Chapter 2 Part A:
Petrol 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 type	V8, 4-stroke, water-cooled, ohv
Cubic capacity:	
3.5 litre engine	3528 cc
3.9 litre engine	3947 cc
Bore:	
3.5 litre engine	88.90 mm
3.9 litre engine	94.00 mm
Stroke	71.12 mm
Compression ratio:	
Low-compression engines	8.13 : 1
High-compression engines	9.35 : 1
Power output (DIN):	
3.5 litre carburettor engines	144.5 bhp at 5000 rpm
3.5 litre fuel injection engines	152 bhp at 4750 rpm
3.9 litre low-compression engines	165 bhp at 4550 rpm
3.9 litre high-compression engines	174 bhp at 4750 rpm
Firing order	1 - 8 - 4 - 3 - 6 - 5 - 7 - 2
Cylinder numbering (front to rear):	
Left-hand bank	1 - 3 - 5 - 7
Right-hand bank	2 - 4 - 6 - 8
Compression pressure at cranking speed, engine warm:	
Low-compression engines	150 psi minimum
High-compression engines	170 psi minimum

Flywheel

Minimum thickness (after machining)	39.9 mm

Lubrication system

Oil pump type	Gear
Oil pump drive	From bottom end of distributor driveshaft, off camshaft gear
Clearance between pump gears and front cover	0.05 mm
Oil pressure at 2400 rpm, engine warm	30 to 40 psi

Torque wrench settings	Nm	lbf ft
Alternator mounting bracket	34	25
Alternator mounting/adjuster bolts	24	18
Big-end bearing bolts	51	38
Clutch cover bolts	27	20
Crankshaft pulley bolt	280	207
Cylinder head bolts (up to 1995 model year with only 14 bolts):		
Inner and centre rows (nos 1 to 10)	92	68
Outer row (nos 11 to 14)	58	43
Cylinder head bolts (1995 model year onwards with 10 bolts):		
Stage 1	20	15
Stage 2	Angle-tighten a further 180 ± 5°	
Distributor clamp nut	20	15
Distributor drivegear retaining bolt	58	43
Driveplate to adaptor plate**	41	30
Driveplate-to-starter ring gear bolts (automatic transmission models)	25	18
Engine mounting nuts	20	15
Engine sump drain plug:		
3.5 litre engine	30	22
3.9 litre engine	40	30
Engine-to-transmission bellhousing bolts	40	30
Exhaust manifold bolts	20	15
Flywheel/adaptor plate to crankshaft**	80	59
Inlet manifold bolts	51	38
Main bearing cap bolts*:		
Nos 1 to 4	72	53
No 5 (rear cap)***	90	66
Oil cooler pipes:		
Oil filter housing unions	45	33
Radiator unions	30	22
Oil pressure relief valve plug	61	45
Oil pump cover bolts	13	10
Rocker cover bolts	9	7
Rocker shaft pedestal bolts	38	28
Spark plugs	20	15
Starter motor bolts	44	32
Sump bolts:		
Up to 1995 model year:		
Front bolts	10	7
Rear bolts	18	13
1995 model year onwards	18	13
Timing chain cover bolts	27	20
Timing chain sprocket to camshaft	58	43
Viscous fan bolt	12	9

**Use new fasteners.*
***Use locking fluid.*
****Use lubricant EXP 16A.*

1 General description

Using this Chapter

Chapter 2 is divided into three Parts; A, B and C. Repair operations that can be carried out with the engine in the vehicle are described in Parts A (petrol engines) and B (diesel engines). Part C covers the removal of the engine/transmission as a unit, and describes the engine dismantling and overhaul procedures.

In Parts A and B, 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 engine is an overhead valve V8, based on a Buick design. The cylinder block and cylinder heads are aluminium alloy castings, and the two banks of four cylinders are set at 90° to each other, forming a vee **(see illustration)**. The cylinder liners are of cast iron, and are integral with the block so they can be rebored within certain tolerances. The valve guides and seats are also of iron and can be renewed.

The camshaft is mounted centrally at the base of the cylinder banks, and is driven by a chain from the crankshaft. The valves are operated by pushrods and self-adjusting hydraulic tappets, meaning that routine valve clearance adjustment is not required.

The crankshaft runs in five main bearings; crankshaft endfloat is controlled by a thrust bearing on the centre main bearing.

Engine coolant is circulated by a pump driven by the crankshaft via an auxiliary drivebelt. A viscous-type fan is fitted to the water pump pulley. For details of the cooling system, refer to Chapter 3.

Lubrication is by a gear-driven oil pump at the front of the engine, which delivers oil under pressure to all the main, big-end and camshaft bearings, the valve gear, distributor driveshaft and cylinder bores **(see illustration)**. A full-flow cartridge type of disposable oil filter is fitted at the front of the engine.

Note: *Because the engine is of aluminium construction, it is vital when refitting engine components that the specified torque settings are strictly observed. It is also of equa*

importance that bolt lengths are noted, so that different-length bolts are refitted in the same location from which they were removed.

Repairs possible with the engine installed in the vehicle

The following operations can be performed without removing the engine:

a) Cylinder heads - removal and refitting.*
b) Rocker gear, pushrods and hydraulic tappets - removal and refitting.
c) Camshaft - removal and refitting.
d) Timing chain and sprockets - removal and refitting.
e) Coolant pump - removal and refitting (see Chapter 3).
f) Crankshaft oil seals - renewal.
g) Crankshaft pulley - removal and refitting.
h) Engine mountings - inspection and renewal.
i) Sump - removal and refitting.
j) Oil pump - removal and refitting.

**Cylinder head dismantling procedures are detailed in Chapter 2C.*

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 2C.*

2 Compression test - description and interpretation

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.

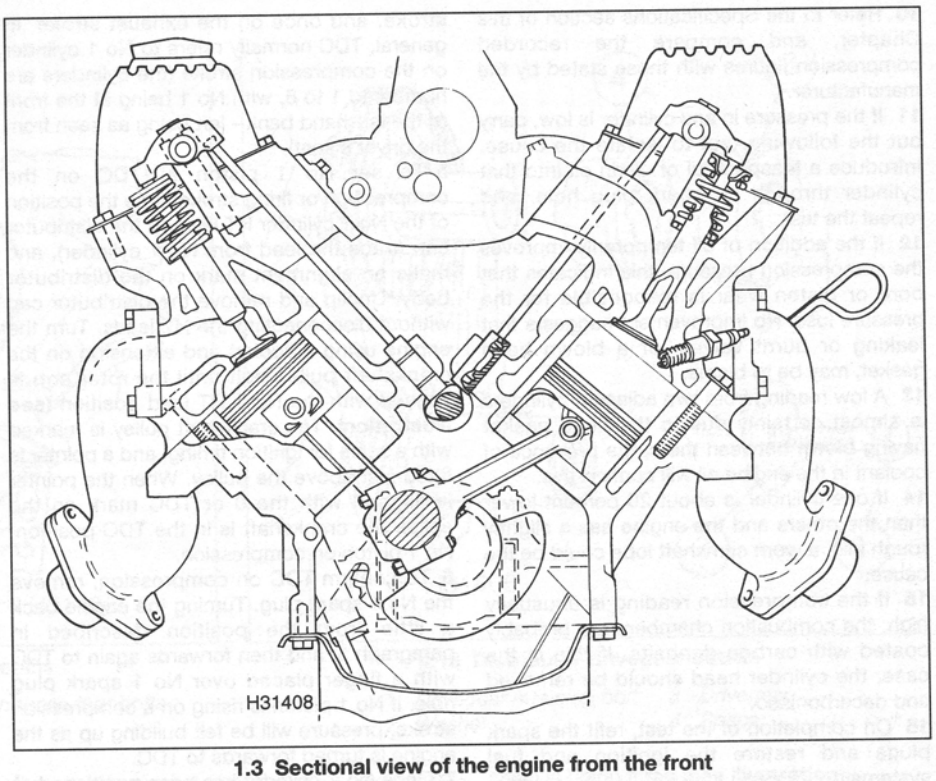
2 The engine must be fully warmed-up to normal operating temperature, the battery must be fully charged, and all the spark plugs must be removed (refer to Chapter 1A). The aid of an assistant will also be required.

3 Disable the ignition system by disconnecting the ignition HT coil lead from the distributor cap and earthing it on the cylinder block. Use a jumper lead or similar wire to make a good connection.

4 Where applicable, 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).

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

6 Have an assistant hold the accelerator pedal in the full-throttle position, then 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.

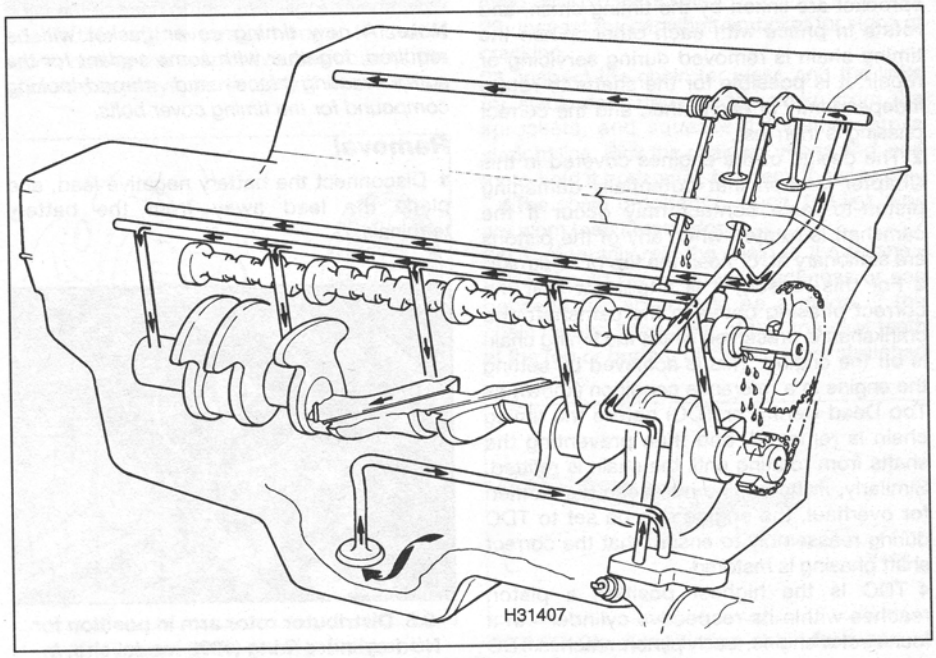


1.3 Sectional view of the engine from the front

7 Repeat the test on the remaining cylinders, recording the pressure in each. Keep the accelerator pedal fully depressed.

8 All cylinders should produce very similar pressures; a difference of more than 2 bars between any two cylinders indicates a fault (the manufacturer quotes a maximum difference between the highest and lowest of all four readings).

9 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). Deposits on the undersides of the valve heads can also cause low compression.



1.7 Lubrication system

10 Refer to the Specifications section of this Chapter, and compare the recorded compression figures with those stated by the manufacturer.

11 If the pressure in any cylinder is 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.

12 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.

13 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.

14 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.

15 If the compression reading is unusually high, the combustion chambers are probably coated with carbon deposits. If this is the case, the cylinder head should be removed and decarbonised.

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

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

Note: *This sub-Section has been written with the assumption that the distributor, HT leads and timing chain are correctly fitted.*

1 The crankshaft pulley and camshaft sprocket are linked by the timing chain, and rotate in phase with each other. When the timing chain is removed during servicing or repair, it is possible for the shafts to rotate independently of each other, and the correct phasing is then lost.

2 The design of the engines covered in this Chapter is such that potentially damaging piston-to-valve contact may occur if the camshaft is rotated when any of the pistons are stationary at, or near, the top of its stroke.

3 For this reason, it is important that the correct phasing between the camshaft and crankshaft is preserved whilst the timing chain is off the engine. This is achieved by setting the engine in a reference condition (known as Top Dead Centre or TDC) before the timing chain is removed, and then preventing the shafts from rotating until the chain is refitted. Similarly, if the engine has been dismantled for overhaul, the engine can be set to TDC during reassembly to ensure that the correct shaft phasing is restored.

4 TDC is the highest position a piston reaches within its respective cylinder - in a four-stroke engine, each piston reaches TDC twice per cycle; once on the compression stroke, and once on the exhaust stroke. In general, TDC normally refers to No 1 cylinder on the compression stroke (the cylinders are numbered 1 to 8, with No 1 being at the front of the left-hand bank - left being as seen from the driver's seat).

5 To set No 1 piston at TDC on the compression or firing stroke, note the position of the No 1 cylinder HT lead on the distributor cap (trace the lead from No 1 cylinder), and make an alignment mark on the distributor body. Unclip and remove the distributor cap without disconnecting the HT leads. Turn the engine using a socket and extension on the crankshaft pulley bolt until the rotor arm is aligned with the No 1 HT lead position **(see illustration)**. The crankshaft pulley is marked with a scale for ignition timing, and a pointer is fitted just above the pulley. When the pointer is aligned with the 0 or TDC mark on the scale, the crankshaft is in the TDC position, No 1 piston on compression.

6 To confirm TDC on compression, remove the No 1 spark plug. Turning the engine back a little from the position described in paragraph 5, and then forwards again to TDC with a finger placed over No 1 spark plug hole. If No 1 piston is rising on a compression stroke, pressure will be felt building up as the engine is turned forwards to TDC.

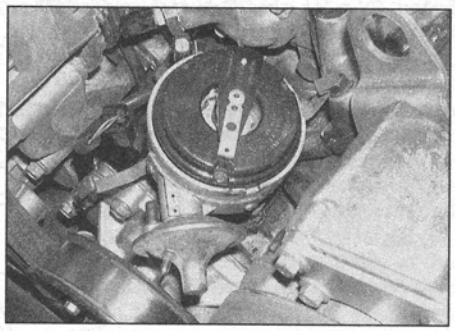
7 Once No 1 cylinder has been positioned at TDC on the compression stroke, TDC for any of the other cylinders can then be located by rotating the crankshaft clockwise 180° at a time and following the firing order (see Specifications).

4 Timing cover, chain and gears - removal, inspection and refitting

Note: *A new timing cover gasket will be required, together with some sealant for the sump mating face and thread-locking compound for the timing cover bolts.*

Removal

1 Disconnect the battery negative lead, and place the lead away from the battery terminals.



3.5 Distributor rotor arm in position for No 1 cylinder firing (1995 model shown - earlier distributors may differ)

2 Referring to Chapter 3, remove the radiator fan cowl and the viscous fan assembly. Although not strictly necessary, access will be further improved if the radiator is also removed.

3 Remove the auxiliary drivebelts (or single drivebelt on later models) as described in Chapter 1A.

4 Drain the cooling system as described in Chapter 1A, then disconnect the hoses from the water pump.

5 Drain the engine oil as described in Chapter 1A, then remove the oil filter. Where applicable, also disconnect the oil cooler pipe unions from the oil filter housing (see Section 14).

6 Using the information in Section 3, set the engine to TDC on No 1 cylinder.

7 Lift off the distributor cap and leads, and place it to one side. Also disconnect the distributor vacuum pipe and wiring plug.

8 Unbolt and remove the power steering pump mounting bracket from the water pump. Loosen the steering pump mounting and adjuster bolts, and pivot the pump body away from the timing cover. Tighten the adjuster bolt to hold the pump in this position.

9 Disconnect the wiring from the oil pressure switch.

10 On models with multiple auxiliary drivebelts, unbolt the alternator adjuster link from the water pump. Detach any wiring from the adjuster link. Also unbolt the alternator support strut from the timing cover, and move it to one side.

11 The crankshaft pulley must now be removed. As the engine has been set to TDC, try to turn the pulley as little as possible as the bolt is loosened.

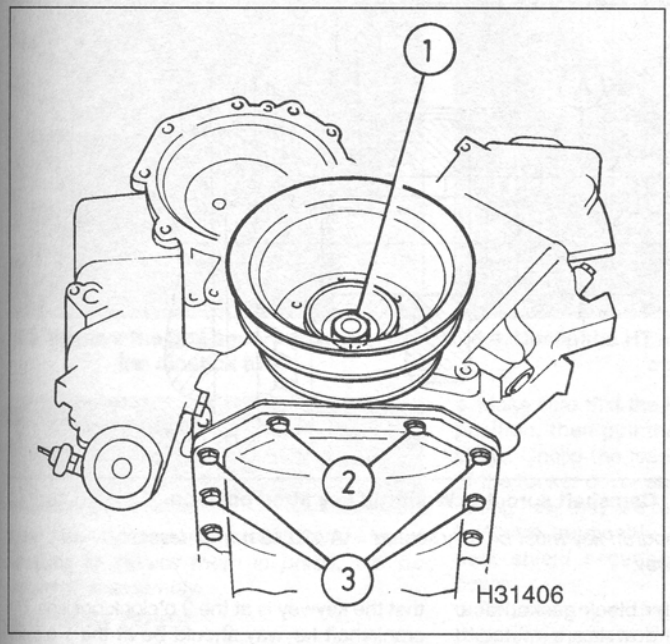
12 Apply the handbrake, then jack up the front of the vehicle and support on axle stands. Remove the engine undertray, and then remove the bolts securing the transmission bellhousing lower cover, for access to the flywheel teeth.

13 Have an assistant jam the flywheel teeth so that the crankshaft cannot turn, then slacken and remove the crankshaft pulley bolt. Particularly on models where a starter dog is incorporated into the bolt head, a deep socket will be needed. The bolt is extremely tight - be sure to use only good-quality, close-fitting tools, and be prepared for the bolt to loosen suddenly under high pressure. Remove the bolt and recover the special washer.

14 Check that the engine is still at TDC, then slide off the crankshaft pulley. This should come off easily by hand, but a puller may be required.

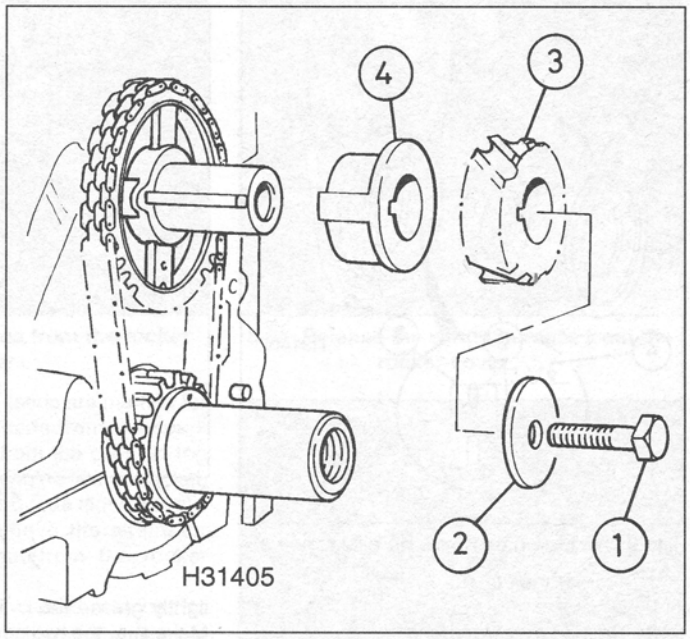
15 Make an alignment mark between the distributor body and the timing cover, so that the distributor can be accurately refitted. Loosen the distributor clamp bolt, and withdraw the distributor from the engine.

16 Remove the two sump bolts nearest the front, which screw through the base of the timing cover. Also loosen the four sump bolts next nearest the front **(see illustration)**.



4.16 Timing cover removal details

1 Crankshaft pulley bolt
2 Remove these two bolts
3 Loosen these four bolts



4.18 Distributor drivegear details

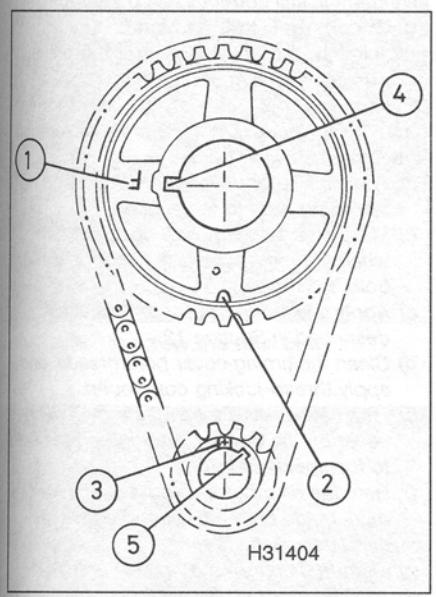
1 Drivegear retaining bolt
2 Washer
3 Drivegear
4 Spacer

17 Loosen and remove the nine timing cover retaining bolts, noting their locations, as they are of different lengths. Separate the cover from the front of the engine, taking great care not to damage the sump gasket, and recover the two dowels. The cover is removed complete with the water and oil pumps. Recover the gasket, if possible - a new gasket will of course be needed when refitting.

18 Making sure the camshaft does not turn, loosen and remove the distributor drivegear retaining bolt and washer. Take off the distributor drivegear and spacer, noting which way round the gear fits **(see illustration)**.

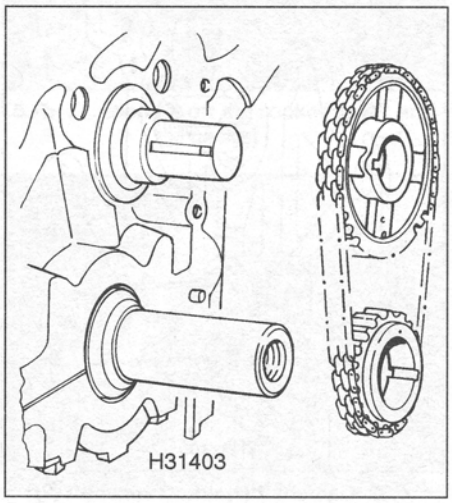
19 As a final check that the engine is set to TDC, note that the punched dot mark in the crankshaft sprocket hub and the notch in one of the camshaft sprocket spokes should be adjacent to each other, and aligned vertically - check this with a straight-edge. It is also worth noting the respective positions of the sprocket keyways, particularly if a new timing chain is being fitted **(see illustration)**.

20 Carefully slide off the crankshaft and camshaft sprockets, together with the timing chain **(see illustration)**. Recover the Woodruff keys from the shafts if they are loose.



4.19 Timing chain and related components set to TDC

1 F mark on camshaft sprocket
2 Notch in camshaft sprocket spoke
3 Punch mark in crankshaft sprocket
4 Camshaft sprocket keyway (at 9 o'clock)
5 Crankshaft sprocket keyway (at 1 o'clock)



4.20 Removing the timing chain and sprockets

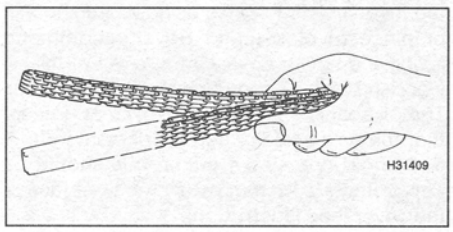
Inspection

21 Examine the teeth on the camshaft and crankshaft sprockets. If they are worn, or have taken on a hooked appearance, they should be renewed. Note that a new chain should not be fitted onto old sprockets.

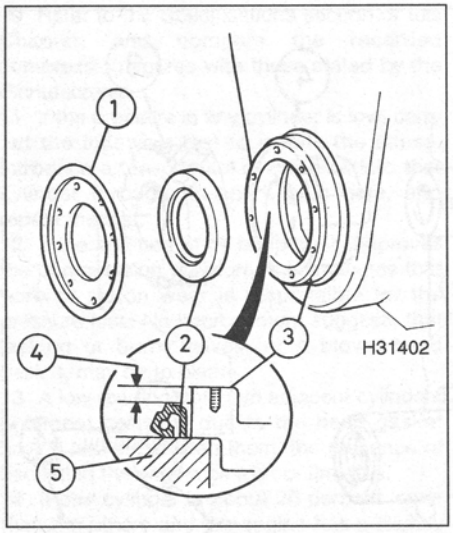
22 Inspect the camshaft sprocket for signs of cracking.

23 Inspect the chain for wear, and the links for slackness. Remove the chain from the sprockets, and squeeze it together into a straight line. Pick the chain up at one end, and try to hold it horizontal, to check the side play - if the chain droops too much, the link pins are worn **(see illustration)**.

24 Temporarily refit the chain to the engine - there should be no undue slackness or sag between the sprockets. As a guide, if the chain can be lifted clear of the sprocket teeth at the top or bottom of its run, it has stretched



4.23 Checking timing chain for wear



4.29 Timing chain cover oil seal renewal

1 Protector plate
2 Oil seal
3 Timing cover front face
4 Oil seal fitted depth (1.5 mm)
5 Wooden block placed under timing cover (Land Rover method)

too far, and must be renewed. There is no chain tensioner, and a slack chain could jump off the sprockets, with potentially disastrous results. Renew the chain if necessary, but note that a new chain should not be fitted onto old sprockets.

25 Check the condition of the front cover oil seal. Although it can be renewed without removing the timing cover, it would be worth fitting a new one as a matter of course, since the job is far easier with the cover removed.

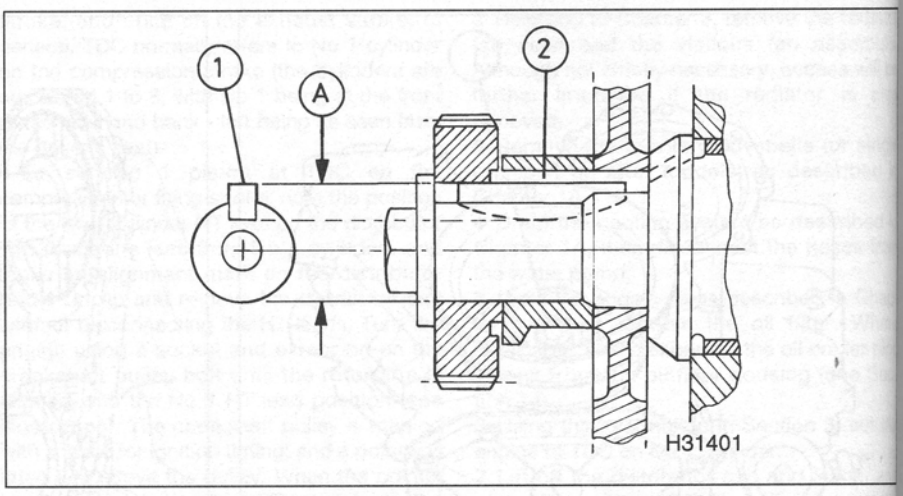
26 Unscrew the eight screws securing the protector plate from the front of the seal, then remove the plate and note the seal's fitted depth in the cover.

27 Drive the seal squarely from its location, taking care not to damage the seal seating, and noting which way round it is fitted. Alternatively, drill two small holes on opposite sides of the front face of the seal and screw in two self-tapping screws, leaving enough of each screw sticking out so that it can be gripped with a pair of pliers. The seal can then be worked out of the front cover.

28 After extracting the old seal, clean the housing and remove any burrs on the front edge.

29 When fitting the new seal, lubricate it and tap it squarely into place using a large socket or piece of pipe (Land Rover recommend laying the timing cover, front face up, over a wooden block placed under the oil seal bore). The oil seal lips should face inwards. Ensure that the new seal is fitted to the same depth as the old one - as a guide, this should be approximately 1.5 mm below the front face of the cover **(see illustration)**.

30 Thoroughly clean the mating faces of the timing cover and the cylinder block, then lightly grease the cylinder block gasket face. Make sure the two cover dowels are refitted to their locations.



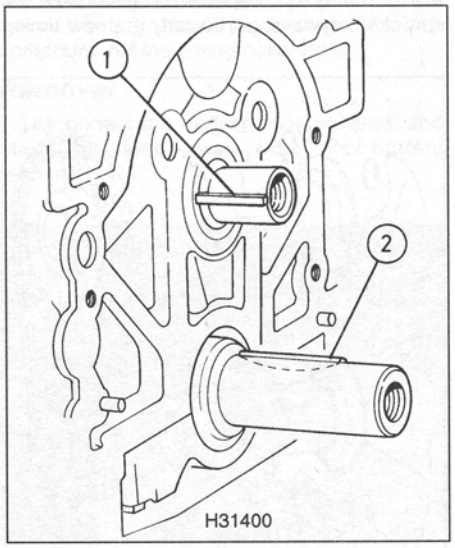
4.31 Camshaft sprocket Woodruff key fitted position

1 Woodruff key must be fully seated A 30.15 mm or less
2 Oilway

Refitting

31 It is essential that the Woodruff key for the camshaft sprocket is correctly fitted. The oil feed for the timing chain is made through a channel in the distributor drivegear spacer. If the key is not fitted so that its top edge is absolutely parallel with the top of the shaft, or if it is loose in its groove and can move under centrifugal force, it will block the oil supply to the timing chain and gears, with serious results. The Woodruff key must also be fully seated in its groove in the shaft, so that the overall height of shaft and key does not exceed 30.15 mm **(see illustration)**.

32 If the camshaft has been disturbed, check that the keyway is at the 9 o'clock position. The crankshaft keyway should be at the 1 o'clock position **(see illustration)**.



4.32 Camshaft (1) and crankshaft (2) Woodruff key positions, prior to fitting timing chain

33 Fit the chain to the sprockets with the timing marks and keyways aligned as noted on removal. The F or FRONT marking on the camshaft sprocket must be visible when fitted.

34 Offer up the sprockets and chain to both the camshaft and crankshaft simultaneously, ensuring that the timing marks stay in line.

35 Fit the sprockets over the keys on both shafts and push them home. Check that the alignment is still correct - see paragraph 19.

36 Check that the camshaft key is still parallel with the shaft, and that the oilway is clear as described in paragraph 31.

37 Refitting the rest of the components removed for access is a reversal of removal, noting the following points:

a) The distributor drivegear is fitted with its oil groove next to the spacer.
b) Make sure the camshaft does not turn when tightening the distributor drivegear bolt..
c) Apply sealant to the sump gasket as described in Section 12.
d) Clean the timing cover bolt threads, and apply thread-locking compound.
e) Fit a new gasket, then locate the timing cover on the dowels, and tighten the bolts to the specified torque.
f) Refit the distributor using the alignment mark made on removal, and check the condition of the O-ring seal.
g) Tighten the crankshaft pulley bolt to the specified torque, preventing crankshaft rotation as on removal.
h) When all remaining components have been refitted and the engine is refilled with oil and coolant, start the engine and check for oil leaks around the timing cover.
i) Check and if necessary adjust the ignition timing as described in Chapter 1A.

5.3 Remov

5 Rocke
remova

Note: *New ro*
adhesive to
needed on rea

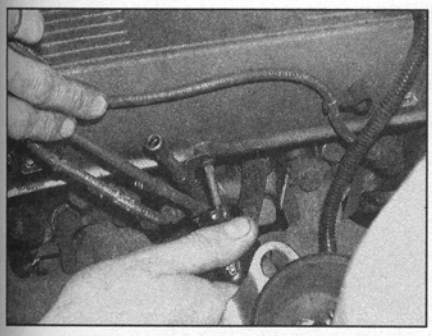
Left-hand

Removal

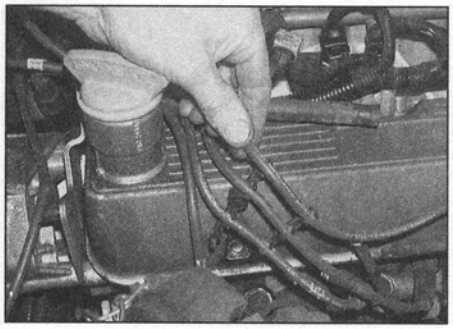
1 On carbure
cleaner as des
2 On fuel inje
ter 4B and rem
3 Pull out the
to one side. U
from the rocke
slide the clamp
cylinder head
tube upwards

5.7a Uns

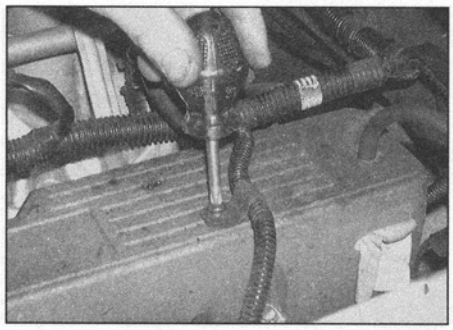
5.8 Loosen th



5.3 Remove the bolt securing the top of the dipstick tube



5.4 Unclip the HT leads from the rocker cover



5.6a Release the wiring harness from the rocker cover . . .

5 Rocker covers - removal and refitting

Note: *New rocker cover gaskets, and impact adhesive to secure them in place, will be needed on reassembly.*

Left-hand cover

Removal

1 On carburettor engines, remove the air cleaner as described in Chapter 1A.

2 On fuel injection engines, refer to Chapter 4B and remove the plenum chamber.

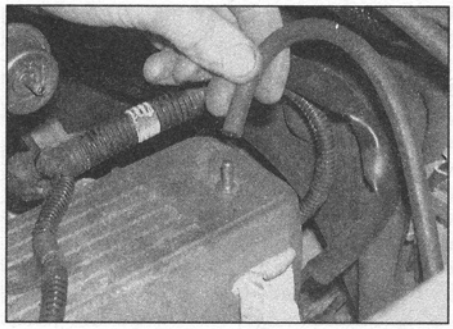
3 Pull out the engine oil dipstick, and place it to one side. Unbolt the dipstick tube clamp from the rocker cover **(see illustration)**, then slide the clamp over the top of the tube. If the cylinder heads are to be removed, pull the tube upwards and remove it.

