






# Chapter 2 Part B: V6 engine – in-car engine repair procedures

## Contents

|   |                |   |               |
|---|----------------|---|---------------|
| Auxiliary drivebelts check and renewal . . . . .                                    | See Chapter 1  | Exhaust manifold - removal and refitting . . . . .                                | 9             |
| Camshaft and hydraulic tappets - removal, inspection and refitting . . . . .        | 15             | Exhaust valve rocker clearances - adjustment . . . . .                            | 7             |
| Camshaft covers - removal and refitting . . . . .                                   | 5              | Flywheel/driveplate - removal, inspection and refitting . . . . .                 | 22            |
| Camshaft oil seals - renewal . . . . .  | 14             | General information . . . . .   | 1             |
| Compression test - description and interpretation . . . . .                         | 3              | Inlet manifold - removal and refitting . . . . .                                  | 8             |
| Crankshaft oil seals - renewal . . . . .  | 20             | Oil cooler and filter head - removal and refitting . . . . .                      | 18            |
| Crankshaft pulley - removal and refitting . . . . .                                 | 10             | Oil pump - removal and refitting . . . . .  | 19            |
| Cylinder head - removal and refitting . . . . .                                     | 16             | Repair operations possible with the engine in the vehicle . . . . .               | 2             |
| Cylinder head, rocker gear and valve assemblies - cleaning and inspection . . . . . | See Chapter 2C | Spark plug renewal . . . . .  | See Chapter 1 |
| Cylinder head side covers - removal and refitting . . . . .                         | 6              | Sump - removal and refitting . . . . .  | 17            |
| Engine oil and filter change . . . . .  | See Chapter 1  | Timing belt - removal, refitting and adjustment . . . . .                         | 12            |
| Engine oil level check . . . . .  | See Chapter 1  | Timing belt covers - removal and refitting . . . . .                              | 11            |
| Engine overhaul - general information . . . . .                                     | See Chapter 2C | Timing belt tensioner and sprockets - removal, inspection and refitting . . . . . | 13            |
| Engine/transmission - removal and refitting . . . . .                               | See Chapter 2C | Top Dead Centre (TDC) for number 1 piston - locating . . . . .                    | 4             |
| Engine/transmission mountings - inspection and renewal . . . . .                    | 21             | Water pump - removal and refitting . . . . .                                      | See Chapter 3 |

## Degrees of difficulty

|  |  |   |  |   |  |  |  |   |  |
|--|--|---|--|---|--|--|--|---|--|
| <b>Easy</b> , suitable for novice with little experience |  | <b>Fairly easy</b> , suitable for beginner with some experience |  | <b>Fairly difficult</b> , suitable for competent DIY mechanic |  | <b>Difficult</b> , suitable for experienced DIY mechanic |  | <b>Very difficult</b> , suitable for expert DIY or professional |  |
|--|--|---|--|---|--|--|--|---|--|

## Specifications

### General

|  |   |
|--|---|
| Engine type . . . . .                      | V6, single overhead camshaft per bank                       |
| Engine code:                               |   |
| 2.5 litre engines . . . . .                | C25A  |
| 2.7 litre engines . . . . .                | C27A  |
| Capacity:                                  |   |
| 2.5 litre engines . . . . .                | 2496 cc   |
| 2.7 litre engines . . . . .                | 2675 cc   |
| Bore:                                      |   |
| 2.5 litre engines . . . . .                | 84 mm   |
| 2.7 litre engines . . . . .                | 87.0 mm   |
| Stroke (all engines) . . . . .             | 75.0 mm   |
| Compression ratio:                         |   |
| 2.5 litre engines . . . . .                | 9.6:1   |
| 2.7 litre engines:                         |   |
| Non-catalyst equipped engines . . . . .    | 9.4:1   |
| Catalyst equipped engines . . . . .        | 9.0:1   |
| Firing order . . . . .                     | 1-4-2-5-3-6 (No 1 cylinder at timing belt end on rear bank) |
| Direction of crankshaft rotation . . . . . | Clockwise (seen from right-hand side of vehicle)            |
| Radial clearance on rocker shaft . . . . . | 0.08 mm maximum   |

### Cylinder head

|  |        |
|--|--------|
| Maximum gasket face distortion . . . . . | 0.2 mm |
|--|--------|

### Camshafts and hydraulic tappets

|   |                   |
|---|-------------------|
| Camshaft endfloat . . . . .               | 0.05 to 0.15 mm   |
| Camshaft bearing running clearance:       |                   |
| New . . . . .                             | 0.045 to 0.081 mm |
| Used . . . . .                            | 0.10 mm maximum   |
| Hydraulic tappet seating stroke . . . . . | 0.08 mm maximum   |

**Lubrication**

|   |               |
|---|---------------|
| Engine oil type/specification . . . . . | See Chapter 1 |
| Engine oil capacity . . . . .           | See Chapter 1 |

