Chapter 2 Part C:
1.6 litre engine in-car repair procedures

Contents

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 A4.000
Bore	86.4 mm
Stroke	67.4 mm
Compression ratio	10.15:1
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	Gear type, driven from auxiliary shaft
Gear teeth-to-cover clearance	0.110 to 0.180 mm
Gear side-to-cover clearance	0.040 to 0.106 mm
Gear side-to-side play	0.015 to 0.048 mm
Drive gear to driven gear clearance	0.30 mm
Oil pressure (at operating temperature)	15 psi at idle, to 54 psi at 4000 rpm

Camshafts

Drive	Toothed belt
No of bearings	5
Camshaft bearing journal diameters:	
No 1 bearing	29.944 to 29.960 mm
No 2 bearing	52.400 to 52.415 mm
No 3 bearing	52.800 to 52.815 mm
No 4 bearing	53.200 to 53.215 mm
No 5 bearing	53.600 to 53.615 mm
Camshaft bearing journal running clearance	0.030 to 0.070 mm
Camshaft endfloat (typical)	0.15 to 0.34 mm

Camshaft housings

Camshaft bearing diameters:	
No 1 bearing	29.989 to 30.014 mm
No 2 bearing	52.445 to 52.470 mm
No 3 bearing	52.845 to 52.870 mm
No 4 bearing	53.245 to 53.270 mm
No 5 bearing	53.645 to 53.670 mm
Hydraulic tappet diameter	32.959 to 32.975 mm
Hydraulic tappet bore diameter	33.000 to 33.025 mm
Hydraulic tappet running clearance	0.025 to 0.066 mm

Torque wrench settings	Nm	lbf ft
Alternator mounting bracket to block	50	37
Auxiliary drivebelt tensioner	48	35
Auxiliary shaft sprocket bolt	80	59
Big-end (connecting rod) bearing cap nuts	51	38
Camshaft housing bolts	15	11
Camshaft sprocket	115	85
Coolant pipe to block	25	18
Crankcase breather pipe:		
M8 bolts	23	17
M10 bolts	48	35
Crankshaft sprocket nut*	220	162
Cylinder head:		
Stage 1	20	15
Stage 2	40	30
Stage 3	Angle-tighten a further 90°	
Stage 4	Angle-tighten a further 90°	
Engine/transmission mountings:		
Mounting brackets to transmission:		
M10 bolts	50	37
M12 bolts	85	63
Mounting through-bolts:		
M10 bolts	50	37
M12 bolts	80	59
Mountings to bodyshell/subframe	32	24
Right-hand mounting bracket to block:		
M8 bolts	25	18
M10 bolts	48	35
M12 bolts	80	59
Exhaust manifold nuts	30	22
Flywheel/driveplate**	83	61
Inlet manifold:		
M7 bolts	15	11
M8 bolts	30	22
Main bearing cap bolts	80	59
Oil pressure switch	32	24
Oil pump mounting bolts	25	18
Sump bolts	9	7
Thermostat housing bolts	25	18
Timing belt covers:		
M6 bolts	9	7
M8 bolts	25	18
M10 bolts	50	37
Timing belt guide pulley bolt	87	64
Timing belt tensioner mounting plate:		
M8 bolts	23	17
M10 bolts	48	35
Timing belt tensioner nut	23	17

**Although not specifically recommended by FIAT, use a new nut and locking fluid.*
*** Use 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.

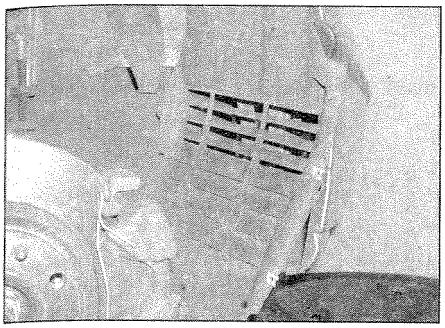
Engine description

The 1.6 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 and two exhaust 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.

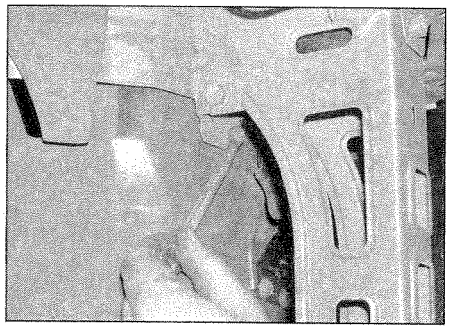
The cylinder head contains the valve assemblies, while the camshafts run in two separate housings bolted on top of the engine. The camshafts are driven by a toothed timing belt, and each one runs in five bearings. The inlet and exhaust valves are closed by single coil springs, and run in guides pressed into the cylinder head. The camshafts actuate the valves directly via hydraulic tappets mounted in the camshaft housings.

The crankshaft is supported by five main bearings, and endfloat is controlled by thrust washers fitted around No 5 main bearing.

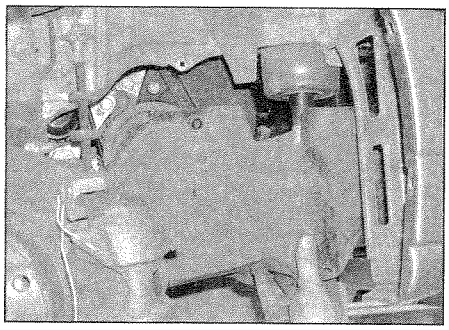
Engine coolant is circulated by a pump, driven by an auxiliary drivebelt. For details of the cooling system, refer to Chapter 3.



2.3a Remove the front section of the wheelarch liner . . .



2.3b . . . for access to the inner panel's front securing screw



2.3c Removing the wheelarch inner panel

Lubricant is circulated under pressure by a gear-type pump, driven via an auxiliary shaft which itself is driven by the timing belt. 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.

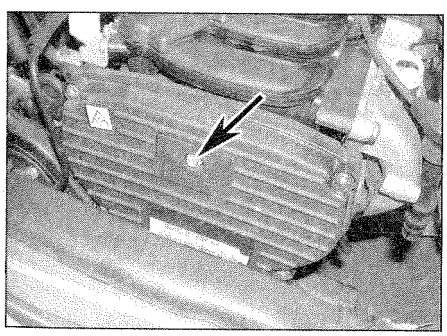
Models from 1999 onwards may be fitted with the revised 'Step A' engine, which features a number of minor modifications. The engine seen in our 1.6 litre project vehicle was a Step A engine.

Repair operations possible with the engine in the car

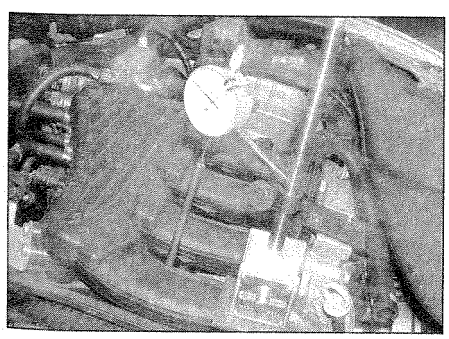
The following work can be carried out with the engine in the car:

a) Auxiliary drivebelts - removal and refitting (see Chapter 1).
b) Camshafts - removal and refitting.
c) Camshaft oil seals - renewal.
d) Auxiliary shaft oil seal - renewal.
e) Camshaft sprockets - removal and refitting.
f) Coolant pump - removal and refitting (refer to Chapter 3).
g) Crankshaft oil seals - renewal.
h) Crankshaft sprocket - removal and refitting.
i) Cylinder head - removal and refitting.
j) Engine mountings - inspection and renewal.
k) Oil pump and pickup assembly - removal and refitting.
l) Sump.
m) Timing belt, sprockets and cover - removal, inspection and refitting.

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.*



2.4 Remove the screw securing the timing belt upper access cover

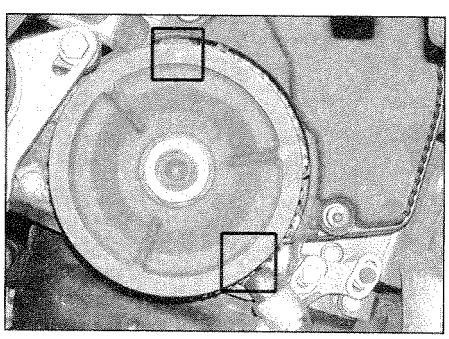


2.6 Using a dial gauge and probe to establish TDC on No 1 piston

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.



2.8a Crankshaft pulley timing marks aligned at TDC

3 Remove the screws securing the inner panel under the right-hand wheelarch, to gain access to the crankshaft pulley. Removing this cover entails removing the screws securing the wheelarch front liner to the end of the bumper, and removing the front liner, for access to the inner panel's front securing screw **(see illustrations)**.

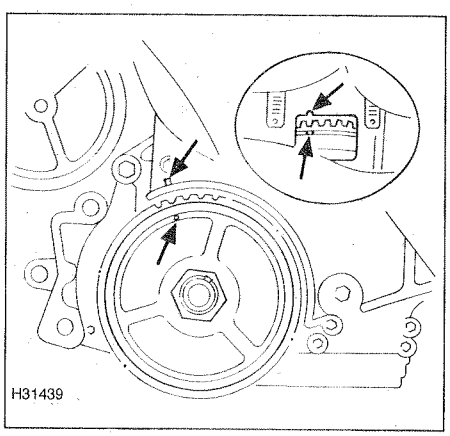
4 Remove the single screw securing the small access cover in the timing belt cover **(see illustration)**, and remove the access cover to view the camshaft sprockets.

5 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).

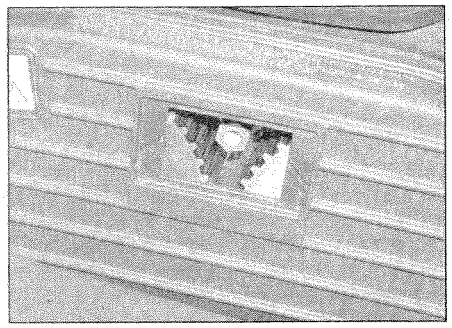
6 Insert a suitable large screwdriver (or, if available, a dial gauge and probe) down No 1 spark plug hole, taking care to keep it vertical, so that it does not bind as the piston rises **(see illustration)**. Do not use any tool which might break off or fall down inside the engine.

7 Have an assistant turn the engine slowly, using a spanner or socket on the crankshaft pulley nut.

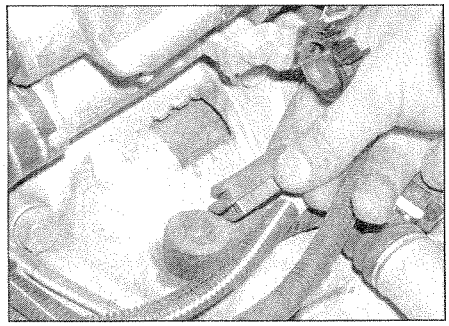
8 Once the screwdriver (or dial gauge reading) starts to rise, continue turning the engine until the crankshaft pulley timing mark is aligned with the mark on the timing belt lower cover. Note that there are actually two marks - the other mark aligns with the centre of the crankshaft timing sensor **(see illustrations)**.



2.8b Crankshaft pulley and flywheel marks (arrowed) aligned at TDC



2.9 Camshaft sprocket painted marks aligned with lines on access hole



2.10 Remove the cover from the bellhousing to view the timing marks

9 The engine will be at TDC on compression only when the painted marks on the camshaft sprockets are visible in the timing belt cover access hole **(see illustration)**. The painted marks on the sprockets should align with the steeply-angled lines at either side of the access hole - judging the alignment is not easy, however.

10 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 first). When the flywheel mark aligns with the 0 notch on the bellhousing, the engine is set to TDC. In practice, however, viewing the marks is impossible without first removing the ignition coil assembly and thermostat housing **(see illustration)**.

11 As a further confirmation, the screwdriver will stop rising (or the reading on the dial gauge will stop increasing) when TDC is reached.

12 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 assembly **(see illustration)**.

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 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).

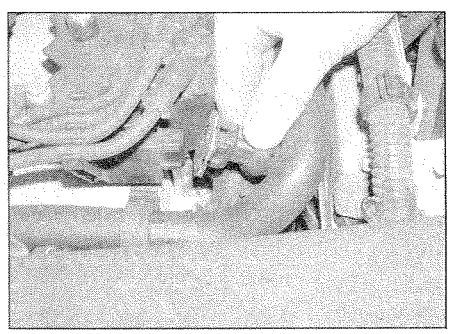
9 If the pressure in any cylinder is very low, carry out the following test to isolate the cause. Introduce a teaspoonful of clean oil into that cylinder through its spark plug hole and repeat the test.

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.



3.3 Disconnecting the ignition coil LT wiring plug

4 Timing belt and covers - removal and refitting

General information

1 The function of the timing belt is to drive the camshafts and auxiliary shaft (which drives the oil 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 various special tools to set and 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 A special tool is also needed to set the timing belt tensioner pulley - it is not possible to set the tension using ordinary workshop tools. A simple alternative tool can be made easily, however, from a strip of metal plate.

5 In the absence of the special locking 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 block. If none are present, take care to make your own, using typists correction fluid or similar, **before** removing the belt.

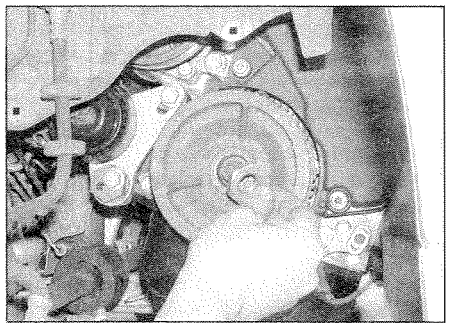
6 If the special locking tools are not used, the procedure given below will suffice to change the belt successfully, but if care is not taken and the camshaft timing is slightly out, the engine may not run very well on completion. It is advisable to have a FIAT dealer confirm the camshaft timing after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

Removal

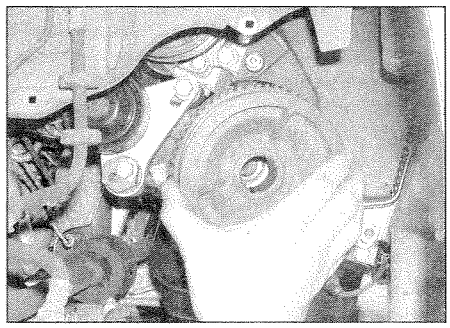
7 Remove the auxiliary drivebelt(s) from the crankshaft pulley, then remove the spark plugs (refer to Chapter 1).