4 Make sure that the HT leads are marked for position, then pull the leads from the spark plugs. Unclip the leads from the clips on top of the rocker cover and engine lifting bracket, noting how they are routed **(see illustration)**.

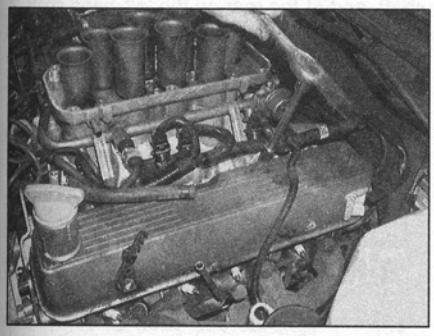
5 Where applicable, remove the alternator heat shield securing nut from the rocker cover.

6 Release any wiring or cables attached to the rocker cover from the cable-ties or clamps, and place to one side as far as possible. Pull off the breather hose from the rear of the cover **(see illustrations)**.

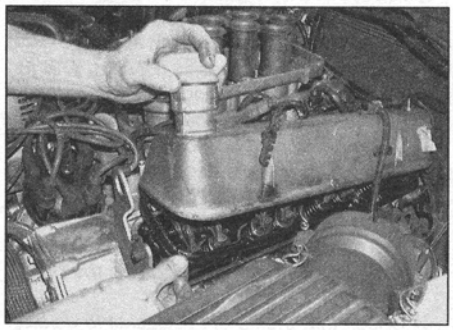
7 Loosen and remove the four rocker cover bolts, and lift off the cover **(see illustrations)**. If it is stuck, try to rock it free - if the cover has to be prised off, do not use force, or the sealing surfaces between the cover and cylinder head will be damaged. Recover the gasket, and note that the outer two bolts are longer than the inner ones.



5.6b . . . and pull off the breather hose at the rear



5.7a Unscrew the four bolts . . .



5.7b . . . then lift off the rocker cover and gasket

Right-hand cover

Removal

8 Disconnect the hose from the crankcase breather filter **(see illustration)**.

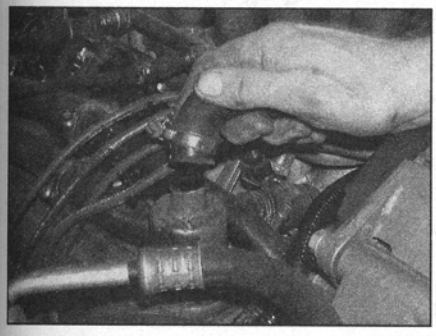
9 On carburettor engines, remove the air cleaner as described in Chapter 1A.

10 Partially drain the cooling system, using the information in Chapter 1A.

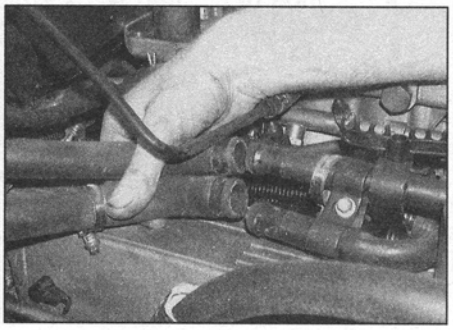
11 Make sure that the HT leads are marked for position, then pull the leads from the spark plugs. Unclip the leads from the clips on top of the rocker cover and heater pipes, noting how they are routed.

12 Loosen the hose clips and detach the heater hoses from the rigid pipes **(see illustration)**.

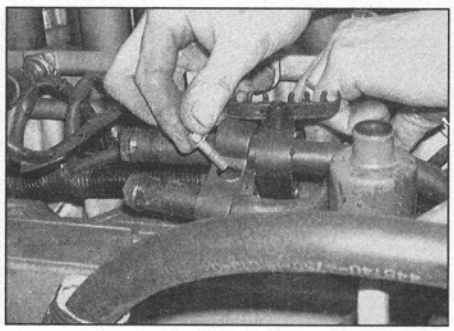
13 Remove the bolt clamping the two rigid heater pipes together, then detach the heater hose from the inlet manifold **(see illustrations)**.



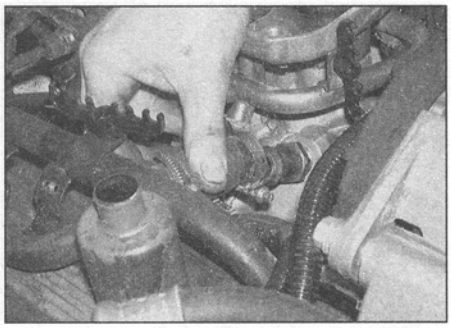
5.8 Loosen the hose clip, and pull off the breather hose



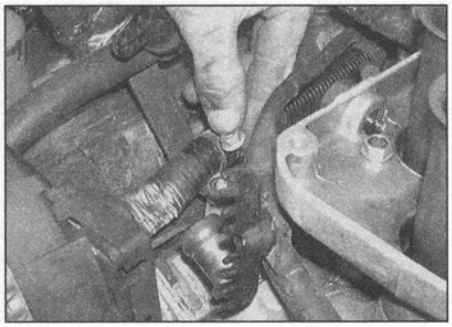
5.12 Disconnecting the heater hoses from the rigid pipes



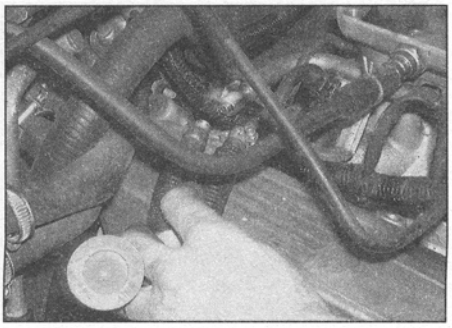
5.13a Remove the heater pipe clamp bolt . . .



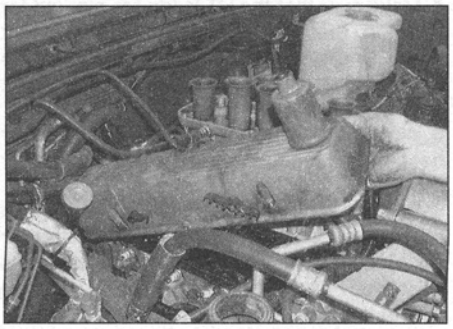
5.13b . . . then disconnect the heater hose from the inlet manifold



5.14 Remove the nut securing the heater pipe bracket



5.15 Unclip and disconnect the fuel injection supply and return hoses



5.17 Removing the right-hand rocker cover

14 Remove the nut and detach the heater hose bracket from the inlet manifold **(see illustration)**. One heater pipe can now be removed completely - move the pipe which was not removed to one side as far as possible.

15 On fuel injection engines, depressurise the fuel system as described in Chapter 4B, then unclip and disconnect the fuel supply and return hoses **(see illustration)**.

16 Release any wiring or cables attached to the rocker cover from the cable-ties or clamps, and place to one side as far as possible.

17 Loosen and remove the four rocker cover bolts, and lift off the cover, manoeuvring it out past the coolant pipes **(see illustration)**. If the cover is stuck, try to rock it free - if the cover has to be prised off, do not use force, or the sealing surfaces between the cover and cylinder head will be damaged. Recover the gasket, and note that the outer two bolts are longer than the inner ones.

Refitting - both covers

18 Refitting is a reversal of removal, noting the following points:

a) Always fit a new gasket. Clean all traces of the old gasket from the cover and cylinder head mating surfaces, then apply a suitable impact adhesive (Bostik 1775) to the rocker cover mating face and to the rocker cover side of the new gasket. When the adhesive is touch-dry, accurately fit the gasket, starting at one end, and press firmly into place. Wait 30 minutes before fitting the rocker cover to the engine.

b) The shorter rocker cover bolts are fitted to the inside of the cover. Tighten the bolts to the specified torque.

c) Check that the lip of the gasket is visible all round the edge of the cover, to ensure a good seal.

d) Refit all components removed for access. On completion, start the engine and check for oil leaks around the covers. If oil leaks are noted, re-check that the cover bolts are tightened to the specified torque - the gasket will compress when fitted, and after time, the bolts may need re-torquing to maintain a good seal.

6 Valve gear - removal, inspection and refitting

Removal

1 Remove the rocker covers as described in Section 5.

2 If the hydraulic tappets are to be removed, refer to Chapter 4A or 4B as applicable, and remove the inlet manifold.

3 It is most important that the original fitted position of all components is maintained - this applies particularly to the pushrods and hydraulic tappets. Take care to identify all removed components for position, as described in the following paragraphs.

4 Undo the four rocker shaft assembly retaining bolts in stages so that the assembly rises evenly on the pressure of the valve springs **(see illustration)**.

5 Lift out the assembly complete with bolts and place it to one side **(see illustration)**.

6 To avoid confusion when refitting, mark the rocker shafts for position (ie left and right). The shafts should be marked with a notch at one end - this is at the front on the right-hand shaft, and at the rear on the left-hand shaft.

7 Make up two pieces of card with numbered holes punched in it, with an arrow to indicate the front of the engine - also mark the cards left and right. Remove the pushrods slowly, and place them in order through the holes in the card **(see illustration)**.

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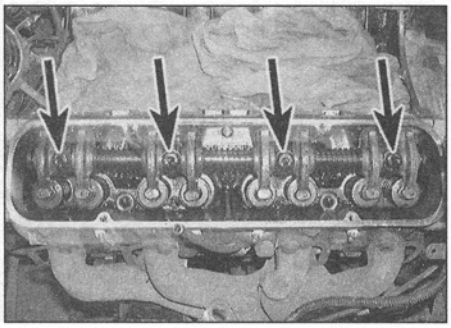
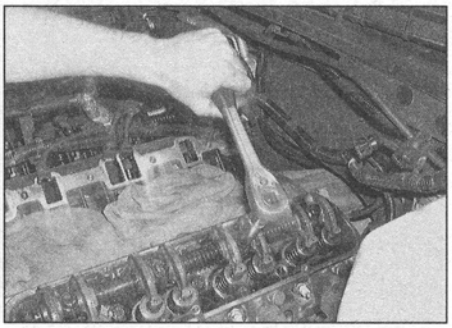
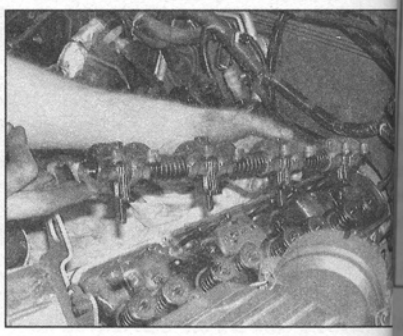
If the pushrods are removed slowly, the hydraulic tappets will usually lift up as the pushrod is pulled upwards, and the tappets can then be removed more easily.



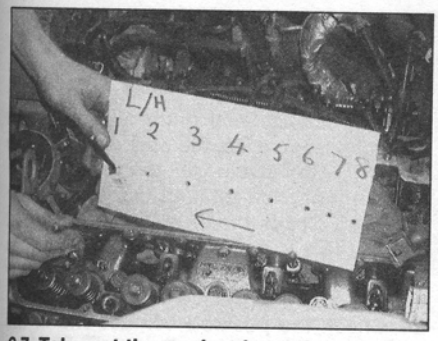
6.4a Rocker shaft retaining bolts (arrowed)



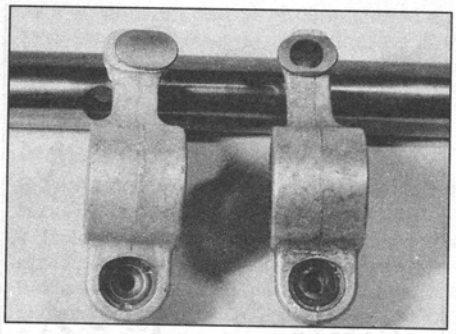
6.4b Loosen the rocker shaft bolts evenly



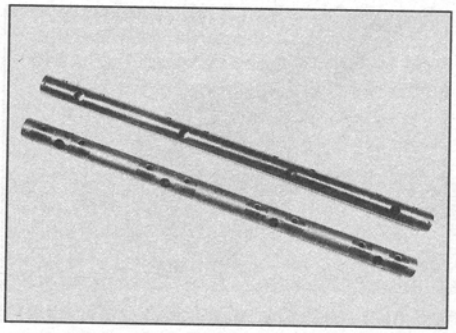
6.5 Lifting out the rocker shaft assembly



6.7 Take out the pushrods, and store them in a clearly-marked piece of card



6.12 New rocker (left) compared with old one (right). Note damage to cup



6.13 Worn (bottom) and new (top) rocker shafts being compared

8 Lift the hydraulic tappets from their bores and store them in a shallow container (an old biscuit tin or cake tin is ideal) full of oil, sufficiently deep to prevent the tappets draining. 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 will result if they are interchanged. Try to lay out the tappets in their fitted positions, and see that the container is not disturbed.

9 If a tappet is difficult to remove, and the engine is being completely stripped, leave it until the camshaft has been withdrawn, and then push it downwards to remove it (the tappet will then have to be removed from the crankcase once the sump has been removed). Otherwise, try using a magnetic probe tool to pull out the tappet.

Inspection

Rocker shafts

10 With the rocker shaft assemblies removed, the first job is to inspect the rockers and shafts for wear, in order to determine whether the assemblies need to be stripped and overhauled.

11 Take one assembly at a time, and do not mix up left and right-hand assemblies. The shafts are handed, and can only fit one way.

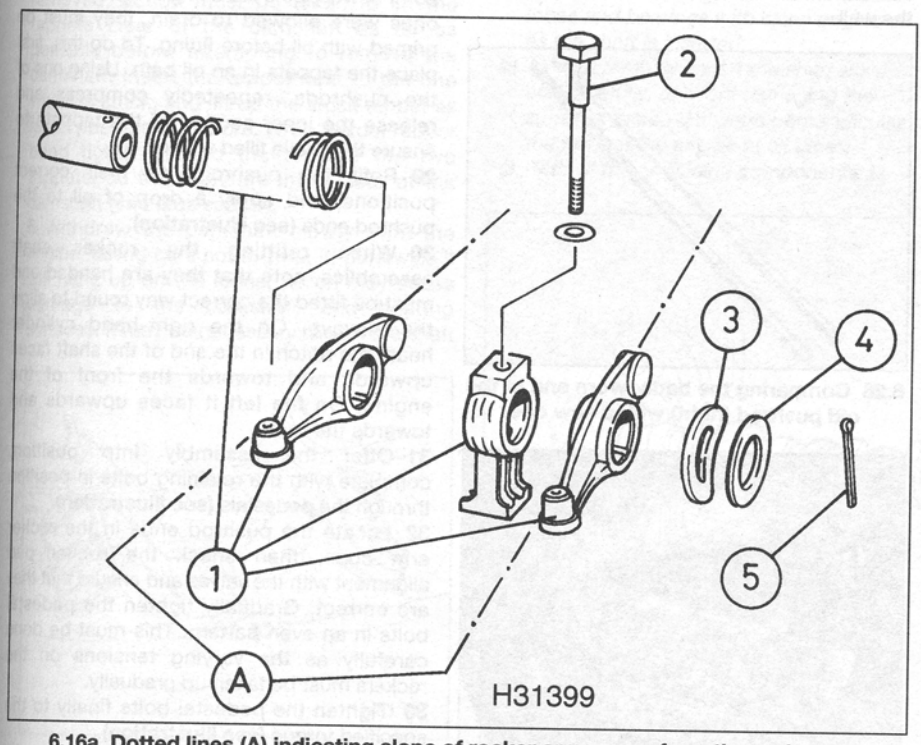
12 First examine the rockers. The rockers themselves are alloy, but they have hardened inserts at each end. The pads bear on the ends of the valve stems, and the cups fit over the upper ends of the pushrods. With high mileage or hard wear, the hardened cup inserts tend to crack up and wear badly. If bad wear is evident in a cup, then the pushrod will be badly worn as well. Similarly the pads will wear, and if this is noticeable the rockers need renewing **(see illustration)**.

13 Check the amount of lateral movement of the rockers on the shafts. If play is evident, then look further. Slide the rockers along the shaft against their springs, and examine the rocker shaft itself. If this is done from above only, the wear pattern on the rocker shaft may be missed, as the wear occurs on the *underside* of the shaft - the rockers cut into the shaft under pressure from the valves and pushrods below. With high-mileage engines, those which have been used for hard work, or where there has been a lack of oil being fed to the top of the engine, the amount of wear can be quite severe **(see illustration)**.

14 Remove the pedestal bolts, and slide the pedestals along the shaft. Check for wear in the pedestal/shaft contact areas.

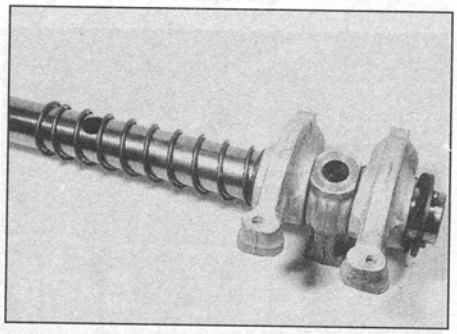
15 To overhaul the rocker shaft assembly, proceed as follows. Remove the split pin from one end of the rocker shaft, and slide off the components, carefully retaining them in the correct order of sequence for reassembly.

16 If new rocker arms are being fitted, ensure that the protective coating material used in storage is removed from the oil holes, and the new rocker given a smearing of clean oil before fitting to the shaft. **Note:** *The rocker arms are handed each side of the pedestals, and must be fitted correctly so that the metal pads locate over the valve stems. The valve ends of the rocker arms should slope away from the pedestals* ***(see illustrations)***.

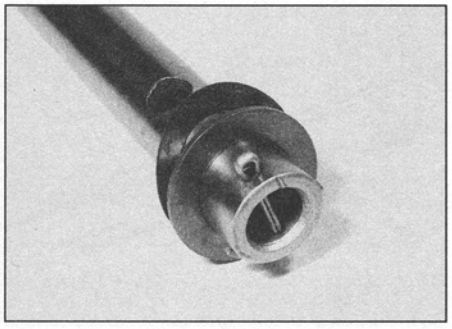


6.16a Dotted lines (A) indicating slope of rocker arms away from the pedestals

1 Pedestal, rocker arms and spring
2 Bolt
3 Wave washer
4 Plain washer
5 Split pin



6.16b Two rockers with pedestal between - note relationship of pushrod bearing faces away from pedestal



6.17 Refit split pin, plain washer and wave washer - notch in shaft uppermost

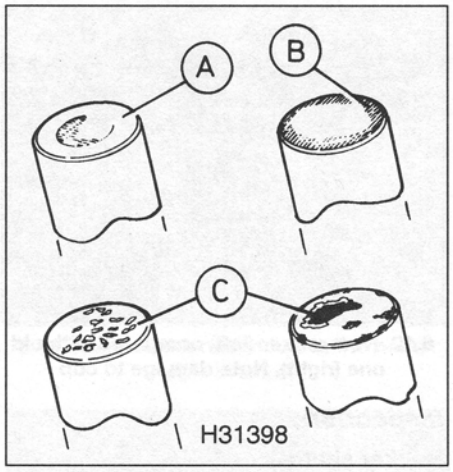
17 The rocker shafts are notched at one end, to ensure that the oil feed holes are positioned correctly facing upwards. The notches must be located uppermost **(see illustration)**. On the right-hand bank (viewed from the driver's seat) the notch must be facing towards the front of the engine, and on the left-hand bank it must be facing towards the rear of the engine. Always use new split pins.

18 Refit the baffle plate (where applicable) and pedestal bolts to the shaft. Note that the plate fits at the opposite end of the shaft to the notch.

19 The rocker shaft assembly is now ready for refitting. Carry out the same inspection and overhaul procedure for the other assembly.

Tappets and pushrods

20 If a hydraulic tappet has to be removed downwards (see paragraph 9) then there is a good chance that the lower end has become



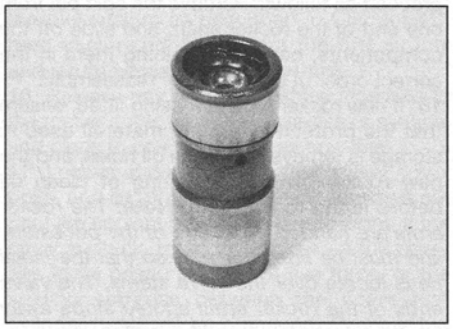
6.23 Tappet wear patterns

A Correct rotating wear pattern
B Wear pattern for non-rotating tappet
C Typical examples of excessive wear

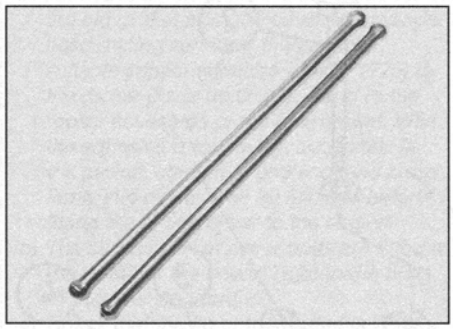
belled or rimmed. Inspect and renew if wear is bad.

21 If there is a prominent wear pattern just above the lower end of the body, this should only merit renewal of the tappet if it is badly grooved or scored. This condition is caused by the side thrust of the cam against the body whilst the tappet moves vertically in its guide.

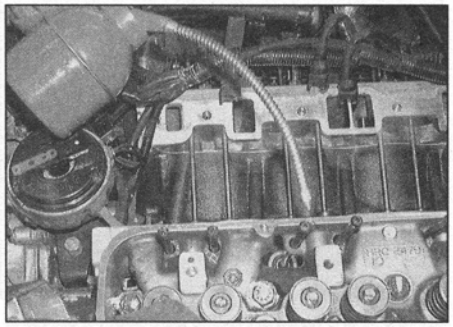
22 Inspect the tappet inner and outer surfaces for blow holes and scoring. Renew the tappet if the body is roughly grooved or scored, or has a blow hole extending through the wall.



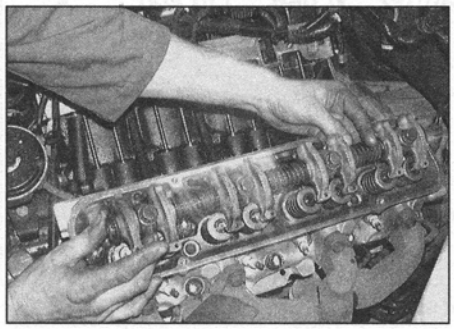
6.24 Check the pushrod seat in the top of the tappet



6.26 Comparing the badly-worn end of the old pushrod (right) with a new one



6.29 Oil the ends of the pushrods before fitting the rocker gear



6.31 Offer the rocker gear into position, aligning the pushrods and rockers

23 Inspect the tappet/camshaft lobe contac area. Fit a new tappet if the surface is bad worn or damaged. The tappet must rotate it moves up and down, and should produc an even circular wear pattern. If the tappe has not been rotating, the wear pattern will b square with a dip in the centre **(se illustration)**. Non-rotating tappets must b renewed. Check the wear on the camshaf lobe if there is a non-rotating tappet. Whe renewing a tappet, check that it moves freel in the guide in the cylinder block.

24 Check the pushrod contact end of th tappet for roughness or damage **(se illustration)**. If either sorts of wear ar apparent, then the tappet must be renewed.

25 Check the pushrods. Firstly ensure tha they are all straight. If any one is bent o distorted, renew it.

26 Check the ends of each pushrod. If th ball end or seat is rough, damaged or bad worn, it must be renewed **(see illustration)**. one pushrod is discovered that is badly wo and you have not rejected either the rocker o tappet for that rod, then check the tappe and/or rocker again.

Refitting

27 Refit the tappets the right way up in th positions from which they were removed New tappets must be fitted to the position where tappets have been discarded fo reasons of wear, etc. Check the tappe oilways before refitting.

28 If new tappets are being fitted, or if the ol ones were allowed to drain, they must b primed with oil before fitting. To do this, firs place the tappets in an oil bath. Using one o the pushrods, repeatedly compress an release the inner section of the tappets t ensure they have filled with oil.

29 Refit the pushrods to their correc positions, and apply a drop of oil to th pushrod ends **(see illustration)**.

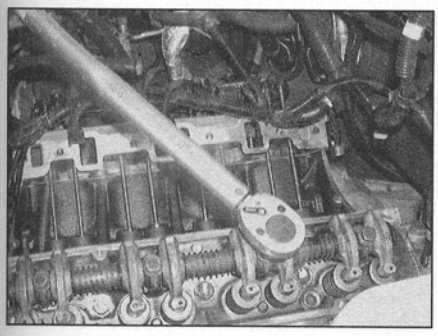
30 When refitting the rocker sha assemblies, note that they are handed an must be fitted the correct way round to alig the oilways. On the right-hand cylinde head, the notch in the end of the shaft face upwards and towards the front of th engine. On the left it faces upwards an towards the rear.

31 Offer the assembly into position complete with the retaining bolts in positio through the pedestals **(see illustration)**.

32 Locate the pushrod ends in the rocke arm cups, then check the rocker pa alignment with the valves and ensure that the are correct. Gradually tighten the pedest bolts in an even pattern. This must be don carefully as the varying tensions on th rockers must be taken up gradually.

33 Tighten the pedestal bolts finally to th specified torque **(see illustration)**.

34 Rotate the crankshaft to ensure that a the valves, rockers and tappets functio correctly.



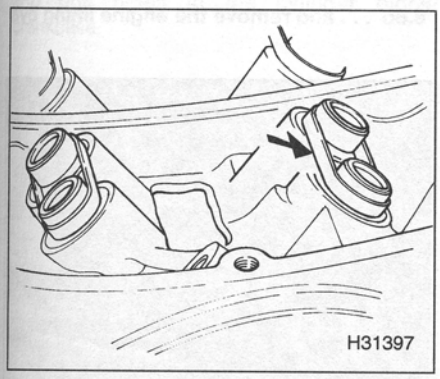
6.33 Tighten the pedestal bolts to the specified torque

35 Refit the inlet manifold as described in Chapter 4A or 4B.
36 Refit the rocker covers as described in Section 5.

7 Camshaft - removal, inspection and refitting

Removal

1 Remove the radiator as described in Chapter 3.
2 Remove the timing cover and timing chain as described in Section 4.
3 Using the information in Section 6, remove the rocker gear, pushrods and hydraulic tappets.
4 If any of the hydraulic tappets cannot be removed, action must be taken to lift the tappets clear of the camshaft as far as possible before attempting to remove the camshaft. Insert the tappet next to the one which is stuck, and lift up the stuck tappet as far as possible in its bore. Wrap a stout rubber band tightly around the tops of the two tappets, so that they are lifted clear of the camshaft **(see illustration)**.
5 Withdraw the camshaft slowly from the engine, taking care not to twist it, otherwise it will hang up on the lobes, which may cause damage to the camshaft and bearing surfaces. It may be necessary to turn the shaft as it is removed, but at no time should any force be used. Take care not to drop the shaft as it emerges from the engine - insert a screwdriver into the threaded end of the shaft to help support it **(see illustration)**.



7.4 Rubber band (arrowed) used to retain hydraulic tappets in position for camshaft removal

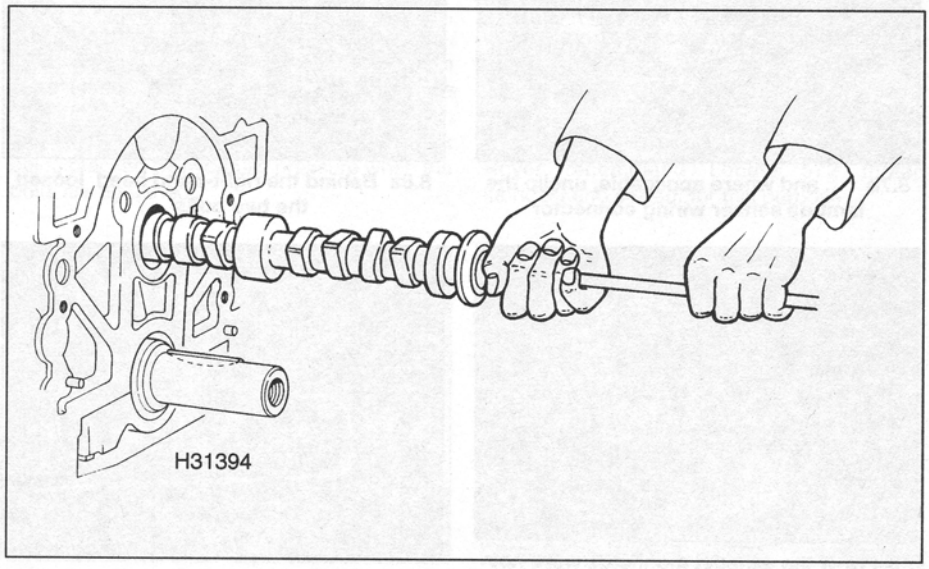
Inspection

6 Thoroughly clean the camshaft and dry off, handling with care.
7 Examine all the bearing surfaces for obvious defects, wear, score marks, etc.
8 Similarly inspect the cam lobes for excessive wear.
9 Ensure that the key or keyway is not damaged or burred, and that the key is a tight fit in its keyway - this is most important (see Section 4, paragraph 31).
10 If in doubt about the camshaft's condition, seek professional advice and/or replace with a new component.
11 If a new camshaft is fitted, it may be advisable to replace all the hydraulic tappets as a set - re-using worn tappets on a new shaft will only lead to premature wear. Seek the advice of a Land Rover dealer or engine rebuilding specialist.
12 The camshaft bearings in the cylinder block are not renewable. If they are badly worn or damaged, a new block will be required.

Refitting

13 Refitting is a reversal of removal, noting the following points:

a) Ensure that the camshaft is absolutely clean when refitting. Lubricate the cam lobes and bearings with clean engine oil as the shaft is inserted.
b) As with removal, insert the shaft slowly and carefully, to avoid damaging the surfaces - keep it aligned perpendicular to the front of the engine at all times.
c) Refit all the remaining components as described in Sections 4 and 6, then refit the radiator as described in Chapter 3.
d) If a new camshaft and tappets have been fitted, the engine should be run-in for the first few hundred miles, and the oil changed soon after.



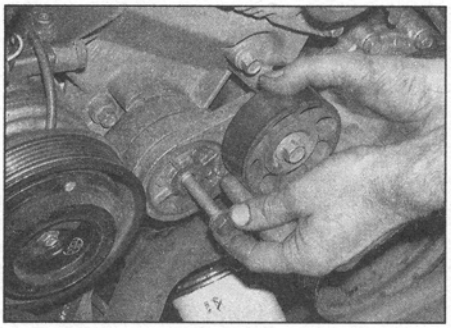
7.5 Removing the camshaft - note use of screwdriver to support the shaft

8 Cylinder heads - removal and refitting

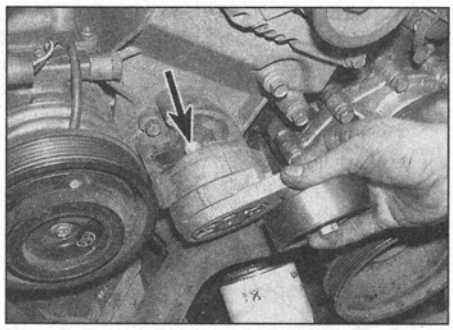
Note: *This procedure assumes that both cylinder heads are to be removed. New head gaskets must be used. On models with 14 head bolts, Loctite 572 thread sealant will also be needed.*

Removal

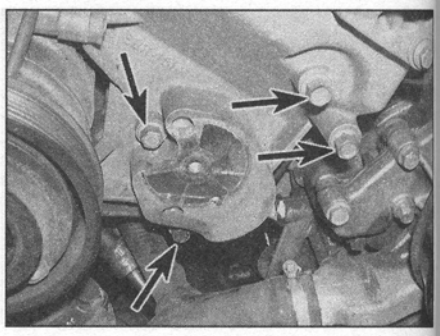
1 Remove the valve gear and pushrods as described in Section 6.
2 To improve access, remove the cooling fan as described in Chapter 3. Although not essential, the job will be made easier if the radiator is also removed.
3 Refer to Chapter 4A or 4B as applicable, and remove the inlet manifold.
4 On early models with multiple auxiliary drivebelts, remove the alternator as described in Chapter 5A. Where applicable, unbolt the air conditioning compressor, and move it to one side, without straining or disconnecting any pipework. Refer to Chapter 11 and unbolt the power steering pump, moving it aside without disconnecting the fluid hoses.
5 On later models with a single drivebelt, unbolt the power steering pump as described in Chapter 11, and lay it to one side with the fluid hoses attached. Remove the mounting bolt from the drivebelt tensioner, and slide the tensioner off, disengaging its locating peg. Remove the four bolts securing the alternator mounting bracket, then slide the bracket



8.5a Remove the drivebelt tensioner mounting bolt . . .



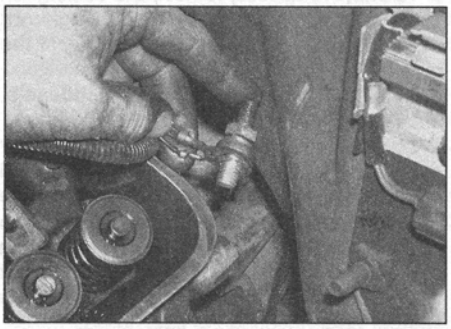
8.5b . . . and slide off the tensioner, noting the mounting peg (arrowed)



8.5c Alternator mounting bracket bolts (arrowed)

forwards slightly, to clear the right-hand cylinder head, but without straining the alternator wiring or air conditioning hoses (where applicable) **(see illustrations)**.

