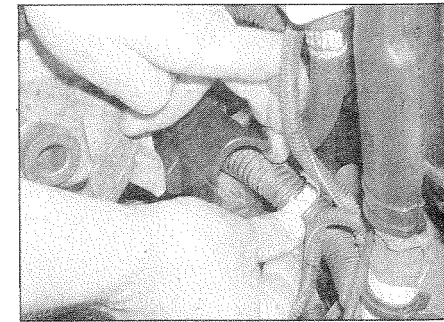
9.15b ... and disconnect the earth lead



9.15c Check that the harness is free, and move it clear of the head



9.16a Cut the cable-tie (where fitted) ...



9.16b ... and separate the plastic guide channel to release the wiring harness

to the downpipe. The safest option (although involving more work) is to remove the exhaust manifold completely, as described.

18 Working under the car, unscrew the four exhaust manifold-to-downpipe nuts, and separate the joint (see illustration). Recover the gasket.

19 Unscrew the manifold-to-cylinder head nuts, and withdraw the manifold from the cylinder head, recovering the gasket.

20 In some cases, the manifold studs will come out with the nuts - this poses no great problem, and the studs can be refitted if they are in good condition. For preference, however, a complete set of manifold and downpipe studs and nuts should be obtained as required, as the old ones are likely to be in less-than-perfect condition.

21 If the downpipe is lowered to the floor, check that the wiring to the oxygen sensor (at the top of the downpipe) is not placed under strain. The wiring plug has already been disconnected, so feed the wiring through.

22 Remove the bolt securing the upper end of the engine oil dipstick tube to the cylinder head, then pull the tube upwards to remove it (see illustration). Removing the tube may displace the seal at the base of the tube - if so, refit it now or store it with the tube for refitting.

23 Check around the head that there are no further wires, hoses or other obstructions which will prevent the head from being lifted off.

24 Unscrew the cylinder head Ribe bolts half a turn at a time, in the reverse order to that shown in illustration 9.42. When the bolts are free, remove them with their washers.

25 Lift the cylinder head from the block, together with the inlet manifold. If it is stuck tight, insert pieces of wood into the exhaust ports (if possible), and use them as levers to rock the head off the block. On no account drive levers into the gasket joint, nor attempt to tap the head sideways, as it is located on positioning dowels.

26 Remove and discard the cylinder head gasket and the manifold gaskets.

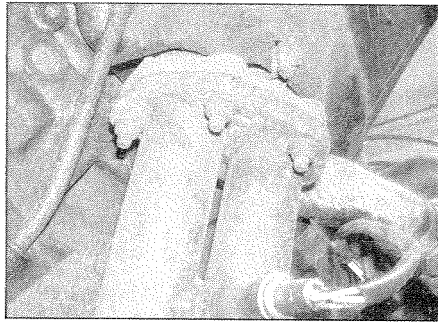
27 The cylinder head can be dismantled after removing the camshaft and cam followers as described in Chapter 2E. Further dismantling and decarbonising are also described in Chapter 2E.

Preparation for refitting

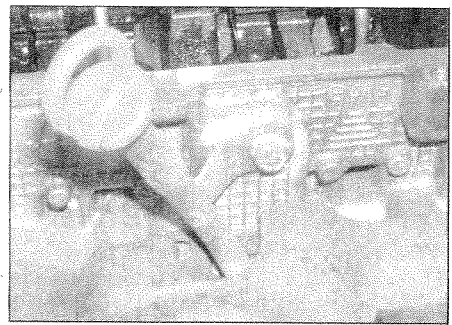
28 The mating faces of the cylinder head and cylinder block must be perfectly clean before refitting the head. Use a hard plastic or wooden scraper to remove all traces of gasket and carbon; also clean the piston crowns.

29 Take particular care when cleaning the piston crowns, as the soft aluminium alloy is easily damaged.

30 Make sure that the carbon is not allowed to enter the oil and water passages - this is particularly important for the lubrication system, as carbon could block the oil supply



9.18 Exhaust manifold-to-downpipe joint



9.22 Dipstick tube mounting bolt

to the engine's components. Using adhesive tape and paper, seal the water, oil and bolt holes in the cylinder block.

31 To prevent carbon entering the gap between the pistons and bores, smear a little grease in the gap. After cleaning each piston, use a small brush to remove all traces of grease and carbon from the gap, then wipe away the remainder with a clean rag. Clean all the pistons in the same way.

32 Check the mating surfaces of the cylinder block and the cylinder head for nicks, deep scratches and other damage. If slight, they may be removed carefully with a file, but if excessive, machining may be the only alternative to renewal.