8 Working beneath the engine, unbolt and remove the flywheel lower cover **(see illustration)**, then hold the flywheel stationary, preferably using a tool which engages the flywheel starter ring gear (see Section 12). Alternatively, have an assistant engage a wide-bladed screwdriver with the starter ring gear.

4.8 Removing the flywheel lower cover



4.12a Unscrew the crankshaft pulley nut . . .



4.12b . . . and remove the pulley

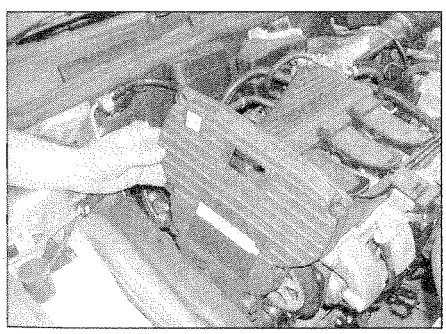
9 Loosen the crankshaft pulley retaining nut - this is tightened to a particularly high torque, so ensure that the car is adequately supported. Use only good-quality, close-fitting tools, and take precautions against personal injury, especially when the nut eventually loosens (wear gloves to protect your hands). Loosen the nut only at this stage - do not remove it.

10 Use the marks on the crankshaft pulley and timing belt cover to reset the engine to TDC, as described in Section 2. Engage top gear; if the handbrake is firmly applied, this should prevent the crankshaft from moving.

11 To further aid refitting, paint an alignment mark between the timing sensor (below and in front of the pulley) and one of the teeth on the sensor pickup wheel.

12 Unscrew the crankshaft pulley nut, and remove the pulley **(see illustrations)**.

13 Unbolt and remove the timing belt cover, which is secured by a total of eight bolts (one additional bolt is used to secure the camshaft sprocket access panel - see Section 2) **(see illustration)**. Note the location of each bolt (and any washers) as it is removed, as they are of different sizes. Where applicable, also recover the rubber gasket fitted between the outer and inner covers.



4.13 Removing the timing belt cover

14 If the special holding tools are not available, make your own sprocket alignment marks as necessary before removing the belt (see paragraph 5).

15 In particular, mark the relative positions of the camshaft sprockets. The best way to do this is to place a straight edge across the centres of the two sprockets, and to draw a line (or several short lines) across the sprockets using an indelible marker **(see illustration)**.

16 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.

17 The FIAT tools (1860874000) for holding the camshafts stationary are modified camshaft housing end covers, with a keyway set into the inner face, which when fitted engage with slots in the end of the camshafts, preventing rotation and maintaining the camshaft timing. To gain access to the camshaft housing end covers, disconnect the coil LT wiring, remove the bolts securing the ignition coil, and lift the coil away from the engine complete with HT leads.

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)**. If the locking tools are not fitted, the tension of the valve springs will move the camshafts very slightly as the belt tension is released - watch how the sprockets move, and compensate for this when fitting the new belt.

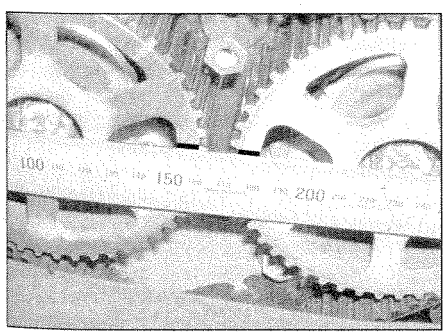
19 Slide the drivebelt from the sprockets, taking great care not to turn them if locking tools have not been used **(see illustration)**. Note that the crankshaft sprocket is a sliding fit only over the end of the crankshaft - try not to remove the sprocket with the belt.

Refitting

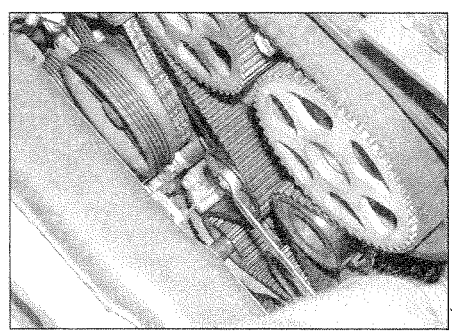
20 When refitting the new belt, first make sure that the sprocket timing marks are still in alignment (the camshaft sprocket marks should be as close as possible).

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

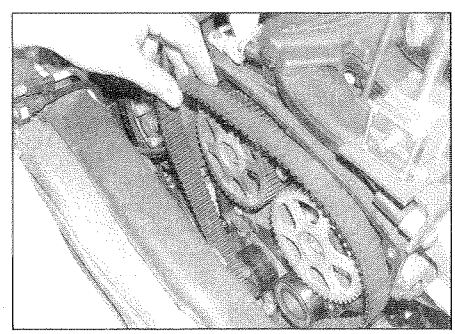
22 If the special locking tools are not being used, it is not advisable to loosen the camshaft sprocket bolts unless absolutely necessary. If the timing belt teeth will not engage the camshaft sprockets satisfactorily, it is permissible to loosen the bolts and turn the sprockets *very slightly*, both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



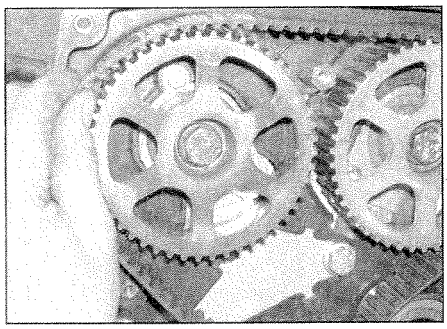
4.15 Mark the camshaft sprockets in relation to each other



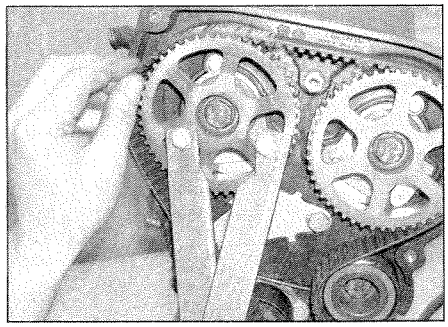
4.18 Loosening the timing belt tensioner nut



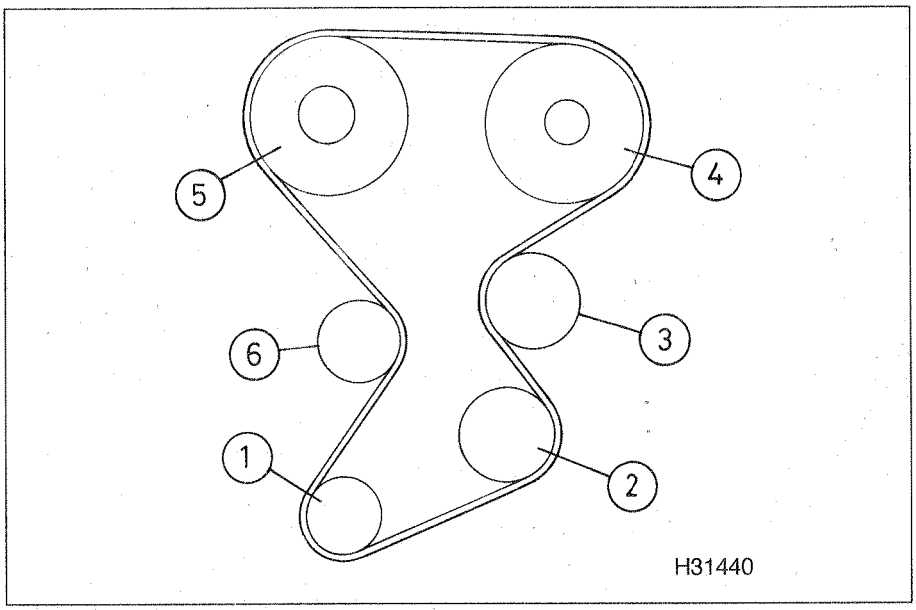
4.19 Removing the timing belt



4.25a If the locking tools are not used, the belt will not engage the exhaust camshaft sprocket . . .

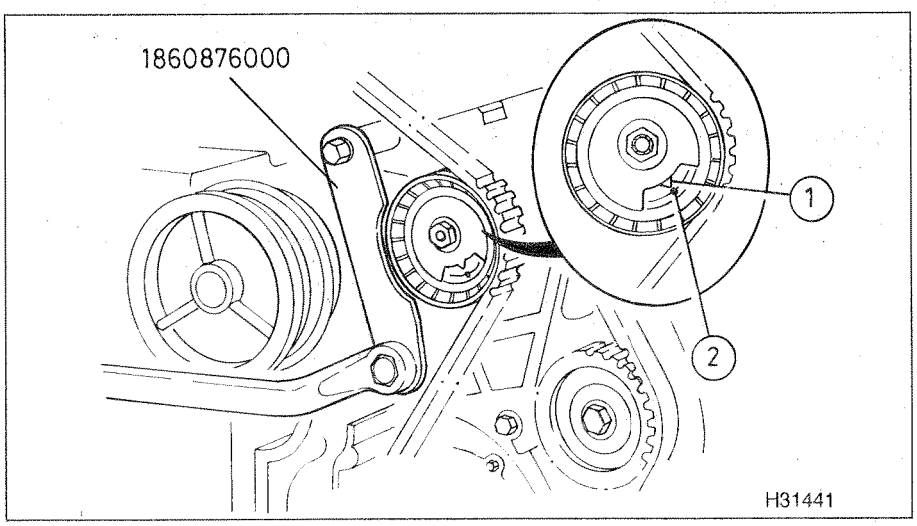


4.25b . . . until the sprocket is turned to align the marks made on the sprockets



4.26 Timing belt run/sprocket fitting order

1 Crankshaft sprocket
2 Auxiliary shaft sprocket (oil pump drive)
3 Fixed guide pulley
4 Inlet camshaft sprocket
5 Exhaust camshaft sprocket
6 Timing belt tensioner pulley



4.27 Tensioner pointer (1) should align with punched mark (2) - note use of spanner and FIAT tool

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.

24 Engage the timing belt with the crankshaft sprocket first, then place it around the auxiliary shaft sprocket, fixed guide pulley, and inlet (front) camshaft sprocket.

25 If the special locking tools are not used, turn the exhaust camshaft sprocket slightly (against the valve spring tension) to bring the timing marks made into alignment, and slip the belt onto the sprocket teeth **(see illustrations)**.

26 Finally, slip the belt around the tensioner pulley. Ensure that any slack in the belt is on the tensioner side of the belt run **(see illustration)**.

Tensioning

With the special tool

27 To tension the timing belt, a special FIAT tool (no 1860876000) is used to turn the tensioner, and to set the tensioner spring tension, in one movement. The tool is bolted into position as shown **(see illustration)**.

28 Release the tensioner nut and use the tool to push the pulley anti-clockwise against the belt.

29 Initially, the belt should be set to the maximum tension possible using reasonable force, indicated by the mark on the tensioner moving past the pointer. Tighten the tensioner nut securely.

30 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.

31 Remove any locking tools used, and/or select neutral. Temporarily fit the crankshaft pulley nut, and 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.

32 Loosen the tensioner nut, and align the tensioner pointer with the punched marking. Hold the tensioner in this position, and tighten the tensioner nut to the specified torque.

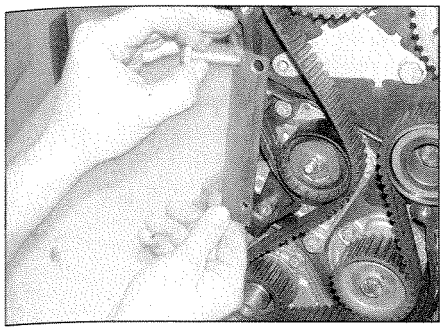
Without the special tool

33 Make up a thin strip of thick metal (to be levered against), with two holes drilled 125 mm apart. Remove two of the tensioner backplate bolts, and bolt the metal strip into position **(see illustrations)**.

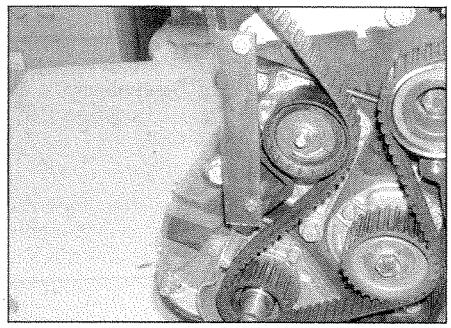
34 Loosen the tensioner nut, but leave it fitted.

35 Locate the end of a suitable screwdriver or large pin punch in the slot in the tensioner backplate, then lever against the metal strip **(see illustration)**. Do not lever against the plastic surface of the tensioner pulley, or it will be damaged.

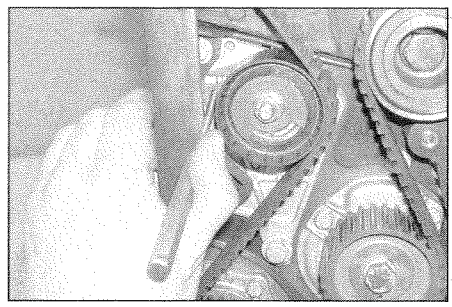
36 Initially, take up the slack in the belt, but then pull on the belt while levering against the strip so that the mark on the tensioner moves



4.33a Make up a metal strip with two drilled holes . . .



4.33b . . . and bolt it into position as shown



4.35 Locate the end of a suitable tool in the notch in the backplate, below the slot, and lever against the metal strip

beyond the pointer, to the full extent of its travel **(see illustration)**. Tighten the tensioner nut to hold the tensioner spring in position.

37 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.

38 Remove any locking tools used, and/or select neutral. Temporarily fit the crankshaft pulley nut, and 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 **(see illustration)**.

39 Using a screwdriver (or pin punch) again as described in paragraph 35, lever against the metal strip to take up the spring pressure in the tensioner.

40 Carefully loosen the tensioner nut, and let the tensioner spring relax gradually until the mark on the tensioner is aligned with the pointer **(see illustration)**. Tighten the tensioner nut to the specified torque.

Final refitting

41 Refit the timing belt cover and rubber gasket, and secure with the eight bolts, correctly refitted to their original locations.

42 Refit the crankshaft pulley, locating the pulley over the crankshaft sprocket and ensuring that the marks made between the timing sensor and pickup wheel are aligned. Holding the flywheel stationary as described in paragraph 8, fit and tighten the (new) nut securely **(see illustrations)**.