**Torque wrench settings**

|   | Nm  | lbf ft |
|---|-----|--------|
| Cylinder head bolts . . . . .                           | 68  | 50     |
| Cylinder head side cover bolts . . . . .                | 12  | 9      |
| Timing belt cover bolts . . . . .                       | 12  | 9      |
| Timing belt backplate bolts . . . . .                   | 12  | 9      |
| Timing belt tensioner bolt . . . . .                    | 43  | 32     |
| Camshaft sprocket bolts . . . . .                       | 32  | 24     |
| Camshaft carrier bolts:                                 |     |        |
| 4 bolts at . . . . .                                    | 12  | 9      |
| 2 bolts at . . . . .                                    | 28  | 21     |
| Oil gallery bolts:                                      |     |        |
| 8 bolts at . . . . .                                    | 28  | 21     |
| 2 bolts at . . . . .                                    | 12  | 9      |
| Crankshaft pulley centre bolt . . . . .                 | 115 | 85     |
| Driveplate bolts . . . . .                              | 75  | 55     |
| Flywheel bolts . . . . .                                | 105 | 78     |
| Filter head bolts . . . . .                             | 22  | 16     |
| Main bearing caps:                                      |     |        |
| Bolts 1 to 8 . . . . .                                  | 41  | 30     |
| Bolts 9 to 16 . . . . .                                 | 68  | 50     |
| Bolts 17 to 24 . . . . .                                | 50  | 37     |
| Big-end bearing caps . . . . .                          | 50  | 37     |
| Oil cooler centre bolt . . . . .                        | 50  | 37     |
| Oil pump housing bolts:                                 |     |        |
| M6 bolts . . . . .                                      | 12  | 9      |
| M8 bolts . . . . .                                      | 22  | 16     |
| Oil pick-up pipe bolts . . . . .                        | 12  | 9      |
| Sump nuts and bolts . . . . .                           | 12  | 9      |
| Rocker arm guide plate bolts . . . . .                  | 12  | 9      |
| Inlet manifold retaining nuts and bolts . . . . .       | 22  | 16     |
| Exhaust manifold retaining nuts . . . . .               | 45  | 33     |
| Exhaust manifold heat shield bolts . . . . .            | 12  | 9      |
| Front engine mounting to transmission bracket . . . . . | 80  | 59     |
| Front engine mounting bracket to transmission . . . . . | 40  | 30     |
| Rear engine mounting bracket to transmission . . . . .  | 40  | 30     |
| Right-hand engine mounting through-bolt . . . . .       | 45  | 33     |
| Right-hand engine mounting to engine bracket . . . . .  | 60  | 44     |
| Right-hand engine mounting bracket to engine . . . . .  | 25  | 18     |
| Engine rear tie-bar to mounting bracket . . . . .       | 75  | 55     |
| Engine rear tie-bar mounting bracket bolts:             |     |        |
| M10 bolts . . . . .                                     | 45  | 33     |
| M12 bolts . . . . .                                     | 85  | 63     |
| Engine rear tie-bar through-bolt . . . . .              | 85  | 63     |
| Longitudinal support member to underbody . . . . .      | 45  | 33     |
| Engine snubber bracket to transmission . . . . .        | 45  | 33     |

**1 General information****How to use this Chapter**

1 This Part of Chapter 2 is devoted to repair procedures possible while the engine is still installed in the car, and includes only the Specifications relevant to those procedures. Since these procedures are based on the assumption that the engine is installed in the car, if the engine has been removed and mounted on a stand, some of the preliminary dismantling steps outlined will not apply.

2 Information concerning engine / trans-

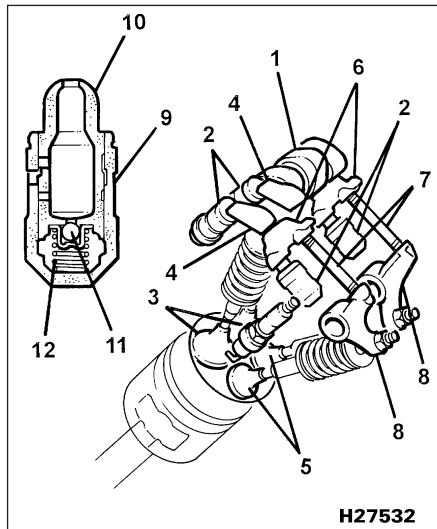
mission removal and refitting, and engine overhaul, can be found in Part C of this Chapter, which also includes the Specifications relevant to those procedures.

**Engine description**

3 The V6 engine fitted to Rover 825, 827 and Sterling models is a water-cooled, six-cylinder, four-stroke petrol engine, of single overhead camshaft configuration per bank, and 2494 cc (2.5 litre) or 2675 cc (2.7 litre) capacity. The larger capacity being achieved by an increase in cylinder bore diameter. The 2.5 litre engine was fitted to Rover 825 models from 1986 until 1988, to be replaced by the 2.7 litre engine which is currently still in production.

4 The combined crankcase and cylinder block is of die-cast aluminium alloy construction, and houses the pistons, connecting rods and crankshaft. The solid skirt cast aluminium alloy pistons have two compression rings and an oil control ring, and are retained on the connecting rods by semi-floating gudgeon pins which are an interference fit in the connecting rods. The forged steel connecting rods are attached to the crankshaft by renewable shell type big-end bearings. The crankshaft is carried in four main bearings, also of the renewable shell type. Crankshaft endfloat is controlled by thrust washers which are located on either side of No 3 main bearing.

5 A single overhead camshaft is located in



1.6 General arrangement of the V6 engine valve gear

- |                        |                  |
|------------------------|------------------|
| 1 Camshaft             | 7 Pushrods       |
| 2 Hydraulic tappet     | 8 Rocker arms    |
| 3 Inlet valves         | 9 Tappet body    |
| 4 Inlet valve slippers | 10 Plunger       |
| 5 Exhaust valves       | 11 Check ball    |
| 6 Exhaust valve        | 12 Return spring |

each cylinder head, and is retained in position by a housing bolted to the cylinder head upper face. The camshafts are supported by bearing journals machined directly into the head and housings. Drive to the camshafts is by an internally-toothed composite rubber timing belt, from a sprocket on the front end of the crankshaft. The belt also drives the water pump pulley, and an automatic tensioner is fitted to eliminate backlash and prevent slackness of the belt.

6 The camshafts operate slippers which pivot on hydraulic tappets, one for each valve. The inlet valves are operated directly from the camshaft slippers, whereas the exhaust valves are operated indirectly from the camshaft slippers by pushrods and adjustable rocker arms (see illustration).

7 The engine utilizes four valves per cylinder, mounted at an inclined angle, and running in guides which are pressed into the cylinder head. The valves are of small diameter, to improve breathing efficiency and reduce valve mass.

8 The distributor is attached to the rear of the front facing cylinder head and is driven off the rear of the camshaft. The power steering pump and alternator are mounted on top of the engine and driven by separate drivebelts from the crankshaft pulley.

9 Blow-by gases from the crankcase are vented by a positive crankcase ventilation system back into the intake air stream for combustion.

10 The pressed-steel sump is attached to the underside of the crankcase, and acts as a reservoir for the engine oil. The oil pump

draws oil through a strainer attached to the pick-up pipe and submerged in the oil. The pump passes the oil along a passage and into the full-flow filter and oil cooler assembly, mounted on the front of the engine. The filtered oil flows from the filter and enters the main cylinder block oil gallery, which feeds the crankshaft main bearings. Oil passes from the main bearings, through drillings in the crankshaft to the big-end bearings.

11 A drilling from the main oil gallery feeds the cylinder head gallery, where the oil is directed to the camshaft bearings, cams and cam slippers, and to the hydraulic tappets, rocker arm pivots and rocker arm shafts. The oil then drains back into the sump via large drillings in the cylinder head and cylinder block.