6 Unbolt and remove the exhaust manifolds as described in Chapter 4D. **Note:** *On later models with only 10 head bolts, the exhaust manifolds can be left on, and the exhaust separated at the manifold-to-downpipe connections (three nuts each side, accessed from below). If this method is used, the locktabs used to secure the manifold bolts will have to be bent to gain access to the outer row of head bolts.*



8.7a Remove the nut and stud from behind the left-hand head . . .

7 Remove the nut and stud, and disconnect the earth leads (and automatic transmission kickdown cable, where applicable) from the rear of the left-hand cylinder head. On models with a catalytic converter, unclip the lambda sensor wiring connector from the rear of the head - the connector halves do not have to be separated **(see illustrations)**.

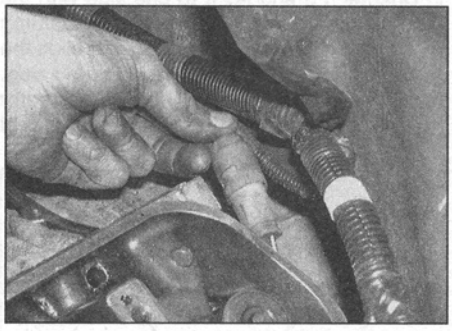
8 At the rear of the right-hand head, remove the two bolts securing the engine lifting eye, and move it to the rear **(see illustrations)**.

9 Make sure that all wiring, hoses and cables have been detached from the heads, and moved clear to permit removal.

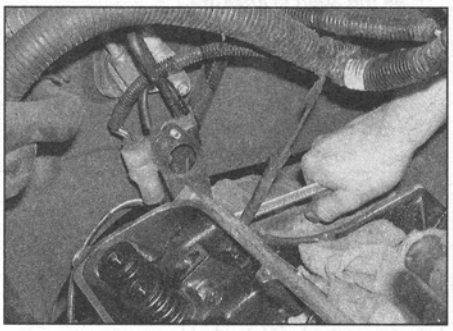
10 Models up to 1995 have, in addition to the ten main head bolts, a row of four small bolts on the spark plug side of each head. Models after this date have had the four additional bolts deleted.

11 Using the reverse of the relevant tightening sequence **(see illustration 8.32 or 8.34)**, loosen each bolt a quarter-turn at a time until all the bolts are completely loose **(see illustrations)**.

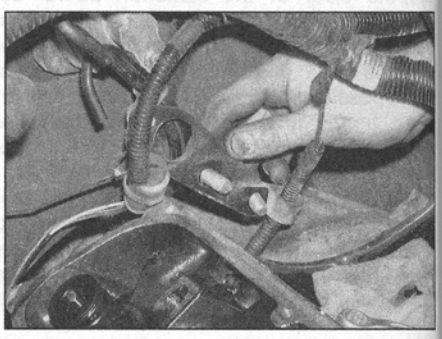
12 Make a careful note of where each bolt fits, since there are three different sizes - two different lengths of main head bolts, and also the four smaller additional bolts (on models so equipped) **(see illustration)**. Label the bolts as they are removed, or store them in their fitted order.



8.7b . . . and where applicable, unclip the lambda sensor wiring connector

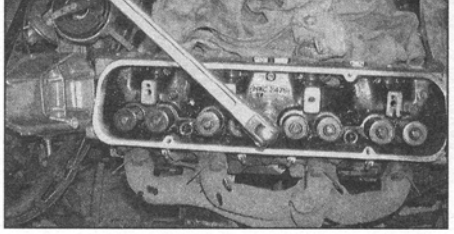


8.8a Behind the right-hand head, loosen the two bolts . . .

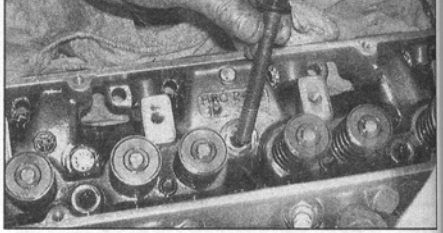


8.8b . . . and remove the engine lifting eye

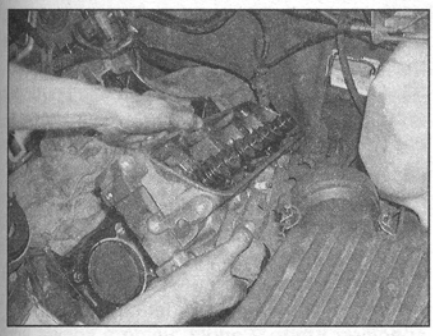
8.11a If the exhaust manifolds were not removed, bend the locktabs for access to the bolts



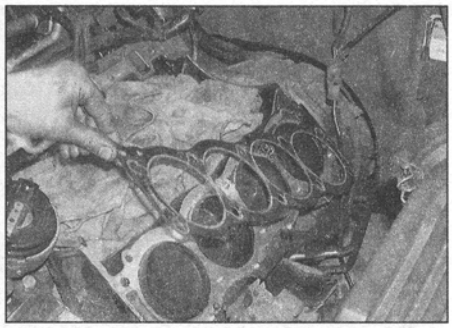
8.11b Loosening the cylinder head bolts



8.12 Removing one of the long head bolts - later model with 10 bolts per head



8.13 Lifting off the cylinder head



8.15 Recover the old cylinder head gasket

13 Lift the head straight up and off the block **(see illustration)**. If it is stuck, try to rock it free - do not strike it from the side, as each head is located on two small dowels. Similarly, take great care if prising the head free, as this can cause damage to the mating faces on the head and block.

14 Repeat the operation for the other cylinder head if that is also to be removed. It would be worth identifying the heads as being left and right, if there is any danger that they might become mixed up during overhaul.

15 Remove the gasket from the top of the block **(see illustration)**. Do not discard the gasket yet.

16 If the cylinder head is to be dismantled for overhaul, refer to Chapter 2C.

Preparation for refitting

17 The mating faces of the cylinder heads and cylinder block/crankcase must be perfectly clean before refitting the head.

18 Remove the locating dowels, noting their locations. Use a hard plastic or wood scraper to remove all traces of gasket and carbon; also clean the piston crowns.

19 Take particular care during the cleaning operations, as aluminium alloy is easily damaged. Also, 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/crankcase.

20 Check the mating surfaces of the cylinder block/crankcase and the cylinder heads 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.

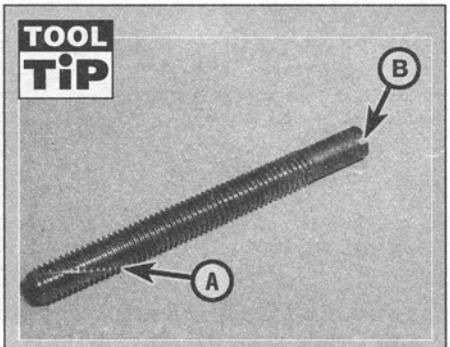
21 If warpage of a cylinder head gasket surface is suspected, use a straight-edge to check it for distortion. Refer to Part C of this Chapter if necessary.

22 Check the condition of the cylinder head bolts, and particularly their threads, whenever they are removed. Clean off all traces of thread sealant, then wash the bolts in suitable solvent, and wipe them dry.

23 Check each bolt for any sign of visible wear or damage, renewing any bolt if necessary. Measure the length of each bolt, to check for stretching (although this is not a conclusive test, if all bolts have stretched by the same amount). Land Rover do not actually specify that the bolts must be renewed - however, it is strongly recommended that the bolts should be renewed as a complete set, particularly if this is not the first time the heads have been removed.

24 Clean out the cylinder head bolt drillings using a suitable tap. If a tap is not available, make a home-made substitute **(see Tool Tip)**. Clean out the bolt holes in the block using a pipe cleaner, or a rag and screwdriver. Make sure that all oil or coolant is removed, otherwise there is a possibility of the block being cracked by hydraulic pressure when the bolts are tightened.

TOOL TiP



If a tap is not available, make a home-made substitute by cutting a slot (A) down the threads of one of the old cylinder head bolts. After use, the bolt head can be cut off, and the shank can then be used as an alignment dowel to assist cylinder head refitting. Cut a screwdriver slot (B) in the top of the bolt, to allow it to be unscrewed

Refitting

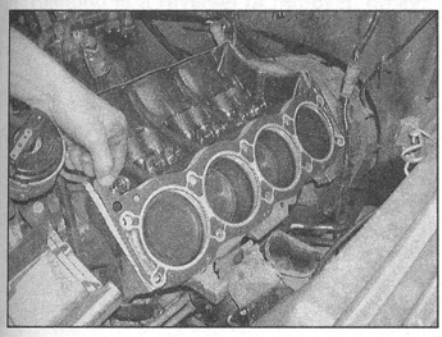
25 When refitting the cylinder heads, it may be found easier to work on one head at a time. Once one head has been refitted, repeat the following procedure on the remaining head.

26 Refit the two locating dowels to their locations.

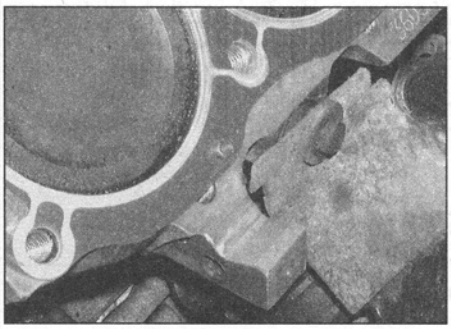
27 Fit a new gasket to the cylinder block, and engage it on the two small dowels **(see illustrations)**. Note that the gasket is marked TOP to show which way up it should fit. Do not use any sealant.

28 Identify each head for position, as noted on removal. Lift up the cylinder head and lower it into position on the two dowels, to ensure that it is aligned correctly **(see illustration)**. Take care not to trap any wiring, etc, between the head and the block.

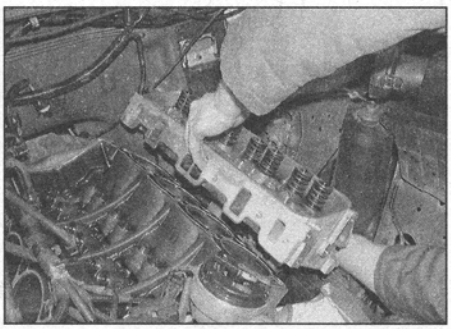
29 On models with 14 head bolts per cylinder head, apply thread sealant to each bolt in turn and refit it to its appropriate position. Land Rover recommend Loctite 572 thread lubricant and sealant for this purpose.



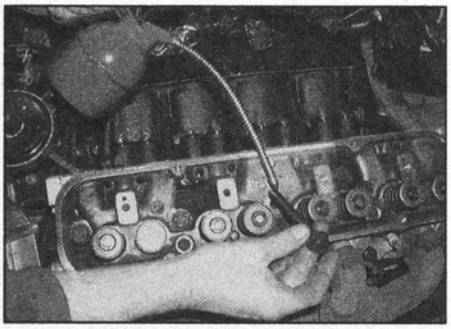
8.27a Lay the new gasket into position . . .



8.27b . . . and locate it over the dowels



8.28 Lift the head into position, and locate it over the dowels



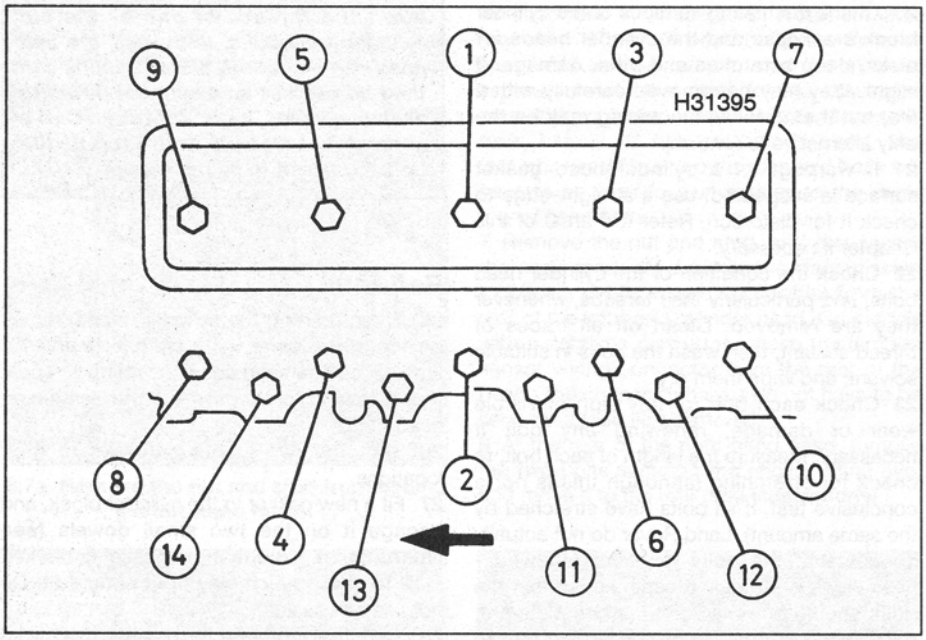
8.30 Lightly oil the threads of the head bolts (later models only)

30 On later models with just 10 bolts per head, lightly oil each bolt, and insert it into position **(see illustration)**.

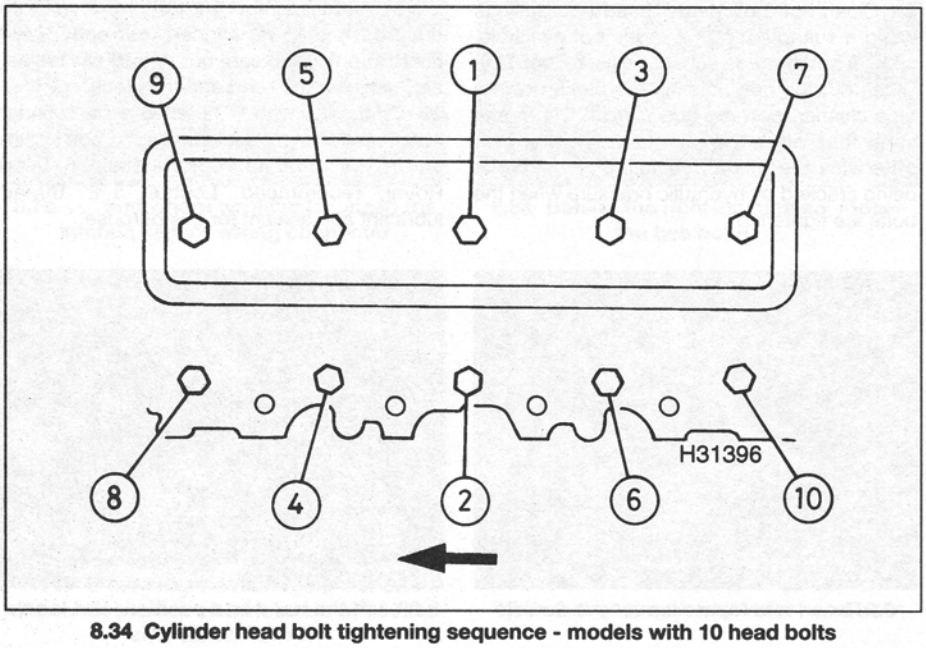
31 Of the 10 main head bolts, there are 3 long bolts, and 7 medium length bolts. The long bolts fit in the three central holes in the centre of the cylinder head (1, 3 and 5 in the tightening sequence). On models with 14 head bolts, the four shortest bolts fit on the outermost (spark plug) side of the head.

Models with 14 head bolts

32 Tighten the cylinder head bolts gradually, in the sequence shown, to the specified torque **(see illustration)**. Note that the four outermost bolts (the last four in the sequence) are tightened to a lesser torque than the ten main bolts.



8.32 Cylinder head bolt tightening sequence - models with 14 head bolts



8.34 Cylinder head bolt tightening sequence - models with 10 head bolts

33 Once all the bolts have been tightened, go around again with the torque wrench, and re-check that all are correctly tightened.

Models with 10 head bolts

34 Working in the sequence shown, first gradually tighten all the bolts to the Stage 1 setting **(see illustration)**.

35 The bolts should now be angle-tightened further, in the same sequence, through the specified Stage 2 angle, using a socket and extension bar.

36 It is recommended that an angle-measuring gauge is used during this stage of the tightening, to ensure accuracy. If a gauge is not available, use white paint to make alignment marks between the bolt head and cylinder head prior to tightening; the marks can then be used to check that the bolt has been rotated through the correct angle during tightening **(see illustration)**.

37 If the cylinder heads are being refitted with the engine in the vehicle, tightening through 180° is not possible, at least not in one movement. We found in the workshop that a more practical solution was to tighten all bolts through 90°, and then to go around again, tightening all bolts a further 90°, making 180° in total.

All models

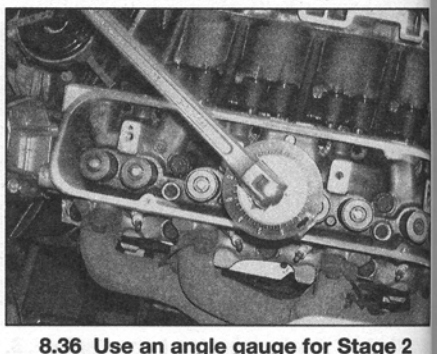
38 Refit all components removed for access, using a reverse of the removal procedure.

9 Crankshaft oil seals - renewal

Crankshaft front oil seal (in timing cover)

1 This seal can be renewed in one of two ways. If the timing cover gasket is also leaking, refer to Section 4 and remove the timing cover - the oil seal (which fits in the timing cover) can then more easily be replaced, and a new gasket fitted.

2 If the front oil seal is to be replaced on its own, proceed as follows.



8.36 Use an angle gauge for Stage 2 tightening

3 Referring to Chapter 3, remove the radiator fan cowl and the viscous fan assembly. Although not strictly necessary, access will be further improved if the radiator is also removed.

4 Remove the auxiliary drivebelts as required (or single drivebelt on later models) as described in Chapter 1A.

5 Apply the handbrake, then jack up the front of the vehicle and support on axle stands. Remove the engine undertray, and then remove the bolts securing the transmission bellhousing lower cover, for access to the flywheel teeth.

6 Have an assistant jam the flywheel teeth so that the crankshaft cannot turn, then slacken and remove the crankshaft pulley bolt. Particularly on models where a starter dog is incorporated into the bolt head, a deep socket will be needed. The bolt is extremely tight - be sure to use only good-quality, close-fitting tools, and be prepared for the bolt to loosen suddenly under high pressure. Remove the bolt and recover the special washer.

7 Slide off the crankshaft pulley. This should come off easily by hand, but a puller may be required.

8 Unscrew the eight screws securing the protector plate from the front of the seal **(see illustration)**, then remove the plate and note the seal's fitted depth in the cover.

9 Drill two small holes on opposite sides of the front face of the seal, and screw in two self-tapping screws, leaving enough of each screw sticking out so that it can be gripped with a pair of pliers. The seal can then be worked out of the front cover.

10 After extracting the old seal, clean the housing and remove any burrs on the front edge.

11 Offer the new seal into position, lips facing inwards, and lubricate it with engine oil **(see illustration)**.

12 Tap the seal squarely into place using a large socket or piece of pipe - whatever method is chosen, take care not to damage the new seal or its seat during fitting **(see illustration)**.

13 Ensure that the new seal is fitted to the same depth as the old one - as a guide, this should be approximately 1.5 mm below the front face of the cover **(see illustration)**.

14 Refitting is a reversal of removal, noting the following points:

a) Tighten the crankshaft pulley bolt to the specified torque, preventing crankshaft rotation as on removal.

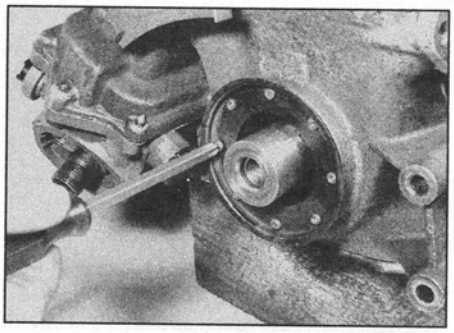
b) When all remaining components have been refitted and the engine is refilled with oil, start the engine and check for oil leaks.

Timing cover gasket

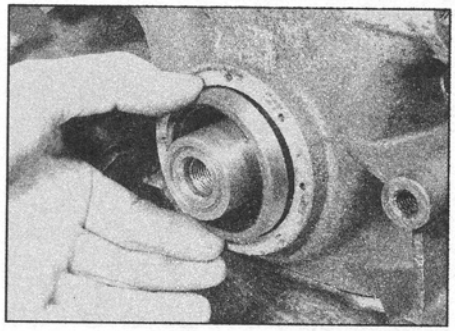
15 Refer to Section 4.

Crankshaft rear oil seal

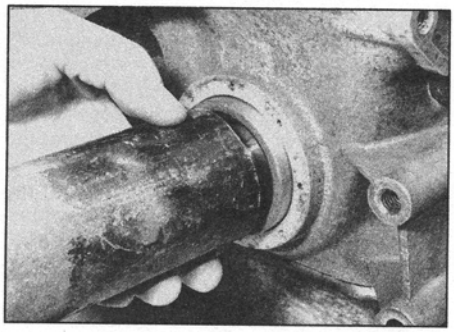
Note: *Besides the main oil seal, new bearing cap side seals and sealant must be obtained.*



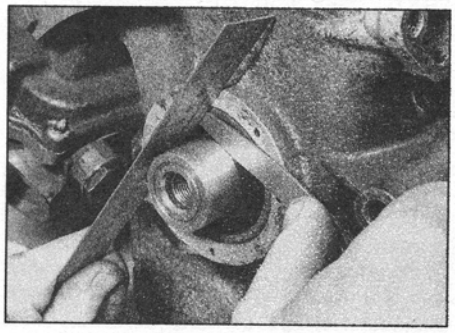
9.8 Undo the screws and remove the protector plate



9.11 Offer up the new seal



9.12 Drive the seal into position using a suitable piece of tube



9.13 Check the fitted depth of the new seal

Fitting the main seal requires either Land Rover tools LRT-12-010 and LRT-12-091, or home-made equivalents, to ensure the new seal is not damaged.

16 Remove the flywheel or driveplate as described in Section 10, and the sump as described in Section 12.

17 Remove the bolts securing the rear main bearing cap, then screw two of the sump retaining bolts into the holes at the front of the cap. Using pliers or a pair of large screwdrivers on the bolt heads, carefully pull or prise the cap from its location, taking care not to damage any sealing surfaces.

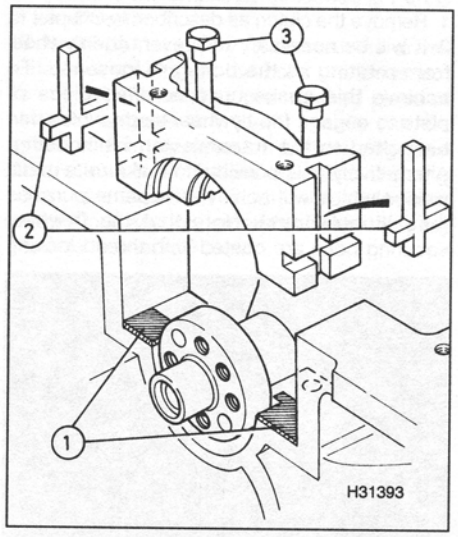
18 Recover the side seals from the bearing cap, then remove the crankshaft oil seal, noting its fitted depth.

19 Thoroughly clean the bearing cap and the oil seal area of the engine block, removing all traces of oil and sealant. Also check for burrs or sharp edges which may damage the new seals on fitting.

20 Apply a coating of suitable sealant (Land Rover recommend Hylomar SQ32M, available from dealers) to the areas shown, and fit the new side seals to the bearing cap **(see illustrations)**.

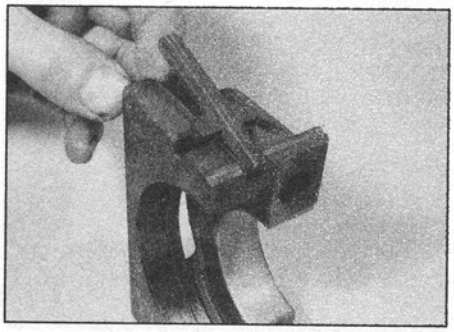
21 Lubricate the bearing shell and side seals with clean engine oil, then carefully fit the bearing cap into position.

22 Ensure that the cap is seated squarely,

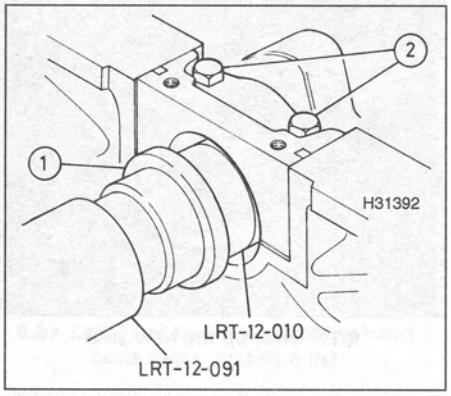


9.20a Crankshaft rear main bearing cap fitting details

1 Apply sealant here
2 Side seals
3 Main bearing cap bolts



9.20b Fitting new side seals



9.23 Land Rover special tools used to fit the crankshaft oil seal

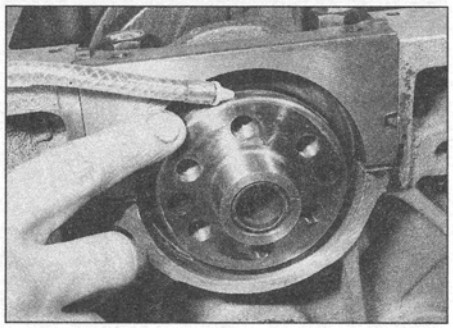
1 Oil seal
2 Main bearing cap bolts

and is pressed fully home (note that the side seals should protrude by 1.5 mm from the face - do not trim them flat). Lubricate and insert the cap retaining bolts, but do not tighten them more than hand-tight at this stage. Clean the oil seal recess in the bearing cap and block - any oil will prevent the new seal from staying in position.

23 When fitting the new crankshaft oil seal, do not handle the inner lips, and ensure that the outside of the seal remains dry. To fit the seal successfully, Land Rover dealers use two special tools (LRT-12-010 and LRT-12-091) **(see illustration)**. These tools are basically two pieces of tube, one exactly the same diameter as the inside diameter of the oil seal, and one slightly larger, which fits over the first tube, and bears fully on the seal face. If these tools cannot be purchased or borrowed, make up your own from suitable pipe - if these tools are not used, there is a danger that the lips of the new seal will be damaged or folded back on fitting, rendering it useless.

24 Lightly oil the inside of the new seal, the outer surface of the crankshaft flange, and the surfaces of any tools used to fit it **(see illustration)**. The outer surface of the seal must not be lubricated, or it will not stay in position when clamped down by the bearing cap.

25 Fit the seal over the first tube, and butt the tube accurately up against the end of the crankshaft. Use the second tube to fit the seal



9.24 Lightly lubricate the crankshaft outer flange

(lips facing inwards) over the end of the crankshaft, taking care that the seal lips do not get caught up or folded as this is done.

26 Using the larger tube, gradually slide the seal fully and squarely into the recess formed by the cap and block, until it abuts the machined step in the recess.

27 Once the seal is fully home, tighten the main bearing cap bolts to the specified torque.

28 Refit the sump as described in Section 12, and the flywheel or driveplate as described in Section 10. On completion, start the engine and check for signs of oil leakage.

10 Flywheel/driveplate - removal, inspection and refitting

Flywheel (manual transmission models)

Note: *New flywheel securing bolts and thread-locking fluid must be used on refitting. Two medium-length 3/8-inch UNC bolts will be required to lift the flywheel from the crankshaft.*

Removal

1 Remove the clutch as described in Chapter 6.

2 It will be necessary to prevent the flywheel from rotating as the bolts are loosened. To achieve this, make up a notched piece of plate to engage the flywheel teeth, which can be bolted to the transmission bellhousing. Alternatively, it is possible to make up a metal wedge which will achieve the same purpose **(see illustrations)**. Note that the flywheel securing bolts are coated with thread-locking compound, and considerable effort may be required to unscrew them.

3 Before removing the flywheel, it is worth marking a line across the end of the crankshaft, to indicate the flywheel's fitted position. While this is not essential, since the flywheel will only fit one way, it will help when offering the (heavy) flywheel into place initially.

4 Support the flywheel, then remove the six securing bolts **(see illustration)**.

5 Carefully lift the flywheel from the crankshaft.

Warning: The flywheel is heavy - take care not to drop it.

Inspection

6 If the clutch friction disc contact surface of the flywheel is scored, or on close inspection shows signs of small hairline cracks (caused by overheating), it may be possible to have the flywheel surface-ground, provided the overall thickness of the flywheel is not reduced below the minimum limit (see *Specifications*). Consult a Land Rover dealer or a specialist engine repairer, and if grinding is not possible, renew the flywheel complete.

7 If the teeth on the flywheel starter ring are badly worn, or if some are missing, then it will be necessary to remove the ring and fit a new one.

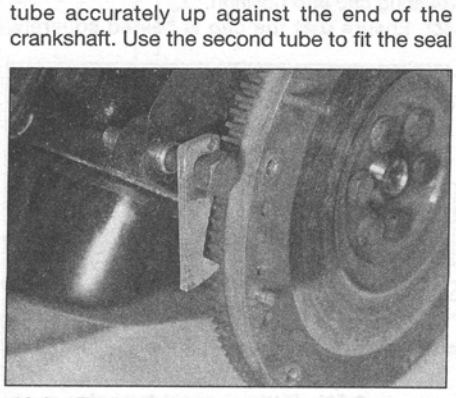
8 To renew the ring gear, firstly drill a 10 mm hole in the side of the ring gear between the roots of any two gear teeth, and the inner diameter of the ring gear. The hole should be just deep enough to weaken the gear - *take great care not to allow the drill to touch the flywheel*.

9 Clamp the flywheel securely in a vice, and cover it with a large cloth to reduce the possibility of personal injury.

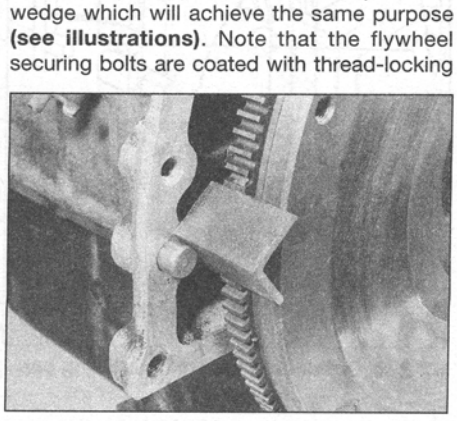
Warning: Wear eye protection during the following procedure.

10 Place a cold chisel between the gear teeth above the drilled hole, then split the gear with the chisel. Take great care not to damage the flywheel during this operation, and wear eye protection at all times. Once the ring has been split, it will spread apart, and can be lifted from the flywheel.

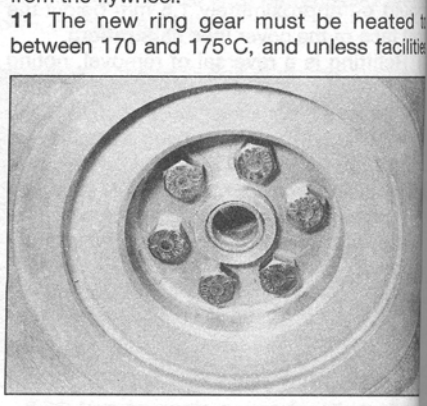
11 The new ring gear must be heated to between 170 and 175°C, and unless facilities



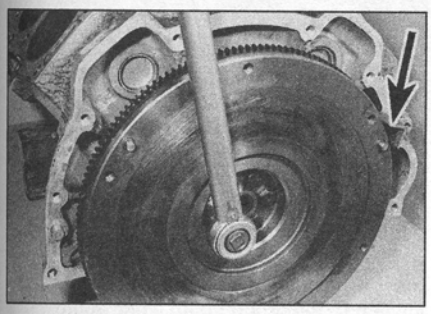
10.2a Typical home-made tool for locking the flywheel



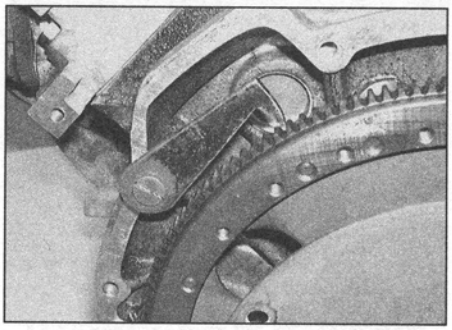
10.2b It is also possible to use a metal wedge to prevent flywheel rotation



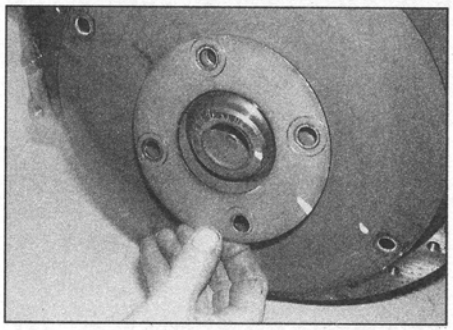
10.4 The flywheel is secured by six bolts



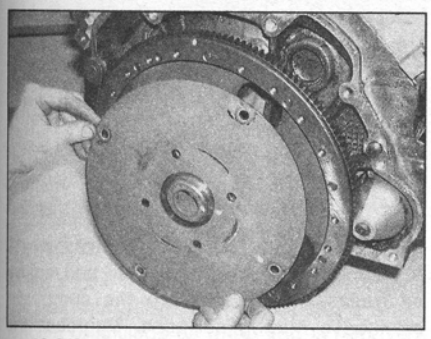
10.15 Tighten the flywheel bolts to the specified torque - note the metal wedge (arrowed)



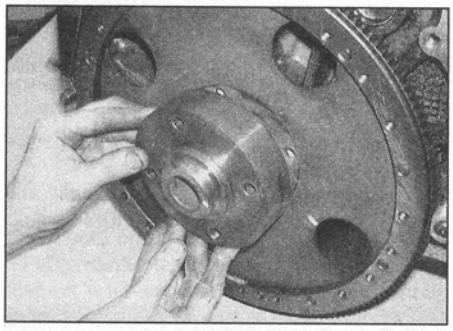
10.18 Home-made tool for preventing driveplate rotation



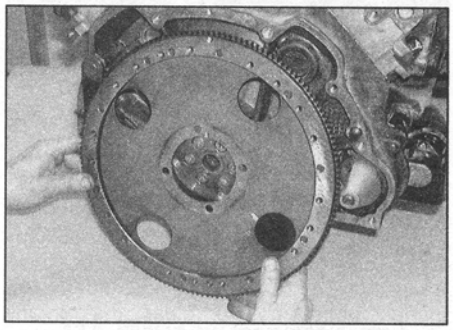
10.21a With the bolts removed, take off the outer shim plate . . .