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

44 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

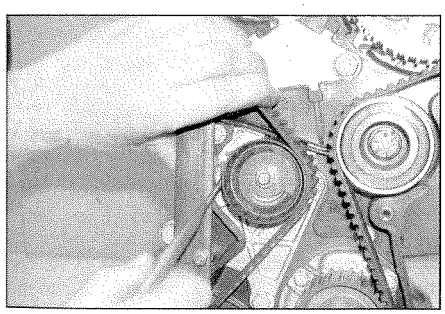
Removal

1 Remove the auxiliary drivebelt(s) from the crankshaft pulley, then remove the spark plugs (refer to Chapter 1).

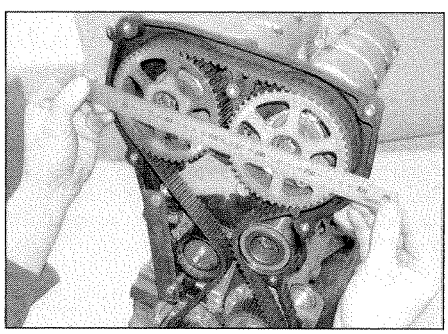
2 Unbolt and remove the timing belt cover, which is secured by a total of eight bolts. Note the location of each bolt (and any washers) as it is removed, as they are of different sizes. Also recover the rubber gasket fitted between the outer and inner covers.

Caution: Provided the timing belt is kept fully engaged with all the 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 the various TDC alignment markings to ensure 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.

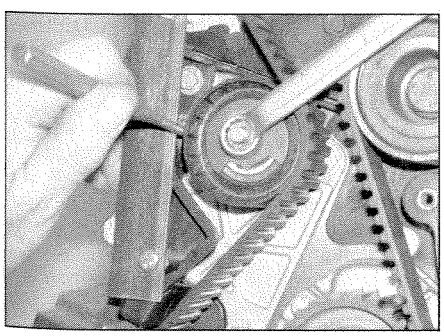
3 Loosen the nut on the timing belt tensioner and move the pulley away from the belt. If necessary, keep the belt engaged with the sprockets using cable-ties, elastic bands or string.



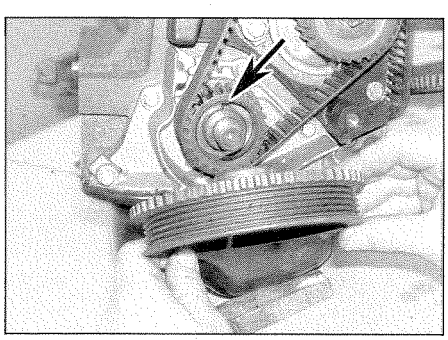
4.36 Pull on the belt with one hand, while levering the tensioner, so that the tensioner marking moves



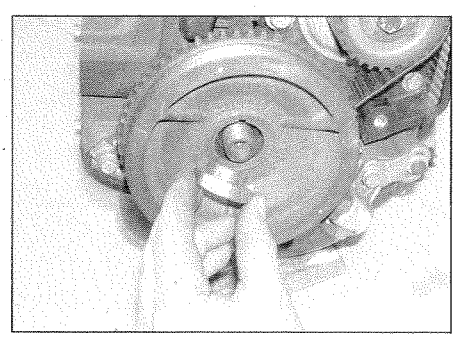
4.38 Checking that the camshaft sprocket marks made are in alignment



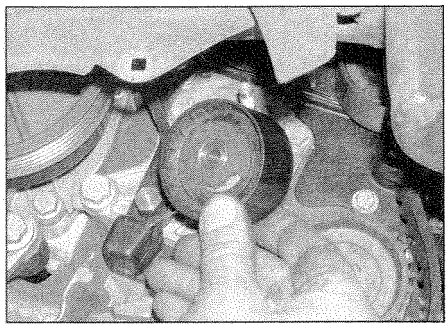
4.40 Release the tensioner gradually, so that the mark aligns with the pointer



4.42a Fit the crankshaft pulley onto the key (arrowed) on the crankshaft sprocket . . .



4.42b . . . and secure using a new nut



5.4 Removing the timing belt tensioner pulley

4 Completely unscrew the nut, and slide the tensioner off the mounting stud **(see illustration)**. If required, the tensioner mounting plate can be unbolted from the engine, noting the location of each bolt, as they are of different sizes.

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.

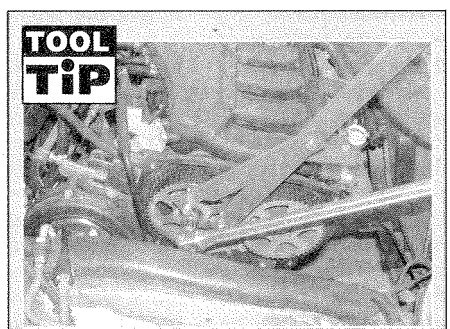
Refitting

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 21 to 24.

8 Refit the timing belt cover and rubber gasket, and secure with the eight bolts, correctly refitted to their original locations.

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



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 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 as follows and engage it with the holes in the sprocket **(see Tool Tip)**.

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 (recover the washer), and slide the sprocket from the end of the camshaft. Note the integral location key on the inner face of the sprocket, and the notch on the end of the camshaft into which it fits **(see illustrations)**.

Inspection

14 With the sprockets removed, examine the 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, noting that it is (loosely) keyed. 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.

20 Slide the sprocket off the end of the crankshaft **(see illustration)**. If it is tight, remove it using a puller or a pair of suitable screwdrivers. The sprocket has a separate key which locates in a groove in the crankshaft nose - recover the key if it is loose.

Inspection

21 With the sprocket removed, examine the crankshaft oil seal for signs of leaking. If necessary, refer to Section 10 and renew it.

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

Refitting

23 Slide the sprocket fully onto the crankshaft, making sure it engages the key.

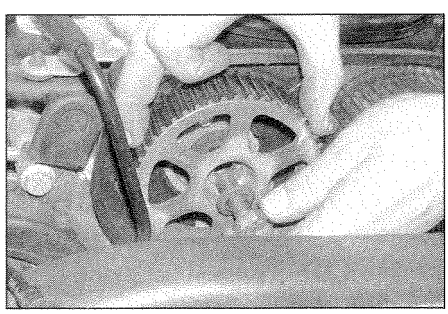
24 Refit the timing belt as described in Section 4.

Auxiliary shaft sprocket

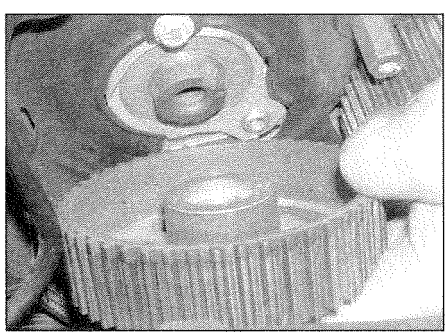
Removal

25 Remove the timing belt as described in Section 4. There is no need to make any alignment marks to show the auxiliary shaft sprocket fitted position.

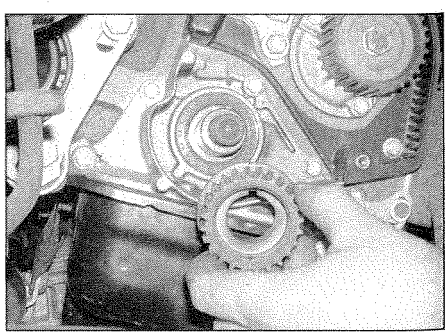
26 The sprocket must now be held stationary while the bolt is loosened. Locking up the flywheel will not help in this case, as the sprocket turns the oil pump driveshaft. One solution would be to hold the sprocket using a strap wrench, as used for oil filter removal;



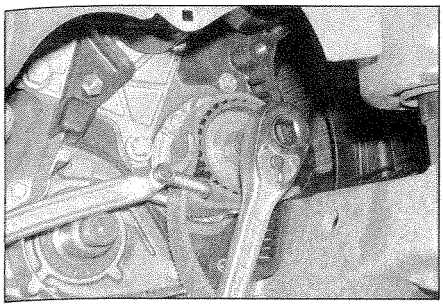
5.13a Unscrew and remove the bolt and washer, and remove the camshaft sprocket . . .



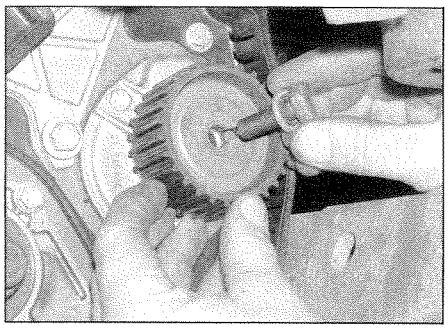
5.13b . . . noting how the sprocket locates on the end of the camshaft



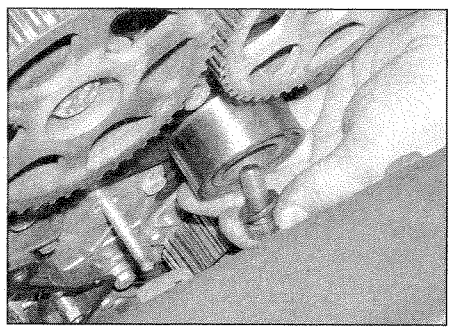
5.20 Slide the crankshaft sprocket off, noting the location of the locating key



5.26 Using a strap wrench to hold the auxiliary shaft sprocket as the bolt is loosened



5.27 Removing the auxiliary shaft sprocket



5.33 Removing the fixed guide pulley

alternatively, a means must be devised for jamming the sprocket teeth. If a chain wrench must be used, wrap a cloth around the sprocket first, to prevent damage to the sprocket teeth **(see illustration)**.

27 Once the bolt has been loosened, remove it and its washer, and take off the sprocket **(see illustration)**. Recover the locating dowel fitted between the sprocket and shaft.

Inspection

28 With the sprocket removed, examine the auxiliary shaft oil seal for signs of leaking. If necessary, refer to Section 9 and renew it.

29 Wipe clean the sprocket and shaft mating surfaces. Check the sprocket teeth for damage.

Refitting

30 Fit the locating dowel, then slide the sprocket fully onto the shaft, making sure the dowel engages correctly.

31 Refit the timing belt as described in Section 4.

Fixed guide pulley

Removal

32 Remove the timing belt as described in Section 4.

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

Inspection

34 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

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

36 Refit the timing belt as described in Section 4.

6 Camshaft housings and camshafts - removal and refitting

Note: *The camshaft housings 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 - larger Ribe bolts are used to secure the cylinder head.*

Removal

1 Making sure that they are labelled for position, disconnect the HT leads from the spark plugs.

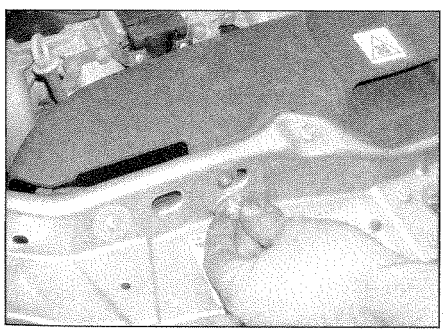
2 Referring to Chapter 5B, remove the ignition coil assembly, and place it to one side without disconnecting the HT leads from it.

3 To improve working room, remove the two bolts securing the air intake at the front of the engine compartment, and lift the intake out of position, detaching it from the intake duct **(see illustrations)**.

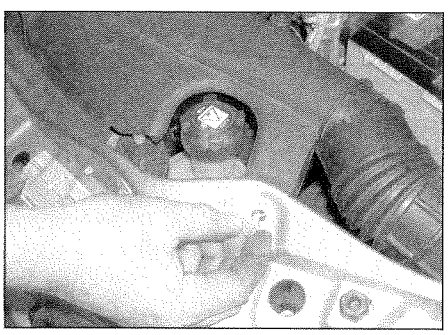
4 Remove both sections of the inlet manifold as described in Chapter 4B.

5 Set the engine to TDC, as described in Section 2.

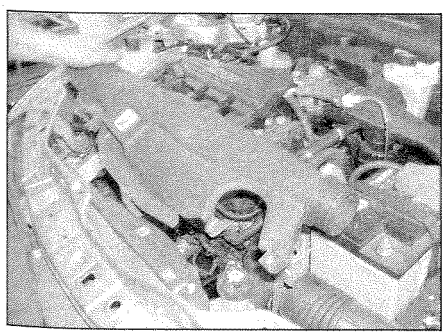
6 Remove the four nuts securing the ignition coil mounting bracket; note that these nuts also serve to secure the camshaft housing end covers themselves. Lift away the coil mounting bracket, and remove it from the engine **(see illustrations)**.



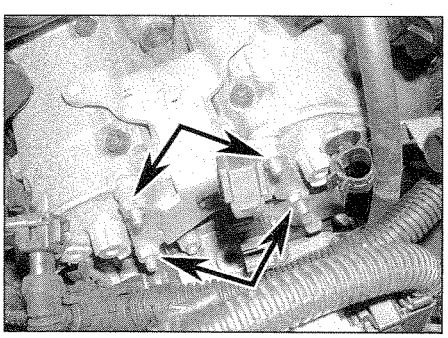
6.3a Remove the right-hand . . .



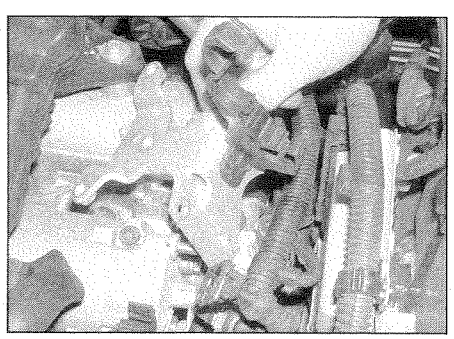
6.3b . . . and left-hand securing bolts . . .



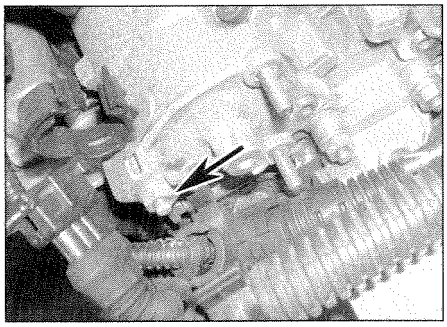
6.3c . . . and lift out the air intake



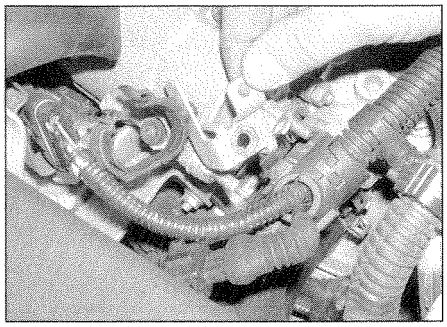
6.6a Unscrew the four mounting nuts (arrowed) . . .