33 If warpage of the cylinder head gasket surface is suspected, use a straight-edge to check it for distortion. Refer to Part E of this Chapter if necessary.

34 Check the condition of the cylinder head bolts, and particularly their threads, whenever they are removed. Wash the bolts in a suitable solvent, and wipe them dry. Check each bolt for any sign of visible wear or damage, renewing them if necessary.

Refitting

35 Before refitting the assembled cylinder head, make sure that the head and block mating surfaces are perfectly clean.

36 The bolt holes in the cylinder block must be mopped out to clear any oil or coolant. If the bolt holes have any significant amount of

liquid in them, the block could be cracked by hydraulic pressure when the head bolts are tightened.

37 Check that the camshaft marks made during dismantling (see Section 4) are aligned.

38 The new gasket should not be removed from its plastic bag until required for use. Fit the gasket dry - no grease or sealant should be used.

39 Place the gasket on the cylinder block so that the word ALTO can be read from above.

40 Lower the cylinder head onto the block so that it locates on the positioning dowels.

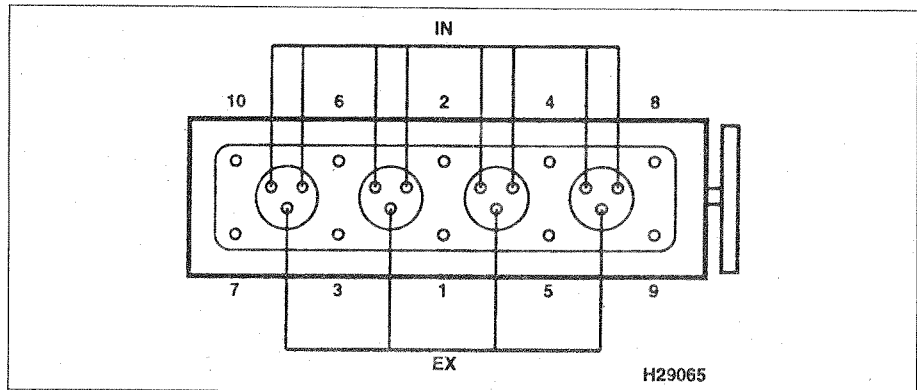
41 Ensure that the cylinder head bolts are cleaned of all debris, and check the threads for signs of damage. Especially if it is known that the bolts have been removed previously, it is advisable to renew all ten bolts as a set, rather than risk the bolts shearing when tightened.

42 Lightly oil the bolt threads. Screw the bolts in finger-tight, and tighten them in the sequence shown to the Stage 1 torque (see illustration).

43 When all ten bolts have been tightened to the Stage 1 torque, go round again in sequence and tighten to the Stage 2 torque.

44 Again working in sequence, tighten the bolts through the specified Stage 3 angle. Note that 90° is equivalent to a quarter-turn or right-angle, making it easy to judge by noting the initial position of the socket handle. If available, use an angle gauge fitted to the socket handle for maximum accuracy.

2B



9.42 Cylinder head bolt tightening sequence

45 With all ten bolts tightened to Stage 3, go round once more and tighten all bolts in sequence to the Stage 4 angle.

46 When all the bolts are fully tightened, refit the camshaft cover as described in Section 6.

47 Refit the exhaust manifold, using new gaskets, studs and nuts, as appropriate according to how the manifold was separated. Tighten all nuts securely.

48 Further refitting is a reversal of removal. Ensure that all wiring and hoses are correctly routed and securely reconnected. Refer to Section 4 when refitting the timing belt, and to Chapter 1 when refitting the spark plugs and auxiliary drivebelt, and when refilling the cooling system.

10 Flywheel - removal, inspection and refitting

Refer to Part A, Section 11.

11 Engine mountings - inspection and renewal

Inspection

1 Jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*).

2 Check the mounting rubbers to see if they are cracked, hardened or separated from the metal at any point; renew the mounting if any such damage or deterioration is evident.

3 Check that all the mounting's fasteners are securely tightened; use a torque wrench to check if possible.

4 Using a large screwdriver or a crowbar, check for wear in the mounting by carefully levering against it to check for free play. Where this is not possible enlist the aid of an assistant to move the engine/transmission back and forth, or from side to side, while you watch the mounting. While some free play is to be expected even from new components, excessive wear should be obvious. If excessive free play is found, check first that the fasteners are correctly secured, then renew any worn components as described below.