10.21b . . . torque converter adaptor plate . . .



10.21c . . . driveplate boss . . .



10.21d . . . and the driveplate itself

for heating by oven or flame are available, leave the fitting to a Land Rover dealer or engineering works. The new ring gear must not be overheated during this work, or the temper of the metal will be affected.

12 The ring should be tapped gently down onto its register, and left to cool naturally - the contraction of the metal on cooling will ensure that it is a secure and permanent fit.

Refitting

13 Commence refitting by thoroughly cleaning the mating faces of the flywheel and the crankshaft. Also apply a little thread-locking fluid to the new flywheel bolt threads.

14 Turn the flywheel so that the marks made on removal are aligned. Lift the flywheel onto the end of the crankshaft, and support it carefully while the new flywheel bolts are aligned and fitted - the bolts are offset, so the flywheel will only fit one way. Initially tighten the bolts so that the flywheel is just lightly gripped.

15 Take up any play in the flywheel by turning it against the direction of rotation, then tighten the bolts to the specified torque, preventing the crankshaft from turning as during removal **(see illustration)**.

16 Refit the clutch as described in Chapter 6.

Driveplate (automatic transmission models)

Removal

17 Remove the engine as described in Part C of this Chapter.

18 It will be necessary to prevent the driveplate from rotating as the bolts are loosened. To achieve this, make up a notched piece of plate to engage the teeth, which can be bolted to the transmission bellhousing **(see illustration)**. Note that the driveplate securing bolts are coated with thread-locking compound, and considerable effort may be required to unscrew them.

19 When removing the driveplate components, it is essential to make alignment marks on all components at every stage. Several of the components can be fitted in any position, and as it is not clear whether this is important, it is preferable to ensure everything is refitted exactly as it came off.

20 With the driveplate held against rotation and supported by an assistant, loosen and remove the four retaining bolts.

21 Taking precautions that every component is marked for alignment as it is removed, take off the outer shim plate and the torque converter adaptor plate. Supporting the driveplate, slide off the boss, then take out the driveplate **(see illustrations)**.

Inspection

22 Refer to paragraphs 6 to 12, noting that the driveplate itself is not subject to wear in the same way as a flywheel.

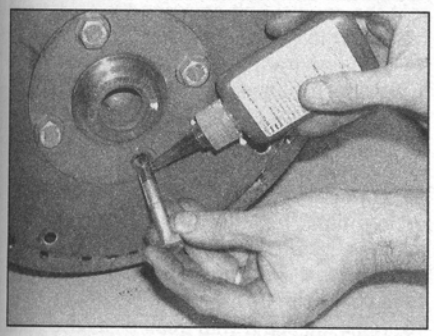
Refitting

23 Commence refitting by thoroughly cleaning the mating faces of the driveplate and the crankshaft.

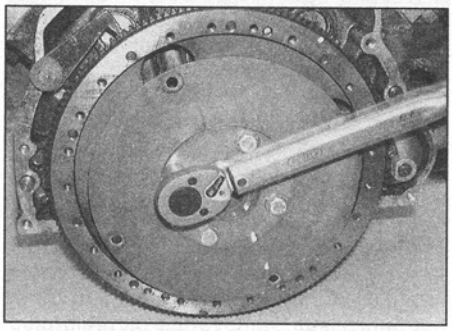
24 Offer up the driveplate so that the marks made on removal are aligned, and fit it over the end of the crankshaft.

25 Fit the boss, torque converter adaptor plate and shim plate, using the marks made on removal to align all components correctly.

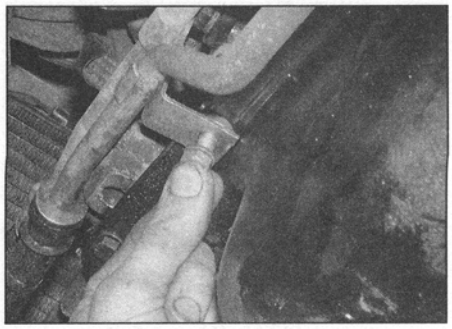
26 Apply a little thread-locking fluid to the new driveplate bolt threads. Fit the bolts into position, and tighten them to the specified torque, holding the driveplate against rotation as on removal **(see illustrations)**.



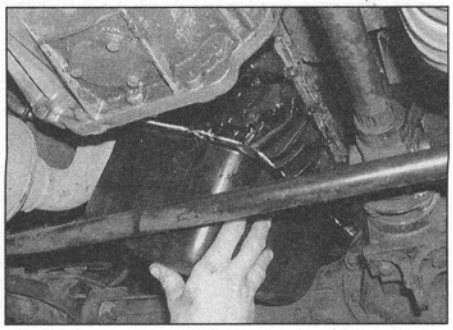
10.26a Apply a little thread-locking fluid to the new bolts . . .



10.26b . . . then insert and tighten them to the specified torque



12.4 Removing the sump bolt which also secures the transmission fluid pipes



12.6 Lowering the sump out from under the car

11 Engine mounting rubbers - removal and refitting

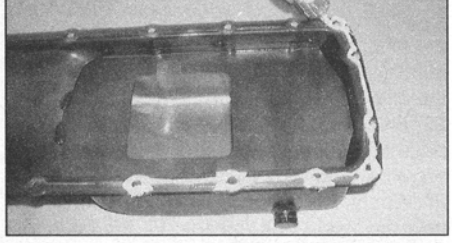
Removal

1 Referring to the engine removal procedure in Part C of this Chapter, disconnect any wiring, hoses or other components which will prevent the engine from being lifted the few inches necessary to clear the engine mountings. On models with air conditioning, the compressor must be unbolted and moved to one side, as the rigid refrigerant pipes will not stand being disturbed too far.

2 Using the information in Part C of this Chapter, attach a lifting chain to the engine lifting eyes, and take the weight of the engine on a suitable engine crane. Alternatively, place a suitable trolley jack with a large interposed block of wood under the engine sump, to just take the weight of the engine. Ensure that the engine is safely supported before proceeding.

3 Working from the relevant side of the engine compartment and from below, unscrew the nuts securing the engine mountings to the brackets on either side of the cylinder block.

4 Taking care that no wiring or hoses are strained unduly, lift the engine clear of the mountings, so that the rubbers can be unbolted from the engine.



12.11 Applying a bead of sealant to the sump - note that the sealant runs to the inside of the two rear bolt holes

Refitting

5 Bolt the new rubbers into position on the engine, then lower the engine back onto the mountings.

6 Tighten the engine mounting nuts to the specified torque.

7 On completion, reconnect and refit any wiring, hoses or other components removed to allow the engine to be lifted.

12 Sump - removal and refitting

Note: *Suitable sealant will be needed for refitting the sump - a conventional gasket is not used. If the oil pick-up pipe is removed, a new gasket must be used when refitting.*

Removal

1 Drain the engine oil as described in Chapter 1A. When jacking up the vehicle, place the stands under the chassis, NOT under the axle - in order for the sump to clear the axle, the axle must be hanging free.

2 To allow clearance for the sump to be removed, the steering damper and track rod must first be removed, as described in Chapter 11. Note that the track rod need only be detached at one end - the rod can then be swung to one side.

3 Where necessary, remove the bolt securing the dipstick tube to the rocker cover.

4 Working from the centre outwards, progressively loosen the sump retaining bolts by a quarter-turn at a time until they have all been removed. Note that, on automatic transmission models, one of the sump bolts secures the transmission fluid cooler pipes - this bolt is longer than the others, and has a spacer fitted above it **(see illustration)**.

5 If the sump has stuck to the bottom of the engine, try running a sharp knife around the joint between the sump and engine, to cut through the bead of sealant used. If this is not successful, remove the oil drain plug. Insert a large screwdriver (with a piece of card wrapped around it to protect the threads) into the drain plug hole, and carefully use it as a lever to break the sump joint. This method is preferable to prising between the sump face and base of the block, as the mating surfaces could be damaged, and the sump would no longer seal. Take care during removal that the base of the sump does not get damaged through contact with the front axle.

6 Withdraw the sump past the front axle and the oil pick-up pipe inside the sump, and lower it to the ground **(see illustration)**.

7 While the sump is removed, examine the condition of the oil pick-up pipe and strainer. If there is any evidence that the strainer is blocked, remove the two bolts and withdraw the oil pick-up pipe and strainer for cleaning.

8 If the sump has been badly dented or otherwise damaged, there's little point in refitting it. Try to source one in better condition from a vehicle breakers, or fit a new one.

Refitting

9 Clean the sump out thoroughly, and remove all traces of sealant from the sump and crankcase mating surfaces. Degrease the mating surfaces before proceeding.

10 If removed, refit the oil pick-up pipe, using a new gasket.

11 Apply a 2 mm bead of suitable RTV silicone rubber sealant (Land Rover recommend a Hylosil product, available from dealers) to the sump mating surface. Run the bead of sealant around all the holes apart from the rear two - the bead should just run inside the edges of these **(see illustration)**. **Do not** apply excess sealant, which may enter the engine when the sump is refitted.

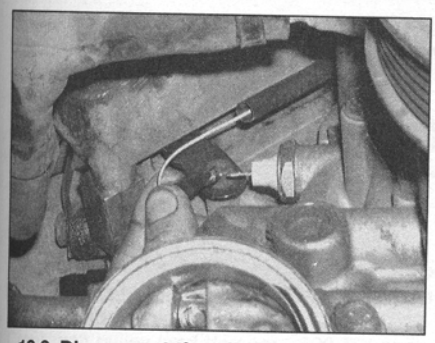
12 Apply a smear of sealant also at the joint between the timing cover and the crankcase - a coating 13 to 19 mm wide will suffice.

13 Insert one of the sump bolts through one of the bolt holes at the corner of the sump, to act as a guide, then offer the sump up into position. Once in position, try to disturb the sump as little as possible, so that the sealant will spread evenly and not enter the sump. Quickly insert all the bolts, and tighten initially by hand. On automatic transmission models refit the special bolt securing the fluid cooler pipes, not forgetting the spacer.

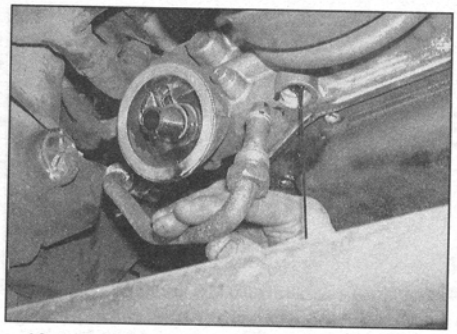
14 Working from the central bolts outwards in a diagonal sequence, tighten all the bolts to the specified torque. Refit the oil drain plug, if not already done, and tighten to the specified torque (see Chapter 1A).

15 On completion, allow the recommended drying time for the sealant (typically 30 minutes) before refilling the sump - use the time to refit the steering damper and track rod as described in Chapter 11.

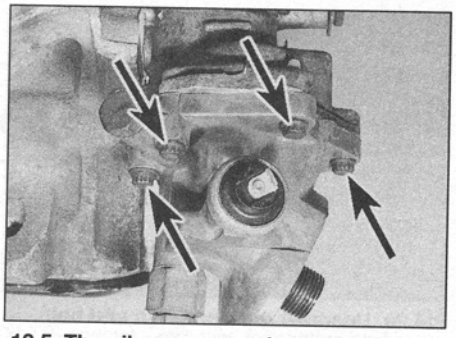
16 Refill the sump with fresh oil as described in Chapter 1A, then start the engine and check for oil leaks.



13.3 Disconnect the oil pressure switch wiring



13.4 Disconnecting the oil cooler pipes



13.5 The oil pump cover is retained by six bolts (four arrowed)

13 Oil pump - removal, inspection and refitting

Note: *A new gasket will be required for refitting. The pump housing must be filled with petroleum jelly before refitting the cover - ordinary grease should not be used.*

Removal

1 The engine oil does not have to be drained for this operation, but anticipate a small amount of spillage as the pump is removed, by placing a drain tray below the pump.

2 Unscrew and remove the oil filter, referring to Chapter 1A if necessary. If the same filter is to be re-used, do not allow the oil to drain.

3 Disconnect the electrical connector from the oil pressure switch **(see illustration)**.

4 On models with an oil cooler, the coolant unions to the cooler must be disconnected. Anticipate some oil spillage, and have ready suitable plugs or tape to cover the pipe ends. Unscrew the unions, and move the pipes to one side **(see illustration)**.

5 Unscrew and remove the six bolts securing the pump cover, taking care not to damage the oil pressure switch **(see illustration)**. Remove the cover, taking care that the pump gears do not fall out as the cover is removed.

6 Noting the fitted position of the oil pump driven gear, slide out the driven gear and the oil pump driveshaft **(see illustration)**.

7 Remove and discard the old cover gasket, and thoroughly clean the pump mating surfaces.

Inspection

8 If the vehicle has covered a high mileage and the engine is being overhauled, renew all the working parts contained in the oil pump as a matter of course.

9 First clean all the components as they are dismantled.

10 Visually check the gears for obvious scoring or chipping of the teeth. Renew if they are in poor condition.

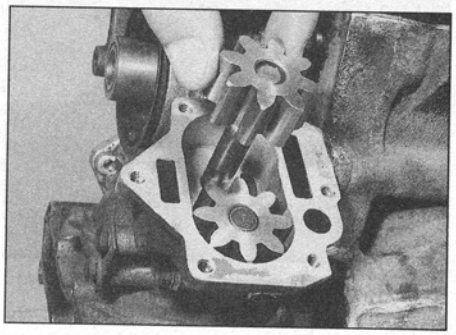
11 Dismantle the pressure relief valve, and inspect it for excessive wear and/or scoring **(see illustration)**. Pay special attention to the pressure relief valve spring. Note whether it shows signs of wear on its sides, or whether it is on the point of collapse.

12 Thoroughly clean the gauze filter housed within the relief valve bore.

13 Test the valve in its bore in the cover; it should have no more clearance than to make it an easy sliding fit. If any side movement is obviously apparent, then the valve and/or the cover will have to be renewed.

14 Wash the stripped casting in clean paraffin or petrol, and dry with a clean rag. Smear all parts with clean engine oil before reassembly.

15 With the gears refitted in the pump housing, check the pump gear endfloat. Lay a straight-edge across the two gear wheels and, with a feeler gauge, measure the clearance between the straight-edge and the surface of the front cover **(see illustration)**. The clearance should be within the specified limits. If the measurement is less than the minimum specified, inspect the front cover recess for signs of wear.



13.6 Sliding out the pump gears

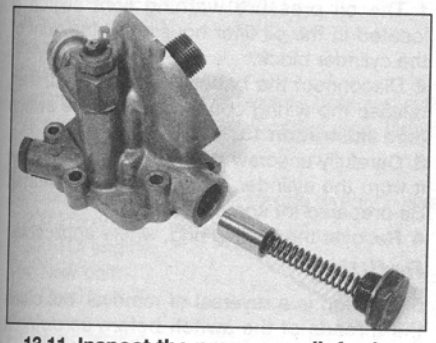
16 Lubricate the relief valve and fit it into its bore, then insert the relief valve spring. Fit the washer to the plug and screw it home, tightening it to the specified torque.

17 The pump housing must now be packed with petroleum jelly. This is essential, otherwise the oil pump will not prime itself with oil when the engine is started **(see illustration)**. Ordinary grease must not be used as a substitute, since it will not dissolve fully in the engine oil, and may block the hydraulic tappets or oil pick-up strainer.

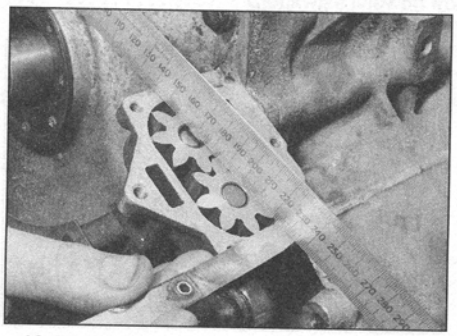
18 Locate the pump gears into their correct positions, ensuring that the petroleum jelly is filling every visible cavity.

Refitting

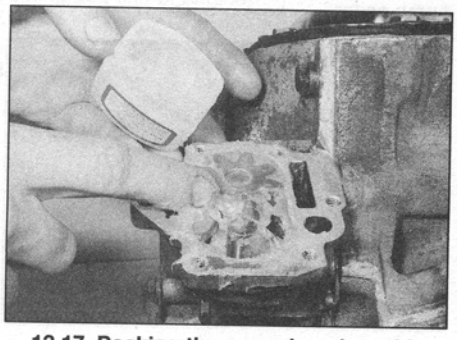
19 Fit a new gasket on the pump cover, then offer up the pump cover to the body and locate it in position. Refit the six securing bolts hand-tight to start with.



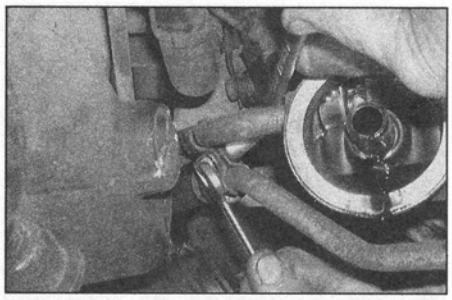
13.11 Inspect the pressure relief valve assembly



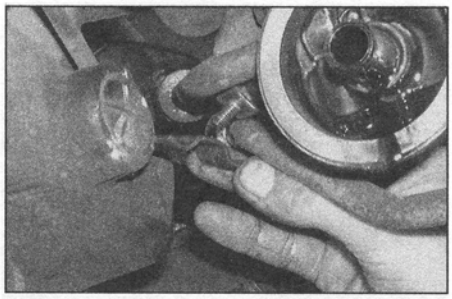
13.15 Checking the pump gear endfloat



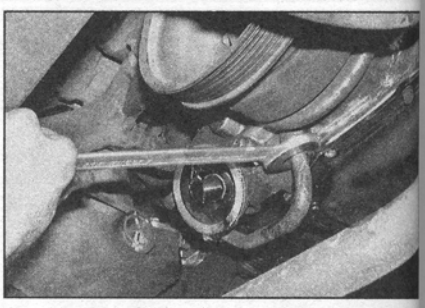
13.17 Packing the pump housing with petroleum jelly



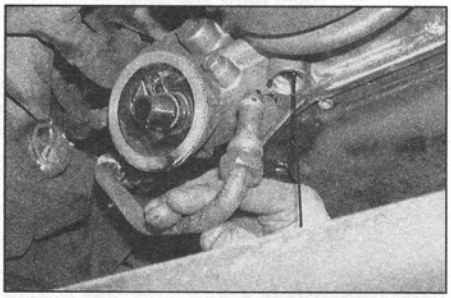
14.2a Unscrew the clamp nut and bolt . . .



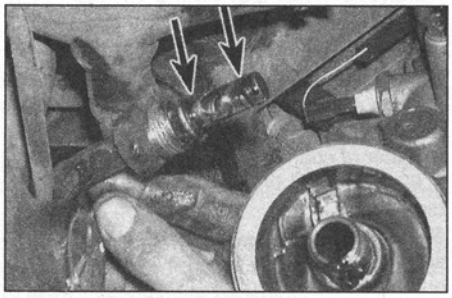
14.2b . . . and separate the clamp joining the two oil cooler pipes



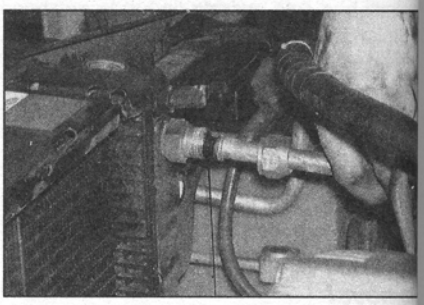
14.3a Loosen the union nuts . . .



14.3b . . . and disconnect the pipes from the base . . .



14.3c . . . and from the side of the oil filter housing - note O-rings (arrowed)



14.4 Disconnecting the upper oil cooler pipe

20 Finally tighten all the securing bolts evenly, working in alternate sequence to the final torque figure given in the Specifications.

21 Reconnect the wiring to the oil pressure warning light switch.

22 On models with an oil cooler, reconnect the pipes, tightening the union nuts to the specified torque.

23 Refit the oil filter, ensuring that it is pre-filled with oil, as described in Chapter 1A.

24 Check the oil level in the sump and top up as necessary.

25 Start the engine without racing it, and let it idle. The oil pressure warning light should go out after a short delay - failure to do so indicates that either the pump is worn, incorrectly assembled, or was not sufficiently packed with petroleum jelly on reassembly. Another reason could be that the oil pump pick-up strainer is blocked - remove the sump and clean the strainer as described in Section 12.

26 *Once the warning light has gone out,* leave the engine running for a few minutes, and check carefully for leaks from the oil pump cover.

14 Oil cooler pipes - removal and refitting

Removal

1 Drain the engine oil as described in Chapter 1A. While this will reduce oil spillage when the pipes are disconnected, oil will still be present in the pipes and cooler - take precautions when these are disconnected. To improve access, also remove the oil filter.

2 At the engine end of the pipes, unscrew the bolt from the clamp which secures the two pipes together, and recover the clamp, washer and nut **(see illustrations)**.

3 Loosen the union nuts, and withdraw the pipe ends from the oil filter housing. Recover the O-rings, which often remain inside the housing **(see illustrations)**.

4 *Loosen the union nuts at the cooler fittings,* and withdraw the pipes **(see illustration)**. Anticipate some oil spillage as this is done, and recover the O-rings.

5 Where applicable, unscrew the bolt from the upper clamp which secures the two pipes together, and recover the clamp, washer and nut.

6 Withdraw the pipes individually, noting how each one is routed.

7 If oil is leaking from the crimped joint where the flexible hose joins the rigid pipe, repair is unlikely to be successful - in the long run, fitting new pipes will be the most effective solution.

Refitting

8 Refitting is a reversal of removal, ensuring that the pipes are correctly routed, and using new O-rings. Tighten the union nuts to the specified torque.

15 Oil pressure warning light switch - removal and refitting

Removal

Note: *A new sealing ring may be required on refitting.*

1 The oil pressure warning light switch is located in the oil filter housing at the front of the cylinder block.

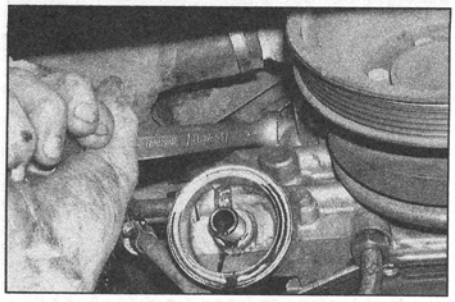
2 Disconnect the battery negative lead, then release the wiring connector from the switch **(see illustration 13.3)**.

3 Carefully unscrew the switch, and withdraw it from the cylinder block **(see illustrations)**. Be prepared for some oil spillage.

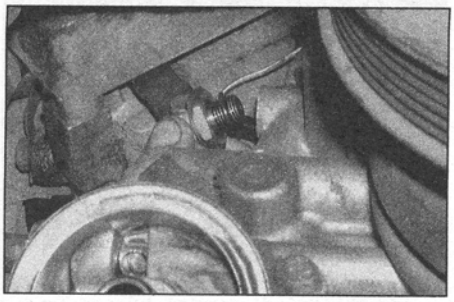
4 Recover the sealing ring, where applicable.

Refitting

5 Refitting is a reversal of removal, but clean the threads of the switch before screwing it into the cylinder block, and if applicable, use a new sealing ring.



15.3a Unscrew the switch . . .



15.3b . . . then remove it from the oil filter housing

Chapter 2 Part B:
Diesel 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 type	Four-cylinder, in-line, water-cooled. Single belt-driven camshaft, operating valves via pushrods and rocker gear
Manufacturer's engine codes:*	
200 TDi engine	12L00001
300 TDi engine:	
Manual transmission and EDC (Electronic Diesel Control)	17L00001
Manual transmission and DETOX system (not UK)	18L00001
Automatic transmission and EDC (Electronic Diesel Control)	19L00001
Automatic transmission and DETOX system (not UK)	20L00001
Manual transmission and EGR (Exhaust Gas Recirculation)	21L00001
Automatic transmission and EGR (Exhaust Gas Recirculation)	22L00001
Bore	90.47 mm
Stroke	97.00 mm
Capacity	2495 cc
Firing order	1-3-4-2 (No 1 at timing belt end)
Direction of crankshaft rotation	Clockwise (viewed from timing belt end of engine)
Compression ratio	19.5:1 ± 0.5:1
Maximum power (DIN)	111 bhp at 4000 rpm
Maximum torque (DIN)	265 Nm (196 lbf ft) at 1800 rpm
Compression pressure difference between cylinders (typical)	70 psi max.

**For details of engine code location, see 'Vehicle identification numbers'.*

Timing belt

	Nm	lbf ft
Tension (using gauge-type torque wrench - see text):		
200 TDi engine	18 to 20	13 to 15
300 TDi engine:		
New belt	14 to 16	10 to 12
Used belt	11 to 13	8 to 10

Rocker arms

Rocker arm freeplay on rocker shaft	0.1010 to 0.1270 mm

Lubrication system

Normal oil pressure (engine at normal operating temperature and operating speeds)	25.0 to 55.0 psi
Oil pump type:	
200 TDi engine	Double gear-type, driven by camshaft via skew gear and driveshaft
300 TDi engine	Rotor type, driven directly from front of crankshaft
Oil pump clearances (200 TDi engine):	
Maximum gear-to-housing clearance (endfloat)	0.026 to 0.135 mm
Maximum gear lobe-to-housing clearance	0.025 to 0.075 mm
Maximum gear backlash	0.100 to 0.200 mm

Flywheel

Maximum permissible lateral run-out of flywheel	0.050 to 0.070 mm
Minimum permissible thickness of flywheel after refinishing	36.960 mm

Torque wrench settings

	Nm	lbf ft
Air conditioning compressor bracket-to-timing belt housing bolts	45	33
Air conditioning compressor/alternator drivebelt idler pulley bolt	45	33
Air conditioning compressor/alternator drivebelt tensioner bolt	25	18
Alternator mounting bracket bolts (models with air conditioning)	45	33
Auxiliaries mounting bracket-to-cylinder block nuts and bolts	25	18
Auxiliary drivebelt tensioner securing nut	45	33
Big-end cap nuts**	59	44
Camshaft oil jet	7	5
Camshaft sprocket bolt (200 TDi engine)	45	33
Camshaft sprocket hub-to-camshaft bolt (300 TDi engine)	80	59
Camshaft sprocket-to-camshaft hub bolts (300 TDi engine)	25	18
Camshaft thrust plate bolts	9	7
Coolant pipe stub-to-cylinder head	22	16
Coolant pump securing bolts (200 TDi engine)	26	19
Coolant temperature sensor/blanking plug	14	10
Crankcase breather cover bolts (300 TDi engine)	25	18
Crankshaft damper bolt (200 TDi engine)	340	251
Crankshaft pulley bolt (300 TDi engine):		
Stage 1	80	59
Stage 2	Angle-tighten a further 90°	
Crankshaft rear oil seal housing bolts (300 TDi engine)	25	18
Cylinder block coolant drain plug	25	18
Cylinder block ladder frame bolts (200 TDi engine)	25	18
Cylinder block oil gallery rear plug	37	27
Cylinder block oil jets	17	13
Cylinder head bolts:		
200 TDi engine (all bolts):		
Stage 1	40	30
Stage 2	Angle-tighten a further 60°	
Stage 3	Angle-tighten a further 60°	
300 TDi engine:		
Stage 1 (all bolts)	Tighten until bolt heads just contact cylinder head	
Stage 2 (all bolts)	40	30
Stage 3 (all bolts)	Angle-tighten a further 60°	
Stage 4 (all bolts)	Angle-tighten a further 60°	
Stage 5 **(M12 x 140 mm bolts only)**	Angle tighten a further 20°	
Dipstick tube bolt	25	18
Driveplate access panel (automatic transmission models)	9	7
Driveplate-to-starter ring gear bolts (automatic transmission models)	25	18
Driveplate-to-torque converter bolts (automatic transmission models)*	39	29
Engine lifting bracket bolts	25	18
Engine mounting bracket-to-chassis nuts	45	33
Engine mounting bracket-to-cylinder block bolts	85	63
Engine mounting bracket-to-flywheel housing bolts	45	33
Engine mounting rubber-to-bracket nuts	85	63
Engine-to-transmission bolts:		
Automatic transmission	45	33
Manual transmission	40	30
Exhaust manifold bracket-to-cylinder block bolts	25	18
Exhaust manifold nuts:		
200 TDi engine	25	18
300 TDi engine	45	33

Torque wrench settings (continued)	Nm	lbf ft
Flywheel housing drain plug	12	9
Flywheel housing-to-bellhousing bolts:		
Automatic transmission	45	33
Manual transmission	40	30
Flywheel housing-to-cylinder block bolts	45	33
Flywheel/driveplate securing bolts**	146	108
Fuel injection pump rear mounting bracket-to-cylinder block bolts	25	18
Fuel injection pump sprocket-to-hub bolts	25	18
Inlet manifold nuts and bolts	25	18
Main bearing cap bolts**	133	98
Oil baffle-to-crankcase breather cover bolts (300 TDi engine)	4	3
Oil cooler pipe-to-oil filter adapter unions	45	33
Oil drain/return pipes-to-cylinder block	25	18
Oil filter adapter bolts	45	33
Oil pick-up pipe-to-bracket bolt (200 TDi engine)	25	18
Oil pick-up pipe-to-oil pump nut (200 TDi engine)	45	33
Oil pick-up/strainer pipe-to-bearing cap bolts (300 TDi engine)*	9	7
Oil pick-up/strainer pipe-to-timing belt housing bolts (300 TDi engine)	25	18
Oil pressure relief valve plug	30	22
Oil pressure warning light switch	17	13
Oil pump cover-to-oil pump bolts (200 TDi engine)	25	18
Oil pump driveshaft bush-to-cylinder block screw (200 TDi engine)	25	18
Oil pump-to-cylinder block bolts (200 TDi engine)	25	18
Oil separator-to-valve cover bolt	9	7
Oil thermostat housing-to-oil filter adapter bolts	9	7
Power steering pump bracket-to-auxiliary mounting bracket bolts	25	18
Rocker shaft pedestal bolts:		
200 TDi engine	30	22
300 TDi engine:		
Stage 1	5	4
Stage 2	Angle-tighten a further 50°	
Sump drain plug:		
200 TDi engine	45	33
300 TDi engine	35	26
Sump securing bolts	25	18
Tappet adjuster nut:		
200 TDi engine	25	18
300 TDi engine	16	12
Tappet guide locating screws	14	10
Thermostat cover-to-thermostat housing bolts:		
200 TDi engine	9	7
300 TDi engine	25	18
Thermostat housing-to-cylinder head bolts	25	18
Timing belt cover bolts	25	18
Timing belt housing-to-cylinder block bolts	25	18
Timing belt idler pulley nut	45	33
Timing belt tensioner bolt	45	33
Turbocharger oil drain adapter to cylinder block	42	31
Turbocharger oil feed adapter to cylinder block	25	18
Valve cover securing bolts:		
200 TDi engine	4	3
300 TDi engine	10	7
Wiring harness bracket bolts	25	18

*Use thread-locking fluid.
**New fasteners must be used on refitting.

1 General information

How to use this Chapter

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

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

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

Engine description

The engine is of four-cylinder in-line, overhead valve type, and is mounted longitudinally at the front of the vehicle. The engine uses

direct diesel injection, and the combustion chambers are incorporated in the pistons.

The crankshaft runs in five shell-type bearings, and the centre bearing incorporates thrustwashers to control crankshaft endfloat.

The connecting rods are attached to the crankshaft by horizontally-split shell-type big-end bearings. The pistons are attached to the connecting rods by gudgeon pins, which are a push-fit in the connecting rod small-end bores. The gudgeon pins are retained by circlips. The aluminium-alloy pistons are fitted with three piston rings - two compression rings and an oil control ring.

The camshaft is driven from the crankshaft by a toothed composite-rubber belt, which also drives the fuel injection pump.

The camshaft runs in four bearings pressed into the cylinder block. Each cylinder has two valves (one inlet and one exhaust), operated from the camshaft via pushrods and rocker arms. To minimise camshaft wear, tappet rollers act on the camshaft lobes, The rollers act on tappet slides, which in turn operate the pushrods. The rocker arms pivot on a shaft bolted to the cylinder head, and incorporate adjuster pins to enable valve clearance adjustment.