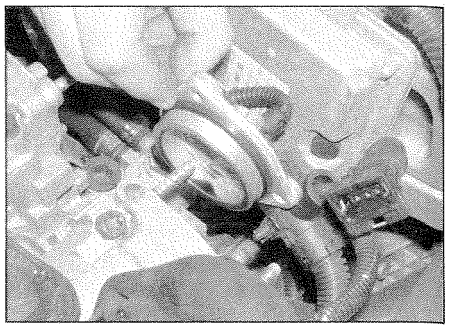
6.6b . . . and remove the ignition coil mounting bracket



6.7a With the coil bracket removed, the end covers are each secured by one nut (arrowed) . . .



6.7b . . . which also secures a hose/wiring harness bracket



6.8 Carefully prise off the camshaft housing end covers

7 Noting their respective fitted positions, remove the hose and wiring harness brackets from the housing end covers (one nut remaining per cover) - note the earth lead which may be fitted to the rear cover **(see illustrations)**.

8 Prise off and remove the end covers from the camshaft housings **(see illustration)**.

9 If the camshaft locking tools described in Section 4 are available, fit them now. If not, make accurate alignment marks between the ends of the camshafts and their housings, for use when refitting.

10 Remove the camshaft sprockets and the fixed guide pulley as described in Section 5.

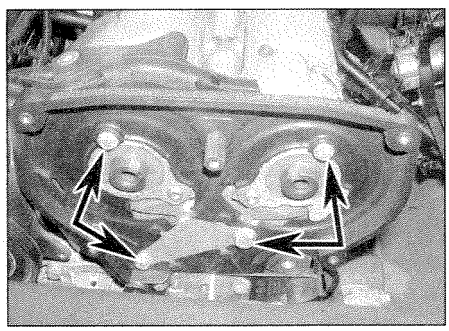
11 On early models, remove the two bolts securing the inlet camshaft timing sensor. Withdraw the sensor from the engine, and disconnect the wiring plug.

12 Unbolt and remove the upper half of the inner timing belt cover, unclip the fuel line plastic guide channel, and remove the inner cover and channel from the top of the engine **(see illustrations)**.

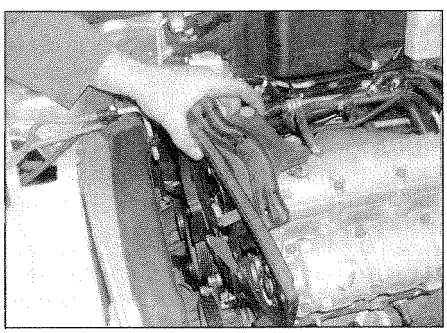
13 Loosen the ten Ribe bolts securing each camshaft housing by a quarter-turn at a time, in a diagonal sequence **(see illustration)**. As the bolts are loosened, some of the valve springs will be released.

14 When all the bolts are loose, carefully tilt the housings towards the front of the car, noting that the housings are each located on two small dowels. Some of the hydraulic tappets may try and fall out; it is important that the tappets are not interchanged, so turn the housings upside-down as soon as they are removed. Recover the gaskets from the top of the cylinder head **(see illustrations)**.

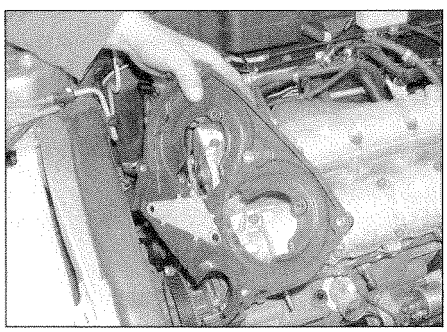
15 Lift the hydraulic tappets from their bores and store them with the valve contact surface facing downwards, to prevent the oil from draining out. Alternatively, place the tappets in a tray full of oil, sufficiently deep to prevent the tappets draining **(see illustration)**.



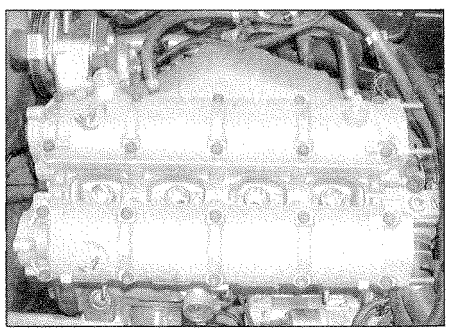
6.12a Remove the four bolts (arrowed) . . .



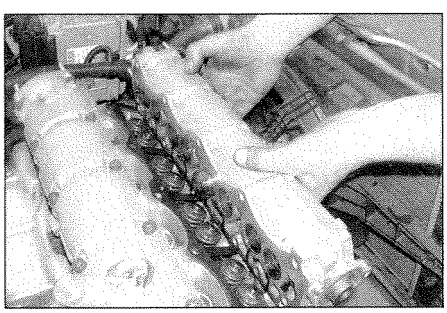
6.12b . . . unclip the fuel line guide channel . . .



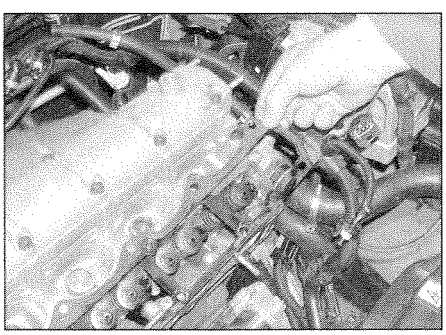
6.12c . . . and remove the timing belt inner cover



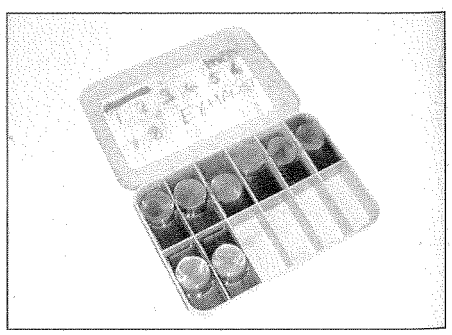
6.13 Top view of the camshaft housings, showing the ten bolts securing each one



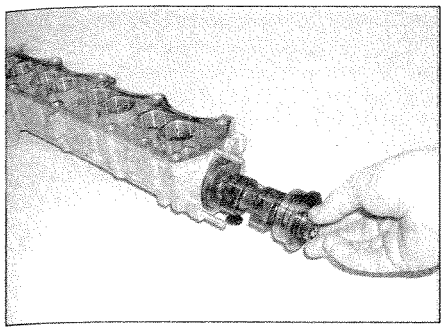
6.14a When removing the housings, tip them over, to prevent the tappets falling out . . .



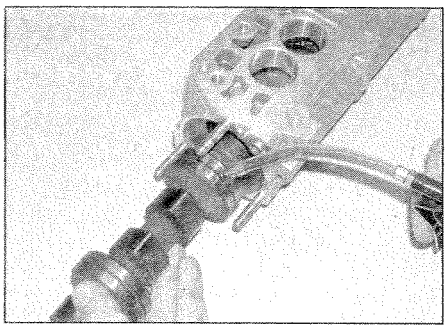
6.14b . . . and recover the gasket from the cylinder head, noting the two dowels



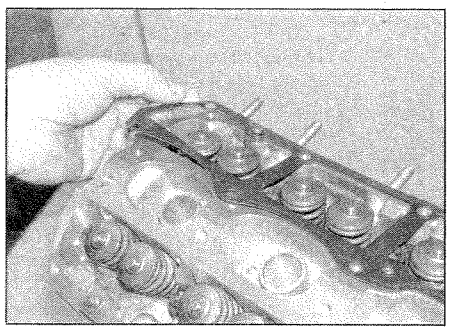
6.15 Immerse the hydraulic tappets in oil, in a numbered container



6.17 Withdrawing one of the camshafts



6.21 Oil the camshaft lobes as the camshaft is inserted



6.24 Place a new housing gasket over the locating dowels

16 Make a note of the position of each tappet, as they must be fitted to the same valves on reassembly - accelerated wear leading to early failure may result if they are interchanged.

17 Carefully withdraw the camshafts from their respective housings, turning them as necessary so that the camshaft lobes do not hang up on the bearings inside the housing **(see illustration)**. Keep the camshaft horizontal as it is withdrawn; force should not be used, or required, otherwise the camshaft and bearings could be damaged.

18 Suitably mark the camshafts (and housings) to avoid confusion when refitting. The camshafts may be found to be marked A and S, which stands for Aspirazione (Inlet) and Scario (Exhaust). Note that the inlet camshaft is nearest to the front facing side of the engine. On the car seen in the workshop, the inlet camshaft had a blue paint mark, while the exhaust camshaft was marked with green paint.

Inspection

19 Examine the camshaft bearing surfaces and cam lobes for signs of wear ridges and scoring. Renew the camshafts if any of these conditions are apparent. As far as possible, check the condition of the bearing surfaces in the camshaft housings. If suitable measuring equipment is available, camshaft bearing journal wear can be checked by direct measurement.

20 Examine the tappet bearing surfaces which contact the camshaft lobes for wear ridges and scoring. Renew any tappet on which these conditions are apparent. If a tappet bearing surface is badly scored, also examine the corresponding lobe on the camshaft for wear, as it is likely that both will be worn. Renew worn components as necessary.

Refitting

21 Liberally lubricate the camshaft lobes, and as far as possible, the bearing surfaces in each camshaft housing **(see illustration)**.

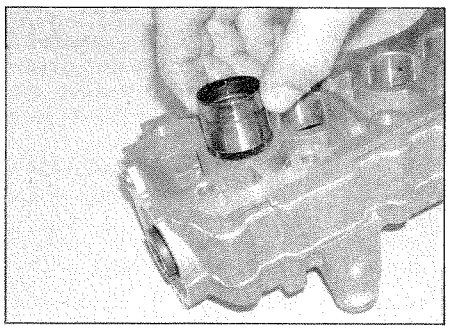
22 Carefully insert the camshafts back into their respective housings, taking the same precautions described in paragraph 17.

23 At this stage, it is advisable to check the camshaft endfloat using a dial gauge mounted on the camshaft housing, with its probe in contact with the camshaft being checked. Move the camshaft one way, zero the gauge, then move the camshaft as far as it will go the other way. Record the reading on the dial gauge, and repeat on the other camshaft and housing. FIAT do not quote a figure for camshaft endfloat, but the figure given in the Specifications can be used as a guide. If either of the readings exceeds the tolerance given, a pair of new camshaft housings will probably be required.

24 Clean all traces of gasket from the mating faces on the housings and cylinder head, then place new gaskets in position over the locating dowels **(see illustration)**.

25 Fit the hydraulic tappets back in their original positions **(see illustration)**.

26 If the FIAT special tools for holding the camshafts were not available, turn the camshafts (if necessary) so that the marks made on removal are aligned, and try not to let the camshafts turn as the housings are refitted.



6.25 Oil and refit the hydraulic tappets

27 Check that the engine is still set to TDC as described in Sections 2 and 4.

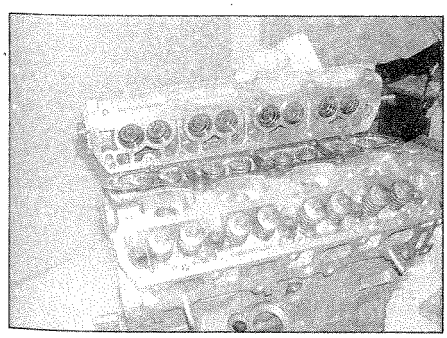
28 Offer the housings into position over the two dowels, ensuring that the tappets engage correctly with the valves. Take care that none of the tappets fall out as the housings are refitted - offer the housing into place on its side initially, and use a ruler to hold the tappets in place **(see illustrations)**.

29 Insert the housing bolts. Note that as the housings are tightened down, some of the valve springs will be compressed - it is important that tightening is done progressively.

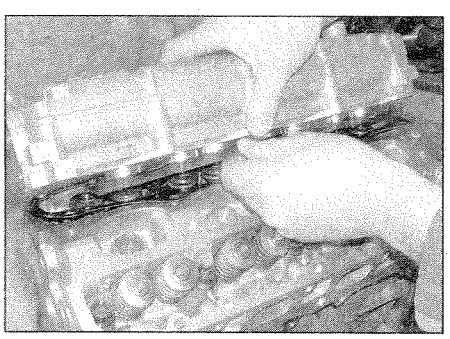
30 Working in a diagonal sequence and keeping the housing as level as possible, tighten each housing bolt by a quarter-turn at a time until the housing just seats on the head.

31 Again working in a diagonal sequence, tighten all bolts to the specified torque **(see illustration)**.

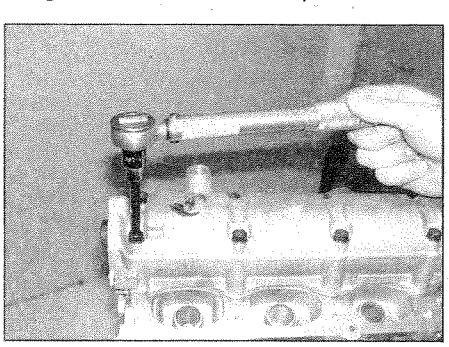
32 Refit all components removed for access, using a reversal of the removal procedure.



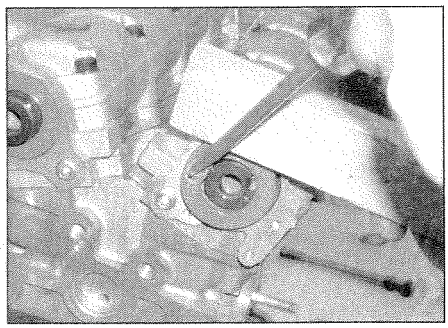
6.28a Offer the housing into position on its side . . .



