

Chapter 2 Part D:

1.8 litre engine in-car repair procedures

Contents

Auxiliary drivebelt - removal and refitting	See Chapter 1	Engine oil level - check	See <i>Weekly Checks</i>
Camshaft cover - removal and refitting	6	Flywheel - removal, inspection and refitting	10
Camshaft oil seals - renewal	7	General information	1
Camshafts - removal and refitting	See Chapter 2E, Section 4	Location of TDC on No 1 cylinder	2
Crankshaft oil seals - renewal	8	Oil pressure switch - removal and refitting	14
Cylinder compression test	3	Oil pump and pick-up tube - removal and refitting	13
Cylinder head - dismantling and overhaul	See Chapter 2E	Sump - removal and refitting	12
Cylinder head - removal and refitting	9	Timing belt and covers - removal and refitting	4
Engine mountings - inspection and renewal	11	Timing belt sprockets and tensioner - removal and refitting	5
Engine oil and filter - renewal	See Chapter 1		

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 code*	182 A2.000
Bore	82.0 mm
Stroke	82.7 mm
Compression ratio	10.3:1
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 0.070 mm
Oil pressure (at operating temperature)	15 psi at idle, 50 to 72 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	25	18
Stage 2	Angle-tighten a further 60°	
Camshaft bearing caps	15	11
Camshaft cover	9	7
Camshaft sprocket bolt	120	89
Coolant pipe to block	9	7
Crankshaft pulley-to-sprocket bolts	32	24
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°	
Stage 5	Angle-tighten a further 90°	

Torque wrench settings (continued)**Engine/transmission mountings:****Mounting brackets-to-transmission:**

M10 bolts	50	37
M12*bolts	80	59

Mounting through-bolts:

Front mounting	38	28
Left- and right-hand mountings	80	59
Reaction rod through-bolt	25	18

Mountings to bodyshell

Right-hand mounting brackets-to-block	70	52
---	----	----

Right-hand mounting reaction rod to strut bracket

.....	50	37
-------	----	----

Exhaust manifold nuts	25	18
-----------------------------	----	----

Flywheel*	160	118
-----------------	-----	-----

Inlet manifold nuts	25	18
---------------------------	----	----

Knock sensor	25	18
--------------------	----	----

Main bearing cap bolts:

Stage 1	25	18
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

Thermostat housing bolts	25	18
--------------------------------	----	----

Timing belt covers	9	7
--------------------------	---	---

Timing belt fixed guide pulley bolt	25	18
---	----	----

Timing belt tensioner nut	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 car 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 car, 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 1.8 litre engine is a water-cooled, double overhead camshaft, in-line four-cylinder unit, with cast-iron cylinder block and aluminium-alloy cylinder head. The engine is a 16-valve unit, with two inlet valves and two exhaust valves per cylinder. The engine is mounted transversely at the front of the car, with the transmission bolted to the left-hand side of the engine.

The cylinder head carries the camshafts, which are driven by a toothed timing belt. Each camshaft runs in six bearings. The

cylinder head 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 camshafts actuate the valves directly via 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. Four jets mounted on the base of the crankcase spray oil onto the undersides of the pistons, to aid cooling.

Note: Several components are 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. Among the components affected are the camshaft cover, sump and cylinder head.

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).
- Camshafts - removal and refitting*.
- Camshaft oil seals - renewal.
- Camshaft sprockets - 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.
- Sump.
- Timing belt, sprockets and cover - removal, inspection and refitting.

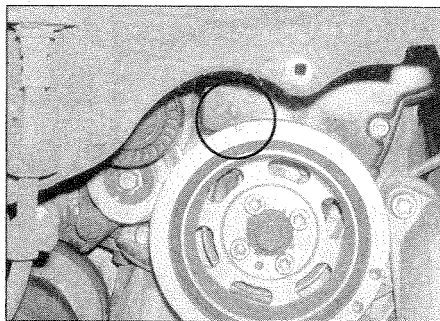
*Cylinder head dismantling procedures are detailed in Chapter 2E, with details of camshaft and tappet removal.

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.

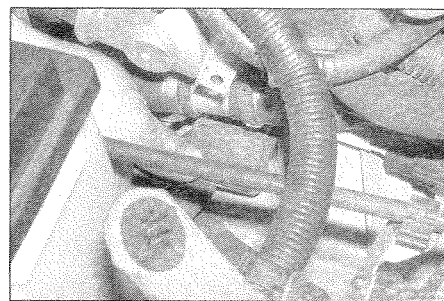
2 Location of TDC on No 1 cylinder

HP500

- 1 Remove the camshaft cover as described in Section 6.
- 2 With the car parked on a level surface, apply the handbrake and chock the rear wheels. Loosen the right-hand front wheel bolts.
- 3 Raise the front of the car, rest it securely on axle stands and remove the right-hand front roadwheel.
- 4 Unscrew and release the fasteners, and remove the wheelarch inner panel, to gain access to the crankshaft pulley.
- 5 Have an assistant turn the engine using a spanner or socket on the crankshaft pulley bolt. As this is done, place your hand over No 1 spark plug hole, and feel for pressure build-up.
- 6 Once pressure is felt, insert the shaft of a large screwdriver (or, if available, a dial gauge and probe) down No 1 spark plug hole. When TDC is reached, the screwdriver will stop rising (or the reading on the dial gauge will stop increasing).
- 7 Once the screwdriver (or dial gauge reading) starts to rise, continue turning the engine until the crankshaft pulley timing mark is aligned with the mark on the timing belt lower cover (see illustration).
- 8 A further TDC mark is provided on the flywheel, and this can be viewed through the aperture in the transmission bellhousing (remove the aperture cover, where fitted) (see illustrations). When the flywheel mark aligns with the notch on the bellhousing, the engine is set to TDC. This mark is quite difficult to see, however, without further dismantling.
- 9 The engine is now set at TDC on No 1 cylinder.



2.7 Camshaft pulley timing mark aligned with mark on timing belt lower cover



2.8a Removing the flywheel aperture cover - seen with the airflow meter removed

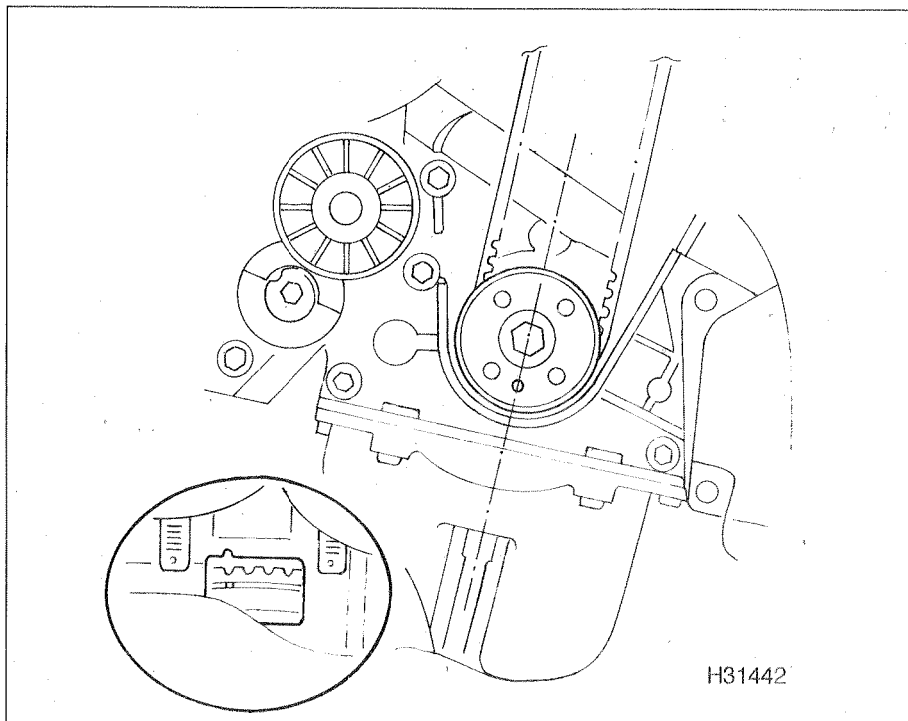
- screws into the plug thread is to be preferred.
- 6 Have the assistant hold the throttle wide open, and crank the engine on the starter motor; after one or two revolutions, the compression pressure should build up to a maximum figure, and then stabilise. Record the highest reading obtained.
 - 7 Repeat 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 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.