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

On 200 TDi engines, a gear-type oil pump is located in the sump, and is driven from the camshaft via a skew gear and driveshaft.

On 300 TDi engines, a rotor type oil pump is fitted, and the pump is driven directly from the front of the crankshaft.

The fuel lift pump and the brake vacuum pump are driven via pushrods acting on lobes on the camshaft.

The coolant pump is located in a housing at the front of the engine, and is driven by the auxiliary drivebelt.

Repair operations possible with the engine in the vehicle

The following operations can be carried out without having to remove the engine from the vehicle:

a) Removal and refitting of the valve operating (rocker) gear.
b) Removal and refitting of the cylinder head.
c) Removal and refitting of the timing belt and sprockets.
d) Removal and refitting of the sump.
e) Removal and refitting of the big-end bearings, connecting rods, and pistons.*
f) Removal and refitting of the oil pump.
g) Renewal of the engine mountings.
h) Removal and refitting of the flywheel/driveplate.

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

2 Compression and leakdown tests - description and interpretation

Compression test

Note: *A compression tester specifically designed for diesel engines must be used for this test.*

1 When engine performance is down, or if misfiring occurs which cannot be attributed to the fuel system, a compression test can provide diagnostic clues as to the engine's condition. If the test is performed regularly, it can give warning of trouble before any other symptoms become apparent.

2 A compression tester specifically designed for diesel engines must be used, because of the higher pressures involved. The tester is connected to an adapter which screws into the glow plug or injector hole. It is unlikely to be worthwhile buying such a tester for occasional use, but it may be possible to borrow or hire one - if not, have the test performed by a garage.

3 Unless specific instructions to the contrary are supplied with the tester, observe the following points:

a) The battery must be in a good state of charge, the air filter must be clean, and the engine should be at normal operating temperature.
b) All the injectors or glow plugs should be removed before starting the test. If removing the injectors, also remove the copper washers (which must be renewed when the injectors are refitted - see Chapter 4C), otherwise they may be blown out.
c) It is advisable to disconnect the stop solenoid on the fuel injection pump, to reduce the amount of fuel discharged as the engine is cranked.

4 There is no need to hold the accelerator pedal down during the test, because the diesel engine air inlet is not throttled.

5 The actual compression pressures measured are not so important as the balance between cylinders. Land Rover do not specify compression pressures, but a typical value for the maximum difference between cylinders is given in the Specifications.

6 The cause of poor compression is less easy to establish on a diesel engine than on a petrol one. The effect of introducing oil into the cylinders ('wet' testing) is not conclusive, because there is a risk that the oil will sit in the recess on the piston crown instead of passing to the rings. However, the following can be used as a rough guide to diagnosis.

7 All cylinders should produce very similar pressures; any difference greater than that specified 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). Deposits on the undersides of the valve heads can also cause low compression.

8 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.

9 If the compression reading is unusually high, the cylinder head surfaces, valves and pistons are probably coated with carbon deposits. If this is the case, the cylinder head should be removed and decarbonised (see Chapter 2C).

Leakdown test

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

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

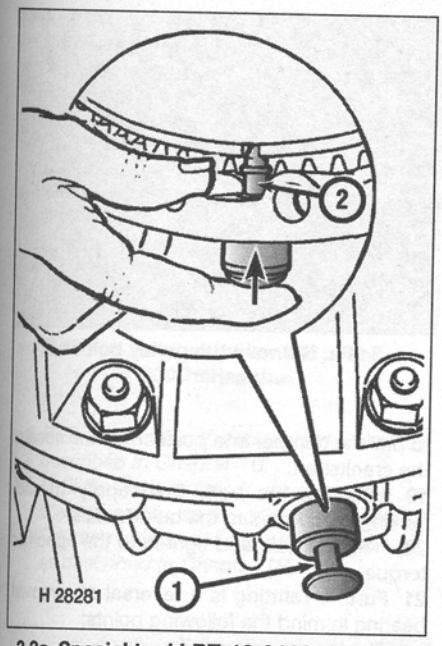
3 Top dead centre (TDC) for No 1 piston - locating

Note: *Suitable tools will be required to lock the flywheel and the fuel injection pump spindle in position during this operation. The Land Rover special tool available to lock the flywheel is LRT-12-044 for models with a conventional fuel injection system, or LRT-12-085 for models with EDC (see Chapter 4C). Special flywheel locking tool LRT-12-044 can be improvised by obtaining a spare flywheel housing blanking plug, and accur-ately drilling a hole though its centre to accept a 3/16 in twist drill. To lock the fuel injection pump sprocket, special tool LRT-12-045 will be required - this tool can be improvised using a short length (approximately 50.0 mm) of 3/8 in (9.5 mm) diameter round bar.*

1 On models with a manual transmission, unscrew the blanking plug from the timing hole in the base of the flywheel housing.

2 On models with automatic transmission, unscrew the larger bolt from the cover plate located on the engine backplate, to the rear of the sump. Pivot the cover plate away from the bolt hole.

3 Screw the appropriate flywheel locking tool (see note at the beginning of this Section) into the timing hole on models with manual transmission, or into the larger cover plate bolt hole on models with automatic transmission. Do not engage the locking tool centre pin at this stage **(see illustrations)**.



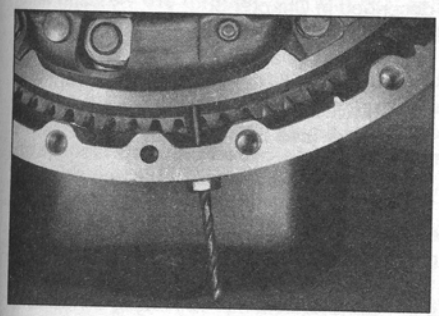
3.3a Special tool LRT-12-044 in position on manual transmission model

1 Special tool LRT-12-044
2 Tool centre pin

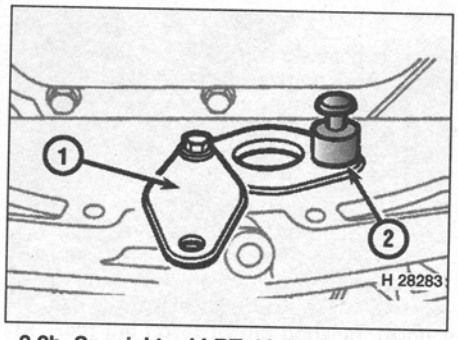
4 On models with air conditioning, remove the air conditioning compressor drivebelt as described in Chapter 1B, Section 17. If desired, unscrew the securing bolts, and move the compressor to one side, clear of the working area - **do not** disconnect the refrigerant lines (refer to the precautions in Chapter 3).

5 Remove the three securing screws, and withdraw the injection pump hub cover plate from the timing belt cover **(see illustration)**. Note that on models with air conditioning, the air conditioning drivebelt tensioner pulley is secured to the cover plate. Recover the gasket.

6 Insert the pump timing pin (Tool No LRT-12-045), or an improvised equivalent, through the U-shaped slot in the pump hub then, using a suitable tool on the crankshaft pulley/damper bolt, turn the crankshaft until the timing pin can be slid through the pump hub into the pump body **(see illustration)**. The tool should slide easily into position.

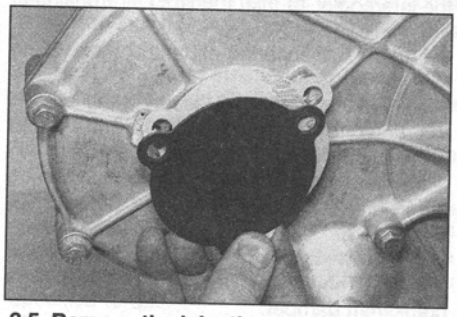


3.7 Improvised flywheel locking tool centre pin engaged with flywheel (viewed with transmission removed)



3.3b Special tool LRT-12-044 in position on automatic transmission model

1 Cover plate
2 Special tool LRT-12-044



3.5 Remove the injection pump hub cover plate and gasket - viewed with engine removed

7 The flywheel locking tool centre pin should now slide easily into engagement with the timing slot in the flywheel (if the tool does not slide easily into position, this indicates that the injection pump timing is incorrect - see Chapter 4C) **(see illustration)**.

8 The engine is now locked with No 1 piston at top dead centre.

4 Valve cover - removal and refitting

Removal

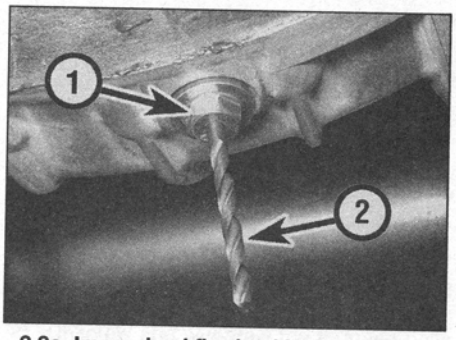
Note: *A new valve cover gasket may be required on refitting (the manufacturers recommend that the gasket is re-used a maximum of five times). New securing bolt sealing washers may be required, and on 200 TDi engines, new semi-circular seals and suitable liquid sealant may be required.*

1 Where applicable, unscrew the oil filler cap, then unclip the plastic cover from the top of the valve cover **(see illustration)**.

2 Loosen the hose clip(s), and disconnect the breather hose(s) from the valve cover, and from the breather filter on the side of the valve cover, where applicable.

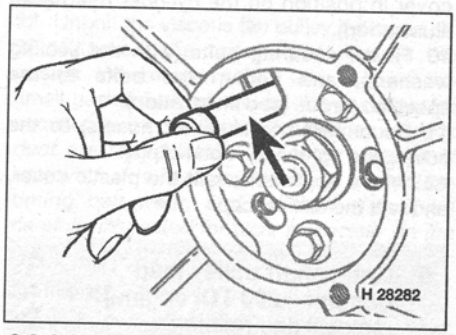
3 Unscrew the three securing bolts, and recover the sealing washers if they are loose, then lift the valve cover from the cylinder head.

4 Recover the gasket.



3.3c Improvised flywheel locking tool in position on manual transmission model

1 Blanking plug
2 3/16 in twist drill



3.6 Injection pump timing pin (arrowed) in position

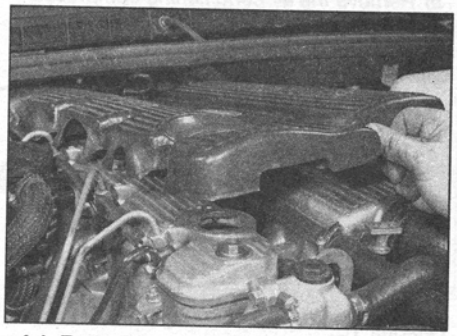
Refitting

5 Commence refitting by thoroughly cleaning the gasket faces of the cover and the cylinder head.

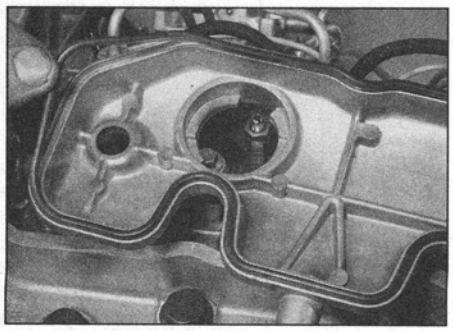
6 On 200 TDi engines, check the condition of the semi-circular seals at each end of the cylinder head, and renew if necessary. To renew the seals, prise them from the cut-outs in the cylinder head, then thoroughly clean the cut-outs, and fit the new seals using suitable liquid sealant.

7 Check the condition of the sealing washers on the securing bolts, and renew if necessary.

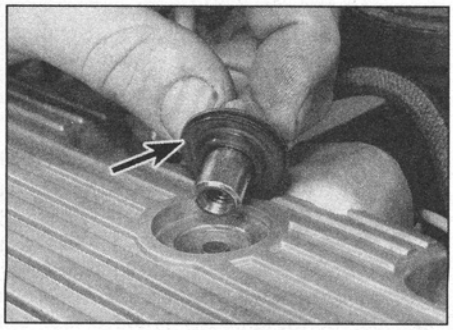
8 Check the condition of the valve cover gasket, and renew if necessary. Note that the manufacturers recommend that the gasket is only re-used a maximum of five times, regardless of apparent condition.



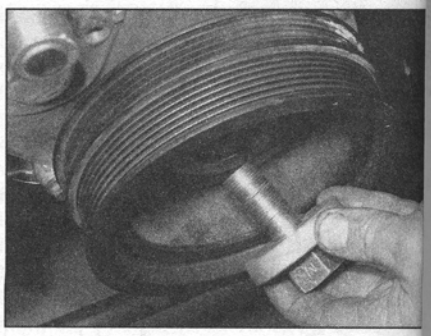
4.1 Removing the plastic cover from the valve cover - 300 TDi engine



4.9 Fitting the gasket to the valve cover - 300 TDi engine



4.10 Ensure that the sealing washers (arrowed) are in place on the valve cover bolts



5.28a Remove the pulley bolt and washer . . .

9 Fit the gasket to the cover, then place the cover in position on the cylinder head **(see illustration)**.
10 Fit the securing bolts (with the sealing washers), and tighten the bolts to the specified torque **(see illustration)**.
11 Reconnect the breather hose(s) to the cover, and tighten the hose clip(s).
12 Where applicable, refit the plastic cover, and refit the oil filler cap.

5 Crankshaft pulley (and damper - 200 TDi engine) - removal and refitting

200 TDi engine

Warning: The crankshaft damper securing bolt is tightened to a very high torque, and both the damper and bolt are coated with thread-locking compound. Ensure that adequate, good-quality tools are used to hold the damper, and to loosen and tighten the bolt. Check the condition of the tools before use, to avoid the possibility of failure and resulting personal injury. Suitable thread-locking compound will be required to coat the threads of the bolt and the damper on refitting.

Removal

1 Disconnect the battery negative lead.
2 On models with air conditioning, proceed as follows:
a) Remove the air conditioning compressor drivebelt, as described in Chapter 1B, Section 17.
b) Disconnect the wiring from the temperature sensor located in the thermostat housing.
*c) Remove the four bolts securing the air conditioning compressor to the engine, and move the compressor to one side, clear of the working area. Take care not to strain the refrigerant hoses - **do not** under any circumstances disconnect the hoses.*
3 Drain the cooling system as described in Chapter 1B.
4 Remove the viscous cooling fan and coupling as described in Chapter 3.
5 Loosen the securing clip, and disconnect the intercooler-to-inlet manifold air trunking at the manifold.
6 Loosen the securing clips and remove the radiator top hose.
7 Unscrew the two nuts securing the cooling fan cowl to the top of the radiator, and withdraw the cowl.
8 Remove the alternator and power steering pump drivebelts as described in Chapter 1B, Section 17.
9 Unscrew the four securing bolts, and remove the crankshaft pulley from the crankshaft damper.
10 To remove the damper, proceed as follows.
11 A suitable tool will now be required to hold the damper stationary as the damper bolt is loosened - note that the bolt is very tight! This is most easily achieved by bolting a suitable metal bar to the damper, using bolts screwed into at least two of the pulley bolt holes. Alternatively, carry out the following:
a) Apply the handbrake.
b) Engage the differential lock.
c) Engage the 'Low' range in the transfer gearbox.
d) On manual transmission models, engage first gear in the main transmission.
e) On automatic transmission models, move the selector lever to position P.
f) Remove the 'ignition' key.
12 Hold the damper stationary, and loosen the damper bolt using a suitable socket and extension bar.
13 Where applicable, unbolt the tool used to hold the damper stationary, then remove the damper bolt and recover the washer.
14 Withdraw the damper from the crankshaft, using a suitable puller to free it if necessary.

Refitting

15 Clean all traces of thread-locking compound from the damper and the securing bolt.
16 Smear the crankshaft contact surfaces of the damper spigot with thread-locking compound.
17 Fit the damper to the crankshaft, then fit the washer and bolt.
18 Using the tool to hold the damper stationary, as during removal, tighten the bolt to pull the damper into position on the nose of the crankshaft.
19 Unscrew the bolt, then apply thread-locking compound to the bolt threads.
20 Refit the bolt, and tighten to the specified torque.
21 Further refitting is a reversal of removal bearing in mind the following points:
a) Tighten the crankshaft pulley bolts securely.
b) Refit and tension the power steering pump and alternator drivebelts as described in Chapter 1B, Section 17.
c) Refit the viscous cooling fan and coupling as described in Chapter 3.
d) On models with air conditioning, refit the air conditioning compressor drivebelt as described in Chapter 1B, Section 17.
e) On completion, refill the cooling system as described in Chapter 1B.

300 TDi engine

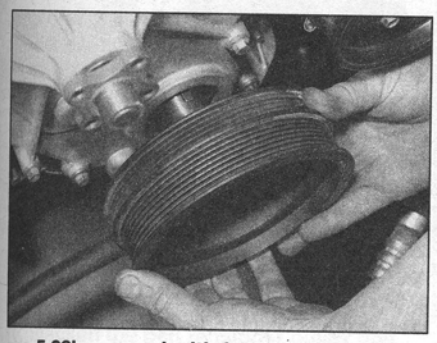
Note: *Suitable thread-locking compound will be required to coat the threads of the damper bolt on refitting.*

Removal

22 Disconnect the battery negative lead.
23 Drain the cooling system as described in Chapter 1B.
24 Disconnect the radiator top hose.
25 Loosen the securing clips, and remove the air trunking connecting the intercooler to the inlet manifold.
26 Remove the viscous fan unit and cowl, as described in Chapter 3.
27 Remove the auxiliary drivebelt, as described in Chapter 1B.
28 Proceed as described in paragraphs 11 to 14 inclusive, substituting the word pulley for damper **(see illustrations)**.

Refitting

29 Refitting is a reversal of removal, bearing in mind the following points:
a) Lightly grease the pulley spigot before fitting.
b) Apply suitable thread-locking compound to the bolt threads, and tighten the bolt to the specified torque, holding the pulley stationary as during removal.



5.28b . . . and withdraw the pulley - 300 TDi engine

c) Refit and tension the auxiliary drivebelt as described in Chapter 1B.
d) Refit the viscous fan, coupling and fan cowl assembly, as described in Chapter 3.
e) On completion, refill the cooling system as described in Chapter 1B.

6 Timing belt cover - removal and refitting

200 TDi engine

Note: *A new timing belt cover gasket and a new coolant pump gasket must be used on refitting, and it is advisable to fit a new crankshaft dust seal to the cover.*

Removal

1 Remove the crankshaft pulley and damper, as described in Section 5.
2 Loosen the hose clip, and disconnect the hoses from the coolant pump.
3 If necessary, hold the coolant pump pulley stationary by wrapping the drivebelt tightly round the pulley, then unscrew the three securing bolts, and withdraw the pulley.
4 Unscrew the securing bolts, and withdraw the coolant pump. Recover the gasket.
5 Loosen the hose clips, and withdraw the air trunking connecting the air cleaner to the turbocharger. Where applicable, disconnect the breather hose from the air trunking.
6 Disconnect the wiring from the alternator, then unscrew the through-bolt and nut, and remove the alternator from its mounting bracket.
7 Unscrew the through-bolt and nut, and remove the power steering pump from the mounting bracket. There is no need to disconnect the fluid hoses - just move the pump to one side clear of the working area, taking care not to strain the hoses.
8 Unscrew the securing bolts, and remove the alternator/power steering pump mounting bracket.
9 Unscrew the nine securing bolts, and remove the timing belt cover. Note the locations of the bolts, as they are of different lengths. Recover the gasket.

Refitting

10 Commence refitting by cleaning all traces of old gasket from the mating faces of the timing belt cover and housing.
11 It is advisable to fit a new crankshaft dust seal to the cover, as follows:
a) Prise the old seal from the aperture in the cover using a suitable screwdriver.
b) Clean the seal seat in the cover.
c) Press a new seal into position using a suitable socket or tube. Take care not to damage the seal lips.
12 Refit the cover to the housing, using a new gasket, then refit the securing bolts in their correct locations as noted before removal **(see illustration)**. Tighten the bolts to the specified torque.
13 Refit the alternator/power steering pump mounting bracket, and tighten the securing bolts.
14 Refit the power steering pump and alternator to the bracket, and reconnect the alternator wiring.
15 Refit the air trunking, and tighten the securing clips.
16 Clean all traces of old gasket from the mating faces of the coolant pump and housing, then refit the coolant pump using a new gasket. Tighten the securing bolts to the specified torque.
17 Refit the coolant pump pulley, and tighten the securing bolts. Hold the pulley using the drivebelt, as during removal.
18 Reconnect the hoses to the coolant pump.
19 Refit the crankshaft damper and pulley as described in Section 5.

300 TDi engine

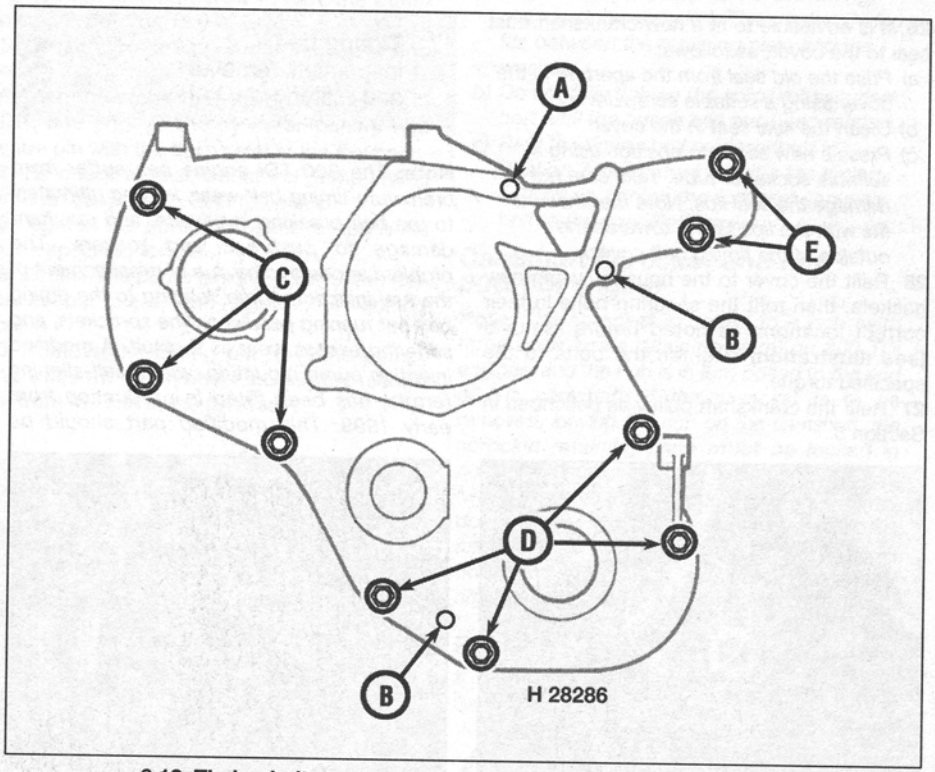
Note: *New gaskets must be used on refitting, and it is advisable to fit a new crankshaft dust seal to the cover.*

Removal

20 Remove the crankshaft pulley as described in Section 5.
21 Unscrew and withdraw the fourteen bolts securing the timing belt cover to the housing. Note the locations of the bolts, as they are of different lengths. Note also that the top two bolts secure the thermostat coolant hose clips.
22 Unbolt the viscous fan pulley if desired.
23 Withdraw the cover, and recover the gasket. Where applicable, also recover the small gasket located around the cover centre securing bolt boss. **Note:** *If quantities of black dust are found inside the cover when it is removed, this is an indication of premature timing belt wear, and the belt should be carefully inspected for wear (especially on the edges of the belt) without delay.*

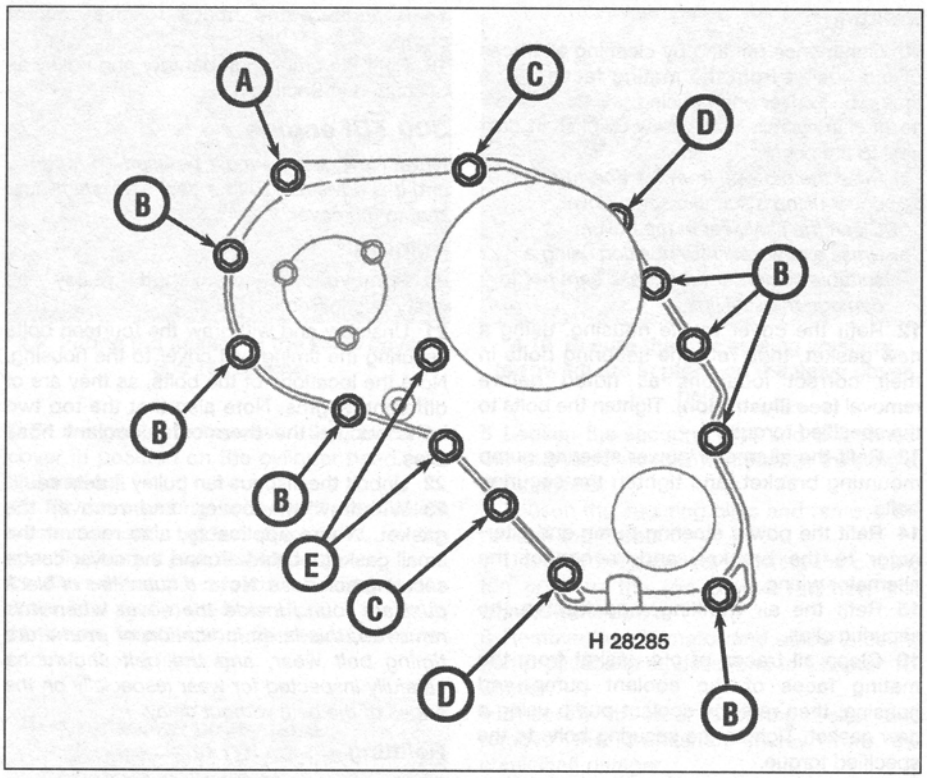
Refitting

24 Commence refitting by cleaning all traces of old gasket from the mating faces of the timing belt cover and housing.



6.12 Timing belt cover securing bolt locations - 200 TDi engine

A Stud hole
B Dowel hole
C 25 mm long bolt
D 80 mm long bolt
E 90 mm long bolt



6.26 Timing belt cover securing bolt locations - 300 TDi engine

A 25 mm long bolt
B 35 mm long bolt
C 50 mm long bolt
D 100 mm long bolt
E 110 mm long bolt

25 It is advisable to fit a new crankshaft dust seal to the cover, as follows:

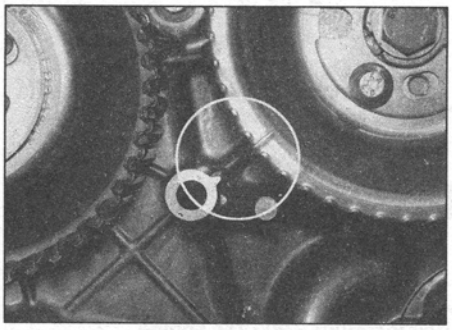
a) Prise the old seal from the aperture in the cover using a suitable screwdriver.
b) Clean the seal seat in the cover.
c) Press a new seal into position using a suitable socket or tube. Take care not to damage the seal lips. Note that the seal fits with the lips facing towards the outside of the timing belt cover.

26 Refit the cover to the housing, using new gaskets, then refit the securing bolts in their correct locations as noted before removal **(see illustration)**. Tighten the bolts to the specified torque.

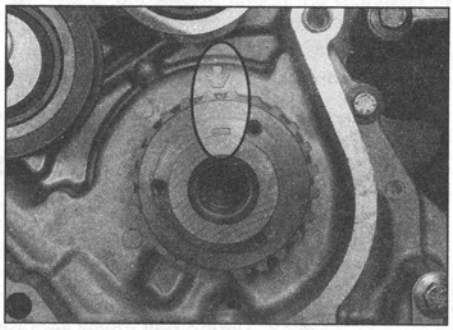
27 Refit the crankshaft pulley as described in Section 5.

7 Timing belt - inspection, removal and refitting

Note: *The 300 TDi engine can suffer from premature timing belt wear, leading ultimately to the belt breaking in service, and resultant damage to pushrods and rockers. The problem appears to be due to misalignment of the fuel injection pump, leading to the timing belt not running parallel on the sprockets, and suffering excess wear as a result. A modified injection pump mounting, with a self-aligning ferrule, has been fitted in production from early 1999. This modified part should be available from Land Rover dealers, who may also be able to advise on its fitment - regrettably, no further details were available at time of writing.*



7.8a Camshaft sprocket timing mark aligned with web on timing belt housing - 300 TDi engine



7.8b Crankshaft Woodruff key aligned with arrow on timing belt housing - 300 TDi engine

Inspection

1 Remove the timing belt cover as described in Section 6.

2 Temporarily refit the crankshaft damper /pulley bolt to the end of the crankshaft.

3 Ensure that the transmission is in neutral, then using a suitable spanner or socket on the crankshaft damper/pulley bolt, rotate the crankshaft so that the full length of the timing belt can be progressively checked. Examine the belt carefully for any signs of uneven wear, splitting or oil contamination, and renew it if there is the slightest doubt about its condition. If the belt exhibits signs of wear on its edges, this is also a sign that it has been weakened, and a new one should be fitted.

4 On completion, refit the timing belt cover as described in Section 6.

Removal

Note: *If the original belt is to be refitted, it must be refitted so that it rotates in the original running direction - mark the running direction before removal. When removed from the engine, timing belts must be stored on edge, on a clean surface. **Do not** bend the belt through acute angles (radius less than 50 mm), as damage and premature failure may result. A gauge- or pointer-type torque wrench will be required to tension the belt during refitting - a 'break' or 'click' type torque wrench is not suitable.*

5 Remove the timing belt cover as described in Section 6.

6 If the camshaft sprocket (sprocket hub on 300 TDi engines) is to be removed for any reason, the sprocket/hub securing bolt should be loosened at this stage, before the timing belt is removed (see Section 8).

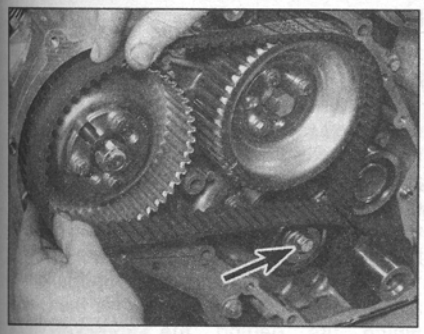
7 Temporarily refit the crankshaft damper/ pulley bolt to the end of the crankshaft, then turn the crankshaft (using a suitable spanner or socket on the damper/pulley bolt) to bring No 1 piston to TDC and lock it in place, as described in Section 3. Ignore the references to removal of the air conditioning compressor and the injection pump hub cover plate.

8 Check that the timing marks are aligned as follows:

*a) The timing mark on the camshaft sprocket should be aligned with the web on the timing belt housing **(see illustration)**.*
*b) The Woodruff key in the end of the crankshaft should be aligned with the arrow on the timing belt housing **(see illustration)**.*

9 Slacken the belt tensioner pulley bolt.

10 Slide the timing belt from the sprockets **(see illustration)**. If the original belt is to be refitted, mark the running direction of the belt to ensure correct refitting.



7.10 Slacken the belt tensioner pulley bolt (arrowed) and slide off the timing belt - 300 TDi engine shown

Warning: Do not turn the camshaft once the timing belt has been removed.

HAYNES HINT

If the belt cannot easily be slid from the sprockets, unscrew the securing nut, and remove the belt idler pulley.

Refitting

Note: *During refitting, the timing belt tensioning procedure is effectively carried out twice. This double-tensioning procedure **must** be carried out as described, to avoid the possibility of belt failure and resultant engine damage.*

11 Slacken the three bolts securing the injection pump sprocket to the pump hub **(see illustration)**.

12 Carefully fit the belt over the sprockets, ensuring that the direction of rotation marks are correctly orientated if the original belt is being refitted. Take care not to move the sprockets, and make sure that the timing marks are still aligned as described in paragraph 8.

13 Where applicable, refit the idler pulley, and tighten the securing nut.

14 If necessary, adjust the position of the belt, so that it sits correctly on the sprockets, with the timing marks still aligned.

15 Tighten the belt tensioner pulley bolt finger-tight.

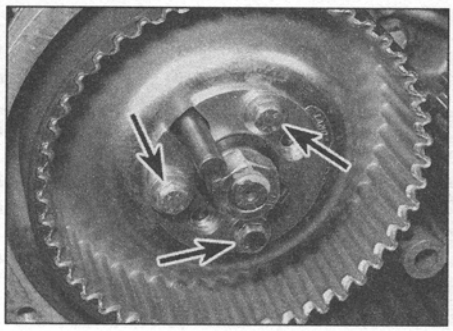
16 Engage a half-inch square-drive extension bar with the hole in the tensioner pulley mounting plate.

17 Using a gauge-type torque wrench held vertically, turn the extension bar to tension the belt to the specified torque. Tighten the tensioner pulley bolt, taking care to maintain the correct torque **(see illustration)**.

18 Tighten the injection pump sprocket-to-hub securing bolts to the specified torque.

19 Remove the pump timing pin from the injection pump sprocket, and withdraw the flywheel locking tool centre pin from the slot in the flywheel.

20 Turn the crankshaft clockwise through two complete turns, until the timing marks are aligned again, as described in paragraph 8.