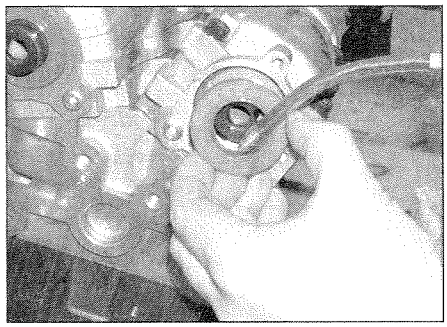
6.28b . . . using a ruler to keep the tappets from falling out



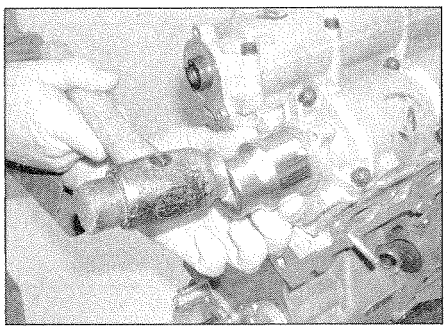
6.31 Tighten the housing bolts to the specified torque



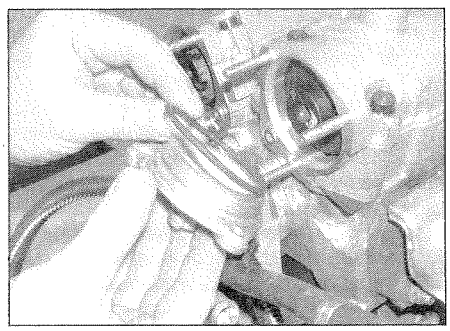
7.5 Levering out the old seal



7.7 Oil the new seal before fitting



7.8 Tap the new seal into place using a socket or similar



7.16 Fit the O-ring into the groove in the end cover

7 Camshaft oil seals - renewal

Front oil seals

1 Remove the camshaft sprockets and the fixed guide pulley as described in Section 5.
2 Unbolt and remove the upper half of the inner timing belt cover (four bolts), unclip the fuel line plastic guide channel, and remove the inner cover and channel from the top of the engine.
3 If necessary, to improve access, remove the upper section of the inlet manifold as described in Chapter 4B.
4 Even if only one seal is found to be leaking, it is advisable to renew both.
5 Carefully drill a hole in the old seal, taking care not to drill too deep. Use a suitable pointed tool and a block of wood to lever against, lever the seal out of its housing **(see illustration)**.
6 Clean the seating in the housing 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.
7 Lubricate the new oil seal **(see illustration)**, then locate it over the camshaft, making sure that the sealing lips are facing inwards.
8 Using a tubular drift, drive the oil seal squarely into the housing **(see illustration)**. Remove the adhesive tape from the camshaft.
9 Renew the seal in the other camshaft housing (as required) using the same procedure.
10 Refit all components removed for access, using a reversal of the removal procedure.

Rear oil seals

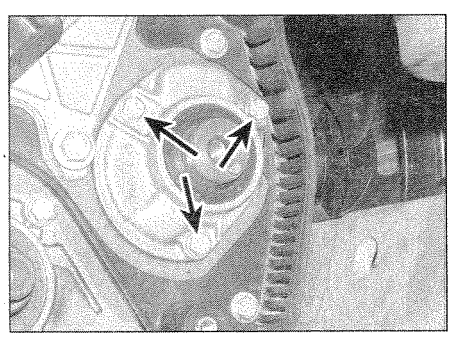
11 Ensuring that they are labelled for position, disconnect the HT leads from the spark plugs.
12 Referring to the information in Chapter 5B, remove the ignition coil assembly, and move it clear without disconnecting the HT leads from it.
13 Refer to Section 6, paragraphs 6 to 8, and remove the camshaft end covers.
14 Using a suitable hooked instrument if necessary, remove the large O-ring seal from each end cover. Even if only one seal is known to be leaking, it is advisable to renew both.
15 Clean the seating in the end cover, and inside the end of the camshaft housing.
16 Dip the new oil seal in oil, then fit it into the groove in the camshaft end cover **(see illustration)**.
17 Refit the end covers, and all components removed for access, using a reversal of the relevant removal procedure.

8 Auxiliary shaft - removal and refitting

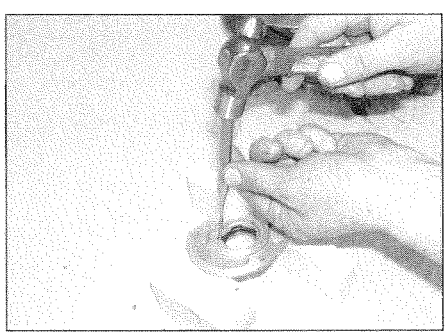
There appears to be insufficient clearance to withdraw the auxiliary shaft while the engine is in the car. For this reason, the procedure is covered in Chapter 2E.

9 Auxiliary shaft oil seal - renewal

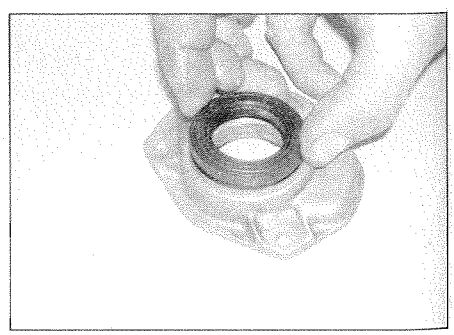
1 Remove the auxiliary shaft sprocket as described in Section 5.
2 Unscrew the three bolts, and withdraw the auxiliary shaft flange from the engine **(see illustration)**. Recover the gasket.
3 Mount the flange in a vice with protected jaws. Taking care not to mark the flange sealing surfaces, drive the seal out from inside using a suitable punch **(see illustration)**.
4 Wipe clean the oil seal location in the flange, and use a file or emery paper to clean up any sharp edges which might cause the new seal to fail.
5 Dip the new oil seal in oil, then carefully tap it into the flange, lips facing inwards. Once the seal has started, use a large socket to drive the seal squarely into position **(see illustrations)**.



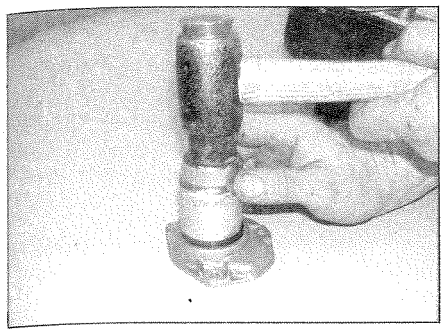
9.2 Auxiliary shaft flange bolts (arrowed)



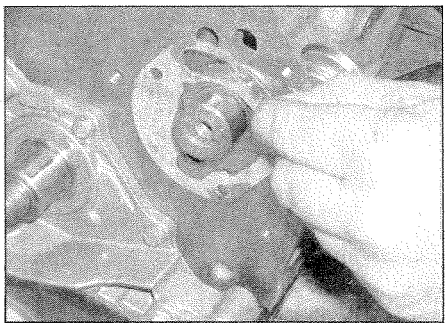
9.3 Tap out the old seal using a punch



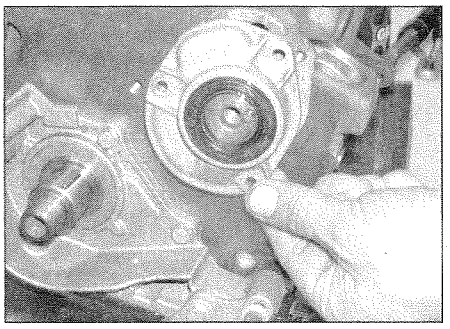
9.5a Fit the new seal with lips facing inwards . . .



9.5b . . . and tap in with a suitable socket



9.6a Fit a new auxiliary flange gasket . . .



9.6b . . . then fit the flange over the auxiliary shaft

6 Fit a new auxiliary flange gasket. Lightly oil the end of the auxiliary shaft, then carefully feed the seal and flange over it **(see illustrations)**.

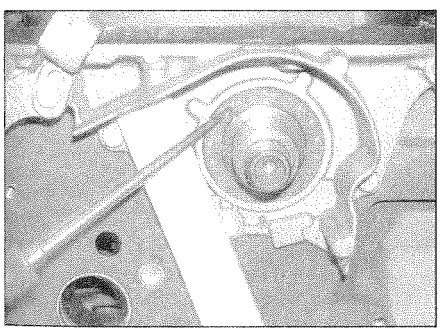
7 Refit the flange bolts, and tighten securely **(see illustration)**.

8 Refit the shaft sprocket, and all other components removed for access, using a reversal of the relevant removal procedure.

10 Crankshaft oil seals - renewal

Front (right-hand side) oil seal

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



10.4 Levering out the old seal

2 There are two possible methods for renewing the oil seal. If the engine is in the car, try the first method first, as this involves much less dismantling.

Method 1

3 Taking care not to damage the crankshaft timing sensor, use a sharp-pointed tool (such as a bradawl) to pierce the seal and thus provide a leverage point. Take care that the tool does not score the crankshaft, and do not penetrate too far, as the seal seat may be damaged.

4 Using the hole made, lever the seal out of position, taking care not to damage the crankshaft **(see illustration)**.

5 As far as possible, clean the oil seal location, and remove any sharp edges which might damage the new seal.

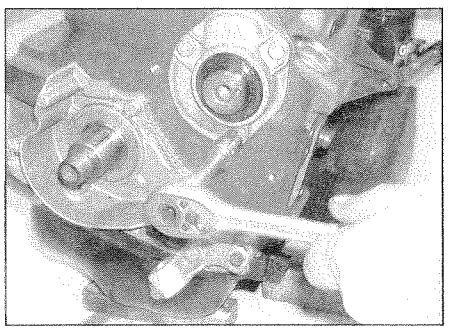
6 Dip the new seal in oil, and carefully feed it over the end of the crankshaft **(see illustration)**.

7 Tap the new seal into its seat, then drive it squarely home using a large socket **(see illustration)**. This is the most difficult part, as there is limited room to use a hammer or mallet. If care is taken, it may be possible to press the seal into place, working progressively around the seal so that is does not distort.

Method 2

8 Remove the sump as described in Section 14.

9 Trace the wiring back from the crankshaft timing sensor, and disconnect it at the wiring plug. Remove the screw securing the sensor to its mounting bracket, and remove it.



9.7 Tightening the auxiliary flange bolts

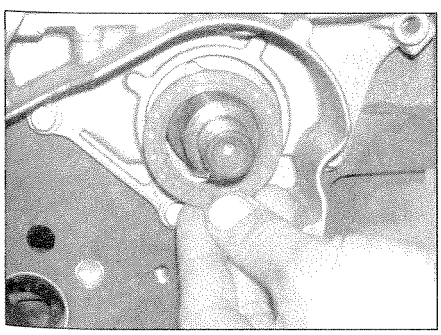
10 Unscrew and remove the bolts securing the crankshaft front flange to the block. Take care not to unscrew the two mounting bolts for the crankshaft timing sensor bracket (one is a shear-head bolt) - if these must be removed for any reason, mark around them very carefully with paint or a sharp tool, so that the sensor position is not lost.

11 Withdraw the flange from the front of the crankshaft, and mount it in a vice with protected jaws. Recover the flange gasket from the engine.

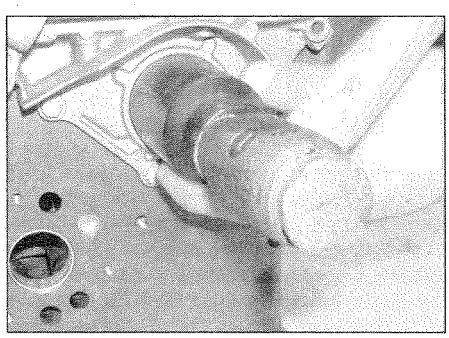
12 Taking care not to mark the flange sealing surfaces, drive the seal out from inside using a suitable punch **(see illustration)**.

13 Wipe clean the oil seal location in the flange, and use a file or emery paper to clean up any sharp edges which might cause the new seal to fail.

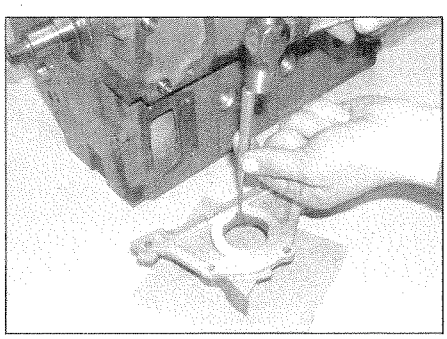
14 Dip the new oil seal in oil, then carefully tap it into the flange, lips facing inwards. Once



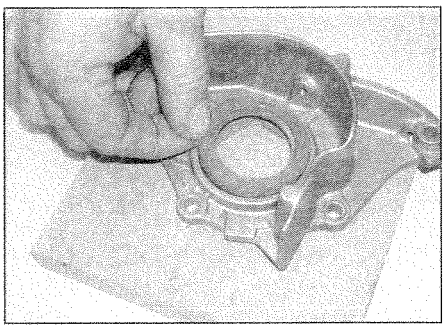
10.6 Lubricate the new seal, and fit it over the crankshaft



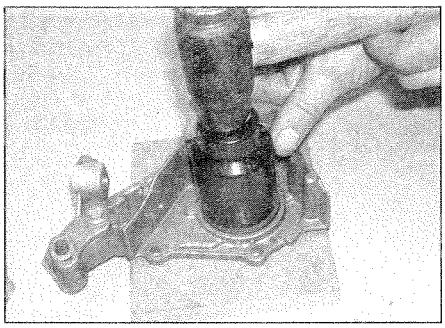
10.7 Tap the new seal into place using a large socket



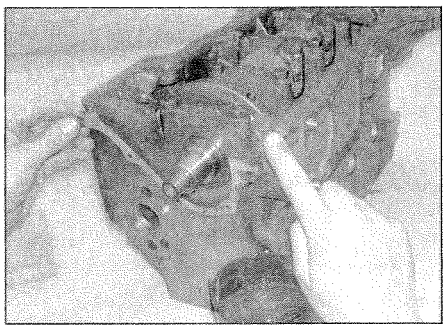
10.12 Tap out the old seal using a pin punch



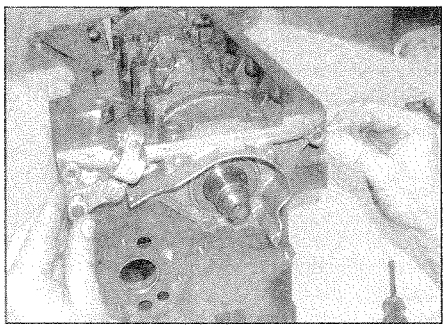
10.14a Oil the new seal, and fit it to the flange . . .