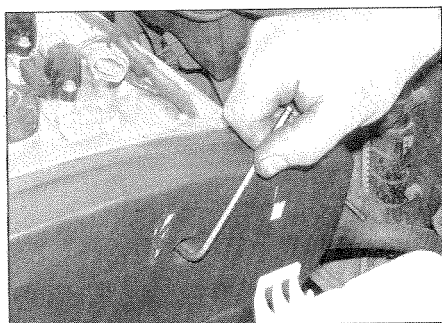
3 Cylinder compression test

HP500

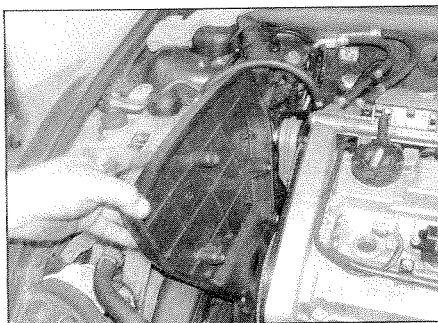
- 1 When engine performance is down, or if misfiring occurs which cannot be attributed to the ignition or fuel systems, a compression test can provide diagnostic clues as to the engine's condition. If the test is performed regularly, it can give warning of trouble before any other symptoms become apparent.
- 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 4B, Section 7).
- 5 Fit a compression tester to the No 1 cylinder spark plug hole - the type of tester which



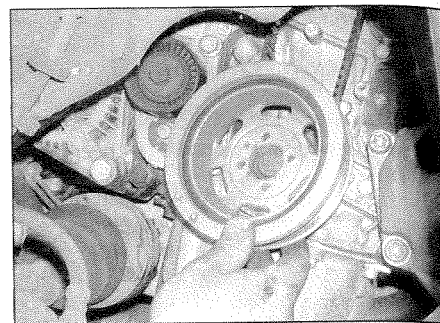
2.8b Showing flywheel alignment at TDC - also shows crankshaft sprocket alignment with sump



4.7a Removing one of the timing belt cover bolts



4.7b Removing the timing belt cover



4.9 Remove the four small bolts and take off the crankshaft pulley

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 camshafts 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 number of special tools to keep the camshaft sprockets and crankshaft sprocket (flywheel) 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 Remove the auxiliary drivebelt, then remove the spark plugs (refer to Chapter 1).

7 Unbolt and remove the timing belt cover, which is secured by a total of eight bolts (see illustrations). Two of the bolts are longer than

the rest - note their locations as they are removed. Recover the rubber gasket fitted between the outer and inner covers, if it is loose.

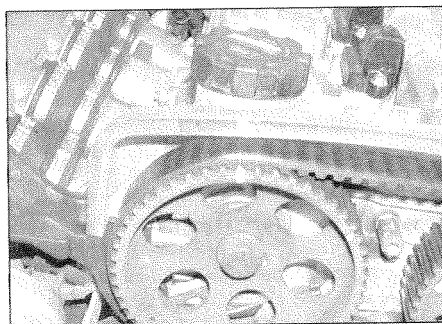
8 Set the engine to TDC as described in Section 2, then engage top gear; if the handbrake is firmly applied, this should prevent the crankshaft from moving.

9 Remove the four small **Ribe** bolts and take off the crankshaft pulley (see illustration). Note that the pulley fits over a locating peg on the crankshaft sprocket.

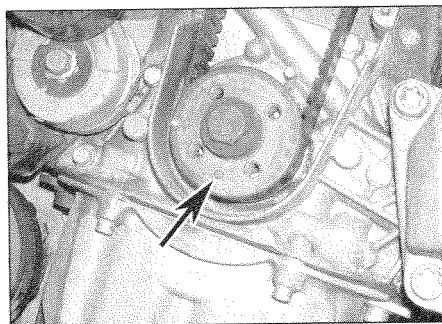
10 If the special holding tools are not available, make your own sprocket alignment marks as necessary before removing the belt (see paragraph 4).

11 In particular, mark the relative positions of the camshaft sprockets. When the engine is at TDC, it should be found that the teeth on each sprocket line up with each other at the point where the sprockets are closest - if one tooth on each sprocket is marked for horizontal alignment, this can be used to confirm the TDC position. Alternatively, refit the camshaft cover, and mark each sprocket at the top, in relation to the edge of the cover (see illustration).

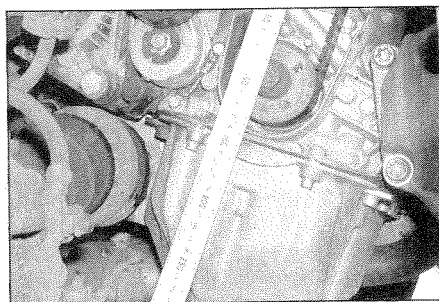
12 The crankshaft sprocket should also be marked for position, if no timing marks are evident. The sprocket is keyed to the crankshaft, so can only be fitted in one position, but a timing mark would be useful as confirmation. When the engine is at TDC, the locating peg for the crankshaft pulley should be perpendicular to the sump mating flange (see illustrations).



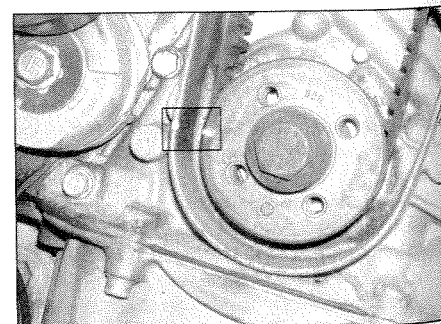
4.11 Mark the camshaft sprockets for TDC position



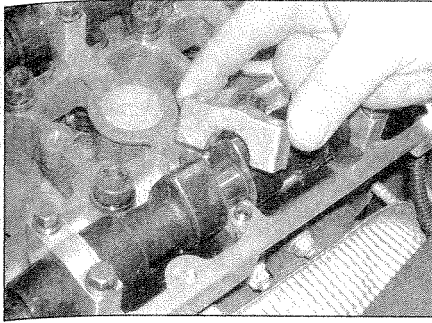
4.12a Locating peg in crankshaft sprocket (arrowed) ...