7.11 Unscrew the three bolts (arrowed) securing the injection pump sprocket to the pump hub - 300 TDi engine shown

21 Slacken the tensioner pulley bolt, and repeat the tensioning procedure described in paragraph 17.

22 Turn the crankshaft through two complete revolutions clockwise, then re-engage the fly wheel locking tool with the slot in the flywheel, and check that the pump timing pin can still be inserted easily. If the pump timing pin cannot be easily inserted into position, proceed as follows, otherwise proceed to paragraph 30.

23 Withdraw the flywheel locking tool centre pin from the slot in the flywheel, then turn the crankshaft as necessary, until the timing pin can be inserted easily into the injection pump.

24 Loosen the pump locking screw, and remove the keeper plate (located at the front of the pump, behind the timing belt housing). Tighten the locking screw to lock the pump spindle in position.

25 Loosen the three pump sprocket-to-hub bolts.

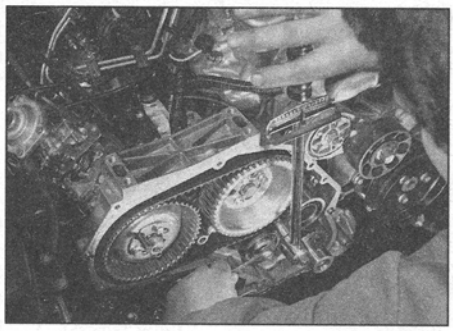
26 Turn the crankshaft the small amount to TDC, and engage the flywheel locking tool centre pin with the timing slot in the flywheel.

27 Re-check to ensure that the pump timing pin is an easy sliding fit in the pump.

28 Tighten the pump sprocket-to-hub bolts to the specified torque.

29 Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.

30 Remove the timing pin from the pump, and withdraw the flywheel locking tool centre pin from the slot in the flywheel.



7.17 Tensioning the timing belt - 300 TDi engine

31 If necessary, tighten the camshaft sprocket to the specified torque.

32 Refit the timing belt cover as described in Section 6.

8 Timing belt sprockets and tensioner - removal and refitting

Camshaft sprocket - 200 TDi engine

Note: *New retaining plate O-rings must be used on refitting.*

Removal

1 Remove the timing belt as described in Section 7.

Warning: Do not turn the crankshaft or the camshaft once the timing belt has been removed.

2 Unscrew the sprocket securing bolt (the bolt should have been loosened before the timing belt was removed). Recover the washer, the small O-ring, the retaining plate, and the larger O-ring.

3 Withdraw the sprocket from the end of the camshaft.

Refitting

4 Refitting is a reversal of removal, bearing in mind the following points:

a) Use new O-rings when refitting the sprocket retaining plate. Note that the larger O-ring fits between the retaining plate and the sprocket. The smaller O-ring fits between the retaining plate and the washer.

b) Do not fully tighten the sprocket securing bolt until the timing belt has been refitted.

c) Refit the timing belt as described in Section 7, but before refitting the timing belt cover, tighten the sprocket securing bolt to the specified torque.

Camshaft sprocket and hub - 300 TDi engine

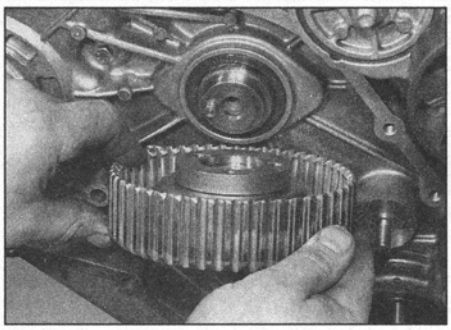
Note: *The sprocket is bolted to a hub (with three bolts and a retaining plate) on 300 TDi engines, and the hub is in turn bolted to the end of the camshaft. If the sprocket is to be removed, leaving the hub on the camshaft, the sprocket retaining plate **must** be locked in position on the sprocket by fitting and tightening two M8 bolts in the holes provided. If this is not done, it is possible for the valve timing to be altered when the sprocket is refitted (the bolt holes are elongated), which may adversely affect the performance of the engine.*

Removal

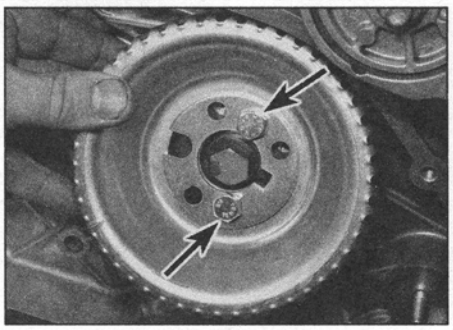
5 Remove the timing belt as described in Section 7.

Warning: Do not turn the crankshaft or the camshaft once the timing belt has been removed.

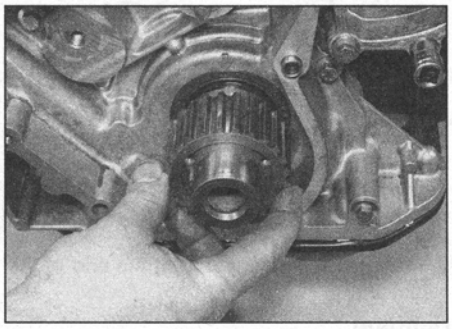
6 If the sprocket/hub assembly is to be removed as a complete unit, proceed as



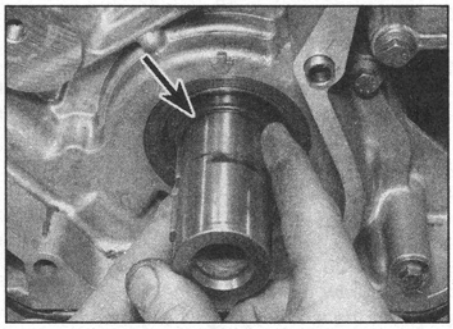
8.7 Removing the camshaft sprocket/hub assembly - 300 TDi engine



8.9 Removing the camshaft sprocket from the hub. Note M8 bolts (arrowed) locking retaining plate to hub - 300 TDi engine



8.12 Withdraw the crankshaft sprocket . . .



8.13 . . . and recover the O-ring (arrowed) from the crankshaft - 300 TDi engine

follows. If the sprocket is to be removed leaving the hub in place on the camshaft, proceed to paragraph 8.

7 If the sprocket/hub assembly is to be removed as a complete unit (such as for camshaft renewal), unscrew the hub securing bolt (the bolt should have been loosened before the timing belt was removed), then recover the washer and withdraw the assembly from the end of the camshaft **(see illustration)**. If the sprocket is to be removed from the hub, ensure that the retaining plate is locked in position first, as described in the note at the beginning of this sub-Section.

8 If the sprocket is to be removed leaving the hub in place on the camshaft, refer to the note at the beginning of this sub-Section, and fit two M8 bolts to lock the retaining plate in position on the sprocket.

9 Counterhold the camshaft using a suitable socket on the hub securing bolt, then unscrew the three bolts securing the sprocket to the hub, and withdraw the sprocket from the hub **(see illustration)**.

Refitting

10 Refitting is a reversal of removal, bearing in mind the following points:

a) Where applicable, do not fully tighten the sprocket hub securing bolt until the timing belt has been refitted.

b) Refit the timing belt as described in Section 7, but before refitting the timing belt cover, where applicable, tighten the sprocket hub securing bolt to the specified torque, and/or remove the two bolts used to lock the retaining plate to the sprocket.

Crankshaft sprocket

Note: *On 300 TDi engines, a new O-ring should be used when refitting the sprocket.*

Removal

11 Remove the timing belt as described
Section 7.

12 Withdraw the sprocket from the end of t
crankshaft **(see illustration)**. If the sprocket
tight, a suitable puller should be used. I
puller is used, do not allow the puller to be
on the end of the crankshaft - temporarily re
the pulley/damper bolt, and allow the puller
bear on the bolt head.

13 Recover the Woodruff key if it is loos
and on 300 TDi engines, recover the O-ri
which fits behind the sprocket (se
illustration).

Refitting

14 Refitting is a reversal of removal, bearin
in mind the following points:

a) Ensure that the Woodruff key is securely fitted to the end of the crankshaft.

b) On 300 TDi engines, refit the sprocket using a new O-ring.

c) If the sprocket is a tight fit on the crankshaft, carefully tap it into position using a soft-faced mallet. On 300 TDi engines, ensure that the O-ring is proper seated.

d) Refit the timing belt as described in Section 7.

Fuel injection pump sprocket

Removal

15 Remove the timing belt as described
Section 7.

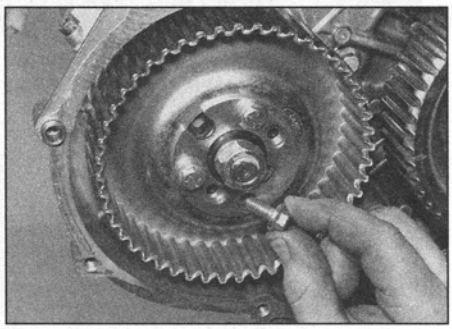
16 Slacken the three bolts securing t
injection pump sprocket to the pump hub.

17 Loosen the pump locking screw, a
remove the keeper plate (located at the fro
of the pump, behind the timing belt housing
Tighten the locking screw to lock the pum
spindle in position.

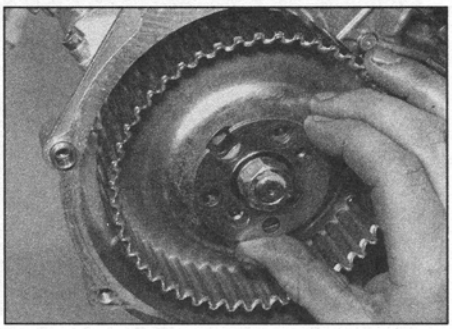
18 Ensure that the flywheel locking tool
engaged with the slot in the flywheel - t
attempt must be made to turn the crankshaf
or the fuel injection pump once the pum
spindle has been locked.

19 Remove the injection pump timing p
from the pump.

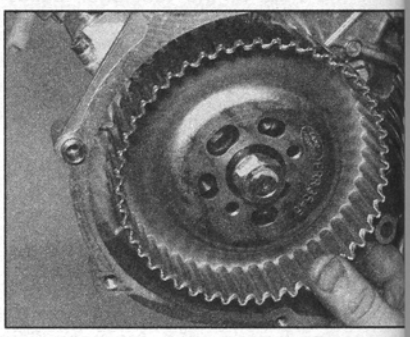
20 Remove the sprocket securing bolts, th
recover the retaining plate, and withdraw t
sprocket from the pump hub (se
illustrations).



8.20a Remove the three securing bolts . . .



8.20b . . . recover the retaining plate . . .



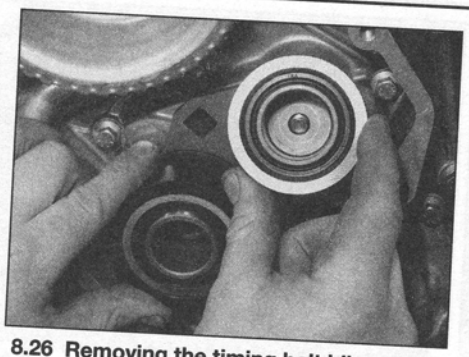
8.20c . . . and withdraw the sprocket

Refitting

21 Fit the sprocket to the pump hub, then fit the retaining plate, and the securing bolts. Do not fully tighten the securing bolts at this stage.
22 Fit the injection pump timing pin, and engage the pin with the pump hub.
23 Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.
24 Refit the timing belt as described in Section 7.

Idler pulley

25 Remove the timing belt as described in Section 7.
26 Unscrew the securing nut, recover the washer, and withdraw the idler pulley **(see illustration)**.
27 Refitting is a reversal of removal, but refit the timing belt as described in Section 7.



8.26 Removing the timing belt idler pulley - 300 TDi engine

Timing belt tensioner

Removal

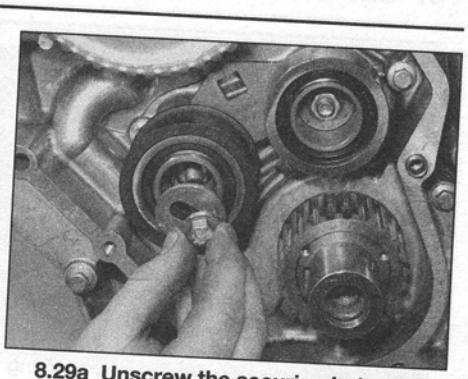
28 Remove the idler pulley as described previously in this Section.
29 Unscrew the securing bolt, recover the washer, and withdraw the tensioner. On 300 TDi engines, recover the spacer washer from the idler pulley stud **(see illustrations)**.
30 Check the tensioner for signs of wear, or of roughness when the wheel is spun. If the tensioner is known to have completed a high mileage, or if there is any doubt as to its condition, renew it.

Refitting

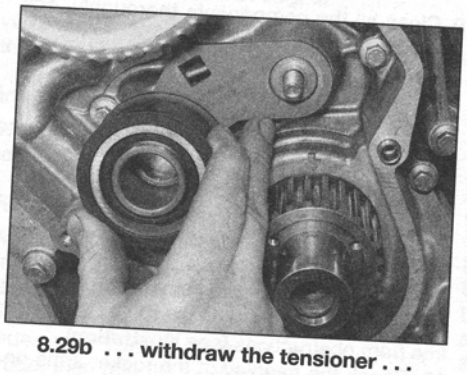
31 Refitting is a reversal of removal, bearing in mind the following points:

a) On 200 TDi engines, make sure that the hole in the tensioner plate locates over the lug on the timing belt housing.
b) On 300 TDi engines, make sure that the spacer washer is in place on the idler pulley stud, and make sure that the tensioner plate locates over the stud.

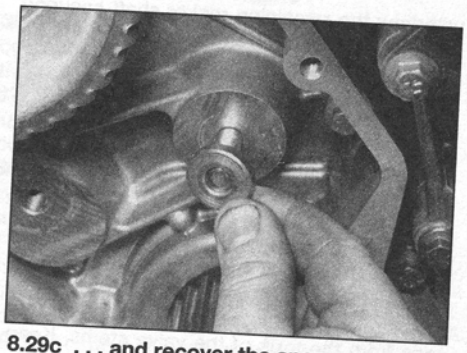
32 Refit the idler pulley, and refit the timing belt as described in Section 7.



8.29a Unscrew the securing bolt and recover the washer . . .



8.29b . . . withdraw the tensioner . . .



8.29c . . . and recover the spacer washer - 300 TDi engine

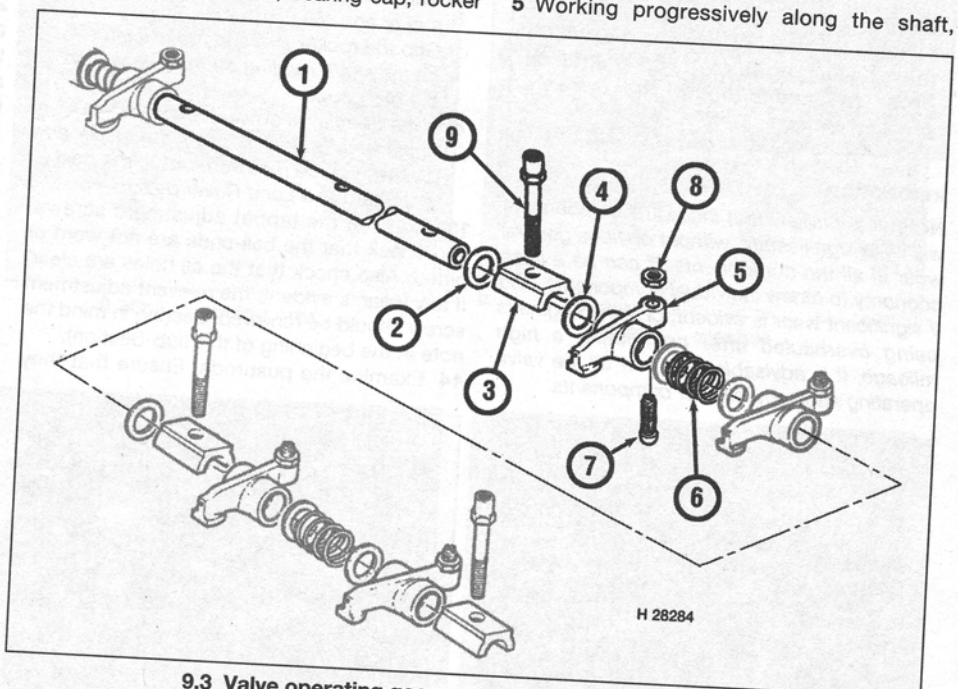
9 Valve operating (rocker) gear - removal, inspection and refitting

Note: *In order to remove the cam follower components, the cylinder head must be removed. Removal of the cam follower components is described in Section 11.*

200 TDi engine

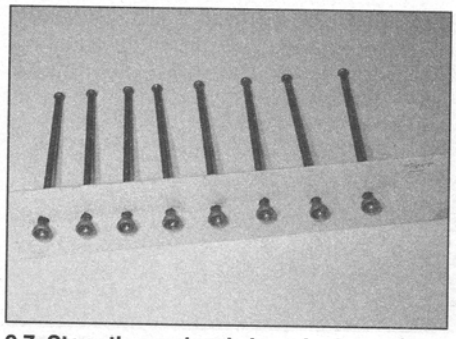
Removal

1 Remove the valve cover as described in Section 4.
2 Progressively unscrew the five rocker shaft securing bolts, but do not remove the bolts from the shaft - if the bolts are removed, the rocker assembly will fall apart when removed from the cylinder head.
3 With the rocker shaft removed, withdraw the securing bolt from one end of the shaft (the components will be forced from the shaft by the springs once the bolt has been removed) **(see illustration)**.
4 Withdraw the spacers, bearing cap, rocker arm, and spring from the shaft. Lay all the components out in order of removal. Take care not to mix the components up, as they must be refitted to the rocker shaft in their original positions.
5 Working progressively along the shaft,



9.3 Valve operating gear components - 200 TDi engine

1 Rocker shaft
2 Spacer
3 Bearing cap
4 Spacer
5 Rocker arm
6 Spring
7 Tappet adjustment screw
8 Tappet locknut
9 Rocker shaft securing bolt



9.7 Store the pushrods in order by pushing them through holes in piece of card

withdraw the remaining rocker shaft securing bolts, and slide the remaining components from the shaft, keeping them in order.

6 Make suitable holes to accommodate the pushrods in a piece of card, then number the holes from 1 to 8 (No 1 at the timing belt end of the engine).

7 Working from the timing belt end of the cylinder head, lift the pushrods from their bores in the cylinder head, and insert them through the holes in the card, in order of removal **(see illustration)**.

8 Where applicable, remove the valve stem caps from the tops of the valve stems. Keep them in order so that they can be refitted to their original locations.

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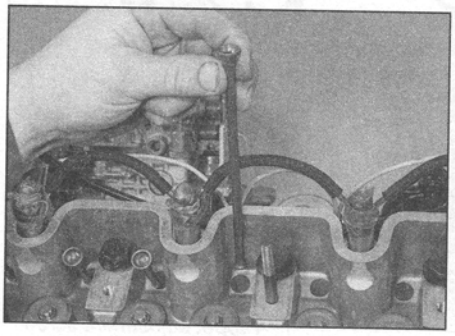
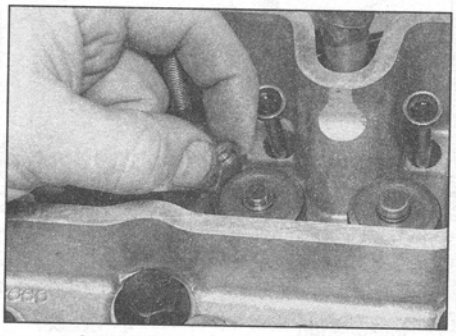
>
> ***To keep the rocker shaft components in order, slide them onto a 'dummy shaft' in order of removal. The dummy shaft can be made from a suitable length of thin bar or rod, which must be longer than the rocker shaft in order to accommodate the uncompressed springs.***

Inspection

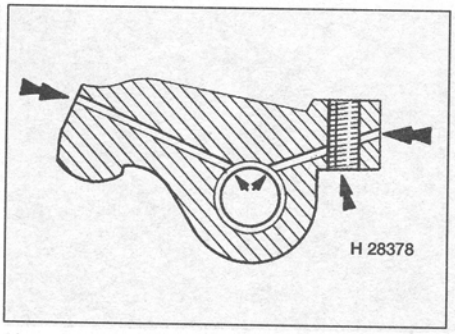
Note: *It is unlikely that individual components will wear significantly, without obvious general wear in all the components. It can be a false economy to renew individual components, and if significant wear is evident, or if the engine is being overhauled after completing a high mileage, it is advisable to renew all the valve operating and cam follower components.*



9.18 Fitting a pushrod



9.19 Fitting a valve stem cap



9.11 Check that the oil holes (arrowed) in the rocker arms are clear - 200 TDi engine

9 Clean all the components thoroughly, one by one, keeping them in order.

10 Examine the rocker shaft for wear. Check the bearing surfaces, and check that the oilways are clear. If there is any sign of wear, scoring or pitting on the bearing surfaces, the shaft must be renewed.

11 Inspect the rocker arm pads (the areas which contact the valve stems) for wear. If excessive wear is evident, the rocker arms must be renewed - it is not permissible to grind the pads to compensate for wear. Check that the oil holes in the rocker arms are free from obstructions **(see illustration)**.

12 Check the freeplay of the rocker arms on the shaft. This is most easily accomplished as follows:

a) Clamp the rocker shaft horizontally in a soft-jawed vice.
b) Slide the rocker arm onto the shaft.
c) Position a suitable dial test indicator to read from the cylindrical section of the rocker arm.
d) Grip the rocker arm and move it laterally on the shaft, reading off the freeplay on the dial gauge.
e) If the freeplay is outside the specified limits (see 'Specifications'), the rocker arm bushes can be renewed, but this is best entrusted to a Land Rover dealer.

13 Examine the tappet adjustment screws, and check that the ball-ends are not worn or pitted. Also check that the oil holes are clear. If any wear is evident, the relevant adjustment screw should be renewed (bearing in mind the note at the beginning of this sub-Section).

14 Examine the pushrods. Ensure that they are all straight, and if any one is bent or distorted, renew it. Check the ends of each pushrod. If either end is rough, damaged or badly worn, the pushrod must be renewed. If it is discovered that one pushrod is worn, examine the corresponding rocker arm and tappet slide also (see Section 10).

15 Examine the rocker shaft springs for damage and deterioration. It is advisable to renew all the springs as a matter of course.

16 Check the condition of the valve stem caps where applicable, and renew them if there is any sign of significant wear. Note that if no valve stem caps are fitted, it is permissible to fit caps (the caps must be fitted to all the valves as a set, and are available from Land Rover dealers) to compensate for wear in the valve stems and/or the rocker arm pads.

Refitting

17 Commence refitting by ensuring that all components are clean. Check all oilways for obstructions.

18 Lightly lubricate the tops of the tappet slides with clean engine oil of the correct grade, then refit the pushrods in their original locations. Make sure that the ball-end of each pushrod locates correctly in the tappet slide **(see illustration)**.

19 Where applicable, refit the valve stem caps to the tops of the valves, in their original locations **(see illustration)**.

20 Lubricate the rocker shaft, then slide one of the end bearing caps onto the shaft, and refit one of the rocker shaft securing bolts to retain the bearing cap.

21 Slide the spacers, rocker arms, springs and bearing caps onto the shaft, keeping them in their original order. Refit the relevant rocker shaft securing bolt as each bearing cap is fitted, to retain the components on the shaft.

22 With the rocker shaft reassembled, lubricate the rocker arm contact faces of the pushrods and valve stems.

23 Refit the rocker shaft assembly to the cylinder head. If necessary, loosen the locknuts, and back off the tappet adjuster screws to aid refitting. Ensure that the ball-ends of the tappet adjuster screws locate correctly in the pushrod cups.

24 Progressively tighten the securing bolts to the specified torque.

25 Adjust the valve clearances as described in Chapter 1B.

Warning: If the crankshaft is rotated with excessive valve clearances, it is possible for the pushrods to become dislodged, and fracture the tappet slides. To prevent the possibility of damage, turn the adjusters to eliminate all clearance from any loose rocker arms before turning the crankshaft to check the valve clearances.

26 On completion, refit the valve cover as described in Section 4.

300 TDi engine

Removal

27 Remove the valve cover as described in Section 4.

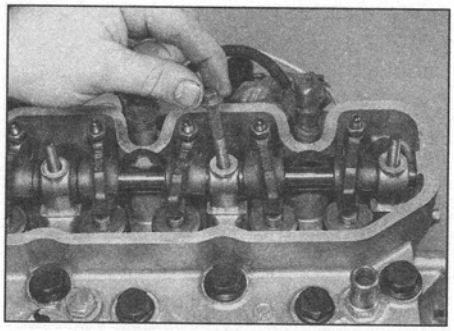
28 Progressively unscrew the three nuts and two bolts securing the rocker shaft to the cylinder head, then lift the assembly from the cylinder head studs **(see illustrations)**. Hold the end pedestals as the assembly is removed, to prevent the components from falling off the rocker shaft. Take care not to dislodge the valve stem caps from the tops of the valves as the rocker gear is removed.

29 With the rocker shaft removed, withdraw the pedestals, spacers, rocker arms and springs from the shaft. Lay all the components out in order of removal. Take care not to mix the components up, as they must be refitted to the rocker shaft in their original positions.

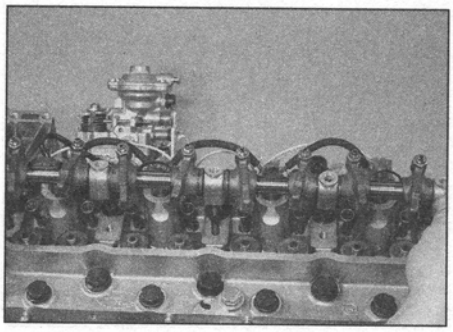
> HAYNES HiNT
> ***To keep the rocker shaft components in order, slide them onto a 'dummy shaft' in order of removal. The dummy shaft can be made from a suitable length of thin bar or rod, which must be longer than the rocker shaft in order to accommodate the uncompressed springs.***

30 Remove the pushrods, as described in paragraphs 6 and 7.

31 Remove the caps from the tops of the valve stems. Again, keep them in order so that they can be refitted to their original locations.



9.28a Removing a rocker shaft securing bolt - 300 TDi engine



9.28b Removing the rocker shaft - 300 TDi engine

Inspection

32 Proceed as described in paragraphs 9 to 16.

Refitting

33 Commence refitting by ensuring that all components are clean. Check all oilways for obstructions.

34 Lightly lubricate the tops of the tappet slides with clean engine oil of the correct grade, then refit the pushrods in their original locations. Make sure that the ball-end of each pushrod locates correctly in the tappet slide.

35 Refit the valve stem caps to the tops of the valves, in their original locations.

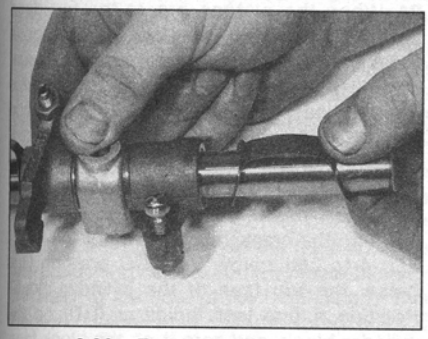
36 Lubricate the rocker shaft, then slide the components onto the shaft, keeping them in their original order **(see illustrations)**.

37 With the rocker shaft reassembled, lubricate the rocker arm contact faces of the pushrods and the valve stems.

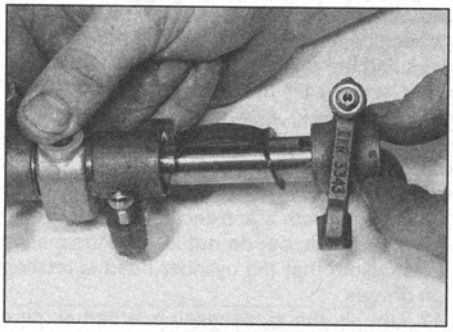
38 Refit the rocker shaft assembly to the cylinder head, ensuring that the three locating studs pass through the shaft and the pedestals. If necessary, loosen the locknuts, and back off the tappet adjuster screws to aid refitting. Ensure that the ball ends of the tappet adjuster screws locate correctly in the pushrod cups.

39 Refit the securing nuts and bolts, and tighten progressively to the specified torque in the two stages given in the Specifications **(see illustrations)**.

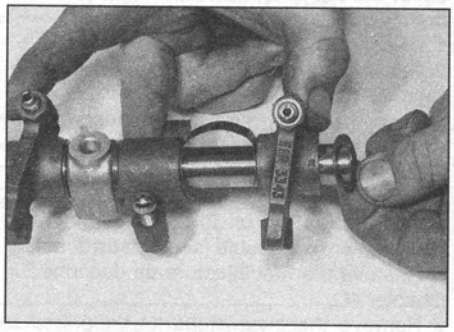
40 Proceed as described in paragraphs 25 and 26.



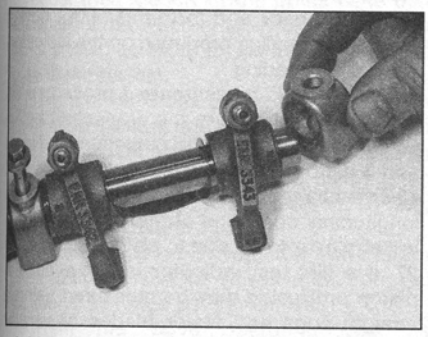
9.36a Refit the spring . . .



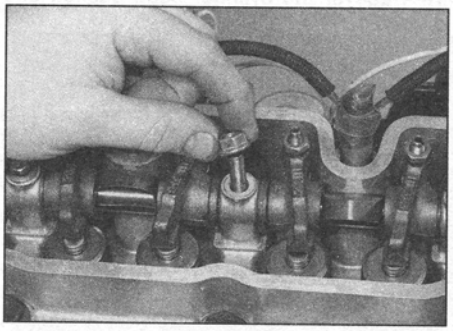
9.36b . . . rocker arm . . .



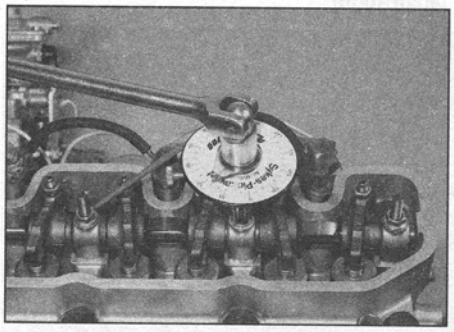
9.36c . . . washer . . .



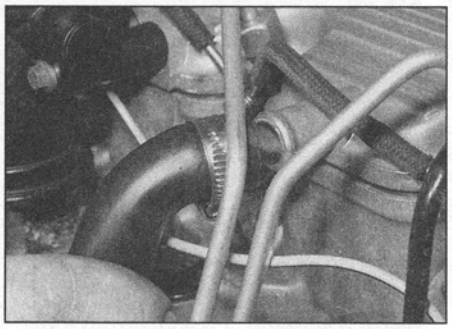
9.36d . . . and end pedestal to the end of the rocker shaft - 300 TDi engine



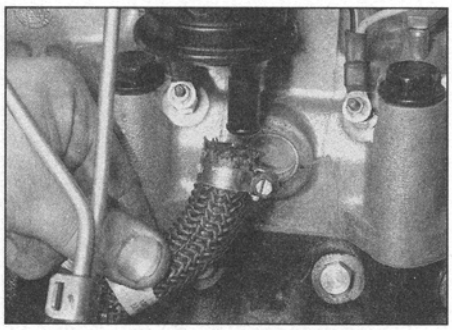
9.39a Refit the rocker shaft securing nuts and bolts . . .



9.39b . . . and tighten to the specified torque, then through the specified angle - 300 TDi engine



10.4a Disconnect the breather hoses from the valve cover . . .



10.4b . . . and the breather - 300 TDi engine

10 Cylinder head - removal, inspection and refitting

Removal

Note: *The cylinder head bolts may be re-used a maximum of five times. Unless the history of the cylinder head bolts is certain (make marks to indicate the number of times they have been used), it is advisable to use new bolts when refitting the cylinder head. A new cylinder head gasket must be used on refitting.*

Warning: Access to lift the cylinder head is awkward, due to the width of the engine compartment. Although the cylinder head is not unusually heavy, it is advisable to enlist the aid of an assistant to help lift the head - do not attempt the job alone.

1 Disconnect the battery negative lead.

2 Remove the bonnet as described in Chapter 12.

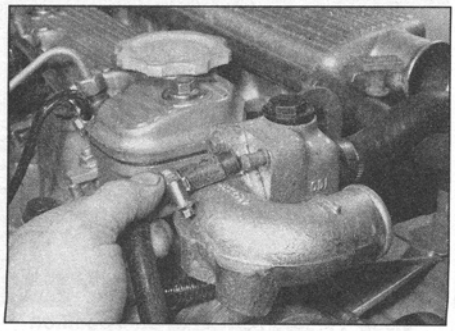
3 Drain the cooling system as described in Chapter 1B.

4 Loosen the hose clips, and disconnect the breather hose(s) from the valve cover, and from the breather on the side of the valve cover, where applicable **(see illustrations)**.

5 Remove the fuel injectors as described in Chapter 4C.

6 Remove the glow plugs as described in Chapter 5C.

7 Disconnect the coolant hoses from the thermostat housing and cover **(see illustration)**.



10.7 Disconnecting the coolant hose from the thermostat housing - 300 TDi engine

8 Disconnect the wiring from the temperature gauge sender, located in the thermostat housing.

9 Remove the inlet manifold, exhaust manifold and turbocharger, as described in the relevant part of Chapter 4.

10 Disconnect the coolant hose connecting the coolant pipe (mounted on the manifold studs) to the water pump, then move the coolant pipe clear of the working area.