12 A pressure relief valve is incorporated in the oil pump, to maintain the oil pressure within specified limits.

13 Apart from minor development differences, both the 2.5 and 2.7 litre versions of the engine are mechanically identical.

## 2 Repair operations possible with the engine in the vehicle

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

- Compression pressure - testing.
- Removal and refitting of the timing belt.
- Removal and refitting of the camshaft and tappets.
- Removal and refitting of the cylinder head.
- Removal and refitting of the sump.
- Removal and refitting of the big-end bearings.\*
- Removal and refitting of the piston and connecting rod assemblies.\*
- Removal and refitting of the oil pump.
- Removal and refitting of the engine mountings.
- Removal and refitting of the flywheel or driveplate (after first removing the transmission).

\* In extreme cases caused by a lack of necessary equipment, repair or renewal of piston rings, pistons, connecting rods and big-end bearings is possible with the engine in the vehicle. However, this practice is not recommended, because of the cleaning and preparation work that must be done to the components involved, and because of the amount of preliminary dismantling work required - these operations are therefore covered in Part C of this Chapter.

### Precautionary note

Due to the layout of the V6 engine, and the very limited space available in the engine compartment, access to most components is extremely limited. Although it is physically possible to carry out the operations described above with the engine in the car, the space

restrictions, the number of components that need to be removed for access, and the complications involved when working on an engine of this complexity, may present unforeseen difficulties.

Read through all the relevant procedures and familiarize yourself with what's involved before proceeding; in many instances, it may actually be easier to remove the engine from the car, and carry out the repair with the unit on the bench. Strictly speaking, much of the work described in this Chapter is not for the faint-hearted, and should really only be undertaken by the more experienced DIY owner.

## 3 Compression test - description and interpretation

Refer to Part A, Section 3.

## 4 Top Dead Centre (TDC) for number 1 piston - locating



### General

1 Top Dead Centre (TDC) is the highest point that each piston reaches as the crankshaft rotates. While each piston reaches TDC both at the top of the compression stroke and again at the top of the exhaust stroke, for the purpose of timing the engine, TDC refers to the piston position (usually No 1 piston) at the top of its compression stroke.

2 It is useful for several servicing procedures to be able to position the engine at TDC.

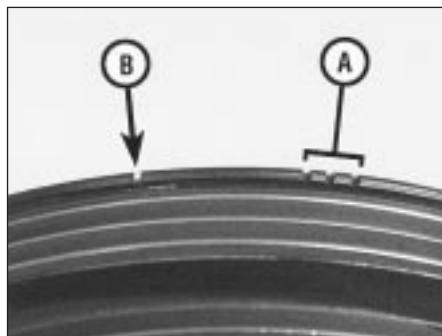
3 No 1 piston and cylinder are at the right-hand (timing belt) end of the engine (right- and left-hand are always as seen from the driver's seat), on the rear bank (ie under the brake master cylinder). The crankshaft rotates clockwise when viewed from the right-hand side of the vehicle.

### Locating TDC

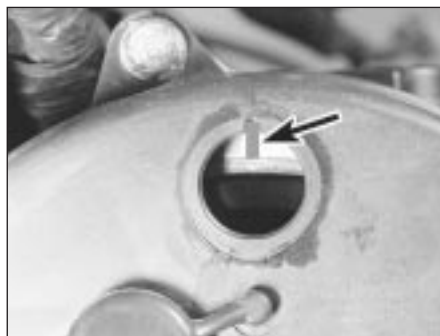
4 Remove the small plastic plug from the viewing hole on the front of each timing belt upper cover (see illustration).



4.4 Remove the plastic plug from the viewing hole on each timing belt upper cover



4.6 Ignition timing notches (A) and TDC notch (B) on the crankshaft pulley



4.8 Paint mark on the camshaft sprocket rim aligned with the notch at on the viewing window



5.5 Lifting off the front camshaft cover

5 Remove the access cover under the right-hand wheelarch.

6 Using a socket and bar on the crankshaft pulley bolt, rotate the crankshaft pulley, in the normal direction of rotation, until a series of very small notches on the pulley inner rim come into view. The first three notches are the ignition timing marks and can be ignored. The next notch (usually coloured white) represents Top Dead Centre (TDC) for No 1 piston on compression, and this is the one we're after (see illustration).

7 Continue turning the crankshaft until the TDC notch is aligned with the pointer on the timing belt cover, just above the pulley. It's best to look down at this from the engine compartment to get the angle right.

8 Now look through the viewing hole on the front timing belt cover. A paint mark on the camshaft sprocket rim should be aligned with the notch at the top of the viewing window (see illustration). If it isn't, turn the crankshaft through one complete revolution and realign the timing marks as before. The mark on the camshaft sprocket should now be correctly aligned. The mark on the rear camshaft sprocket should also be visible through the other window.

9 When all the marks are aligned, the engine is at TDC for No 1 cylinder on compression, and is correctly positioned for any work that requires the timing belt to be disturbed.

10 Refit the plugs to the viewing windows on completion.

5 Undo the two bolts securing each camshaft cover to the cylinder head and lift off the covers (see illustration). Collect the washers under the bolt heads, and remove the cover gaskets.

6 Inspect the cover gasket and the seals on the retaining bolts and renew any that are damaged.

7 Clean the cover and mating faces carefully then, if necessary, fit a new gasket to the cover, ensuring that it locates in the cover grooves.

### Refitting

8 Refitting is a reversal of removal.

## 6 Cylinder head side covers - removal and refitting

### Removal

1 If the rear cover is being removed, jack up the front of the vehicle and support it on axle stands. Access to the rear cover is marginally better from below.

2 Move the adjacent components clear as much as possible and undo the side cover retaining bolts. Note the oxygen sensor wiring support bracket attachments on one of the lower bolts and the engine earth lead on the upper front cover bolt (see illustration).



6.2 Engine earth lead (arrowed) on the upper front side cover bolt

3 Withdraw the side covers from the cylinder head being prepared for some oil spillage.

4 Inspect the condition of the cover gasket and renew it if necessary.

5 Clean the cover and mating faces carefully then, if necessary, fit a new gasket to the cover, ensuring that it locates in the cover grooves.

### Refitting

6 Refitting is a reversal of removal. Ensure that the arrow, and the word UP are at the top when refitting each cover (see illustration).

## 7 Exhaust valve rocker clearances - adjustment

**Note:** This is not a routine maintenance operation and will only be necessary if the cylinder head, camshafts or any components of the valve train have been disturbed or renewed.