Renewal

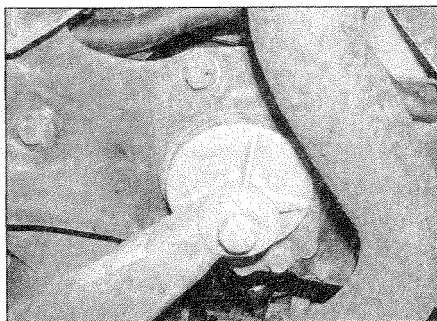
Right-hand mounting

5 Raise the front of the vehicle and support on axle stands (see *Jacking and vehicle support*).

6 Place a trolley jack beneath the right-hand side of the engine, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine.

7 Working from below, unscrew the nut securing the engine bracket to the mounting.

8 Lower the engine sufficiently to disengage the engine bracket from the mounting, then



11.15 View of the rear engine mounting, showing the through-bolt (centre) and two mounting-to-body bolts

remove the three bolts securing the mounting to the body, and remove it.

9 Locate the new mounting on the body, then insert the mounting-to-body bolts and tighten by hand.

10 Raise the engine and locate the bracket on the mounting. Refit the nut and tighten to the specified torque, then tighten the mounting-to-body bolts.

11 Remove the trolley jack and lower the vehicle to the ground.

Left-hand/rear mounting

12 Raise the front of the vehicle and support on axle stands (see *Jacking and vehicle support*).

13 Place a trolley jack beneath the transmission, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine/transmission.

14 Unscrew the through-bolt securing the transmission bracket to the mounting, and recover the washers.

15 Unscrew the two bolts securing the left-hand mounting to the body (see illustration).

16 Lower the transmission sufficiently to remove the mounting from the transmission bracket.

17 Locate the new mounting in position, and loosely refit the mounting-to-body bolts.

18 Raise the engine/transmission and refit the through-bolt securing the bracket to the mounting. Tighten the bolt to the specified torque, then tighten the mounting-to-body bolts.

19 Remove the trolley jack and lower the vehicle to the ground.



12.4 Applying sealant to the sump flange

Front mounting

20 Raise the front of the vehicle and support on axle stands (see *Jacking and vehicle support*).

21 Place a trolley jack beneath the engine/transmission flange, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine and transmission.

22 Working from below, unscrew the nut securing the bracket to the mounting.

23 Lower the engine sufficiently to disengage the bracket from the mounting, then remove the three bolts securing the mounting to the body, and remove it.

24 Locate the new mounting on the body, then insert the mounting-to-body bolts and tighten by hand.

25 Raise the engine and locate the bracket on the mounting. Refit the nut and tighten to the specified torque, then tighten the mounting-to-body bolts.

26 Remove the trolley jack and lower the vehicle to the ground.

12 Sump - removal and refitting

Removal

1 Jack up the front of the vehicle and support on axle stands. Drain the engine oil.

2 Unscrew the sump securing bolts and pull the sump downwards past the exhaust pipe to remove it. The joint sealant will require cutting with a sharp knife to release the pan.

Refitting

3 Clean away all old gasket material, from the sump pan and from the base of the block.

4 Apply a bead of RTV silicone instant gasket 3 mm in diameter to the sump flange. The bead of sealant should pass around the inside of the sump bolt holes (see illustration).

5 Fit the sump, screw in the fixing bolts and tighten in a diagonal sequence to the specified torque.

6 Wait one hour for the gasket compound to harden before filling with oil.

7 Lower the vehicle to the ground and fill the engine with oil (see Chapter 1). Check the oil level after running the engine for a few minutes, as described in *Weekly checks*.

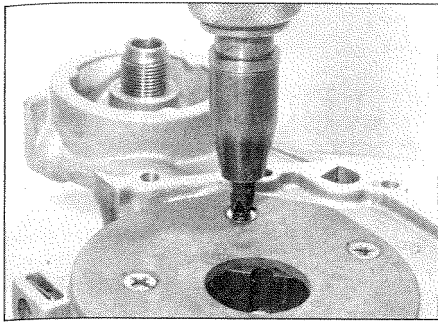
13 Oil pump and pick-up tube - removal and refitting

Removal

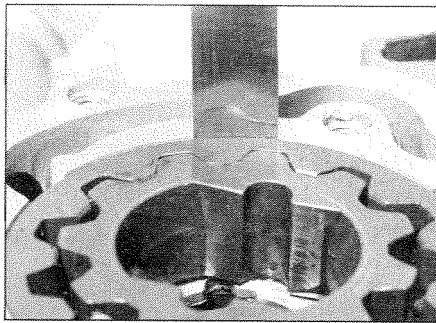
1 Drain the engine oil and remove the sump as described in Section 12.