4.12b ... should be aligned vertically with indent in sump (perpendicular to sump flange)



4.12c We made alignment marks between the sprocket and oil pump flange



4.13a Removing No 3 exhaust camshaft bearing cap

13 The FIAT tools (1860875000) for holding the camshafts stationary are modified No 2 Inlet (rear) and No 3 exhaust camshaft bearing caps which locate over their respective camshaft lobes, preventing rotation and maintaining the camshaft timing. If available, the tools are fitted after removing the camshaft cover, as described in Section 6 (see illustrations).

14 The tool used to lock the flywheel (1860898000) is a metal plate which is fitted after removing the lower access plate from the base of the flywheel. The tool engages the flywheel ring gear teeth, and prevents the flywheel (and therefore, the crankshaft sprocket) from turning. The same effect could be achieved by jamming a suitable screwdriver blade in the flywheel ring gear. However, if the procedure in paragraph 8 is followed, even this should not be necessary.

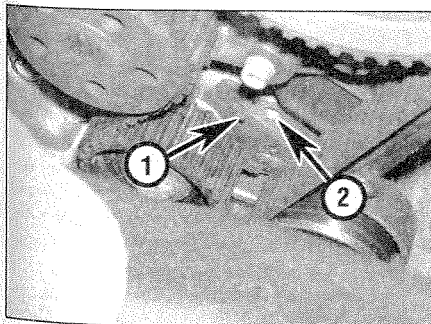
15 Release the nut on the timing belt tensioner, move the sprocket away from the belt and retighten the nut to hold the sprocket in the retracted position.

16 Slide the timing belt from the sprockets, taking great care not to turn them if locking tools have not been used.

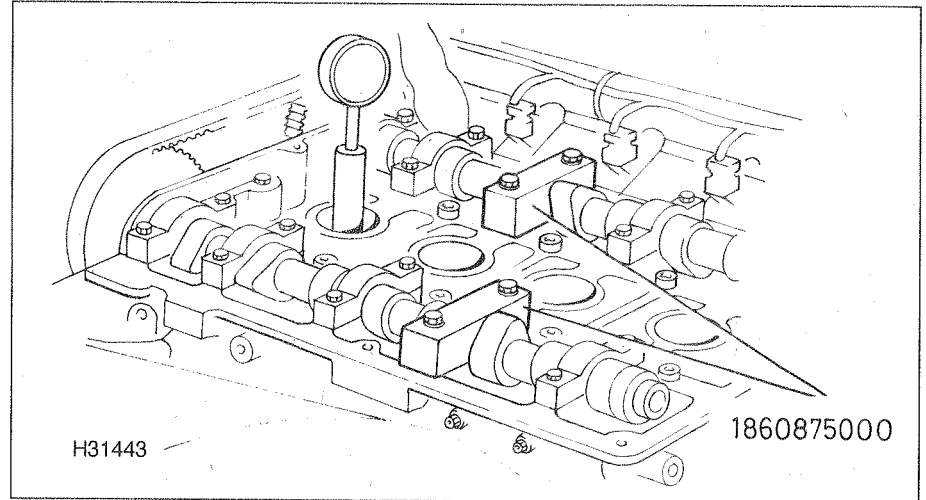
Refitting

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

18 If the special locking tools are being used, the camshaft sprocket bolts should be loosened to allow the sprockets to move slightly as the timing belt is refitted and tensioned. To hold each sprocket stationary



4.22a Rib (1) on tensioner backplate and hole (2) for inserting bolt or tool



4.13b Showing FIAT special tools for locking and timing the camshafts

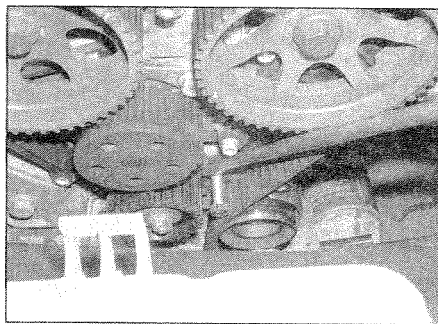
while the retaining bolt is loosened, make up a tool as described in Section 5.

19 If the special locking tools are not being used, it is not advisable to loosen the camshaft sprocket bolts unless absolutely necessary. If the timing belt teeth will not engage the camshaft sprockets satisfactorily, it is permissible to loosen the bolts and turn the sprockets very slightly, both in the same direction.

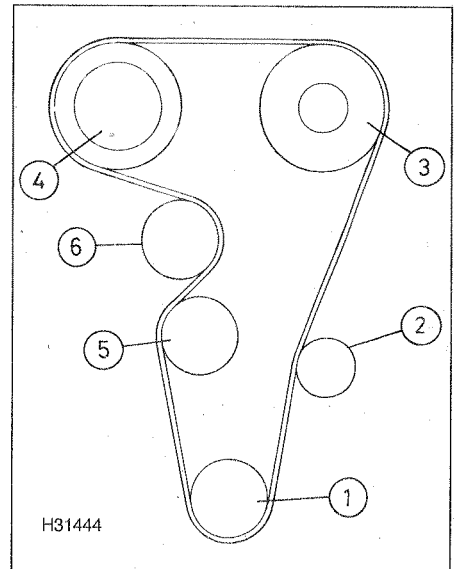
20 Fit the belt so that the arrows on the belt (where applicable) point in the direction of engine rotation. Also where applicable, the lines painted on the belt should coincide with marks on the sprockets.

21 Engage the timing belt with the crankshaft sprocket first, then place it around the fixed guide pulley, exhaust (front) camshaft sprocket, inlet camshaft sprocket and the tensioner sprocket. Finally, slip the belt around the coolant pump sprocket. Ensure that any slack in the belt is on the tensioner side of the belt run (see illustration).

22 Release the tensioner nut and push the sprocket against the belt, using the raised rib on the tensioner backplate. Inserting an 8 mm bolt into the hole next to the tensioner will provide a levering point. This hole could also be used to locate the tool we made from an 8 mm bolt, two nuts and an oversize washer (see illustrations below and Tool Tip overleaf).

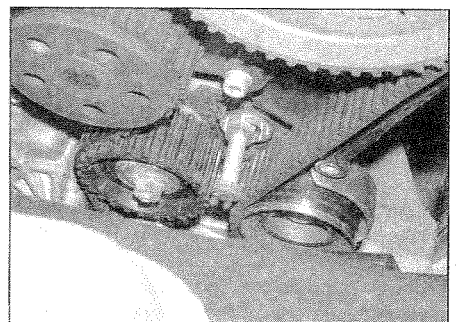


4.22b Levering against an 8 mm bolt

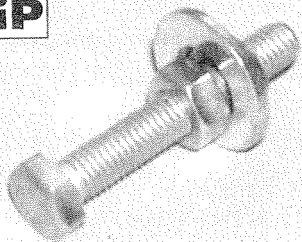


4.21 Order of fitting the timing belt over the sprockets

- | | |
|-----------------------------|---------------------------|
| 1 Crankshaft sprocket | 4 Inlet camshaft sprocket |
| 2 Fixed guide pulley | 5 Tensioner |
| 3 Exhaust camshaft sprocket | 6 Coolant pump sprocket |



4.22c Workshop tool inserted in hole

TOOL TIP

The timing belt tensioning tool consists of an 8 mm bolt, two 8 mm nuts, and an oversize washer. Clamp the washer so that it is off-centre, using the two nuts VERY firmly tightened (use two smaller washers either side of the main washer, if wished). The short end of the bolt locates in the hole already shown. The off-centre washer acts like an eccentric against the tensioner rib - as the bolt is turned, the washer bears on the rib and pushes the tensioner, thus tensioning the timing belt.