1 Remove the camshaft covers and the cylinder head side covers as described in Sections 5 and 6 respectively.

2 Set the engine to TDC for No 1 cylinder on compression, as described in Section 4.

3 Slacken the rocker arm adjusting screw locknuts for No 1 cylinder exhaust valves on the rear cylinder head.

4 Tighten the adjusting screw until it just contacts the valve, then tighten it a further



6.6 Ensure that the arrow, and the word UP are at the top when refitting the side covers

## 5 Camshaft covers - removal and refitting

### Removal

1 Release the spark plug HT leads from their clips on the camshaft covers and move the leads to one side.

2 Release the clips and disconnect the breather hoses from the camshaft covers.

3 Disconnect the oil temperature switch wiring multiplug from the rear camshaft cover.

4 Undo the two bolts and detach the pipe support brackets from the rear cover.





7.4 Exhaust valve rocker clearance adjustment

one and a half turns. Tighten the locknut securely (see illustration).

5 Repeat paragraphs 3 and 4 for No 2 cylinder exhaust valves on the rear cylinder head, and No 4 cylinder exhaust valves on the front cylinder head.

6 Rotate the crankshaft through one complete revolution and realign the timing marks.

7 Repeat paragraphs 3 and 4 for No 5 and No 6 cylinder exhaust valves on the front cylinder head, and No 3 cylinder exhaust valves on the rear cylinder head.

8 Refit the cylinder head side covers and camshaft covers on completion.

## 8 Inlet manifold - removal and refitting



### Removal

1 Drain the cooling system as described in Chapter 1.

2 Disconnect the spark plug HT leads from the spark plugs and cable clips and move the leads clear of the engine. Ensure each lead is labelled to identify its respective spark plug.

3 Refer to Chapter 4, Part D and remove the following components:

(a) Air cleaner and air intake components (Section 2).

(b) Throttle body (Section 12).

(c) Electronic idle control valve (Section 12).

(d) Fast idle valve (Section 12).

(e) Front and rear fuel rail and injectors (Section 12).

4 Refer to Chapter 4, Part E and remove the air suction valve pipe.

5 Check that all the vacuum hoses at the pipe cluster are numbered with corresponding numbers on their respective pip stubs. Mark any as necessary, then disconnect all the hoses from the pipe cluster stubs.

6 Check that all pipes, hoses and cables have been disconnected; undo the eight nuts and bolts securing the manifold to the cylinder head.

7 Lift the manifold up and off the engine and recover the two gaskets.

### Refitting

8 Ensure that the manifold and cylinder mating faces are clean then place the manifold on the cylinder head using new gaskets. Secure the manifold with the eight nuts and bolts.

9 Refer to the relevant Parts of Chapter 4 and refit the previously removed components.

10 Reconnect the spark plug leads, then refill the cooling system as described in Chapter 1.

## 9 Exhaust manifold - removal and refitting



**Note:** Never work on or near a hot exhaust system and in particular, the catalytic converter (where fitted).

### Removal

1 If the front manifold is being removed, refer to Chapter 3 and remove the radiator.

2 Jack up the front of the vehicle and support it on axle stands.

3 On the front manifold, undo the two nuts and lift off the small heat shield and the air suction pipe flange. Recover the gasket.

4 Disconnect the oxygen sensor wiring harness connectors and release the wiring from the support brackets.

5 Undo the bolts from the main manifold heatshields and remove the heatshields.

6 Undo the flange nuts and lower the exhaust front pipe from the manifold studs. Recover the gaskets.

7 Undo the seven nuts securing each manifold to its respective cylinder head, and remove the manifold(s).

8 Clean the mating faces of all components and obtain new gaskets prior to refitting.

### Refitting

9 Refitting is a reversal of removal. Refit the radiator as described in Chapter 3 on completion.

## 10 Crankshaft pulley - removal and refitting



### Removal

1 Remove the auxiliary drivebelts for the alternator, power steering and if fitted, the air conditioning compressor as described in Chapter 1.

2 Remove the starter motor as described in Chapter 5.

3 Jack up the front of the car and support it on axle stands.

4 Remove the access panel under the right-hand wheelarch.

5 Using a socket and long handle, undo the crankshaft pulley retaining bolt. Lock the flywheel ring gear, through the starter motor



10.5 Remove the bolt and washer and withdraw the crankshaft pulley

aperture, using a large screwdriver or tool to prevent the crankshaft rotating as the pulley bolt is undone. Remove the bolt and washer (see illustration).

6 Withdraw the pulley from the crankshaft.

### Refitting

7 Refitting is a reversal of removal. Tighten the pulley retaining bolt to the specified torque. Refit the starter motor as described in Chapter 5, and the drivebelts as described in Chapter 1.

## 11 Timing belt covers - removal and refitting



2B

### Upper covers

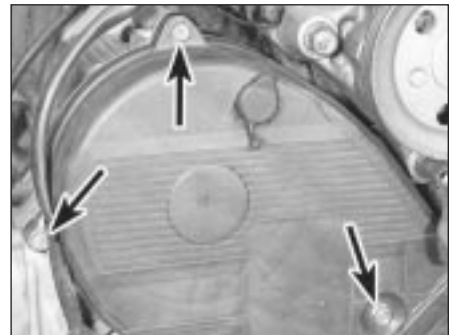
#### Removal

1 If the covers are being removed for any procedure that will entail disturbing the timing belt, set the engine at TDC with No 1 cylinder on compression, as described in Section 4, before proceeding.

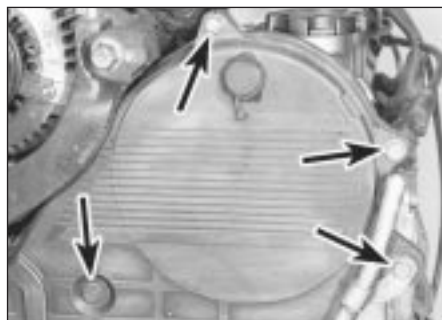
2 Remove the auxiliary drivebelts for the alternator, power steering and if fitted, the air conditioning compressor as described in Chapter 1.