11 Disconnect the coolant hose from the rear of the cylinder head.

12 Unbolt the wiring harness bracket from the cylinder head.

13 Remove the valve operating gear as described in Section 9.

14 Where applicable, lift the valve stem caps from the tops of the valves. Keep the caps in order, so that they can be refitted in their original positions.

15 Working in a spiral pattern, progressively loosen and remove the eighteen bolts securing the cylinder head.

16 Carefully lift the cylinder head from the cylinder block, and move it forwards for access to the bolt securing the transmission breather pipe bracket to the rear of the cylinder head. If necessary, tap the cylinder head gently with a soft-faced mallet to free it from the block, but **do not** lever at the mating faces. Note that the cylinder head is located on dowels.

17 Unbolt the transmission breather pipe bracket from the cylinder head then, with the aid of an assistant, lift the cylinder head from the vehicle.

18 Recover the cylinder head gasket, and discard it.

Inspection

19 The mating faces of the cylinder head and block must be perfectly clean before refitting the head. Use a scraper to remove all traces of gasket and carbon, and also clean the tops of the pistons. Take particular care with the aluminium cylinder head, as the soft metal is damaged easily. Also, make sure that debris is not allowed to enter the oil and water channels - this is particularly important for the oil circuit, as carbon could block the oil supply to the camshaft or crankshaft bearings. Using adhesive tape and paper, seal the water, oil and bolt holes in the cylinder block. Clean t piston crowns in the same way.

> **HAYNES HiNT** ***To prevent carbon entering the gap between the pistons and bores, smear a little grease in the gap. After cleaning the piston, rotate the crankshaft so that the piston moves down the bore, then wipe out the grease and carbon with a cloth rag.***

20 Check the block and head for nicks, de scratches and other damage. If slight, th may be removed carefully with a file. Mo serious damage may be repaired machining, but this is a specialist job.

21 If warpage of the cylinder head suspected, use a straight-edge to check it distortion. Refer to Part C of this Chapte necessary.

22 Clean out the bolt holes in the block us a pipe cleaner, or a rag and screwdriver. Ma sure that all oil is removed, otherwise there a possibility of the block being cracked hydraulic pressure when the bolts tightened.

23 Examine the bolt threads and the threa in the cylinder block for damage. If necessa use the correct-size tap to chase out threads in the block, and use a die to cle the threads on the bolts.

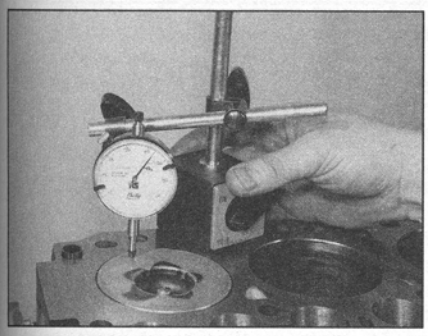
Gasket selection

24 When the pistons are at the top de centre (TDC) position, they protrude abo the top face of the cylinder block. The amo of protrusion determines the thickness of cylinder head gasket required. The protrus of all the pistons above the cylinder blo must be measured, and the thickness of gasket to be used is determined by the larg protrusion measured.

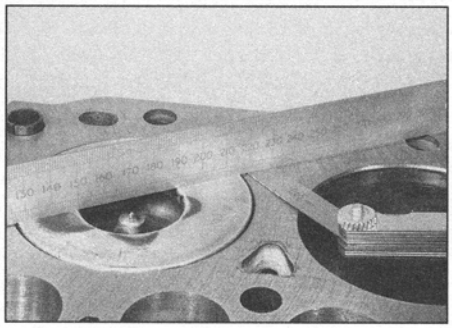
25 Turn the crankshaft to bring piston No and 4 to just below the TDC position below the top face of the cylinder bloc Position a dial test indicator (DTI) on cylinder block, and zero it on the block fa Transfer the probe to the crown of No 1 pis (as close as possible to the centre, avoid the combustion chamber), then slowly turn crankshaft back and forth past TDC, not the highest reading produced on the indica Record this reading.

26 Repeat this measurement procedure No 4 piston, then turn the crankshaft ha turn (180°) and repeat the procedure on No and 3 pistons **(see illustration)**. Ensure all measurements are taken along longitudinal centreline of the crankshaft will eliminate errors due to piston slant).

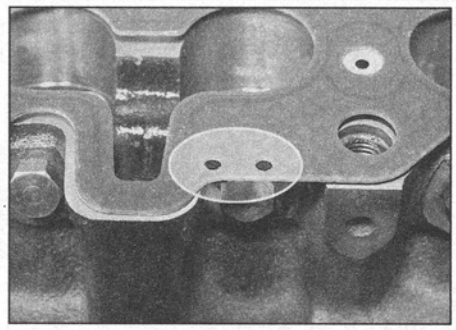
27 If a dial test indicator is not availa piston protrusion may be measured usin *straight-edge and feeler blades or ver* calipers. However, these methods inevitably less accurate, and cannot there be recommended **(see illustration)**.



10.26 Measuring piston protrusion using a dial gauge



10.27 Measuring piston protrusion using a straight-edge and feeler blades



10.28 Cylinder head gasket identification holes

Ensure that measurements are taken along the longitudinal centreline of the crankshaft (this will eliminate errors due to piston slant)

28 Ascertain the greatest piston protrusion measurement, and use this to determine the correct cylinder head gasket from the table. The gasket identification holes are located at the rear right-hand (fuel injection pump) side of the gasket **(see illustration)**.

Piston protrusion	Gasket identification
0.5000 to 0.6000 mm	1 hole
0.6100 to 0.7000 mm	2 holes
0.7100 to 0.8000 mm	3 holes

Refitting

29 Ensure that the cylinder head locating dowels are fitted to the cylinder block, then fit the correct gasket the right way round on the cylinder block, with the identification mark(s) at the rear right-hand (fuel injection pump) side of the gasket. The TOP mark should be uppermost on the fuel injection pump side of the engine **(see illustration)**.

30 Lower the cylinder head onto the block, to enable the transmission breather pipe to be refitted. Refit the bolt securing the breather pipe bracket, then position the head over the two positioning dowels in the cylinder block.

31 Refer to the note at the beginning of this Section, and fit new cylinder head bolts if there is any doubt about the number of times the original bolts have been used.

32 Lightly lubricate the cylinder head bolt threads, then loosely fit the bolts. Note that there are three different sizes of bolt, and the bolts should be fitted to the locations shown **(see illustrations)**.

33 Tighten the bolts in the order shown in illustration 10.32a, and in the stages given in the Specifications - ie, tighten all bolts in sequence to the Stage 1 torque, then tighten all bolts in sequence to the Stage 2 torque, and so on **(see illustration)**.

34 Where applicable, refit the valve stem caps to the tops of the valves in their original locations, as noted before removal.

35 Refit the valve operating gear as described in Section 9.

36 Refit the wiring harness bracket, and tighten the securing bolt.

37 Reconnect the coolant hose to the rear of the cylinder head.

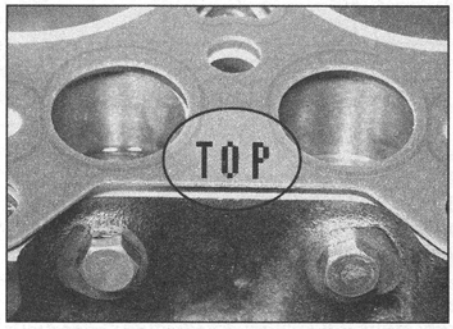
38 Reconnect the coolant hose connecting the manifold-mounted coolant pipe to the water pump.

39 Refit the exhaust manifold, turbocharger and inlet manifold, as described in the relevant part of Chapter 4.

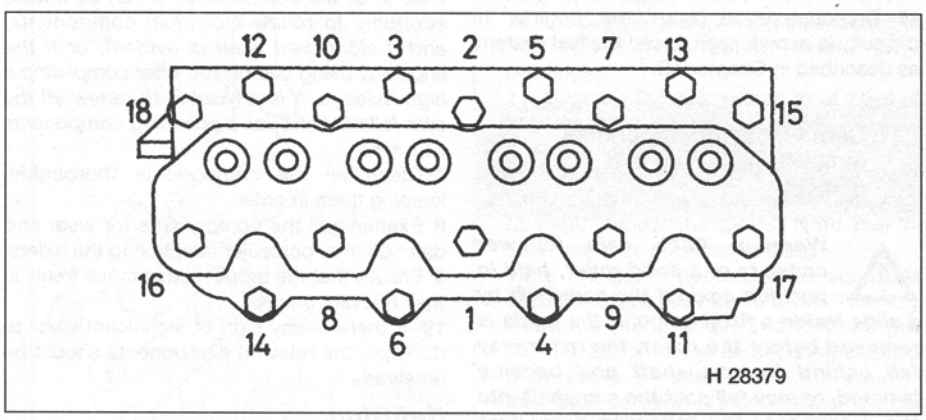
40 Reconnect the temperature gauge sender wiring, and reconnect the coolant hoses to the thermostat housing and cover.

41 Refit the glow plugs as described in Chapter 5C.

42 Refit the fuel injectors as described in Chapter 4C.

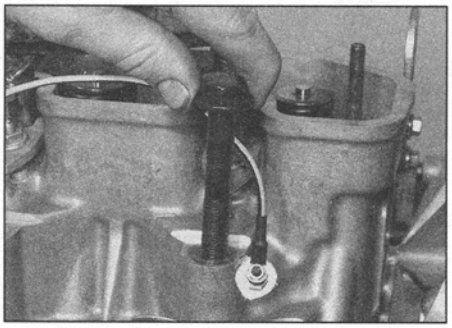


10.29 Cylinder head gasket TOP mark

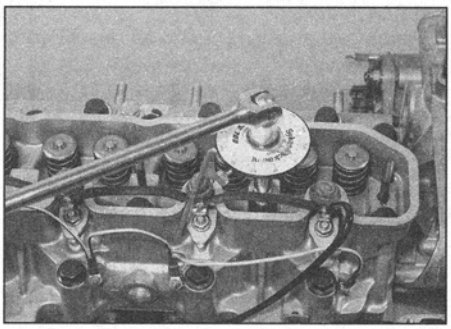


10.32a Cylinder head bolt locations and tightening sequence

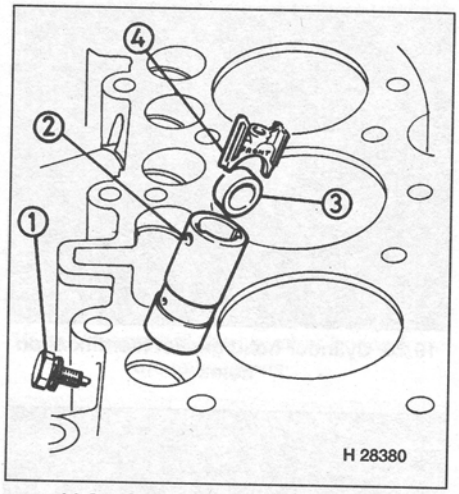
M10 x 117 mm bolts at locations 3, 5, 12 and 13
M12 x 140 mm bolts at locations 1, 2, 7, 8, 9, 10, 15, 16, 17 and 18
M12 x 100 mm bolts at locations 4, 6, 11 and 14



10.32b Refit the cylinder head bolts . . .



10.33 . . . and tighten to the specified torque, then through the specified angle



11.2a Cam follower components

1 Guide locating screw
2 Guide
3 Roller
4 Tappet slide

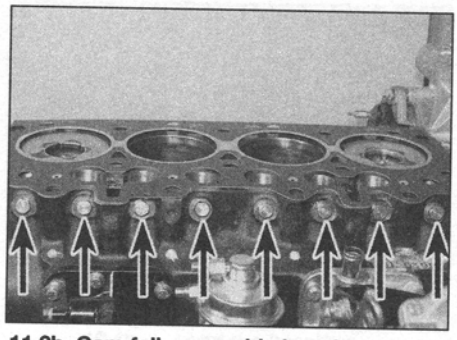
43 Reconnect the breather hoses to the valve cover and the breather filter, if not already done.
44 Refill the cooling system as described in Chapter 1B.
45 Refit the bonnet as described in Chapter 12.
46 Reconnect the battery negative lead.
47 On completion, start the engine. If difficulty is experienced, bleed the fuel system as described in Chapter 4C.

11 Cam follower components - removal, inspection and refitting

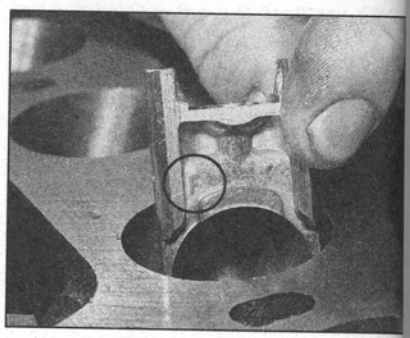
Warning: Each cam follower consists of a solid roller, held in position against the camshaft by a slide inside a fixed guide. If the guide is removed before the roller, the roller may fall behind the camshaft and become jammed, or may fall past the camshaft into the crankcase. The following procedure must therefore be followed exactly when removing the cam followers.

Removal

Note: *New guide locating screws must be used on refitting.*
1 Remove the cylinder head as described in Section 10.
2 Starting at the front of the engine, loosen the first cam follower guide locating screw (accessed from the camshaft side of the cylinder block), until the end of the screw rests just below the hole in the inner bore of the guide **(see illustrations)**.
3 Using a suitable length of wire with a hooked end, lift out the tappet slide. Note that the FRONT or F mark on the slide should face the timing belt end of the engine **(see illustration)**.
4 Using the same piece of wire, lift out the roller **(see illustration)**. Mark the roller on the side facing the timing belt end of the engine, so that it can be refitted in its original position.
5 Remove the guide locating screw, and lift out the guide **(see illustration)**. On 200 TDi engines, recover the washer from under the screw head.
6 Repeat the procedure on the remaining components, and number the components from 1 to 8, so that they can be refitted in their original locations.



11.2b Cam follower guide locating screws (arrowed)



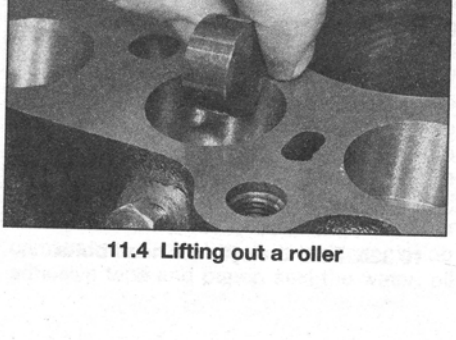
11.3 Lifting out a tappet slide. Note F ma faces timing belt end of engine

Inspection

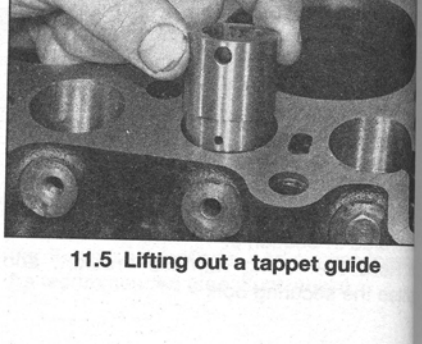
Note: *It is unlikely that individual components will wear significantly, without obvious general wear in all the components. It can be a false economy to renew individual components, and if significant wear is evident, or if the engine is being overhauled after completing a high mileage, it is advisable to renew all the cam follower and valve operating components as a set.*
7 Clean all the components thoroughly, keeping them in order.
8 Examine all the components for wear and damage. Pay particular attention to the rollers.
9 Ensure that the tappet slides move freely in their relevant guides.
10 If there is any sign of significant wear or damage, the relevant components should be renewed.

Refitting

11 Insert the first guide into its original location in the cylinder block, and align the locating screw holes in the block and the guide.
12 Fit a new guide locating screw, but do n allow the end of the screw to protrude into t inner bore of the guide at this stage.
13 Fit the relevant roller, making sure that t mark made before removal faces the timi belt end of the engine. New rollers can b fitted either way round.
14 Before fitting the tappet slide, check th the oilways are clear.
15 Fit the tappet slide with the FRONT or mark facing the timing belt end of the engin
16 Tighten the tappet guide locating screw the specified torque.
17 Repeat the procedure for the remaini components, ensuring that all componen are refitted in their original locations.
18 Refit the cylinder head as described Section 10.



11.4 Lifting out a roller



11.5 Lifting out a tappet guide

12 Sump - removal and refitting

Removal

Note: *Suitable sealant will be required refitting.*
1 Drain the engine oil as described in Cha ter 1B. When jacking up the vehicle, place t stands under the chassis, NOT under the a - in order for the sump to clear the axle, t axle must be hanging free.
2 To allow clearance for the sump to removed, the steering damper and track r must first be removed, as described Chapter 11. Note that the track rod need o

be detached at one end - the rod can then be swung to one side.

3 Where necessary, remove the bolt securing the dipstick tube to the rocker cover.

4 Support the sump, then remove the bolts (on 200 TDi engines, note the locations of the bolts, as bolts of different lengths are used).

5 If the sump has stuck to the bottom of the engine, try running a sharp knife around the joint between the sump and engine, to cut through the bead of sealant used. If this is not successful, remove the oil drain plug. Insert a large screwdriver (with a piece of card wrapped around it to protect the threads) into the drain plug hole, and carefully use it as a lever to break the sump joint. This method is preferable to prising between the sump face and base of the block, as the mating surfaces could be damaged, and the sump would no longer seal. Take care during removal that the base of the sump does not get damaged through contact with the front axle.

6 Withdraw the sump past the front axle and the oil pick-up pipe inside the sump, and lower it to the ground.

7 While the sump is removed, examine the condition of the oil pick-up pipe and strainer. If there is any evidence that the strainer is blocked, remove the two bolts and withdraw the oil pick-up pipe and strainer for cleaning.

8 If the sump has been badly dented or otherwise damaged, there's little point in refitting it. Try to source one in better condition from a vehicle breakers, or fit a new one.

Refitting

9 Clean the sump out thoroughly, and remove all traces of sealant from the sump and crankcase mating surfaces. Degrease the mating surfaces before proceeding.

10 Examine the sump mating face for damage or distortion. Check the condition of the drain plug threads.

11 Apply a 2.0 mm wide bead of RTV sealant to the mating face of the sump flange, ensuring that the sealant is applied inboard of the bolt holes. **Do not** apply excess sealant, which may enter the engine when the sump is refitted. Also apply sealant to the groove between the timing belt housing and the cylinder block.

12 Lift the sump into position, then loosely fit the securing bolts sufficiently to locate the sump securely on the engine. On 200 TDi engines, ensure that the bolts are refitted to their correct locations, as noted before removal - the three longest bolts fit at the front of the sump.

13 Progressively tighten the securing bolts to the specified torque.

14 Ensure that the sump drain plug has been refitted and tightened, using a new sealing ring, then lower the vehicle to the ground.

15 On completion, allow the recommended drying time for the sealant (typically 30 minutes) before refilling the sump - use this time to refit the steering damper and track rod as described in Chapter 11.

16 Refill the sump with fresh oil as described in Chapter 1B, then start the engine and check for oil leaks.

13 Oil pump and skew gear (200 TDi engine) - removal, inspection and refitting

Oil pump

Removal

1 Remove the sump as described in Section 12.

2 Loosen the two bolts securing the oil pump to the cylinder block **(see illustration)**. Note that access to the right-hand bolt may require the use of a socket with a universal joint adapter.

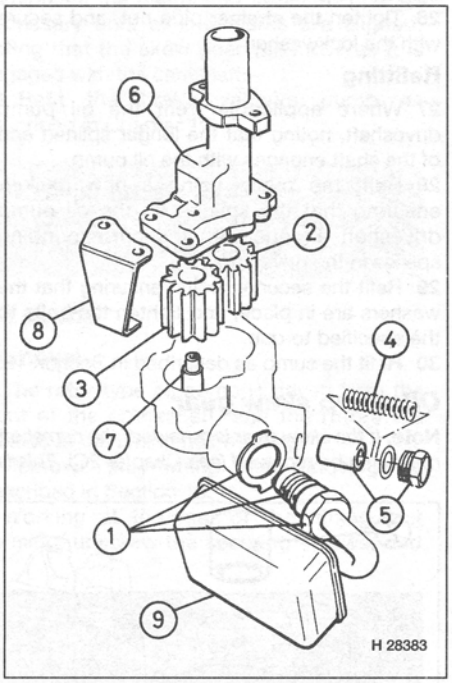
3 Remove the bolts and recover the washers, then lower the oil pump from the engine.

4 Recover the gasket.

5 Where possible, withdraw the oil pump driveshaft.

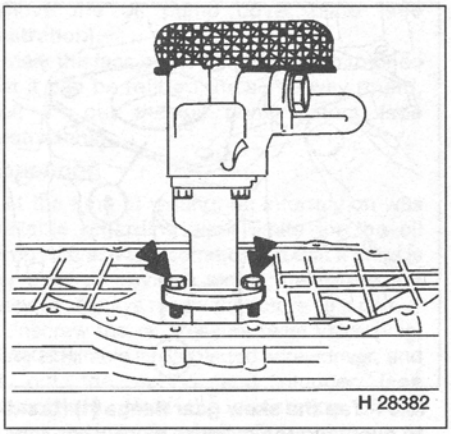
Inspection

6 With the pump removed from the engine, thoroughly clean the external surfaces.



13.8 Oil pump components - 200 TDi engine

1 Lockwasher, O-ring and union nut
2 Driven gear
3 Idler gear
4 Pressure relief valve spring
5 Pressure relief valve plunger and plug
6 Pump cover
7 Idler gear spindle
8 Oil strainer support bracket
9 Oil strainer



13.2 Oil pump securing bolts (arrowed) - 200 TDi engine

7 Unscrew the bolt securing the oil strainer to the support bracket, and recover the washers.

8 Using a suitable screwdriver, bend back the lockwasher, then unscrew the nut securing the strainer pipe to the pump body. Withdraw the strainer, and recover the O-ring if it is loose **(see illustration)**.

9 Unscrew the four securing bolts and washers, and lift off the pump cover. Note that two of the bolts also secure the oil strainer support bracket.

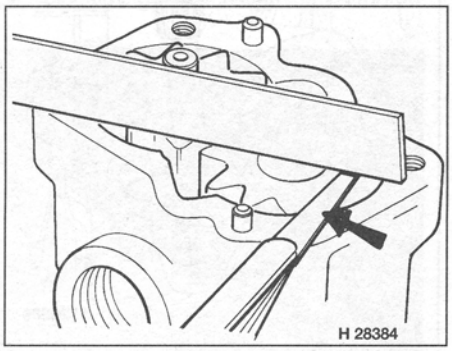
10 Lift out the gears, noting their locations so that they can be refitted in their original positions.

11 Unscrew the oil pressure relief valve plug, and recover the sealing washer. Lift out the relief valve spring and plunger.

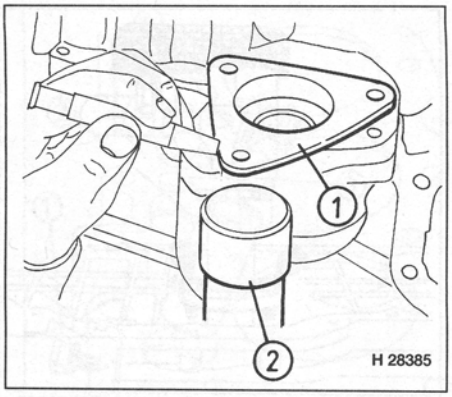
12 Examine the gears for wear, scoring and pitting, and if there is any evidence of wear or damage, renew the gears. Note that both gears must be renewed as a pair.

13 If the gears appear to be serviceable, check the endfloat as follows. Thoroughly clean the pump body, and refit the gears. Place a straight-edge across the pump body, then using a feeler blade, measure the clearance between the end face of the pump body and the gears **(see illustration)**.

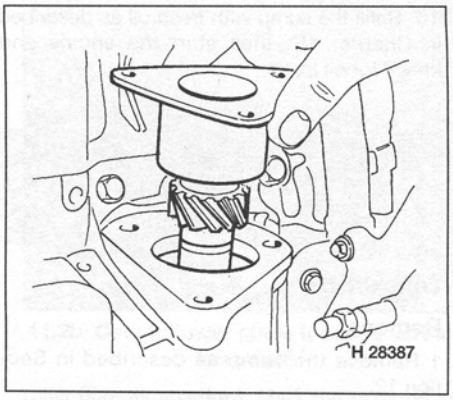
14 Also check the clearance between the gear lobes and the pump body, again using a feeler blade.



13.13 Checking the oil pump gear endfloat using a feeler blade (arrowed) - 200 TDi engine



13.34 Tap the skew gear flange (1) round to overhang the cylinder block, then tap upwards using a suitable tool (2) - 200 TDi engine



13.35 Withdrawing the skew gear assembly from the cylinder block - 200 TDi engine

15 If either of the measurements is outside the specified limits (see *Specifications*), the pump should be renewed.
16 Examine the relief valve plunger for wear or scoring, and check the condition of the spring. Renew the components if there is any sign of wear or damage.
17 Examine the condition of the idler gear spindle in the pump body. This is unlikely to show wear, but if necessary, the spindle can be renewed as follows. Drive or press the spindle from the pump body, and drive or press the new spindle into position up to the locating shoulder on the spindle.
18 Check the pump cover for signs of wear or scoring, and renew if necessary.
19 Reassemble the pump as follows.
20 Fit the idler gear to the spindle.
21 Fit the driven gear to the pump body, with the plain section of the bore uppermost (facing the pump cover).
22 Fit the pump cover, then refit the securing bolts, ensuring that the oil strainer support bracket is in place on the bolts. Do not fully tighten the bolts at this stage.
23 Hold the pump body so that the pressure relief valve bore is vertical, then fit the relief valve plunger, solid end first. Fit the spring, then fit the plug using a new sealing washer. Tighten the plug to the specified torque.
24 Fill the pump with oil through the strainer pipe orifice in the pump body, then slide the lockwasher over the end of the oil strainer pipe. Fit a new O-ring to the end of the pipe, and engage the pipe with the pump body. Loosely tighten the securing nut.
25 Refit and tighten the bolt securing the strainer assembly to the support bracket, then tighten the pump cover bolts.
26 Tighten the strainer pipe nut, and secure with the lockwasher.

Refitting

27 Where applicable, refit the oil pump driveshaft, noting that the longer splined end of the shaft engages with the oil pump.
28 Refit the pump using a new gasket, ensuring that the splines on the oil pump driveshaft engage with the corresponding splines in the driven gear.
29 Refit the securing bolts, ensuring that the washers are in place, and tighten the bolts to the specified torque.
30 Refit the sump as described in Section 12.

Oil pump skew gear

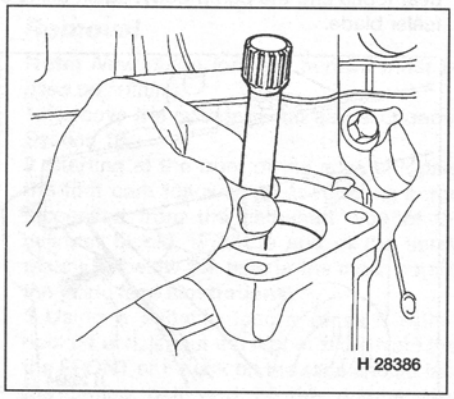
Note: *If the skew gear is renewed, the camshaft must also be renewed (see Chapter 2C). This is necessary to preserve the meshing of the skew gear teeth with the teeth on the camshaft. New skew gear shaft O-rings will be required on refitting.*

Removal

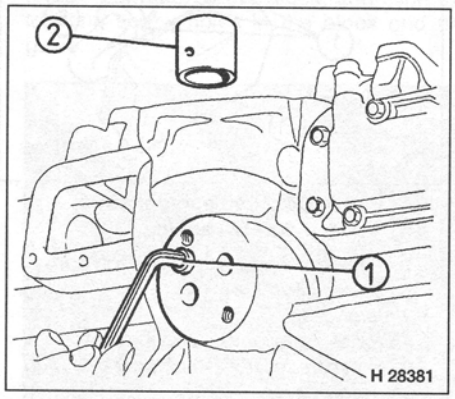
31 The skew gear drives the oil pump driveshaft, which also drives the brake vacuum pump.
32 Remove the brake vacuum pump as described in Chapter 10.
33 Make alignment marks between the skew gear flange and the cylinder block, so that the skew gear assembly can be refitted in its original position. Similarly, make alignment marks between the inner face of the skew gear shaft, and the skew gear flange. This is necessary because the skew gear teeth must mesh with the same teeth on the camshaft when the skew gear is refitted.
34 Using a suitable punch or similar tool, tap the skew gear flange round so that the edges overhang the cylinder block **(see illustration)**.
35 Carefully tap the skew gear flange upwards until the assembly can be lifted from the cylinder block **(see illustration)**.
36 Remove the O-rings from the inside diameter of the skew gear shaft, and from the outside diameter of the skew gear flange, and discard them.
37 Using a pair of long-nosed pliers, or a suitable length of wire, withdraw the oil pump driveshaft from the cylinder block **(see illustration)**.
38 If desired, the skew gear guide can be removed from the cylinder block as follows:
a) Remove the oil filter adapter assembly for access to the guide retaining screw.
*b) Working at the side of the cylinder block, using a suitable Allen key, unscrew the guide retaining screw **(see illustration)**.*
c) Using a suitable length of hooked wire, lift the guide from the cylinder block.

Inspection

39 Thoroughly clean the skew gear and oil pump driveshaft components
40 Check that the oil pump driveshaft is straight, and check the condition of the splines on the ends of the shaft. If the shaft is bent, or the splines are worn or damaged, the shaft should be renewed. Note that if the splines at the oil pump end of the shaft are damaged or worn, then the condition of the corresponding splines on the oil pump should be checked (remove the oil pump as described previously in this Section).
41 Check the condition of the skew gear teeth, and if there is any sign of wear or damage, renew the assembly (note that in this case, the camshaft must also be renewed - see note at the beginning of this sub-Section).
42 If the condition of the skew gear is satisfactory, turn the gear in the flange to check the condition of the bearing. If the gear does not turn smoothly, or if there is excessive play in the bearing, the bearing should be renewed. To renew the bearing, proceed as follows **(see illustration)**:



13.37 Withdrawing the oil pump driveshaft from the cylinder block - 200 TDi engine



13.38 Unscrew the retaining screw (1) to remove the skew gear guide (2) - 200 TDi engine

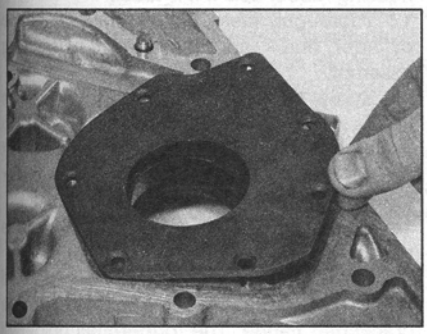
a) Using a suitable pair of circlip pliers, remove the retaining circlip from the skew gear shaft.
b) Similarly, remove the bearing retaining circlip from the groove in the skew gear flange.
c) Support the skew gear flange, then press the bearing and the skew gear from the flange.
d) Support the bearing, then press the skew gear from the bearing.
e) Using a tube or socket of suitable diameter on the bearing outer race, press the bearing into the flange up to the shoulder.
f) Refit the bearing retaining circlip.
g) Support the bearing inner race using a socket or tube of suitable diameter, then press the skew gear into the bearing.
h) Refit the retaining circlip to the skew gear shaft.

43 Examine the internal surfaces of the skew gear guide for wear or damage, and renew if necessary.

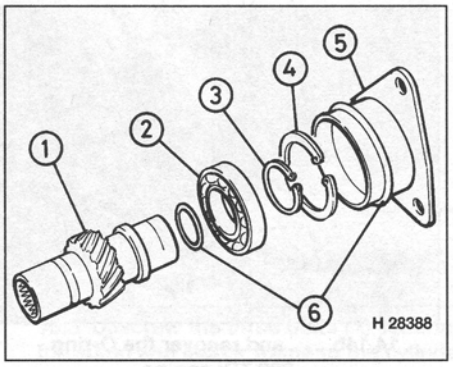
Refitting

44 Where applicable, fit the skew gear guide to the cylinder block, ensuring that the retaining screw hole in the guide aligns with the corresponding hole in the cylinder block. Refit and tighten the guide retaining screw, ensuring that the screw locates correctly in the hole in the guide. Refit the oil filter adapter, using a new gasket.

45 Fit the oil pump driveshaft, noting that the longer splined end of the shaft engages with the oil pump.



14.3 Removing the oil pump cover plate - 300 TDi engine



13.42 Oil pump skew gear components - 200 TDi engine

1 Skew gear
2 Bearing
3 Skew gear shaft circlip
4 Bearing retaining circlip
5 Housing
6 O-rings

46 Fit new O-rings to the inside diameter of the skew gear shaft, and to the outside diameter of the flange.

47 Refit the skew gear assembly to the cylinder block, ensuring that the marks made on the inner face of the skew gear shaft and the skew gear flange, and on the skew gear flange and the cylinder block, are aligned. Manipulate the flange and the skew gear as necessary until all the marks are aligned, noting that the skew gear will move as it is engaged with the camshaft.

48 Refit the brake vacuum pump as described in Chapter 10.

14 Oil pump and strainer (300 TDi engine) - removal, inspection and refitting

Oil pump

Removal

1 The rotor-type oil pump is driven from the front of the crankshaft, and the rotors are located in the timing belt housing.