23 Initially, the belt should be set to the maximum tension possible using reasonable force. Tighten the tensioner nut securely.

24 If the camshaft sprocket bolts were loosened, tighten them to the specified torque, holding each sprocket in the same way as when they were loosened.

25 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.

26 Loosen the tensioner nut, and align the pointer with the small hole on the tensioner backplate (see illustration). Hold the tensioner in this position, and tighten the tensioner nut to the specified torque.

27 Refitting the components removed for access is a reversal of removal.

5 Timing belt sprockets and tensioner - removal and refitting

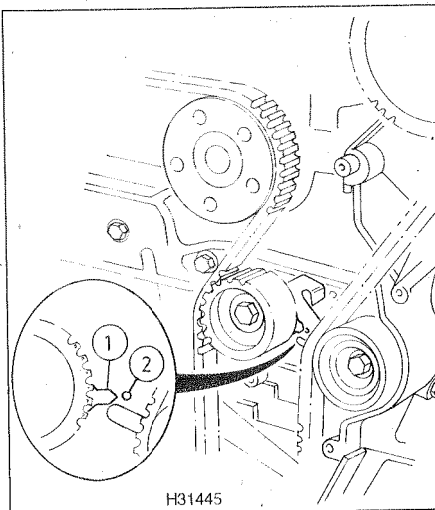
Timing belt tensioner

Removal

1 Remove the auxiliary drivebelt as described in Chapter 1.

2 Unbolt and remove the timing belt cover, which is secured by a total of eight bolts. Two of the bolts are longer than the rest - note their locations as they are removed. Recover the rubber gasket fitted between the outer and inner covers, if it is loose.

Caution: Provided the timing belt is kept



4.26 Timing belt tensioner details - pointer (1) must align with hole (2)

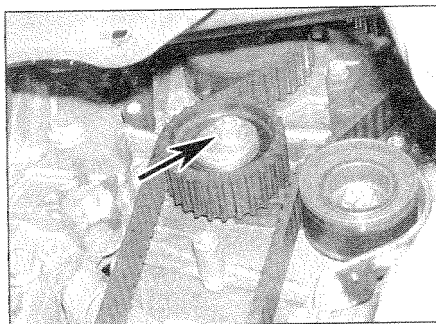
fully engaged with the camshaft, crankshaft and coolant pump sprockets during the following procedure, it is not necessary to align the timing TDC marks. However if any doubt exists, read through the full procedure given in Section 4, noting the advice on setting to TDC, and ensuring that the timing 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.

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

4 Completely unscrew the nut, recover the washer, and slide the tensioner off the mounting stud.

Inspection

5 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.



5.3 Timing belt tensioner - securing nut arrowed

Refitting

6 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.

7 Set the belt tension with reference to Section 4, paragraphs 22 to 26.

8 Refit the timing belt cover (and gasket) and tighten the bolts.

9 Refit the auxiliary drivebelt as described in Chapter 1.

Camshaft sprockets

Removal

10 Remove the timing belt as described in Section 4. In addition to the alignment marks suggested in Section 4, it is useful to have a mark between each sprocket and the cylinder head - make your own if none are present, particularly if the camshaft holding tools described in Section 4 are not available.

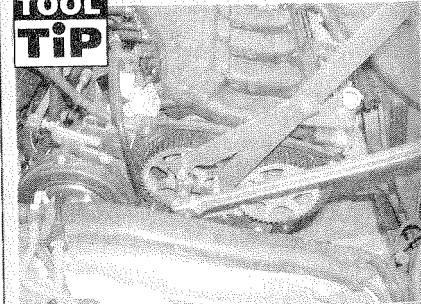
11 The camshaft sprocket must now be held stationary while the retaining bolt is loosened; if the sprocket turns very far, there is a risk that the valves will hit the pistons. Make up a tool and engage it with the holes in the sprocket (see Tool Tip below).

12 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.

13 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.

Inspection

14 With the sprockets removed, examine the

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.

camshaft oil seals for signs of leaking. If necessary, refer to Section 7 and renew them.

15 Check the sprocket teeth for damage.

16 Wipe clean the sprocket and camshaft mating surfaces.

Refitting

17 Locate the sprocket on the end of the camshaft, then refit the bolt and washer and tighten to the specified torque while holding the camshaft stationary using the method described previously.

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

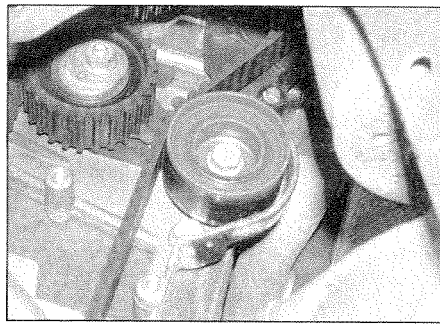
Crankshaft sprocket

Removal

19 Remove the timing belt as described in Section 4. It is essential that an alignment mark is made between the sprocket and the engine, to preserve the timing - make your own if none are present.

20 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.

21 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



5.29 Timing belt fixed guide pulley

to protect your hands). The bolt has a **left-hand thread** - ie it unscrews **clockwise**.

22 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. Recover the spacer fitted behind the sprocket.

Inspection

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

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

Refitting

25 Slide the sprocket and spacer onto the crankshaft, making sure the sprocket engages the integral key or separate key. Fit 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.

26 Fit the new bolt and washer, tightening the bolt to the specified torque while holding the crankshaft stationary using the method described in paragraph 20. Also bear in mind the advice in paragraph 21.

27 Refit the timing belt as described in Section 4.

Fixed guide pulley

Removal

28 Remove the timing belt as described in Section 4.

29 Loosen and remove the pulley bolt and its washer, and take off the pulley (see illustration).

Inspection

30 Check the pulley for any sign of damage, and check that it spins freely, with no sign of roughness. Wipe the pulley clean before fitting.

Refitting

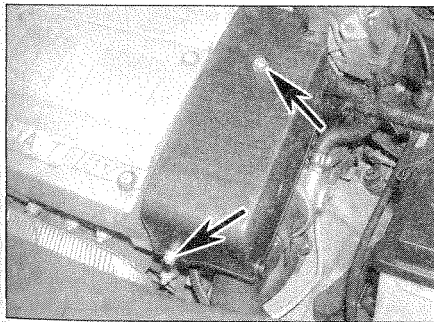
31 Offer the pulley up to the engine, and secure with the retaining bolt and washer. Tighten the bolt to the specified torque.