3 Undo the three bolts securing the rear upper cover to the cylinder head (see illustration).

4 Release the wiring harness support clips,



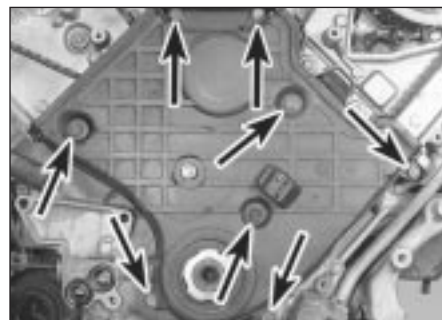
11.3 Timing belt rear upper cover retaining bolts (arrowed)



11.5 Timing belt front upper cover retaining bolts (arrowed)



11.7 Ensure that the lip on the upper cover lower edge engages behind the lower cover



11.10 Timing belt lower cover retaining bolts (arrowed)

and move the harness clear, then withdraw the rear cover from the engine.

5 Undo the four bolts securing the front cover to the cylinder head (see illustration).

6 Undo the dipstick tube bolt and remove the front cover from the engine.

### Refitting

7 Refitting is a reversal of removal, but ensure that the lip on the cover lower edge engages behind the lower cover (see illustration). Refit the drivebelts as described in Chapter 1.

### Lower cover

#### Removal

8 Remove the upper covers as described previously.

9 Remove the crankshaft pulley as described in Section 10.



11.11 Release the rubber grommet from the protruding head of the timing belt tensioner retaining bolt

10 Undo the eight bolts securing the lower cover to the engine (see illustration).

11 Release the rubber grommet from the protruding head of the timing belt tensioner retaining bolt (see illustration).

12 Undo the two bolts from the air conditioner compressor bracket and remove the drivebelt tensioner from the compressor bracket.

13 Withdraw the lower cover from the engine.

### Refitting

14 Refitting is a reversal of removal.

## 12 Timing belt - removal, refitting and adjustment



**Note:** Access may be improved if the coolant is drained and the expansion tank is removed (see Chapter 1).

### Removal

1 Remove the timing belt upper and lower covers, as described in Section 11. Note that it will be necessary to support the engine, and remove the bolts from the right-hand engine mounting, to allow auxiliary drivebelt removal (see Chapter 1).

2 Slacken the timing belt tensioner retaining bolt and move the tensioner, against the pressure of the spring, to the fully released position. Tighten the bolt to hold the tensioner in this position.

3 Remove the belt guide from the crankshaft sprocket noting that it is fitted with its concave side facing outwards (see illustration).

4 Sketch the timing belt arrangement around the sprockets, water pump pulley and tensioner, as a guide when refitting (see illustration).

5 Ease the belt off the camshaft sprockets, then the water pump pulley and tensioner and finally, the crankshaft sprocket (see illustration). Remove the belt from the engine.

6 If the timing belt is to be re-used, mark its running direction with an arrow in chalk, and store it on its edge while it is off the engine.

7 Check the belt for any sign of cracks or splits, particularly around the roots of the teeth. Renew the belt if wear is obvious, if there are signs of oil contamination, or if the belt has exceeded its service interval (see Chapter 1). Also renew the sprockets if they show any signs of wear or chipping of the teeth.

8 Check the tensioner and sprockets as described in Section 13.

9 Before refitting the belt, check that the engine is still at TDC with No 1 cylinder on compression (Section 4) as it will probably have moved when the crankshaft pulley was removed. Use a screwdriver engaged with the flywheel teeth to move the crankshaft as necessary, and move the camshafts by means of their sprockets. With the covers removed, it is possible to see the mark or notch on the ends of the camshaft sprockets, which should be aligned with the corresponding line in the backplate (see



12.3 Remove the belt guide from the crankshaft sprocket



12.4 Timing belt arrangement around the sprockets, pulley and tensioner



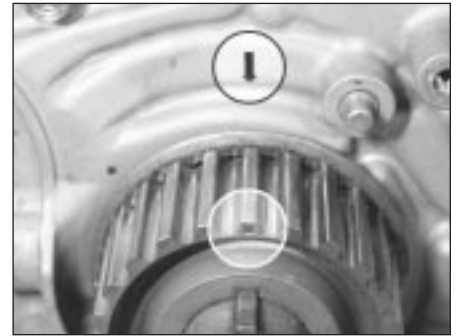
12.5 Ease the belt off the camshaft sprockets



**12.9a** Front camshaft sprocket timing mark, aligned with the corresponding line in the backplate



**12.9b** Rear camshaft sprocket timing notch, aligned with the corresponding line in the backplate



**12.9c** Notch on the front of the crankshaft sprocket aligned with the arrow cast into the oil pump housing

**illustrations).** Similarly, there is a notch on the front of the crankshaft sprocket which should align with an arrow cast into the oil pump housing (see illustration).

### Refitting and adjustment

**10** Feed the timing belt around the sprockets, starting with the crankshaft sprocket, then, keeping it taught, feed it over the front camshaft sprocket, water pump pulley, rear camshaft sprocket, and tensioner pulley.

**11** Slacken the timing belt tensioner retaining bolt, allow the tensioner to automatically tension the belt, then re-tighten the bolt.

**12** Refit the belt guide to the crankshaft sprocket noting that it is fitted with its concave side facing outwards.

**13** Check that the timing marks are still aligned with the engine at TDC, then refit the timing belt covers and crankshaft pulley.

**14** Turn the engine over by means of the crankshaft pulley bolt to settle the belt on the sprockets. Return the crankshaft to TDC for No 1 cylinder on compression.

**15** Now turn the crankshaft further by approximately nine teeth on the camshaft sprocket until an additional notch (usually coloured blue) is aligned with the pointer on the lower cover.

**16** Slacken the timing belt tensioner bolt, then retighten it once more.

**17** Turn the crankshaft further to return it to the TDC position for No 1 cylinder on

compression, and check that all the timing marks, on the pulley and camshaft sprockets are aligned as previously described. If they are all is well. If not, the belt is probably a tooth out and should be repositioned as previously described.

**18** Refit the plugs to the upper covers, then refit the auxiliary drivebelts as described in Chapter 1.

### 13 Timing belt tensioner and sprockets - removal, inspection and refitting



#### Tensioner

##### Removal

**1** Remove the timing belt as described in Section 12.

**2** Unhook the tensioner spring from the anchorage stud.

**3** Remove the tensioner retaining bolt, lift off the tensioner and remove the spring (see illustration).

##### Inspection

**4** Spin the tensioner, and ensure that there is no roughness or harshness in the bearing. Also check that the endfloat is not excessive and there is no sign of free play. Check the surface of the tensioner for any signs of roughness, nicks or scoring which may

damage the timing belt. Renew the tensioner if worn.