10.14b . . . then drive it in with a large socket



10.15 Use a little grease to stick the new flange gasket in place

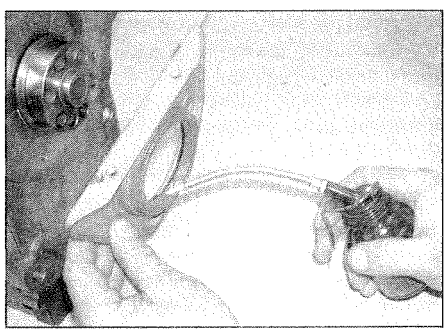


10.16 Fit the flange into place, then fit and tighten the bolts

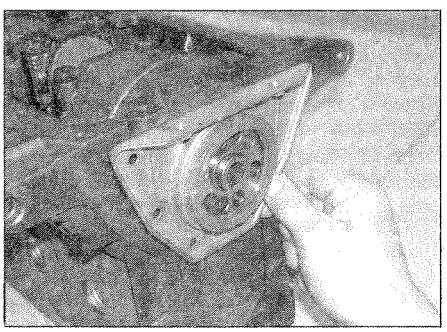
the seal has started, use a large socket to drive the seal squarely into position **(see illustrations)**.

15 Fit a new flange gasket, sticking it in place with a little grease **(see illustration)**.

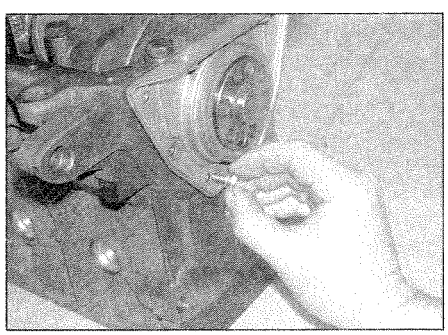
16 Lightly oil the end of the crankshaft, then carefully feed the seal and flange over it **(see illustration)**. Use a straight edge to ensure that the flange is aligned with the bottom of the engine.



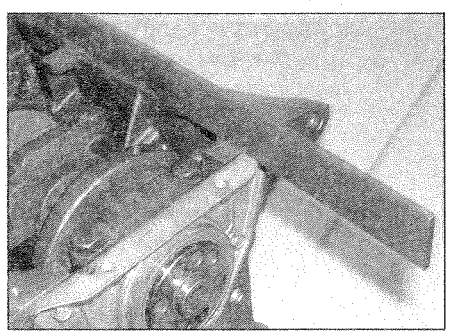
10.27a Oil the new seal . . .



10.27b . . . fit the flange and seal over the end of the crankshaft . . .



10.27c . . . then fit and tighten the flange bolts



10.28 Check that the flange is square to the base of the engine

17 Refit the flange bolts, and tighten evenly and securely, ensuring that the flange does not twist out of alignment.

All methods

18 Refit the crankshaft sprocket, and all other components removed for access, using a reversal of the relevant removal procedure.

Rear (left-hand side) oil seal

Note: *On early models (up to approximately 1999, before the introduction of the 'Step A' engine) the rear oil seal is available separately from the housing. On later models, the seal is integral with its housing.*

19 Remove the flywheel/driveplate as described in Section 12.

Early models

20 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. Alternatively, carefully drill the seal and screw in two self-tapping screws on either side of the seal; using pliers on the screws, pull the seal from its seat.

21 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.

22 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.

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

Later models

24 Remove the sump as described in Section 14.

25 Unbolt the oil seal flange from the engine, and remove it from the end of the crankshaft.

26 Clean the flange mating surface on the engine, 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.

27 Oil the new seal, and fit the flange with the gasket side to the engine **(see illustrations)**.

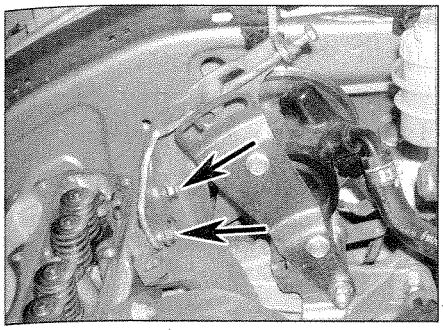
28 Use a straight edge to align the base of the flange with the bottom of the engine **(see illustration)**.

29 Fit the flange securing bolts, and tighten evenly and securely, ensuring that the flange does not twist out of alignment.

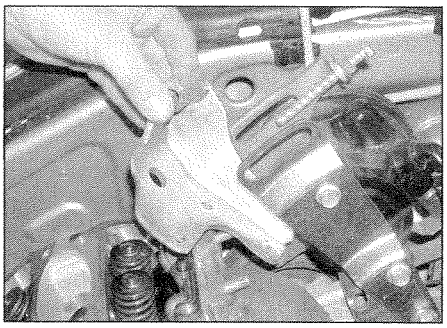
30 Refit the sump as described in Section 14.

All models

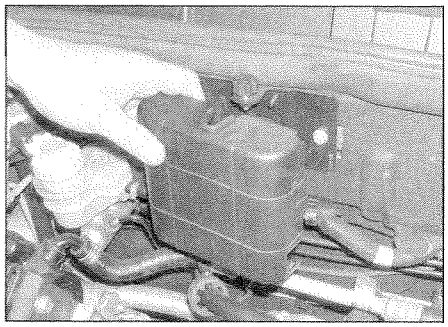
31 Refit the flywheel/driveplate with reference to Section 12.



11.9a Remove the two nuts securing the power steering pump mounting bracket . . .



11.9b . . . and remove the bracket from the manifold



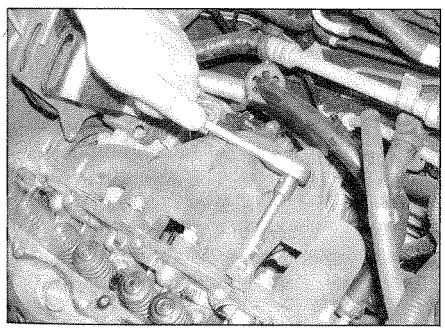
11.11a Unscrew the retainer and remove the relay box cover . . .

11 Cylinder head - removal and refitting

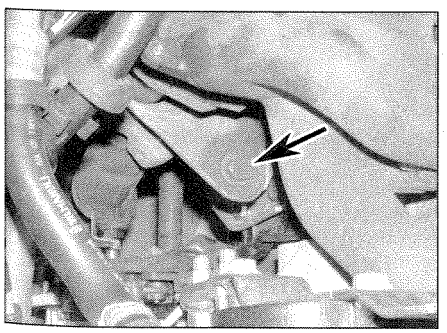
Note: *The cylinder head is secured by Ribe bolts, which are similar in appearance to Torx types, but require different tools. A set of Ribe sockets can be obtained from good tool stockists - smaller Ribe bolts are used to secure the camshaft housings.*

Removal

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

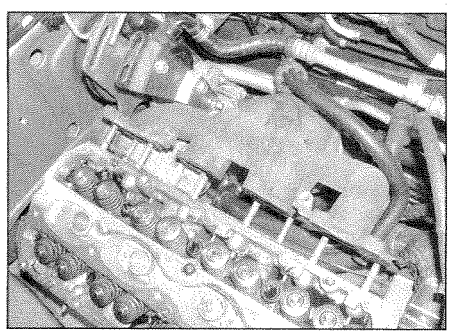


11.12a Unscrew the manifold-to-cylinder head nuts . . .

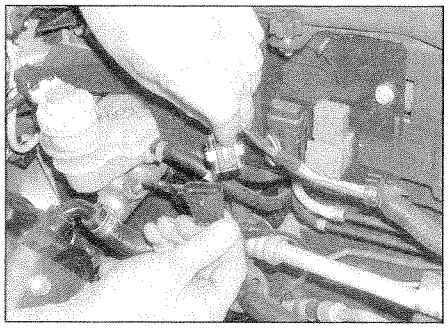


11.12b . . . and the bolt (arrowed) from the manifold support bracket

5 Remove the spark plugs as described in Chapter 1.
6 To improve working room, remove the two bolts securing the air intake at the front of the engine compartment, and lift the intake out of position, detaching it from the intake duct.
7 Loosen the hose clips and disconnect the air duct which runs from the air cleaner to the inlet manifold, also disconnecting the breather pipe which runs to the oil filler tube.
8 Remove the camshaft housings as described in Section 6.
9 Loosen/remove the power steering pump mounting bolts, and tip the pump to the rear, clear of the mounting bracket attached to the exhaust manifold. Remove the nuts securing the power steering pump mounting bracket to the manifold, and remove the bracket **(see illustrations)**.
10 Unbolt the exhaust manifold heat shield (three bolts), and remove the shield.
11 To avoid the possibility of straining the oxygen sensor wiring when the exhaust manifold is detached, trace the wiring back to the connector plug inside the relay box on the bulkhead, and disconnect it **(see illustrations)**.
12 Unscrew the exhaust manifold-to-cylinder head nuts, and the bolt from the manifold support bracket at the downpipe joint **(see illustrations)**.
13 Withdraw the manifold from the cylinder head, recovering the gasket. Tie the manifold back clear of the head **(see illustration)**.
14 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 studs and nuts should be obtained as required, as the old ones are likely to be in less-than-perfect condition.

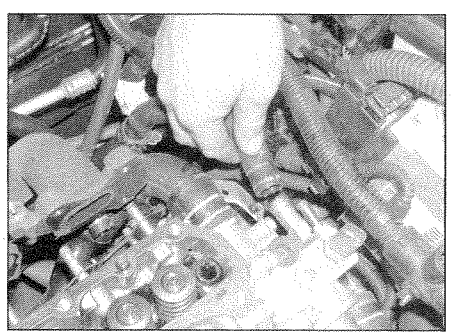


11.13 Move the manifold clear of the cylinder head studs, and recover the gasket

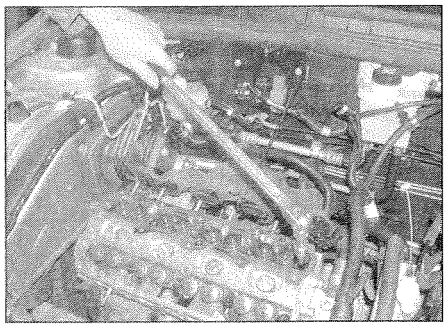


11.11b . . . then locate and disconnect the wiring plug for the oxygen sensor

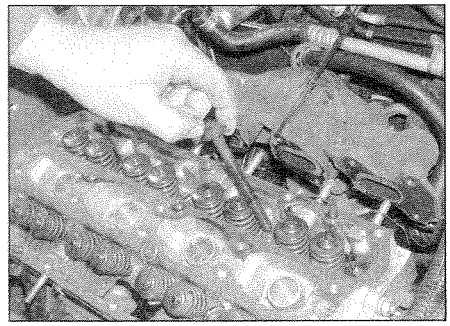
15 Disconnect the coolant hoses from the thermostat housing, noting their fitted positions **(see illustration)**.
16 Check around the head that there are no further wires, hoses or other obstructions which will prevent the head from being lifted off.
17 Unscrew the cylinder head Ribe bolts half a turn at a time, in the reverse order to that shown in illustration 11.33. When the bolts are free, remove them **(see illustrations)**.
18 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



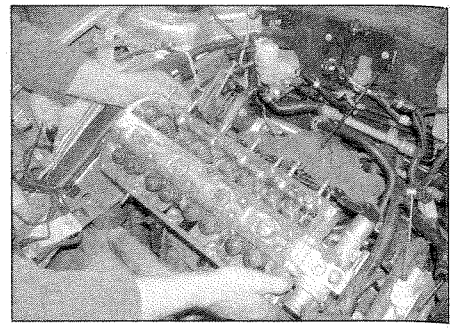
11.15 Disconnect the hoses from the thermostat housing



11.17a Unscrew the cylinder head bolts . . .



11.17b . . . and remove them



11.18a Lifting the cylinder head from the block

drive levers into the gasket joint, nor attempt to tap the head sideways, as it is located on positioning dowels **(see illustrations)**.

19 Remove and discard the cylinder head gasket.

20 The cylinder head can be dismantled as described in Chapter 2E.

Preparation for refitting

21 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.

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

23 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.

24 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.

25 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.

26 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.

27 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

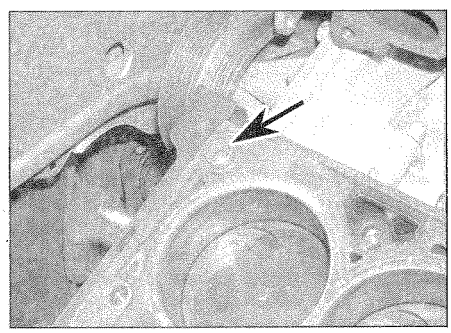
28 Before refitting the assembled cylinder head, make sure that the head and block mating surfaces are perfectly clean, and that the bolt holes in the cylinder block have been mopped out to clear any oil or coolant. If the bolt holes have any significant amount of liquid in them, the block could be cracked by hydraulic pressure when the head bolts are tightened.

29 Fit the two dowels to their locations on the cylinder block **(see illustration)**.

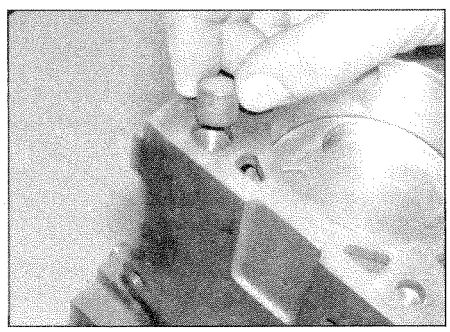
30 The new gasket should not be removed from its plastic bag until required for use. Fit the gasket dry - no grease or sealant should be used. Place the gasket on the cylinder block so that the word ALTO can be read from above **(see illustrations)**.

31 Lower the cylinder head onto the block so that it locates on the positioning dowels **(see illustration)**.

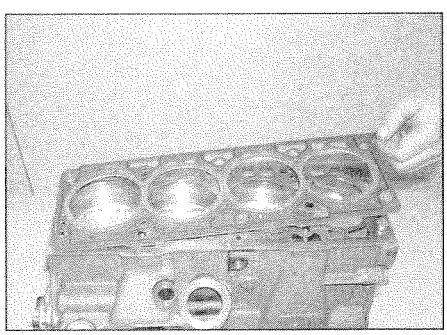
32 Ensure that the cylinder head bolts are cleaned of all debris, and check the threads for signs of damage. Especially if it is known that the bolts have been removed previously, it is advisable to renew all ten bolts as a set, rather than risk the bolts shearing when tightened.