32 Refit the timing belt as described in Section 4.

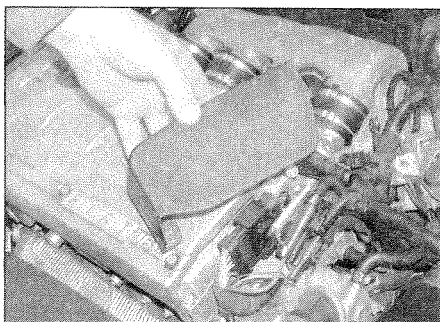
6 Camshaft cover - removal and refitting

2D

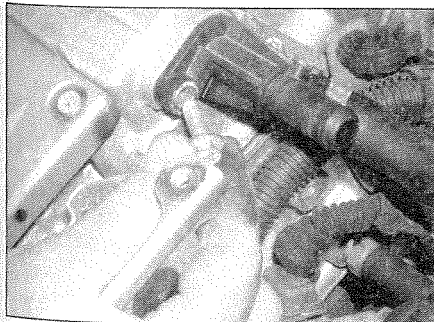
2D



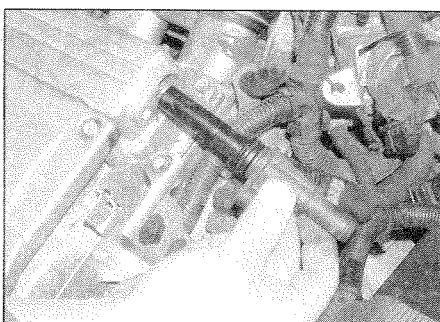
6.1a Unscrew the two bolts (arrowed) ...



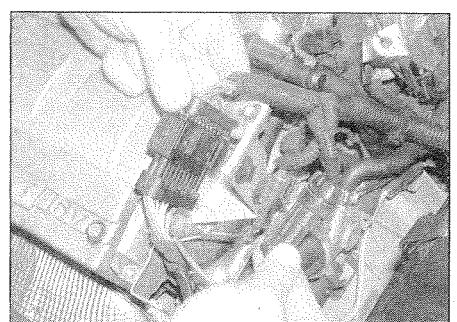
6.1b ... and take off the plastic end cover



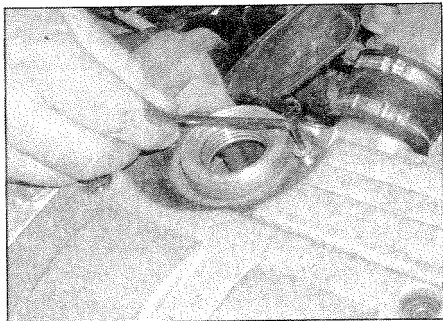
6.2a Unscrew the retaining bolt ...



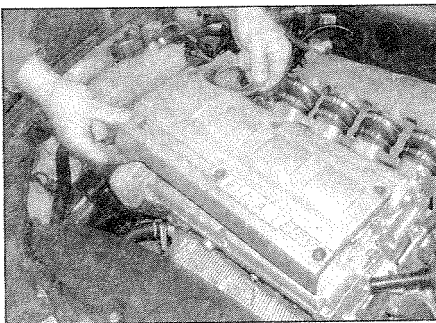
6.2b ... and remove the breather pipe stub



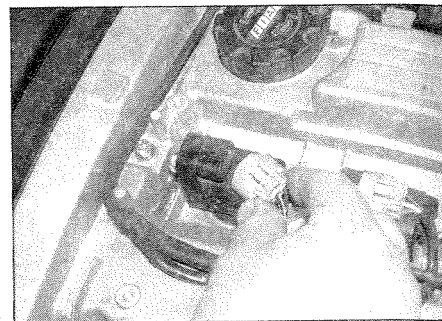
6.3 Unclip the wiring plugs from the end of the cover



6.4 Removing one of the Allen screws under the oil filler cap



6.5 Removing the engine top cover



6.6 Disconnecting No 1 coil wiring plug

- 4 Unscrew and remove the oil filler cap, and remove the two Allen screws concealed underneath (see illustration).
5 Remove the six main bolts securing the

engine top cover, then lift the cover away (see illustration).

6 Label the ignition coil connector plugs for position (No 1 is at the timing belt end of the engine), then disconnect them (see illustration).

7 Ensuring that they are marked for position, remove each of the ignition coils by unscrewing the two mounting bolts and pulling them upwards off the spark plugs (see illustrations).

8 Disconnect the earth lead between coil Nos 2 and 3, unscrew the two bolts securing the harness brackets, then move the harness aside (see illustrations).

9 On models with air conditioning, trace the wiring back from the compressor, and disconnect it at the wiring plug.

10 The camshaft cover is secured by a total of nine Ribe bolts - eight around the sides,

and one in the centre (see illustration). Progressively unscrew the bolts in a diagonal sequence. When all the bolts are loose, remove them, noting their locations, as one is longer than the rest.

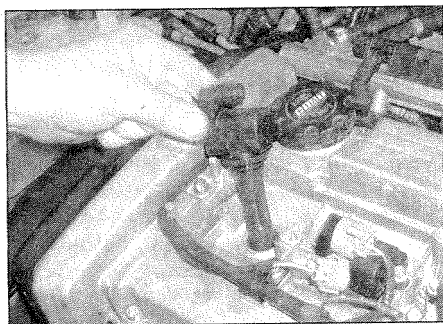
11 Lift off the cover, and recover the main seal (see illustration). If the cover sticks, do not attempt to lever it off - instead free it by working around the cover and tapping it lightly with a soft-faced mallet.

12 Peel off the main rubber seal from around the inside of the cover, and check its condition. It is permissible to re-use it, provided it is not perished, crushed or otherwise damaged. Clean the mating surfaces of the cylinder head and camshaft cover thoroughly.

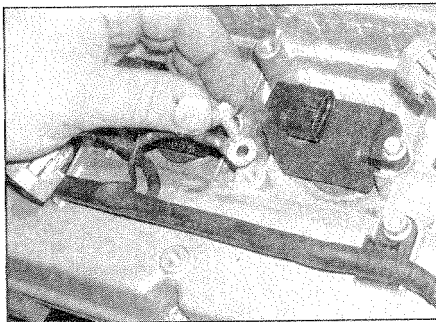
13 Check the condition of the four round seals fitted to the inside of the cover, which fit over the ignition coils.



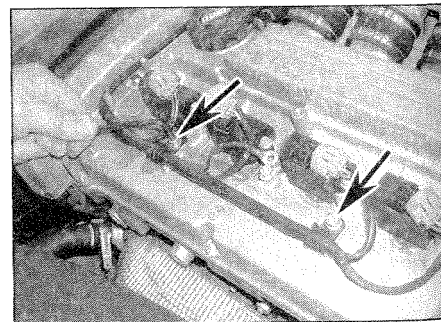
6.7a Unscrew the two mounting bolts ...



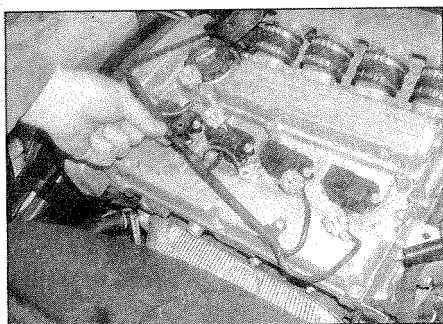
6.7b ... and pull the each coil upwards off its spark plug



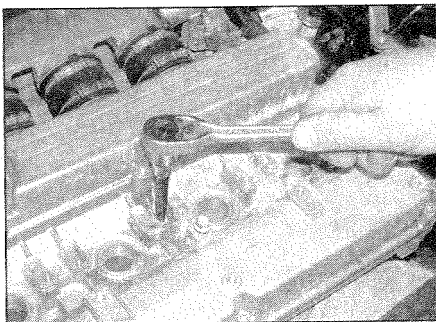
6.8a Disconnect the central earth lead ...