##### Refitting

**5** Refitting is a reversal of removal, but ensure that the lower tensioner arm engages over the lug in the casing (see illustration).

#### Camshaft sprockets

##### Removal

**6** Remove the timing belt as described in Section 12.

**7** Undo the three retaining bolts securing each sprocket to its respective camshaft. To prevent the sprockets turning as the bolts are undone, either insert a large screwdriver through one of the sprocket holes and engage it with one of the backplate bolts behind, or make up a holding tool from scrap metal, which is of a scissor shape, with a bolts at each end to engage with the holes in the sprocket (see illustration).

**8** Withdraw the two sprockets from the camshafts, noting their orientation; the sprocket with the flanged edge is fitted to the front camshaft, and the sprocket with the spokes is fitted to the rear camshaft.

##### Inspection

**9** Check the condition of the sprockets, inspecting carefully for any wear grooves, pitting or scoring around the teeth, or any wear ridges which might cause damage to the timing belt. Make sure that the dowels are not



**13.3** Remove the tensioner retaining bolt, lift off the tensioner and remove the spring



**13.5** Ensure that the lower tensioner arm engages over the lug in the casing when refitting



**13.7** Use a tool like this to hold the camshaft sprocket as the bolts are undone





14.2 Front cylinder head backplate retaining bolts (arrowed)

worn and are not a loose fit in the camshaft or sprocket holes.

### Refitting

10 Refitting is a reversal of removal. Ensure that the sprockets are fitted to their correct camshafts and tighten the retaining bolts to the specified torque.

### Crankshaft sprocket

#### Removal

11 Remove the timing belt as described in Section 12.

12 Slide the sprocket off the front of the crankshaft followed by the timing belt guide behind.

#### Inspection

13 Check the condition of the sprocket, inspecting carefully for any wear grooves, pitting or scoring around the teeth, or any wear ridges which might cause damage to the timing belt. Examine the Woodruff key and its groove and make sure it is a tight fit.

### Refitting

14 Refitting is a reversal of removal.

### 14 Camshaft oil seals - renewal



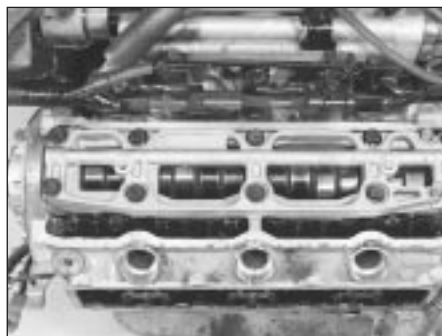
**Note:** The use of an oil seal extractor which screws into the seal inside circumference is preferable for this operation. These are available at most accessory shops and can often be hired from tool hire outlets. In the absence of this type of tool, an alternative (but less satisfactory) method of removal is described in the following procedure.

1 Remove the camshaft sprockets as described in the previous Section.

2 Undo the retaining bolts and remove the backplate from the front or rear cylinder head as required (see illustration).

3 The oil seals are now accessible for removal. Punch or drill two small holes opposite each other in the oil seal. Screw a self-tapping screw into each hole and pull on the screws with pliers to extract the seal.

4 Check that the housing is clean before



15.8 Undo the ten bolts securing the oil gallery to the camshaft carrier

fitting the new seal. Lubricate the lips of the seal and the running faces of the camshaft with clean engine oil, then carefully locate the seal over the camshaft and drive it squarely into position using a tube or a socket. Take care not to turn over the lips of the seal as it is being fitted. Another method of fitting is to draw it squarely into position using the sprocket bolt and a distance piece.

5 With the seal fully inserted in its housing, refit the backplate, then refit the camshaft sprocket as described in the previous Section.

### 15 Camshaft and hydraulic tappets - removal, inspection and refitting



#### Removal

1 Remove the air cleaner assembly and air intake trunking as described in Chapter 4, Part D.

2 Remove the camshaft covers as described in Section 5.

3 Remove the cylinder head side covers as described in Section 6.

4 Remove the camshaft sprocket(s) as described in Section 13.

5 If working on the front camshaft, remove the distributor as described in Chapter 5.

6 If working on the rear camshaft, remove the power steering pump as described in Chapter 10.

7 Undo the retaining bolts and remove the



15.11 Lift the camshaft carrier off the cylinder head



15.9 Recover the small O-ring seal in the camshaft carrier

backplate from the front or rear cylinder head as required.

8 Undo the ten bolts securing the oil gallery to the camshaft carrier noting the locations of the two short bolts (see illustration).

9 Lift off the oil gallery and recover the small O-ring seal in the camshaft carrier (see illustration).

10 If working on the front camshaft, undo the two small camshaft carrier retaining bolts at each end.

11 Lift the camshaft carriers off the cylinder head (see illustration).

12 Carefully lift out the camshafts, marking or labelling them FRONT or REAR as applicable (see illustration).

13 Withdraw the oil seal off the front of the camshaft.

14 If working on the rear camshaft, remove the end plug from the cylinder head.

15 Obtain a compartmented box, and mark it inlet and exhaust for each cylinder (ie 1 INLET, 1 EXHAUST, 2 INLET, 2 EXHAUST etc).

16 Lift out the slippers, tappets and pushrods for each cylinder, in turn, and place the components in their respective compartments in the box (see illustration).

#### Inspection

17 Clean and inspect the various components removed, for signs of excessive wear.

18 Examine the camshaft bearing journals and lobes for damage or obvious wear. If evident, a new camshaft must be fitted, or one that has been renovated by a company



15.12 Carefully lift out the camshafts





15.16a Lift out the rocker arms . . .



15.16b . . . and hydraulic tappets



15.18 Measure the camshaft journal diameters using a micrometer

specialising in exchange components. If the camshaft appears sound, measure the journal diameters using a micrometer (see illustration).

**19** The camshaft bearing bore diameters in the cylinder head should be measured and checked against the tolerances specified. A gauge will be required for this but if not available, check for excessive movement between the camshaft journals and the bearings. Alternatively, the Plastigage method, described in Part C of this Chapter, for main and big-end bearing running clearance checks, can be used. If the bearings are found to be unacceptably worn, either a new camshaft or a new cylinder head is the only answer as the bearings are machined directly in the head.