2 Remove the timing belt housing as described in Section 16.

3 Working at the rear of the timing belt housing, unscrew the securing screws, and remove the oil pump cover plate **(see illustration)**.

4 Mark the face of the outer oil pump rotor so that it can be refitted the same way round, then lift out the oil pump rotors **(see illustrations)**.

Inspection

5 At the time of writing, no information was available regarding wear limits for the oil pump rotors. It is recommended that if there is any sign of obvious wear, the rotors are renewed. Always renew the rotors as a pair.

6 Unscrew the oil pressure relief valve plug, using a suitable large-bladed screwdriver, and lift out the spring and plunger **(see illustration)**. Note the orientation of the plunger, to ensure correct refitting.

7 Examine the relief valve plunger for wear or scoring, and check the condition of the spring. Renew the component if there is any sign of wear or damage.

8 Refit the relief valve plunger and spring, ensuring that the plunger is orientated as noted before removal.

9 Coat the threads of the relief valve plug with suitable thread-locking compound, then refit the plug and tighten securely.

Refitting

10 Ensure that the rotors are clean, then lubricate them with clean engine oil, and refit them to the housing. Ensure that the mark made on the outer rotor is visible, indicating that the rotor is orientated correctly.

11 Ensure that the mating faces of the pump cover and the housing are clean, then refit the cover and tighten the screws securely.

Strainer

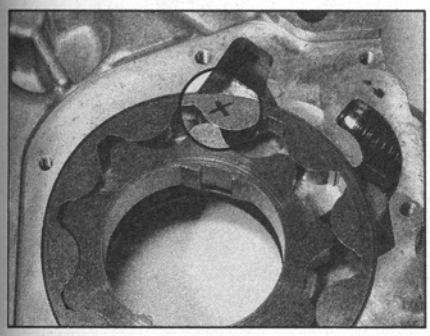
Note: *A new pick-up pipe O-ring must be used on refitting. The pick-up pipe and support bracket bolts must be coated with thread-locking fluid when refitting.*

Removal

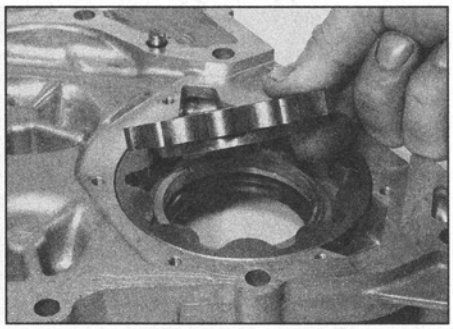
12 Remove the sump as described in Section 12.

13 Unscrew the two bolts securing the strainer support bracket to the main bearing cap.

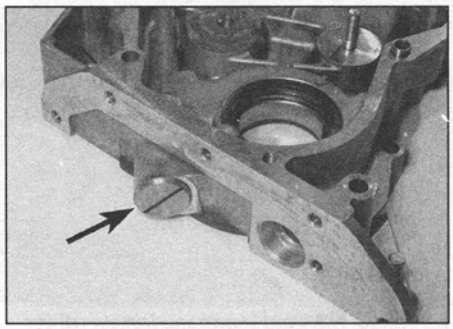
14 Unscrew the bolt securing the oil pick-up pipe to the timing belt housing, then withdraw



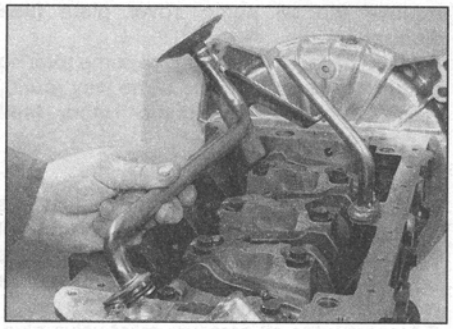
14.4a Mark the face of the outer oil pump rotor . . .



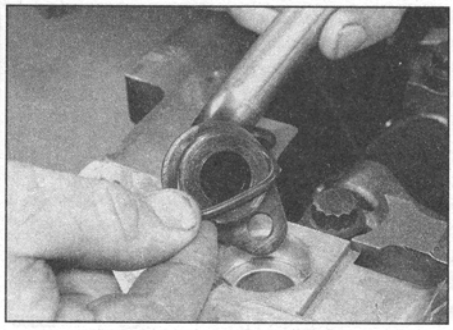
14.4b . . . then lift the rotors from the housing - 300 TDi engine



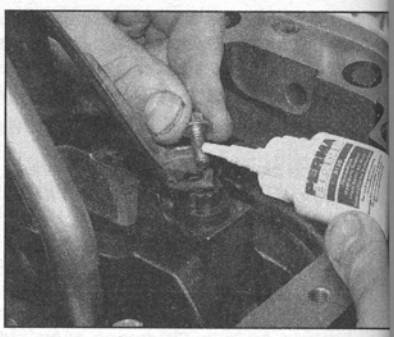
14.6 Oil pressure relief valve plug (arrowed) - 300 TDi engine



14.14a Withdraw the oil strainer . . .



14.14b . . . and recover the O-ring - 300 TDi engine



14.16 Coat the threads of the strainer support bracket bolts with thread-lockin compound - 300 TDi engine

the strainer. Recover the O-ring from the pick-up pipe **(see illustrations)**.

Inspection

15 Check the strainer gauze and the pick-up pipe for obstructions, and clean the assembly thoroughly before refitting.

Refitting

16 Refitting is a reversal of removal, bearing in mind the following points:

a) Use a new pick-up pipe O-ring.

*b) Coat the threads of the pick-up pipe and strainer support bracket bolts with suitable thread-locking compound **(see illustration)**, and tighten all fixings to the specified torque.*

c) Refit the sump as described in Section 12.

15 Oil seals - renewal

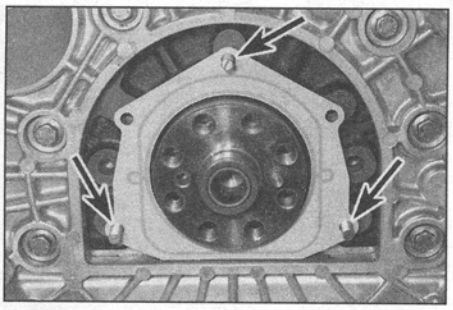
Crankshaft front (timing belt cover) dust seal

1 The procedure is described with the timing belt cover removal and refitting procedure in Section 6.

Crankshaft front (timing belt housing) oil seal

2 Remove the crankshaft sprocket, as described in Section 8.

3 Prise out the old oil seal using a small screwdriver, taking care not to damage the surface of the crankshaft.



15.13 M8 stud locations (arrowed) for fitting of crankshaft rear oil seal housing - 300 TDi engine

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An oil seal can be removed by drilling two small holes diagonally opposite each other, and inserting self-tapping screws in them. A pair of grips can then be used to pull out the oil seal, by pulling on each side in turn.

4 Wipe clean the oil seal seating, then dip the new seal in fresh engine oil, and locate it over the crankshaft with its closed side facing outwards. Make sure that the oil seal lip is not damaged as it is located over the crankshaft.

5 Using a tube of suitable diameter, drive the oil seal squarely into the housing until the outer edge of the seal is approximately 0.5 mm below the face of the housing.

6 Refit the crankshaft sprocket as described in Section 8.

Crankshaft rear oil seal

200 TDi engine

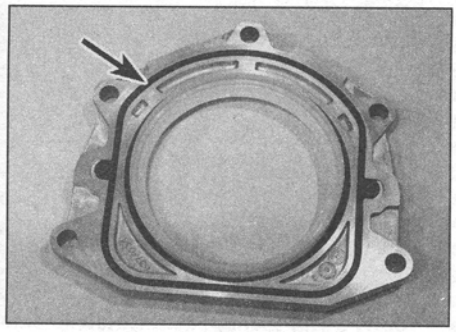
7 Remove the flywheel/driveplate as described in Section 17.

8 Proceed as described in paragraphs 3 to 5, bearing in mind the following points:

a) Wind a length of tape around the crankshaft nose, to prevent damage to the oil seal lips as the seal is fitted over the crankshaft.

b) Take care to ensure that the seal enters its housing squarely, and make sure that the seal lip does not fold over.

c) Press the seal into position until it rests against the shoulder in the housing.



15.14 Fit a new rubber seal (arrowed) to the housing - 300 TDi engine

9 Refit the flywheel/driveplate as describe Section 17.

300 TDi engine

Note: *The oil seal is retained in a housing, a the seal and housing must be renewed as assembly. A new assembly is supplied fit with a former/seal guide. **Do not** remove former/seal guide before fitting the assem to the engine. If a new assembly is recei without a former/seal guide fitted, return i the supplier. Used formers/seal guides m be discarded. Three M8 studs (or bolts w the heads cut off) will be required when fit the new seal.*

10 Remove the flywheel/driveplate described in Section 17.

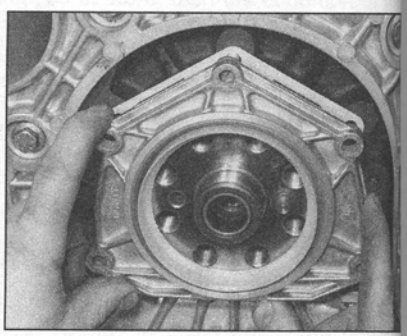
11 Unscrew the five securing bolts, a remove the seal/housing assembly from t cylinder block. Recover the gasket, and t housing rubber seal if it is loose.

12 Thoroughly clean the gasket faces of t cylinder block and the new seal/hous assembly.

13 Screw three M8 studs (or bolts with t heads cut off, and slots cut in the top enable removal) into the cylinder block b holes, then fit a new seal housing gasket o the studs **(see illustration)**.

14 Fit a new rubber seal to the rear of t new oil seal housing **(see illustration)**.

15 Fit the new assembly, with the former/s guide in place, over the studs and t crankshaft flange. The former/seal guide w be ejected as the assembly is fitted (s **illustration)**.



15.15 Fitting the new crankshaft rear o seal/housing assembly

16 Loosely fit the two bolts to the holes not occupied by the studs.
17 Unscrew one of the studs, and loosely refit the bolt in its place. Repeat the procedure for the two remaining studs.
18 Progressively tighten the seal/housing securing bolts to the specified torque.
19 Refit the flywheel/driveplate as described in Section 17.

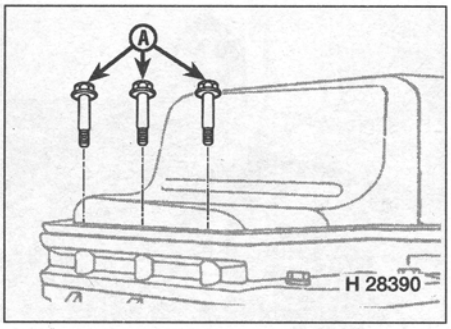
Camshaft front oil seal

20 Remove the camshaft sprocket as described in Section 8.
21 Proceed as described in paragraphs 3 to 5.
22 Refit the camshaft sprocket as described in Section 8.

16 Timing belt housing gasket - renewal

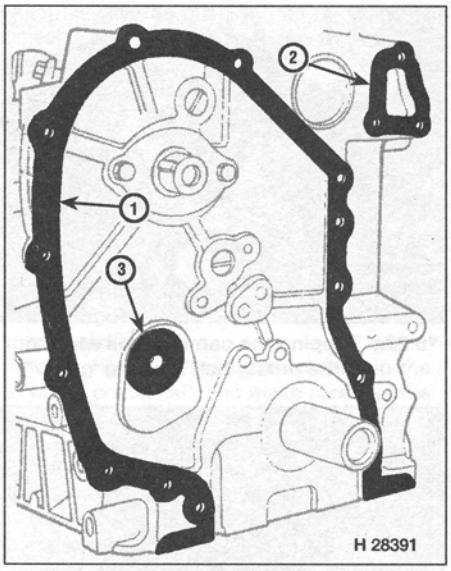
200 TDi engine

1 Remove the fuel injection pump as described in Chapter 4C.
2 Remove the timing belt sprockets, and the timing belt tensioner, as described in Section 8.
3 Unscrew the three bolts securing the sump and the ladder frame to the timing belt housing **(see illustration)**.
4 Unscrew the five bolts securing the timing belt housing to the cylinder block, noting their locations, as different lengths of bolt are used.
5 Withdraw the timing belt housing from the front of the engine. Recover the main gasket, the coolant aperture gasket, and the gasket washer which fits around the timing belt tensioner pulley bolt hole **(see illustration)**.
6 Thoroughly clean all traces of old gasket from the mating faces of the cylinder block and the timing belt housing.



16.3 Unscrew the three bolts (A) securing the sump and ladder frame to the cylinder block - 200 TDi engine

7 Note that whilst the timing belt housing is removed, it is advisable to renew the camshaft oil seal and the crankshaft front oil seal, as described in Section 15.
8 Fit a new main gasket to the cylinder block, using a little grease to hold it in position.
9 Similarly, fit new gaskets to the coolant aperture and the timing belt tensioner bolt hole in the cylinder block.
10 Carefully offer the timing belt housing to the cylinder block, taking care not to damage the oil seals as they are passed over the crankshaft and camshaft. Ensure that the housing fits over the locating stud.
11 Refit the five securing bolts to their original locations, as noted before removal, and progressively tighten the bolts to the specified torque **(see illustration)**.
12 Refit the three bolts securing the sump and the ladder frame to the timing belt housing, and tighten to the specified torque.
13 Refit the timing belt tensioner, and the timing belt sprockets, as described in Section 8.

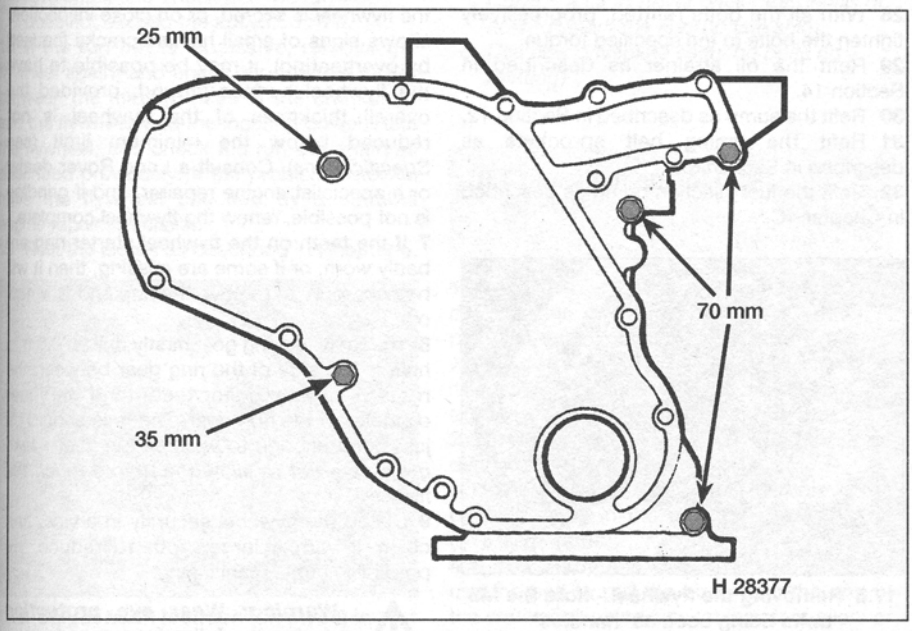


16.5 Timing belt housing main gasket (1), coolant aperture gasket (2) and washer gasket (3) - 200 TDi engine

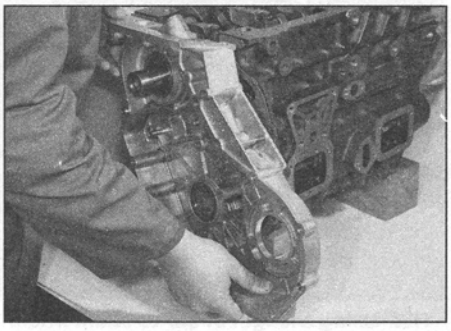
14 Refit the fuel injection pump as described in Chapter 4C.

300 TDi engine

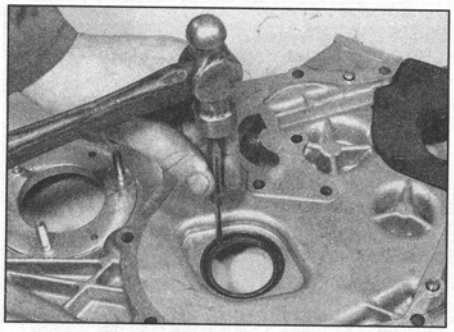
Note: *Six M8 studs (or bolts with the heads cut off) will be required when refitting the housing.*
15 Remove the fuel injection pump as described in Chapter 4C.
16 Remove the timing belt sprockets as described in Section 8.
17 Remove the sump as described in Section 12.
18 Remove the oil strainer as described in Section 14.
19 Unscrew the ten timing belt housing securing bolts, noting their locations, as several different lengths of bolt are used.
20 Withdraw the timing belt housing from the front of the engine, and recover the gasket **(see illustration)**. Note that the housing locates on two dowels.
21 Thoroughly clean the gasket faces of the cylinder block and the timing belt housing.
22 Note that whilst the timing belt housing is removed, it is advisable to renew the



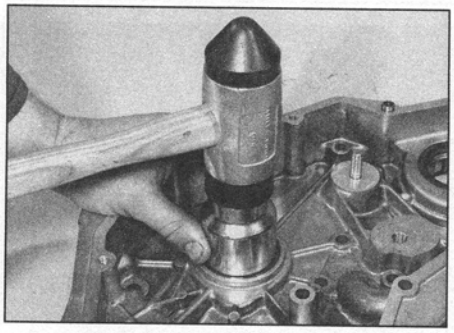
16.11 Timing belt housing securing bolt locations - 200 TDi engine



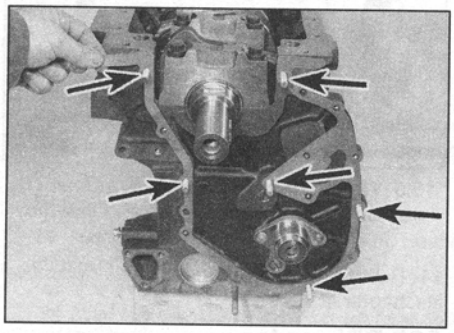
16.20 Withdrawing the timing belt housing (engine shown inverted) - 300 TDi engine



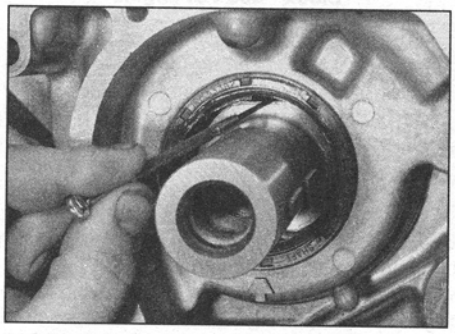
16.22a Tapping the camshaft oil seal from the timing belt housing



16.22b Fitting a new camshaft oil seal to the timing belt housing using a socket



16.23 Fitting the timing belt housing gasket. M8 guide stud locations arrowed (engine shown inverted) - 300 TDi engine



16.25 Using a screwdriver to align the oil pump rotor with the flats on the crankshaft (engine shown inverted) - 300 TDi engine

camshaft oil seal and the crankshaft front oil seal. The seals can be tapped from the housing using a suitable punch, and the new seals can be fitted by tapping into position using a suitable socket or tube **(see illustrations)**.

23 Fit six M8 studs (or bolts with the heads cut off, and slots cut in the top to enable removal) to the bolt holes in the cylinder block, then locate the new gasket over the studs **(see illustration)**.

24 Align the flats on the oil pump driven rotor with the corresponding flats on the crankshaft.

25 Carefully offer the timing belt housing to the cylinder block, taking care not to damage the oil seals as they are passed over the crankshaft and camshaft. Locate the housing on the studs, and the two dowels. If necessary, alter the position of the oil pump rotor using a small screwdriver, to enable it to engage with the crankshaft as the housing is fitted **(see illustration)**.

26 Refit bolts of the correct length to the holes not occupied by the studs, but do not fully tighten them at this stage.

27 Remove one of the studs, and fit the correct length of bolt to the relevant hole. Repeat the procedure for the remaining studs.

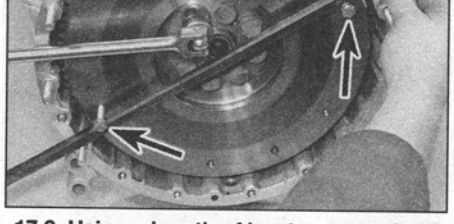
28 With all the bolts refitted, progressively tighten the bolts to the specified torque.

29 Refit the oil strainer as described in Section 14.

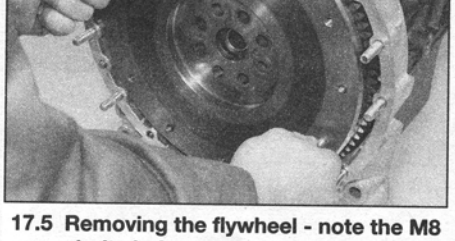
30 Refit the sump as described in Section 12.

31 Refit the timing belt sprockets as described in Section 8.

32 Refit the fuel injection pump as described in Chapter 4C.



17.3 Using a length of bar to counterhold the flywheel as the bolts are unscrewed. M8 bolt locations arrowed - 300 TDi engine



17.5 Removing the flywheel - note the M8 bolts being used as 'handles'

17 Flywheel/driveplate - removal, inspection and refitting

Flywheel (manual transmission models)

Note: *New flywheel securing bolts must be used on refitting. Two M8 bolts will be required to lift the flywheel from the crankshaft.*

Removal

1 Remove the clutch as described in Chapter 6.

2 Fit two long M8 bolts to two of the clutch cover bolt holes in the flywheel, diametrically opposite each other.

3 Using a suitable length of bar positioned between the two bolts, prevent the crankshaft from turning as the flywheel securing bolts are unscrewed **(see illustration)**. It will be necessary to reposition the M8 bolts and the bar, using different clutch cover bolt holes, in order to reach all of the flywheel securing bolts. Note that the flywheel securing bolts are coated with thread-locking compound and considerable effort may be required to unscrew them.

4 Remove all the flywheel securing bolts, and where applicable withdraw the reinforcing plate from the centre of the flywheel.

5 Carefully lift the flywheel from the crankshaft, using the two bolts as 'handles' **(see illustration)**. Note that the flywheel locates on a dowel in the end of the crankshaft.

Warning: The flywheel is heavy - take care not to drop it.

Inspection

6 If the clutch friction disc contact surface of the flywheel is scored, or on close inspection shows signs of small hairline cracks (caused by overheating), it may be possible to have the flywheel surface-ground, provided the overall thickness of the flywheel is not reduced below the minimum limit (see *Specifications*). Consult a Land Rover dealer or a specialist engine repairer, and if grinding is not possible, renew the flywheel complete.

7 If the teeth on the flywheel starter ring are badly worn, or if some are missing, then it will be necessary to remove the ring and fit a new one.

8 To renew the ring gear, firstly drill an 8.0 mm hole in the side of the ring gear between the roots of any two gear teeth, and the inner diameter of the ring gear. The hole should be just deep enough to weaken the gear - *take great care not to allow the drill to touch the flywheel*.

9 Clamp the flywheel securely in a vice, and cover it with a large cloth to reduce the possibility of personal injury.

Warning: Wear eye protection during the following procedure.

10 Place a cold chisel between the gear teeth above the drilled hole, then split the gear with the chisel. Take great care not to damage the flywheel during this operation, and wear eye protection at all times. Once the ring has been split, it will spread apart, and can be lifted from the flywheel **(see illustration)**.

11 The new ring gear must be heated to between 225 and 250°C, and unless facilities for heating by oven or flame are available, leave the fitting to a Land Rover dealer or engineering works. The new ring gear must not be overheated during this work, or the temper of the metal will be affected.

12 The ring should be tapped gently down onto its register, and left to cool naturally - the contraction of the metal on cooling will ensure that it is a secure and permanent fit.

Refitting

13 Commence refitting by thoroughly cleaning the mating faces of the flywheel and the crankshaft.

14 If the two M8 'handle' bolts have been removed, refit them to the flywheel.

15 Align the dowel hole in the flywheel with the crankshaft dowel, then lift the flywheel onto the end of the crankshaft.

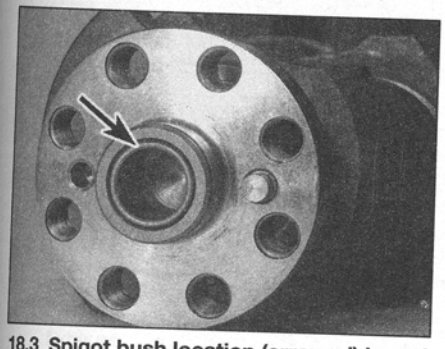
16 Where applicable, refit the reinforcing plate, then fit new flywheel securing bolts, and tighten them to the specified torque, preventing the crankshaft from turning as during removal.

17 With all the flywheel bolts tightened, and the two M8 bolts removed, check the flywheel run-out as follows:

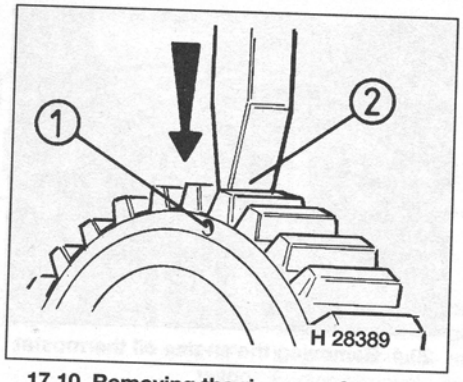
a) Mount a dial test indicator securely on the end face of the flywheel housing.
b) Position the probe to read from the flywheel face at a radius of 114.0 mm from the centre of the crankshaft.
c) Turn the crankshaft through one complete revolution, and check that the run-out does not exceed the specified limit.

18 If the run-out is excessive, remove the flywheel again, and check for damage or dirt between the mating faces of the crankshaft and the flywheel, and the locating dowel. Refit the flywheel, and check the run-out again as described previously. If the problem persists, have the flywheel checked by a suitable engine repair specialist.

19 Refit the clutch as described in Chapter 6.



18.3 Spigot bush location (arrowed) in end of crankshaft



17.10 Removing the ring gear from the flywheel

1 Drill an 8.0 mm hole
2 Split the gear using a cold chisel

Driveplate (automatic transmission models)

20 At the time of writing, no information was available regarding the removal and refitting of the driveplate.

21 Once the transmission has been separated from the engine, the procedure should prove similar to that described previously for the flywheel, noting the following points. Consult a Land Rover dealer for further details.

a) On 200 TDi engine models, a separate torque converter plate and driveplate are fitted. Mark the relationship of the two plates before the components are removed.
b) Note the locations of any spacers and shims, and ensure that they are refitted to their original locations.
c) On 200 TDi engines, selective shims are used to set the position of the torque converter in relation to the driveplate. Consult a Land Rover dealer for details of how to select the appropriate shim.
d) Use new driveplate securing bolts on refitting.

18 Crankshaft spigot bush - renewal

1 With the transmission removed as described in the relevant part of Chapter 7, proceed as follows. Note that if no further work is to be carried out on the transmission, it will prove easier to remove the engine for access, as described in Chapter 2C.

2 Where applicable, remove the clutch as described in Chapter 6.

3 Using a suitable tap, thread the bore of the bush, located in the end of the crankshaft **(see illustration)**.

4 Screw a suitable bolt into the bush, then use the bolt to pull the bush from the end of the crankshaft using a suitable pair of pliers or grips.

5 Alternatively, the bush can be removed as follows.

a) Obtain a short length of metal rod, with a diameter which provides a firm sliding fit in the bore of the bush.
b) Pack the bore of the bush with grease.
c) Insert the metal rod into the bush, and cover the rod and bush with a cloth or rag (to prevent the possibility of injury due to grease splashes or the ejection of the bush).
d) Give the rod a sharp tap with a hammer - the grease should force the bush from the crankshaft.

6 Thoroughly clean the bush location in the end of the crankshaft, and make sure that the new bush is absolutely clean.

7 Tap the bush into position in the end of the crankshaft using a suitable drift. Take care not to produce any burrs on the edge of the bush. The bush should be fitted flush with the end of the crankshaft.

8 Where applicable, refit the clutch as described in Chapter 6, then refit the engine as described in Chapter 2C.

19 Engine mountings - removal and refitting

Removal

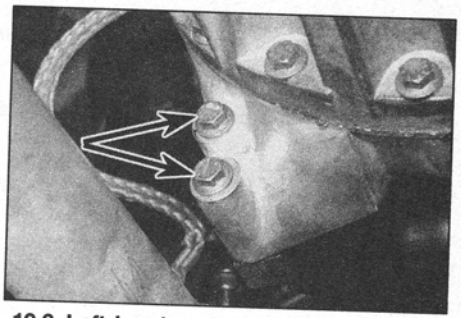
1 Place a suitable trolley jack with a large interposed block of wood under the engine sump, to just take the weight of the engine. Ensure that the engine is safely supported before proceeding.

2 Working from the relevant side of the engine compartment, unscrew the two upper bolts securing the engine mounting bracket to the cylinder block.

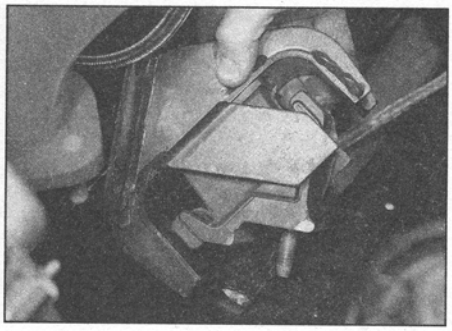
3 Working underneath the vehicle, unscrew the two lower bolts securing the engine mounting bracket to the cylinder block, and the two bolts securing the mounting bracket to the flywheel housing **(see illustration)**.

4 Again working underneath the vehicle, unscrew the nut securing the engine mounting to the bracket on the chassis.

5 Working from the engine compartment, lift the complete engine mounting assembly from



19.3 Left-hand engine mounting bracket-to-flywheel housing bolts (arrowed) - 300 TDi engine



19.5 Lifting the left-hand engine mounting from the engine compartment - 300 TDi engine

the vehicle, taking care not to damage surrounding components in the engine compartment **(see illustration)**.

6 If desired, the mounting rubber can be renewed by unscrewing the nut securing it to the engine mounting bracket.

Refitting

7 Refitting is a reversal of removal, but tighten all fixings to the specified torque.

20 Engine oil cooler and thermostat - removal and refitting

Oil cooler

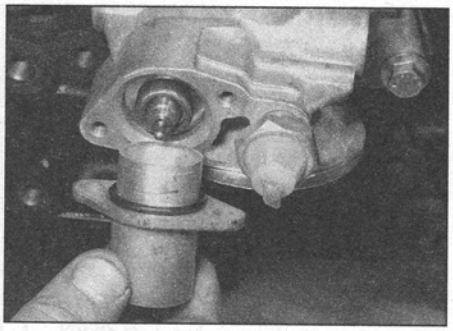
1 The oil cooler is integral with the radiator. Refer to Chapter 3 for removal and refitting details.

Thermostat

Note: *A new thermostat cover O-ring must be used on refitting.*

Removal

2 The oil cooler thermostat is located in the oil filter adapter on the right-hand side of the cylinder block.



20.4 Removing the engine oil thermostat cover

3 Place a suitable container beneath the oil filter adapter, then disconnect the oil cooler hose union from the thermostat cover. Be prepared for oil spillage, and cover the open end of the hose to prevent further spillage and dirt ingress.

4 Unscrew the two securing bolts, and remove the thermostat cover **(see illustration)**.

5 Lift out the thermostat assembly **(see illustration)**.

Refitting

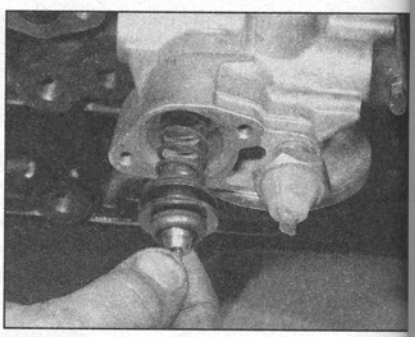
6 Refitting is a reversal of removal, but use a new O-ring when refitting the thermostat cover, and on completion, check the oil level.

21 Oil pressure warning light switch - removal and refitting

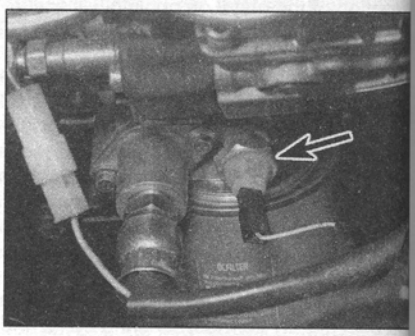
Removal

Note: *A new sealing ring may be required on refitting.*

1 The oil pressure warning light switch is located in the oil filter adapter at the right-hand side of the cylinder block **(see illustration)**.



20.5 Removing the engine oil thermostat



21.1 Oil pressure warning light switch (arrowed) - 300 TDi engine

2 Disconnect the battery negative lead, the release the wiring connector from the switch.

3 Carefully unscrew the switch, and withdra it from the cylinder block. Be prepared f some oil spillage.

4 Recover the sealing ring, where applicable

Refitting

5 Refitting is a reversal of removal, but clea the threads of the switch before screwing into the cylinder block, and where applicabl use a new sealing ring. Check the oil level.