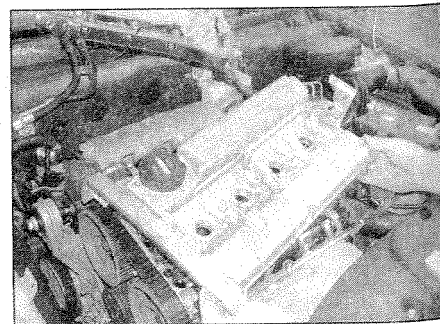
6.8b ... unscrew the harness bracket bolts (arrowed) ...



6.8c ... and move the harness clear of the cover



6.10 Removing the camshaft cover bolts



6.11 Lifting off the camshaft cover

14 If necessary, remove and clean the baffle plate fitted inside the cover. If this is particularly in need of cleaning, also check the breather pipe stub which was removed in paragraph 2. When refitting the stub, check the condition of the O-rings which seal the stub to the cover, and renew if necessary.

Refitting

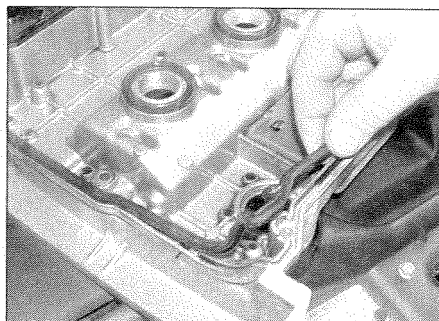
15 Locate the main seal in the cover, making sure it is correctly seated in its groove (see illustration).

16 Apply a little sealant to the joints between the camshaft front bearing cap (nearest the sprockets) and the cylinder head (see illustration).

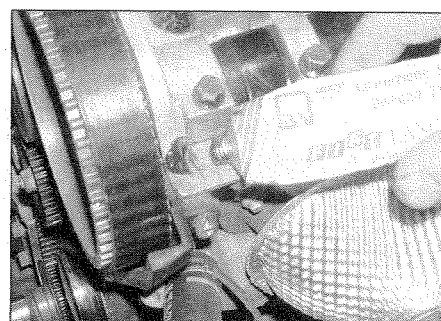
17 Lower the cover into position on the cylinder head, making sure the seals are not displaced.

18 Insert the bolts and tighten them progressively in a diagonal sequence to the specified torque.

19 Refit all components removed for access, using a reversal of the removal procedure.



6.15 Check the condition of the cover main seal, and of the four round seals



6.16 Applying sealant to the joint at the camshaft front bearing cap

7 Camshaft oil seals - renewal



1 Remove the camshaft sprockets as described in Section 5.

2 Using a suitable hooked instrument, remove each oil seal as required, taking care not to damage the surface of the camshaft or the front bearing cap. Even if only one seal is found to be leaking, it is advisable to renew both.

3 Clean the seating in the cylinder head and front bearing cap, 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.

5 Using a suitable tubular drift, drive the oil seal squarely into the housing. Remove the adhesive tape from the camshaft.

6 Renew the other seal (as required) using the same procedure.

7 Refit all components removed for access, using a reversal of the relevant removal procedure.

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.

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

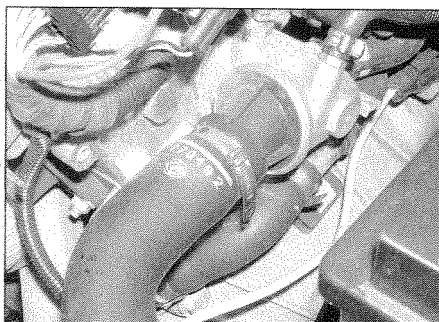
Note: The following paragraphs describe renewal of the rear oil seal leaving the housing in position. Refer to Chapter 2E for details of removing the housing.

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



9.9a Disconnect the hoses from the thermostat housing . . .

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



Removal

1 Depressurise the fuel system as described in Chapter 4B, Section 7.

2 Disconnect the battery negative terminal (refer to *Disconnecting the battery*). Remove the battery as described in Chapter 5A.

3 Drain the cooling system as described in Chapter 1. Disconnect the top and bottom hoses, and the expansion tank hoses, from the engine.

4 Remove the auxiliary drivebelt as described in Chapter 1.

5 Remove the spark plugs as described in Chapter 1.

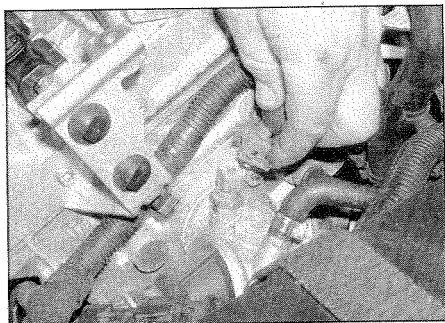
6 Remove the timing belt from the camshaft sprockets, using the information in Section 4. Unless the belt has been changed recently, remove it completely and fit a new one on reassembly.

7 To improve working room, remove the two bolts securing the air intake shroud at the front of the engine compartment, and lift the shroud out of position, detaching it from the intake duct.

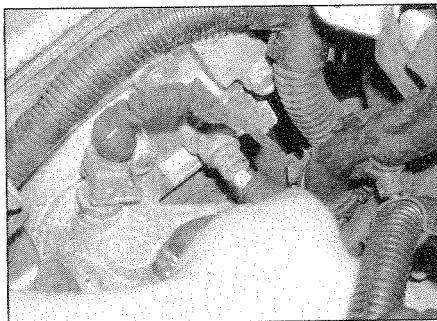
8 Remove the inlet manifold as described in Chapter 4B. Alternatively, disconnect all hoses and connections from the inlet manifold, including the manifold support brackets at the rear of the engine, using the manifold removal procedure in Chapter 4B.

9 Disconnect the hoses from the thermostat housing, and the coolant temperature sensor wiring plug on top of the housing. Also disconnect the (smaller) temperature gauge sender wiring plug from the end of the head (see illustrations).

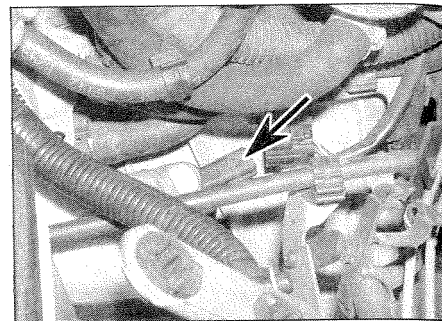
10 Unbolt the cable clip in front of the thermostat housing - this retains the oxygen sensor wiring. Trace the wiring back to the



9.9b ... the coolant temperature sensor on top of the housing ...



9.9c ... and the temperature gauge sender on the head



9.10 Disconnecting the oxygen sensor wiring plug

connector plug below the thermostat housing, and disconnect it (see illustration).

11 Remove the camshaft cover as described in Section 6.

12 Working just behind the inlet camshaft sprocket, remove the bolt securing the ignition coil wiring bracket to the cylinder head, and remove the bracket.

13 Remove the nut securing the engine oil dipstick to the exhaust manifold. Remove the dipstick, and move the tube clear of the head.