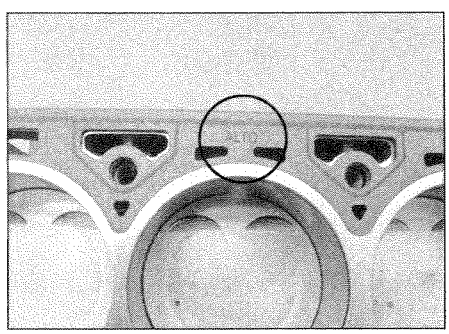
11.18b The head is located on two dowels - one shown



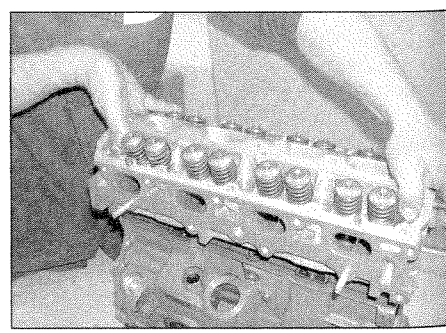
11.29 Refit the cylinder head positioning dowels



11.30a Fit the gasket over the dowels . . .



11.30b . . . so that the word ALTO is visible



11.31 Lower the cylinder head into position

33 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)**.

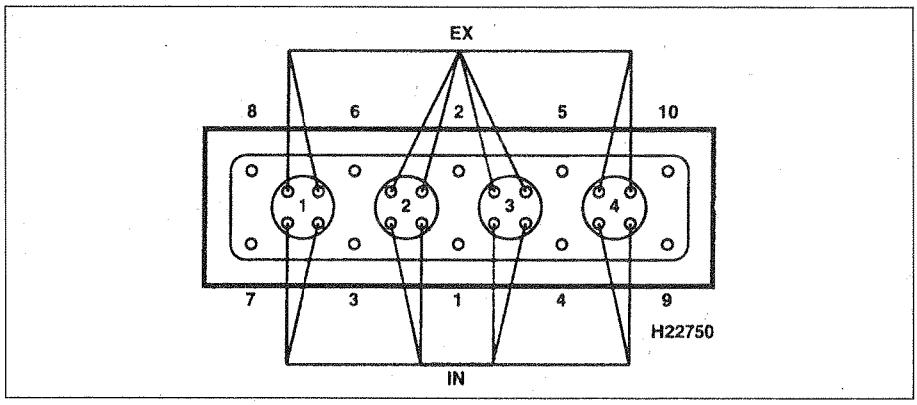
34 When all ten bolts have been tightened to the Stage 1 torque, go round again in sequence and tighten to the Stage 2 torque **(see illustration)**.

35 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)**.

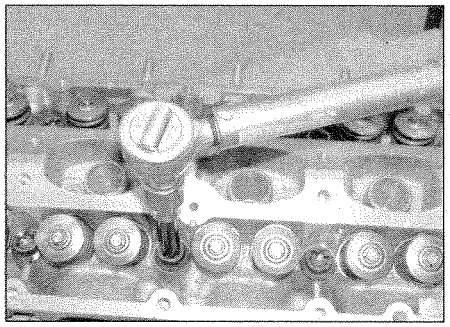
36 With all ten bolts tightened to Stage 3, go round once more and tighten all bolts in sequence to the Stage 4 angle.

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

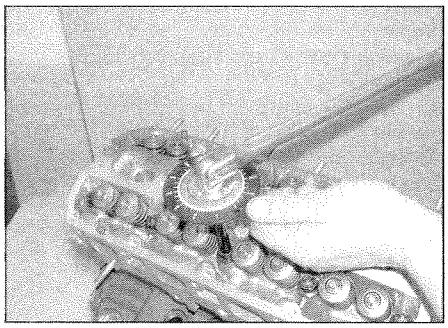
38 Further refitting is a reversal of removal. Ensure that all wiring and hoses are correctly routed and securely reconnected. Refer to Section 4 when refitting the timing belt, and to Chapter 1 when refitting the spark plugs and auxiliary drivebelt, and when refilling the cooling system.



11.33 Cylinder head bolt tightening sequence



11.34 Tightening the cylinder head bolts



11.35 Use an angle gauge if possible for the latter stages of tightening

12 Flywheel/driveplate - removal, inspection and refitting

Removal

1 Remove the transmission as described in Chapter 7A or 7B. On manual transmission models, also remove the clutch as described in Chapter 6.

2 Mark the position of the flywheel/driveplate with respect to the crankshaft using a dab of paint. Note that on some models although there is only one location dowel on the flywheel/driveplate, there are two holes in the end of the crankshaft and it is therefore possible to locate the flywheel 180° out.

3 The flywheel/driveplate must now be held stationary while the bolts are loosened. A home-made locking tool may be fabricated from a piece of scrap metal and used to lock the ring gear. Bolt the tool to one of the transmission bellhousing mounting holes **(see Tool Tip)**.

4 Support the flywheel as the bolts are loosened - the flywheel is very heavy. Unscrew and remove the mounting bolts, take off the mounting plate, then lift off the flywheel/driveplate. Where applicable, recover the spacer fitted between the flywheel and crankshaft.

Inspection

Manual transmission models

5 If the flywheel's clutch mating surface is deeply scored, cracked or otherwise damaged, the flywheel must be renewed. However, it may be possible to have it surface-ground; seek the advice of a FIAT dealer or engine reconditioning specialist.

6 If the ring gear is badly worn or has missing teeth, the flywheel must be renewed.

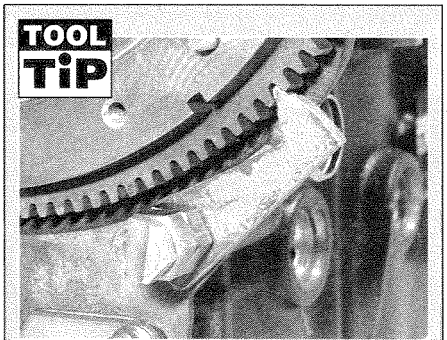
Automatic transmission models

7 Check the driveplate for signs of damage and renew it if necessary. If the ring gear is badly worn or has missing teeth, the driveplate must be renewed.

Refitting

8 Clean the mating surfaces of the flywheel/driveplate and crankshaft. Remove any remaining locking compound from the threads of the crankshaft holes, using the correct-size tap, if available.

TOOL TiP



To lock the flywheel, make up a pointed tool to engage the ring gear teeth, and bolt it to the engine using one of the bellhousing bolts

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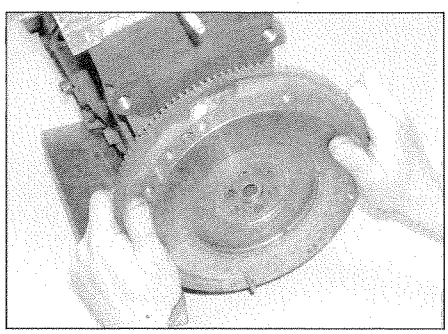
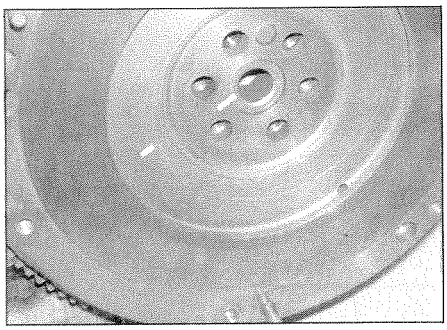
If a suitable tap is not available, cut two slots down the threads of one of the old bolts with a hacksaw, and use the bolt to remove the locking compound from the threads.

9 Clean the flywheel bolt threads, then apply a suitable thread-locking compound to the threads of each bolt.

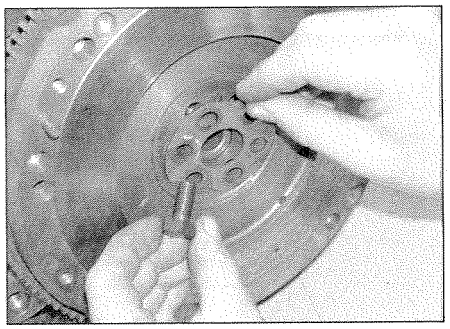
10 Offer up the flywheel/driveplate to the crankshaft (with the spacer behind, where applicable). Use the alignment marks made during removal to ensure correct refitting **(see illustrations)**.



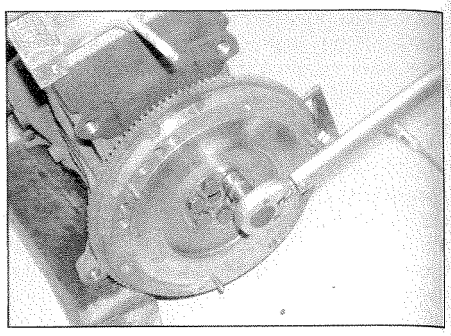
12.10a Fit the flywheel into position . . .



12.10b . . . making sure the marks made on removal are aligned



12.11a Refit the mounting plate and flywheel bolts . . .



12.11b . . . and tighten the bolts to the specified torque

11 Fit the mounting plate and secure the flywheel/driveplate loosely with the bolts. Lock the flywheel/driveplate using the method employed on dismantling, and tighten the retaining bolts to the specified torque **(see illustrations)**.

12 Refit the clutch on manual transmission models as described in Chapter 6.

13 Refit the transmission as described in Chapter 7A or 7B.

13 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

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

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

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 washer **(see illustration)**.

15 Unscrew the two bolts securing the mounting to the subframe.

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 (and washer) securing the bracket to the mounting. Tighten the bolt to the specified torque, then tighten the mounting-to-subframe bolts.

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

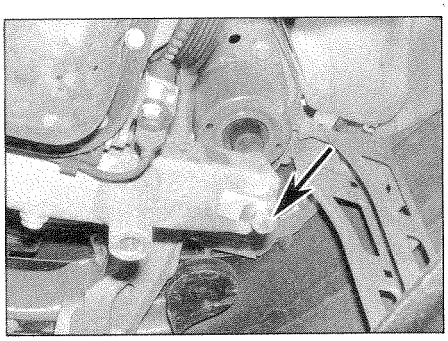
Left-hand mounting

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

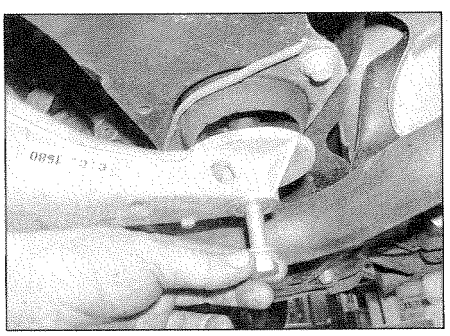
21 Place a trolley jack beneath the engine/transmission flange, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine and transmission.

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

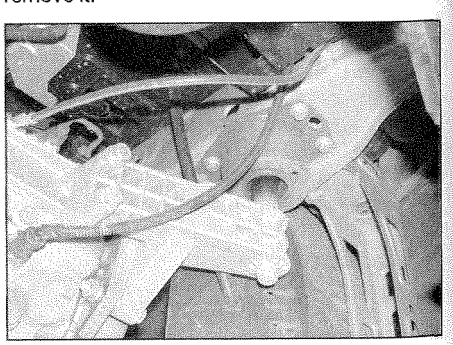
23 Lower the engine sufficiently to disengage the bracket from the mounting, then remove the bolts securing the mounting to the body, and remove it.



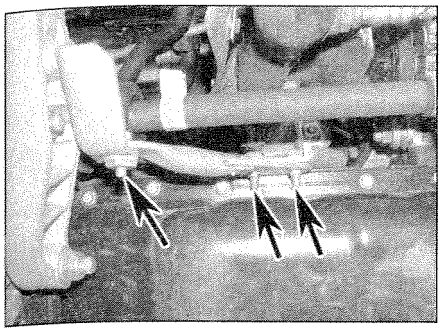
13.7 Engine right-hand mounting (seen from below) - through-bolt arrowed



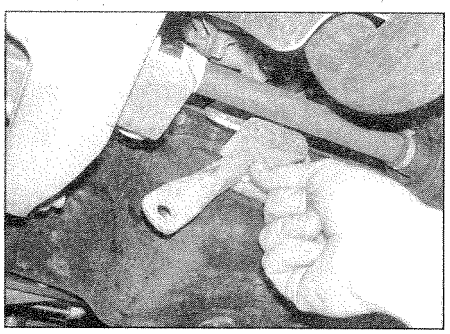
13.14 Removing the engine rear mounting through-bolt



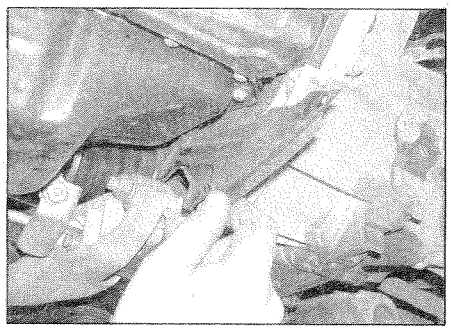
13.22 Engine left-hand mounting (seen from below)



14.2a Unscrew the bolts (arrowed) . . .



14.2b . . . and remove the support bracket from the rear mounting



14.2c Removing the flywheel lower cover

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 through-bolt (and washers) 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.

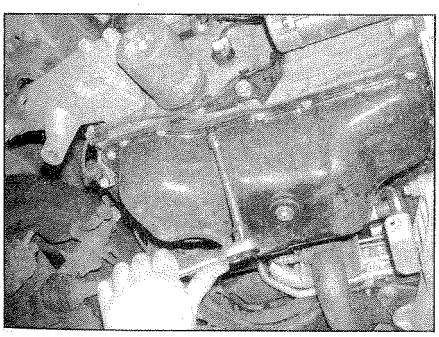
14 Sump - removal and refitting

Removal

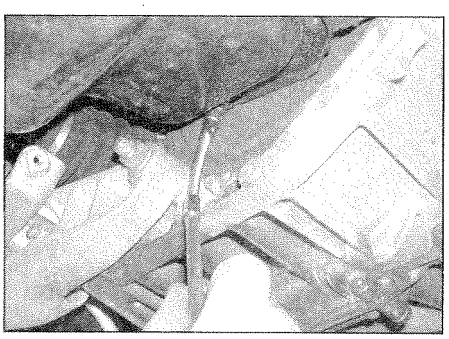
1 Jack up the front of the vehicle and support on axle stands. Drain the engine oil.
2 To improve access to some of the sump bolts, unbolt and remove the support bracket fitted to the engine rear mounting. It is also helpful to remove the flywheel lower cover **(see illustrations)**.
3 Unscrew the sump securing bolts, and recover the elongated washers fitted under the head of each. We found that a flexible extension piece was required to reach the bolts at the transmission end of the sump **(see illustrations)**.
4 A conventional sump gasket is not used - the sump is sealed using liquid gasket. Use a sharp knife to cut around the bead of sealant, then pull the sump downwards to remove it **(see illustration)**.