**20** It is seldom that the hydraulic tappets are badly worn in the cylinder head bores but again, if the tappets are scored, or the bores are found to be worn beyond an acceptable level, either the tappet(s) or the complete cylinder head must be renewed. If any of the tappets have been noisy in operation, or their internal condition is suspect, perform a tappet seating stroke check as described below.

**21** If the contact surface of the cam lobes show signs of depression or grooving, note that they cannot be renovated by grinding as the hardened surface will be removed and the overall length of the tappet(s) will be reduced. The self-adjustment point of the tappet will be exceeded as a result, so that the valve adjustment will be affected and they will then

be noisy in operation. Therefore, renewal of the camshaft is the only remedy in this case.

**22** Check the rocker arms for signs of scoring on their contact faces and for any visible signs of wear on the pushrods. Renew any that are noticeably worn or damaged.

### **Tappet seating stroke check**

**23** Carry out this check if any of the tappets have been noisy in operation, or their internal condition is suspect.

**24** Using a small drill bit that will just fit through the hole in the end of the tappet, immerse the tappet in a small container of clean engine oil so that the tappet is submerged. Insert the drill bit through the hole in the tappet ball end and push the valve inside the tappet in and out several times, using a slow pumping action, to remove all air from the tappet (see illustrations).

**25** Remove the tappet from the container and place it on the bench with the ball end uppermost.

**26** Mount a dial gauge and test stand over the tappet with the dial gauge probe in contact with the tappet ball end. Zero the gauge.

**27** Push the ball end down quickly by hand and note the reading on the dial gauge. This is the tappet seating stroke and, if it is outside the maximum figure given in the Specifications, renew the tappet.

**28** After checking, the tappet must be drained of oil so as to be fitted dry on reassembly.

**Caution:** On reassembly, do not fit a tappet that is full of oil from the seating stroke check, otherwise there is a possibility of the valves being held open on initial cranking.

**29** Turn the tappet upside down and, using the small drill bit, depress the internal valve to drain the oil from the tappet (see illustration).

**30** Repeat the above procedure on any other suspect tappets.

### **Refitting**

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

(a) Fill the tappet bores to oil path level before fitting the tappets and do not rotate them once in position (see illustration).



15.24a Using a small drill bit that will just fit through the hole in the end of the tappet . . .



15.24b . . . immerse the tappet in oil and push the valve inside in and out to remove all the air



15.29 Depress the internal tappet valve to drain the oil prior to installation



15.31a Fill the tappet bores with oil before fitting the tappets



**15.31b Prime the tappet oil feeds in the cylinder head with oil**

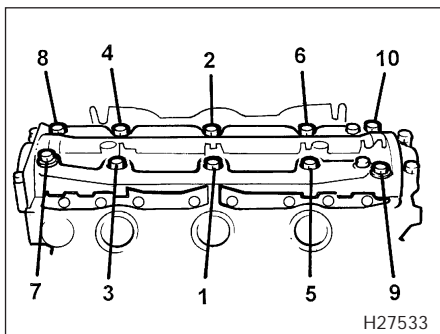
- (b) Prime the tappet oil feeds in the cylinder head with oil (see illustration).
- (c) Apply RTV sealant to the ends of the camshaft carrier before refitting (see illustration).
- (d) Use new gaskets on all joints and tighten the retaining nuts and bolts to the specified torque where given. Tighten the oil gallery bolts in the sequence shown (see illustration).
- (e) Refit all components removed for access as described in the relevant Sections and Chapters of this manual.

## 16 Cylinder head - removal and refitting

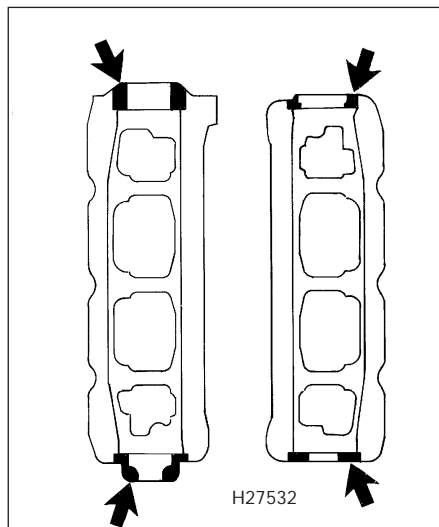


### Removal

- 1 Remove the inlet manifold as described in Section 8.
- 2 Remove the camshaft and hydraulic tappets on the side concerned as described in Section 15.
- 3 Undo the flange bolts and remove the exhaust front pipes from the exhaust manifolds. Recover the flange gaskets.
- 4 Undo the bolts securing the coolant connecting pipe. Disconnect the temperature sensor wiring multiplug, move the wiring harness aside and remove the connecting pipe. Recover the sealing O-rings from the pipe.
- 5 If removing the front cylinder head,



**15.31d Oil gallery retaining bolt tightening sequence**



**15.31c Apply RTV sealant to the ends of the camshaft carrier (shown shaded) before refitting**

disconnect the camshaft sensor wiring multiplug (where fitted).

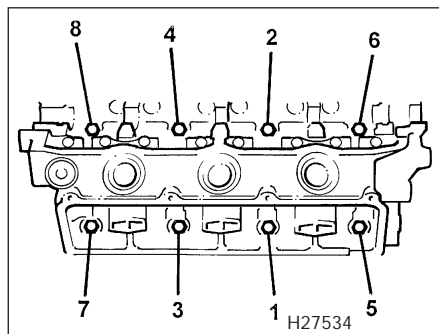
6 If not already removed, remove the push rods from their locations and place them in a marked box to indicate their respective cylinders.

7 Progressively slacken the cylinder head retaining bolts a third of a turn at a time, in the sequence shown until all are slack, then remove the bolts (see illustration).

8 Lift the cylinder head off the locating dowels and remove it from the engine. If the head is stuck, it can be carefully levered up using a large screwdriver between the cylinder block and the protruding cylinder head flanges. Do not insert the screwdriver under the head-to-block mating face. Place the head on blocks on the bench to protect the valves.

9 Remove the cylinder head gasket from the block.

10 Prior to refitting, ensure that the cylinder block and head mating faces are thoroughly clean and dry, with all traces of old gasket removed. Clean the threads of the retaining bolts, and remove any oil, water and thread sealer from the bolt holes.