14 Working under the car, unscrew the exhaust manifold-to-downpipe nuts, and separate the downpipe from the manifold, recovering the gasket (see illustration).

15 Unscrew the manifold-to-cylinder head nuts, and withdraw the manifold from the engine compartment, recovering the gasket.

16 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.

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

18 Unscrew the cylinder head bolts half a turn at a time, in the reverse order to that shown in illustration 9.35a - a suitable Ribe socket will be required (see illustration). When the bolts are free, remove them with their washers.

19 Lift the cylinder head from the block. If it is

stuck tight, insert pieces of wood into the exhaust or inlet ports, 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.

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

21 The cylinder head can be dismantled after removing the camshafts and tappets as described in Chapter 2E. Further dismantling and decarbonising are also described in Chapter 2E.

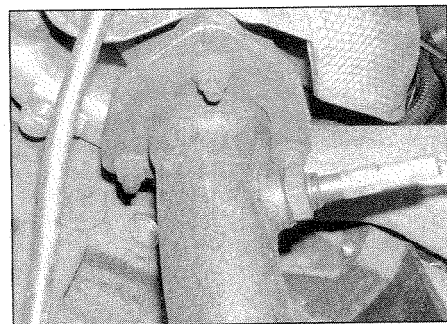
Preparation for refitting

22 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.

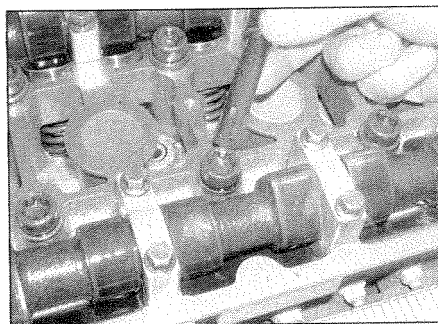
23 Take particular care when cleaning the piston crowns, as the soft aluminium alloy is easily damaged.

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

25 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.



9.14 Exhaust manifold-to-downpipe nuts



9.18 A Ribe socket is needed to unscrew the cylinder head bolts

26 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.

27 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.

28 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

29 Before refitting the assembled cylinder head, make sure that the head and block mating surfaces are perfectly clean, and that the bolt holes in the cylinder block have been 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.

30 The camshaft sprocket timing marks should be aligned with the mark on the cylinder head.

31 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.

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

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

34 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.

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

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

37 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 (see illustration).

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

39 When all ten bolts have been tightened to Stage 4, finally tighten all bolts in sequence to the Stage 5 angle.

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

41 Refit the exhaust manifold, using new gaskets, studs and nuts, as necessary. Tighten all nuts securely.

42 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

66666

Inspection

1 Jack up the front of the car 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.

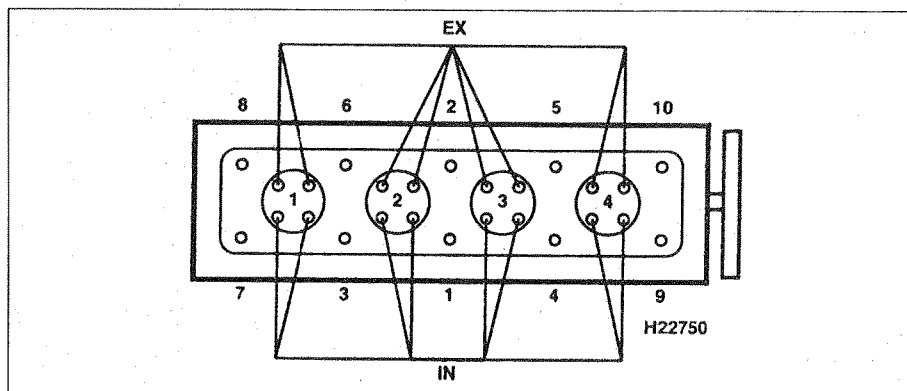
4 Using a large screwdriver or a crowbar, check for wear in the mounting by carefully levering against it to check for free play. Where this is not possible enlist the aid of an assistant to move the engine/transmission back and forth, or from side to side, while you watch the mounting. While some free 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

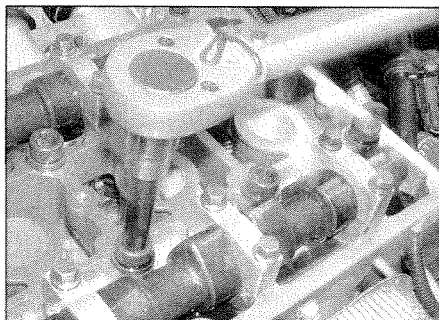
Note: Left and right are as seen from the driver's seat.

Right-hand mounting

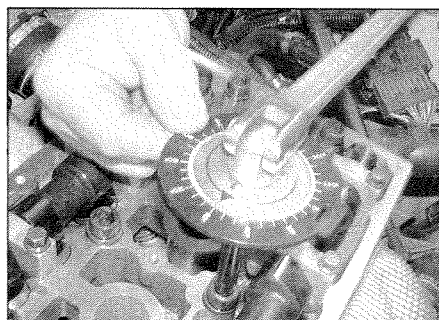
5 Raise the front of the car and support on



9.35a Cylinder head bolt tightening sequence



9.35b Tightening the cylinder head bolts using a torque wrench



9.37 Angle-tightening the cylinder head bolts

axle stands (see *Jacking and vehicle support*).

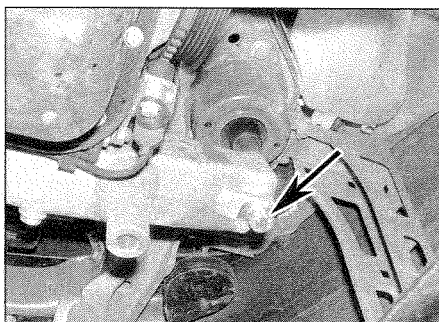
6 Place a trolley jack beneath the right-hand side of the engine, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine.

7 Working from below, unscrew the through-bolt (and washers) securing the engine bracket to the mounting (see illustration).

8 Lower the engine sufficiently to disengage the engine bracket from the mounting, then remove the 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 through-bolt (and washers) and tighten to the specified torque, then tighten the mounting-to-body bolts.



11.7 Engine right-hand mounting (seen from below) - through-bolt arrowed

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

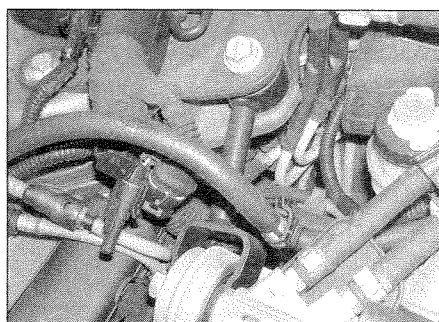
Right-hand reaction rod

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

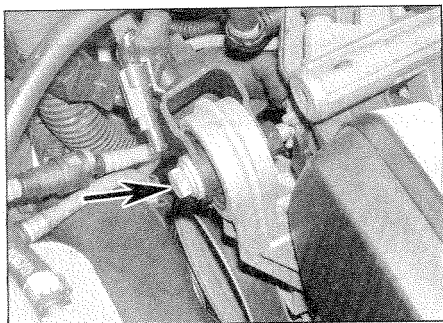
13 Place a trolley jack beneath the right-hand side of the engine, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine.