2 Unbolt and remove the oil pick-up/filter screen assembly. Note the sealing washer.

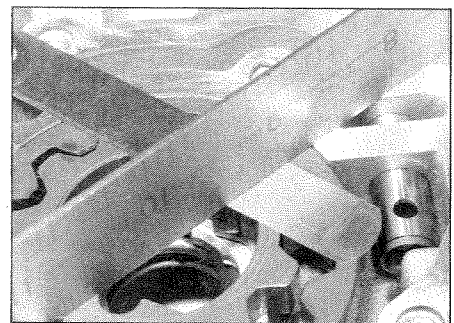
3 Unscrew and remove the oil filter cartridge (see Chapter 1).



13.8 Using an impact screwdriver to remove the oil pump rear cover plate screws



13.9a Measuring oil pump outer gear-to-pump housing clearance



13.9b Measuring oil pump gear endfloat

4 Remove the timing belt as described in Section 4.

5 Remove the crankshaft sprocket as described in Section 5.

6 Extract the oil pump fixing bolts, noting their locations (there are four long bolts, and four short ones). Withdraw the pump and remove the gasket.

Inspection

7 The oil pump incorporates a pressure relief valve, which can be removed for examination by unscrewing the plug and pulling out the spring and valve.

8 If pump wear is suspected, check the gears in the following way. Extract the five fixing screws and remove the rear cover plate. The screws are very tight, and will probably require the use of an impact screwdriver (**see illustration**).

9 Check the clearance between the outer gear and the pump housing using feeler blades. Check the gear endfloat by placing a straight-edge across the pump body, and checking the gap between the straight-edge and gear face (**see illustrations**). If the clearances are outside the specified tolerance, renew the oil pump complete.

10 If the pump is unworn, refit the rear cover plate and tighten the screws fully.

11 Apply air pressure from a tyre pump to the oil pump oil ducts, to clear any sludge or other material. If any solvents are used, the pump must be allowed to dry thoroughly before refitting.

12 Prime the pump by pouring clean engine oil into its inlet duct, at the same time turning the oil pump inner gear with your fingers.

13 Lever out the oil seal, and drive a new one squarely into the oil pump casing (**see illustration**). Lubricate the oil seal lips.

Refitting

14 Clean all traces of old gasket from the pump and the mating surfaces on the cylinder block.

15 Bolt the pump into position using a new joint gasket. Insert the four longer bolts into the positions noted on removal, and tighten all to the specified torques.

16 Bolt on the oil pick-up assembly using a new sealing washer.

17 Refit the crankshaft sprocket as described in Section 5.

18 Fit and tension the timing belt as described in Section 4.

19 Fit the pump as described in Section 12.

20 Screw on a new oil filter cartridge, and fill the engine with oil (**see Chapter 1**).

21 Run the engine for a few minutes, then

check and top-up the oil level as described in *Weekly checks*.

14 Oil pressure switch - removal and refitting



Removal

1 The oil pressure switch is located at the rear of the engine block, next to the knock sensor (**see illustration**). Access to the switch is hampered by the inlet manifold.

2 Disconnect the switch wiring connector (**see illustration**).

3 Unscrew the switch from the block, and remove it.

4 Clean the switch location in the block as far as possible. If the switch is to be refitted, clean its threads.

5 Examine the switch for signs of cracking or splits. If the top part of the switch is loose, this is an early indication of impending failure.

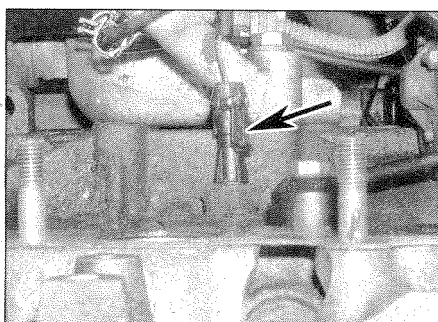
Refitting

6 Apply a smear of sealant to the threads of the switch, then screw it into place and tighten to the specified torque.

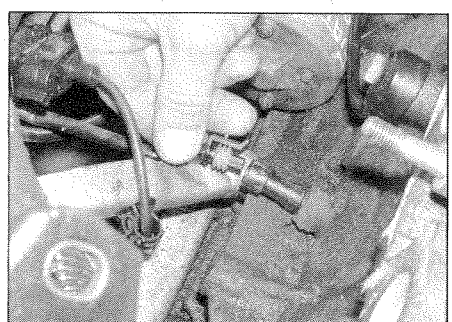
7 Reconnect the switch wiring on completion.



13.13 Using a socket to fit a new oil seal to the oil pump



14.1 Oil pressure switch (arrowed) - seen with inlet manifold removed



14.2 Disconnect the switch wiring connector