Refitting

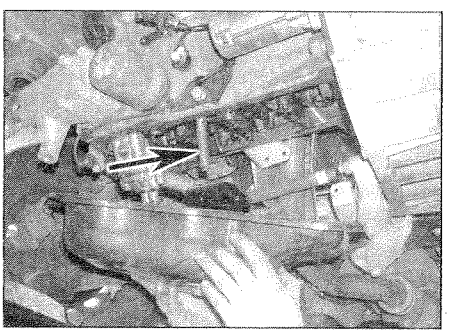
5 Clean away all the old sealant, from the sump pan and from the base of the block. Also clean any sealant from the sump bolts.
6 Where removed, refit the oil spill tube to the base of the engine, tightening its retaining bolt securely **(see illustration)**.
7 Apply a bead of RTV silicone instant gasket 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 **(see illustrations)**.
8 Fit the sump, then screw in the fixing bolts (and washers) and tighten in a diagonal sequence to the specified torque.
9 Wait one hour for the gasket compound to cure before filling with oil.
10 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*.



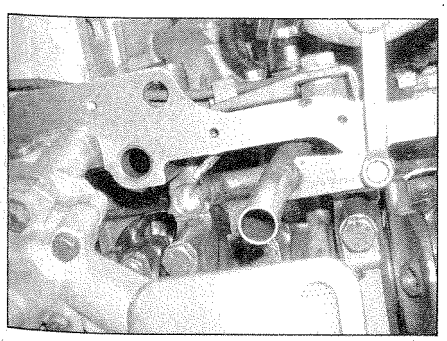
14.3a Removing the sump bolts



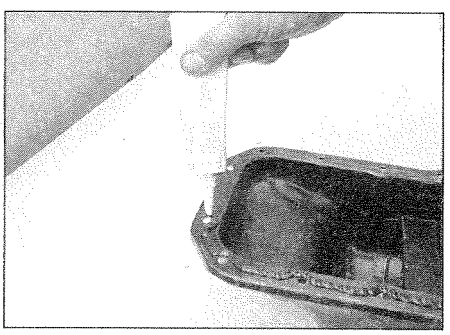
14.3b Using a flexible extension to reach the sump bolts at the transmission end



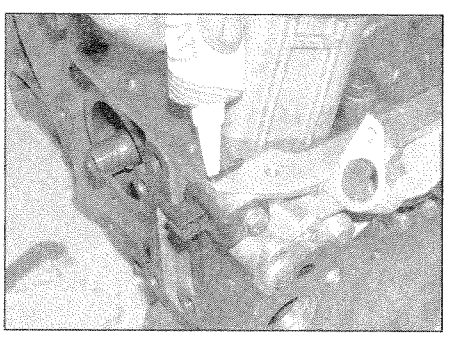
14.4 Removing the sump - note oil spill tube (arrowed)



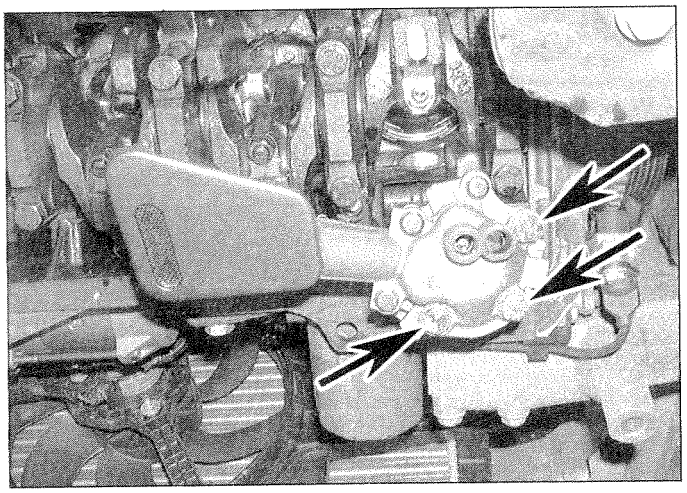
14.6 Tightening the oil spill tube bolt



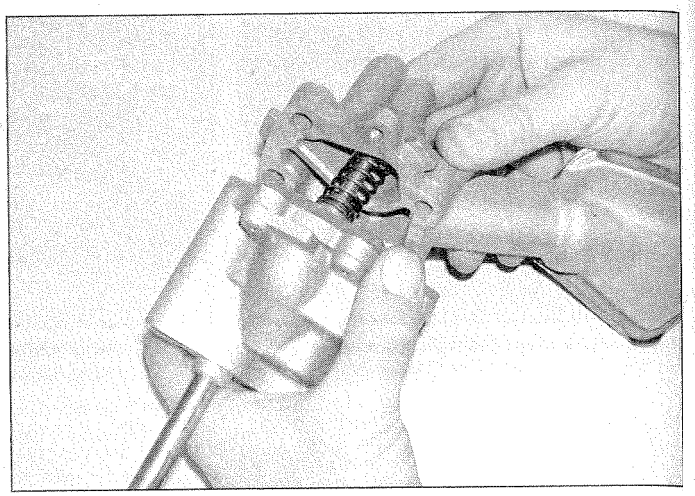
14.7a Run a bead of sealant around the sump flange . . .



14.7b . . . and across the oil seal flange joints



15.2 Oil pick-up/pump assembly retaining bolts (arrowed)



15.7a Take care removing the oil pump cover . . .

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

Removal

1 Drain the engine oil and remove the sump as described in Section 14.

2 Unbolt and remove the oil pick-up/pump assembly, which is secured by the three larger bolts visible (the smaller bolts retain the oil pump cover) **(see illustration)**. Remove the assembly, withdrawing the driveshaft from the idler gear. Recover the gasket.

3 Removing the oil pump idler gear requires the auxiliary shaft to be removed first. There is insufficient room to withdraw the auxiliary shaft with the engine fitted; removal of the auxiliary shaft is covered in Chapter 2E.

4 Once the shaft has been removed, the plug fitted over the idler gear must be removed from the cylinder block. The plug is driven into position, and is fitted using sealant, so removal will not be easy.

5 With the plug removed, the idler gear and its guide can be tapped out from below, using a long drift of diameter slightly larger than the oil pump driveshaft.

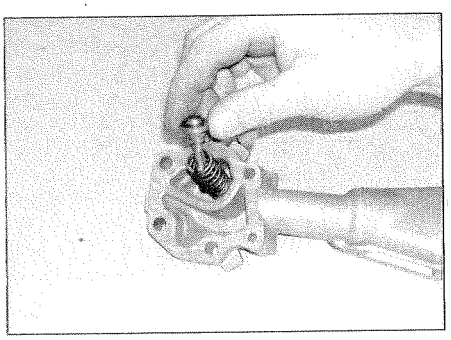
Inspection

6 If pump wear is suspected, dismantle the pump as follows.

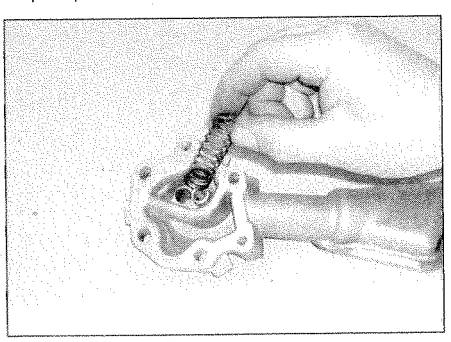
7 Extract the three fixing bolts and remove the cover plate. Take care as the cover is removed, and recover the oil pressure relief valve, spring and spring seat **(see illustrations)**.

8 Lift off the adaptor plate fitted between the cover and pump body **(see illustration)**.

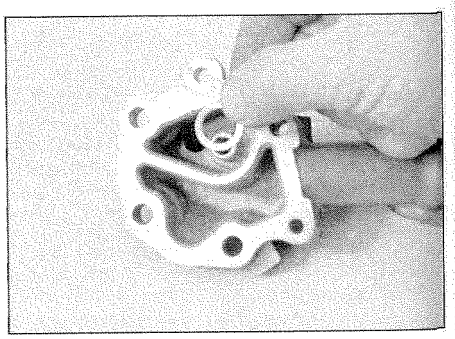
9 Check the clearance between the outer gear and the pump housing using feeler blades. Check the gear endfloat by placing a straight-edge across the pump body, and checking the gap between the straight-edge and gear face **(see illustrations)**. If the



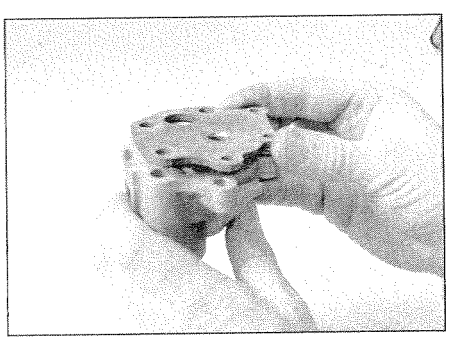
15.7b . . . retrieve the oil pressure relief valve . . .



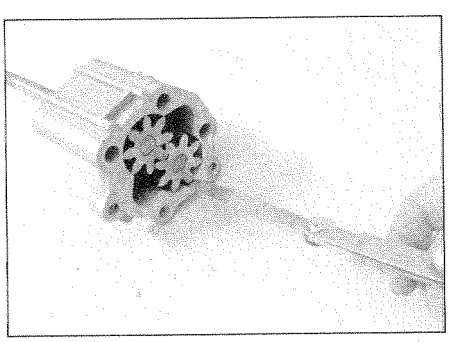
15.7c . . . valve spring . . .



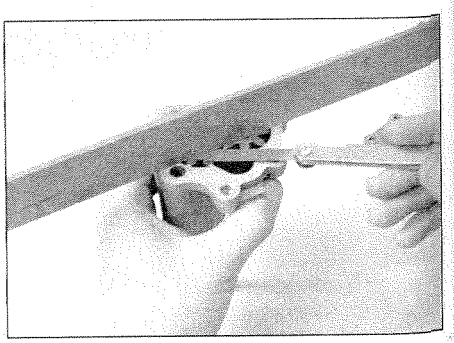
15.7d . . . and spring seat



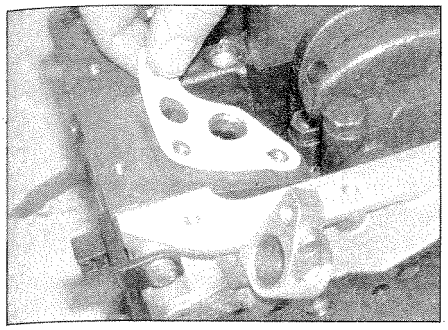
15.8 Remove the adaptor plate from the oil pump body



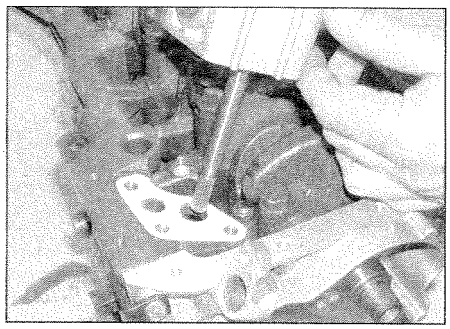
15.9a Checking the pump gear-to-body clearance . . .



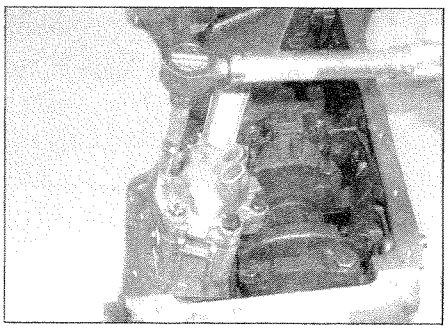
15.9b . . . and the gear endfloat



15.14a Fit a new oil pump gasket . . .



15.14b . . . then fit the pump into position . . .



15.14c . . . and tighten the mounting bolts to the specified torque

clearances are outside the specified tolerance, renew the oil pump complete.

10 If the pump is unworn, refit all removed components in reverse order to removal, and tighten the cover bolts 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 Where the idler gear has been removed, check the condition of the gear teeth, and of those on the auxiliary shaft. Renewal of both components will be necessary if either is worn. Use a new plug when refitting the idler gear.

Refitting

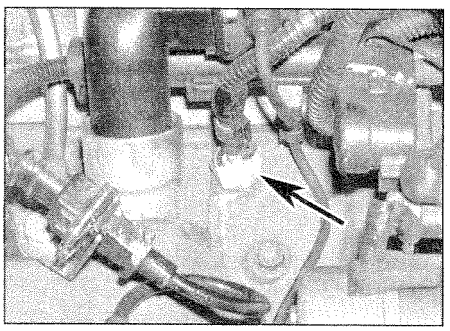
13 Clean all traces of old gasket from the pump and the mating surfaces on the crankcase.

14 Fit a new joint gasket, then offer the pump into position. Tighten the mounting bolts to the specified torque **(see illustrations)**.

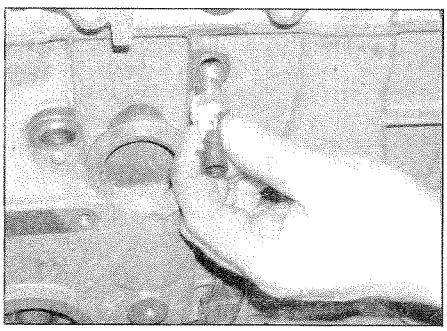
15 Fit the sump as described in Section 14.

16 Fill the engine with oil (see Chapter 1).

17 Run the engine for a few minutes, then check and top-up the oil level as described in *Weekly checks*.



16.1 Oil pressure switch (arrowed)



16.3 Removing the oil pressure switch

16 Oil pressure switch - removal and refitting

Removal

1 The oil pressure switch is located at the front of the engine block, next to the oil filler tube **(see illustration)**.

2 Disconnect the switch wiring connector.

3 Unscrew the switch from the block, and remove it **(see illustration)**.

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.