14 Unscrew the through-bolt and nut from the engine mounting, and remove the bolt securing the rod to the suspension strut mounting plate (see illustrations). Separate the rod from the mounting on the engine and suspension strut mounting, and remove it.

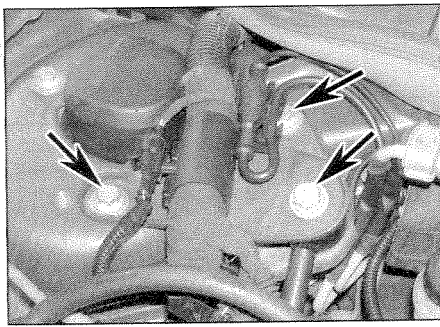
15 If required, the engine mounting and/or strut mounting plate can be unbolted and removed. Note that the strut mounting plate is



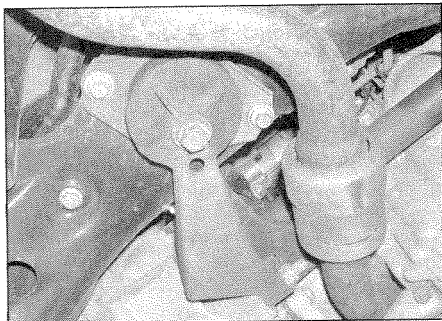
11.14a View of reaction rod



11.14b Reaction rod through-bolt (arrowed)



11.15 Reaction rod strut mounting plate bolts (arrowed)



11.19 Engine rear mounting

secured by two of the three suspension strut mounting bolts (see illustration).

16 Refitting is a reversal of removal. Tighten all bolts to the specified torque, then remove the trolley jack and lower the car to the ground.

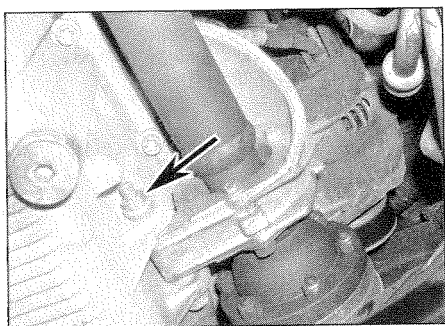
Rear mounting

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

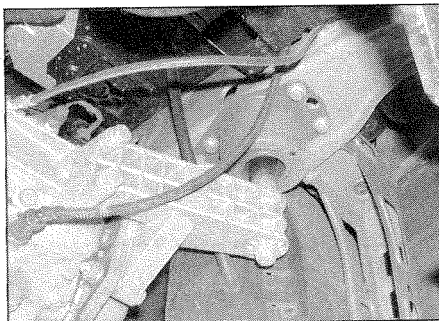
18 Place a trolley jack beneath the engine/transmission flange, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine and transmission.

19 Working from below, unscrew the through-bolt securing the bracket to the mounting (see illustration).

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



12.5a Right-hand driveshaft support/shield-to-sump nut and bolt (arrowed)



11.26 Engine left-hand mounting (seen from below)

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

22 Raise the engine and locate the bracket on the mounting. Refit the through-bolt and tighten to the specified torque, then tighten the mounting-to-body bolts.

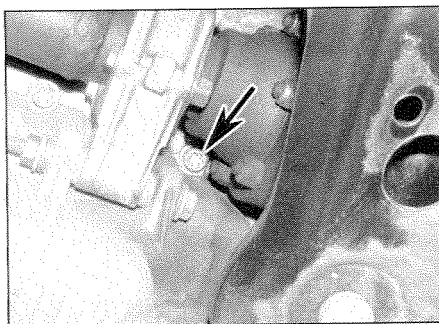
23 Remove the trolley jack and lower the car to the ground.

Left-hand mounting

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

25 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.

26 Unscrew the through-bolt securing the transmission bracket to the mounting, and recover the washers (see illustration).



12.5b Access to one of the sump bolts (arrowed) is hampered by the driveshaft

27 Unscrew the two bolts securing the left-hand mounting to the subframe.

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

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

30 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.

31 Remove the trolley jack and lower the car to the ground.

12 Sump - removal and refitting

Removal

1 Jack up the front of the car and support on axle stands. Drain the engine oil as described in Chapter 1.

2 Unscrew and remove the various fasteners, and completely remove the engine undertray.

3 Remove the exhaust downpipe as described in Chapter 4C, Section 5.

4 Support the weight of the engine/transmission using a trolley jack with a block of wood under the engine-to-transmission flange. Unbolt and remove the engine rear mounting from the rear of the sump.

5 Removing the sump will be made easier by removing the right-hand driveshaft and support/shield, using the information in Chapter 8. However, although access to one of the sump bolts is hampered by the right-hand driveshaft, it is sufficient to unbolt the driveshaft support/shield from the rear of the sump (see illustrations).

6 Unscrew the Ribex bolts, and pull the sump downwards to remove it. The joint sealant will require cutting with a sharp knife to release the pan.

Refitting

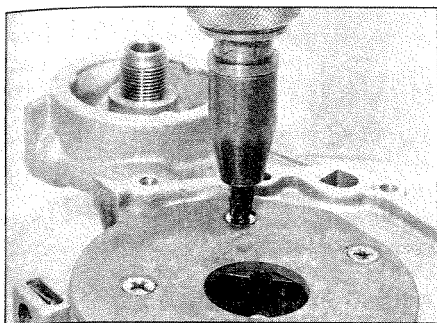
7 Clean away all old gasket material, from the sump pan and from the base of the block.

8 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. Also apply a little sealant to the joints between the front and rear oil seal flanges and the engine block.

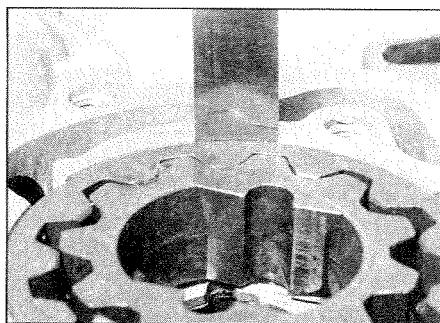
9 Fit the sump, screw in the fixing bolts, and tighten securely in a diagonal sequence.

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

11 Lower the car 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*.



13.8 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

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).
- 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 nine bolts in all, of three different lengths). Withdraw the pump and remove the gasket.

Inspection

- 7 The oil pump incorporates a pressure relief valve, which can be removed for examination by depressing the spring plunger and pulling out the keeper plate.
- 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.

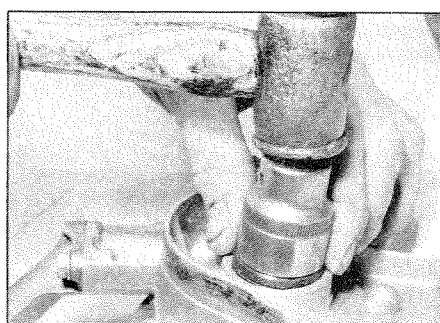
11 Apply air pressure from a tyre pump to the oil pump oil ducts, to clear any sludge or other material. If any solvents are used, the pump must be allowed to dry thoroughly before refitting.

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 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 sump 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*.



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

14 Oil pressure switch - removal and refitting

Removal

- 1 The oil pressure switch is located at the rear of the cylinder head.
- 2 Disconnect the switch wiring connector.
- 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.