**16.7 Cylinder head bolt slackening and tightening sequence**

### Refitting

11 Locate a new gasket over the dowels on the cylinder block.

12 Lower the cylinder head assembly onto the gasket, and refit the retaining bolts. Working in the sequence shown, tighten the retaining bolts to the specified torque (see illustration 16.7). Note that the cylinder head bolt slackening and tightening sequence are the same.

13 The remainder of refitting is a reversal of removal but refer to the relevant Sections and Chapters of this manual for adjustment details.

## 17 Sump - removal and refitting



### Removal

1 Disconnect the battery negative (earth) lead (refer to Chapter 5, Section 1).

2 Apply the handbrake, jack up the front of the car and support it on axle stands.

3 Drain the engine oil as described in Chapter 1.

4 Remove the exhaust front pipe with reference to Chapter 4, Part D.

5 Undo the bolts securing the longitudinal support member to the underbody beneath the engine, and remove the member.

6 Undo the six nuts and sixteen bolts securing the sump to the crankcase.

7 Withdraw the sump from the crankcase, tapping it from side to side with a hide or plastic mallet if it is stuck. Recover the sump gasket.

8 If the oil pick-up tube and strainer are to be removed, undo the two bolts securing the strainer bracket to the crankcase, and the two bolts securing the pick-up tube flange to the oil pump.

9 Remove the pick-up pipe and tube from the crankcase. Recover the O-ring from the pick-up pipe flange. Remove the baffle plate from the cylinder block.

10 Clean the sump, and the mating faces of both the sump and crankcase thoroughly.

11 If removed, clean the pick-up pipe, and the filter gauze in the strainer.

### Refitting

12 Refitting is a reversal of removal. Use a new sump gasket and O-ring seal on the pick-up pipe flange and tighten the sump retaining nuts and bolts progressively to the specified torque. Fill the engine with oil as described in Chapter 1 on completion.

## 18 Oil cooler and filter head - removal and refitting

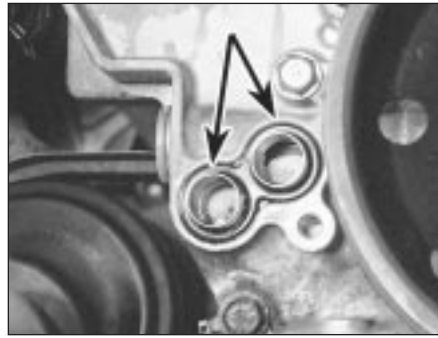


### Removal

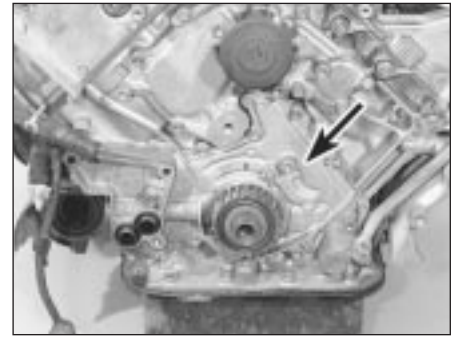
1 Drain the cooling system as described in Chapter 1.



**18.8 Removing the oil cooler and filter head assembly**



**18.9 Recover the double O-ring seal from the filter housing outlets**



**19.11 Oil pump housing location on the front of the engine**

2 Jack up the front of the car and support it on axle stands.

3 Remove the right-hand front road wheel and the access panel under the wheelarch.

4 Place a jack with interposed block of wood under the sump and just take the weight of the engine.

5 Undo the two right-hand engine mounting retaining bolts.

6 Lower the jack slightly to provide access to the oil cooler and filter head assembly from under the wheelarch.

7 Undo the three bolts securing the assembly to the front of the engine.

8 Withdraw the assembly from the engine, and disconnect the oil pressure switch wiring and the two coolant hoses (see illustration).

9 Recover the double O-ring seal from the filter housing outlets on the engine (see illustration).

10 With the assembly on the bench, undo the centre bolt from the oil cooler and remove the cooler from the filter head. Recover the O-rings.

### Refitting

11 Refitting is a reversal of removal, but lubricate the O-rings prior to fitting. Fill the cooling system and top-up the engine oil as described in Chapter 1, on completion.

### 19 Oil pump - removal and refitting



### Removal

1 Drain the engine oil as described in Chapter 1.

2 Remove the timing belt as described in Section 12.

3 Remove the crankshaft sprocket and the timing belt tensioner as described in Section 13.

4 Remove the timing belt inner guide from the front of the crankshaft.

5 Unscrew the timing belt tensioner spring anchorage stud from the oil pump housing.

6 Remove the oil cooler and filter head as described in Section 18.

7 Support the engine from above using a crane and chains or sturdy slings attached to suitable anchorage points on the engine.

8 Remove the jack from under the sump (from the previous operation) then remove the sump and oil pick-up strainer as described in Section 17.

9 Undo the retaining bolt and remove the dipstick tube. Recover the O-ring.

10 Undo the two bolts from the oil feed tube and remove the tube. Recover the O-rings.

11 Undo the nine oil pump housing retaining bolts, noting the locations of the two longer bolts (see illustration).

12 Release the pump housing from the dowels and remove it from the engine.

13 Clean off all traces of sealant on the pump housing and cylinder block mating faces prior to reassembly.

### Refitting

14 Refitting is a reversal of removal. Apply a bead of RTV sealant to the housing mating face, inside the line of bolt holes and tighten the retaining bolts to the specified torque. Use new O-rings on all components.

### 20 Crankshaft oil seals - renewal



### Front oil seal

1 Remove the timing belt as described in Section 12.

2 Withdraw the sprocket from the crankshaft together with the timing belt guide plate.

3 Remove the Woodruff key from the slot in the crankshaft.

4 Note the fitted depth of the oil seal in relation to the front of the housing as an aid to refitting.

5 Punch or drill two small holes opposite each other in the seal. Screw a self tapping screw into each, and pull on the screws with pliers to extract the seal.

6 Clean the seal location in the pump housing, and clean off any burrs or raised edges, which may have caused the seal to fail.

7 Lubricate the lips of the new seal with clean engine oil and carefully locate the seal over the crankshaft and into the housing.

8 Using a tubular drift which bears on the hard outer edge of the seal, drive the seal into the housing to the previously noted depth.

9 Refit the Woodruff key to the crankshaft.

10 Refit the timing belt guide plate and sprocket to the crankshaft.

11 Refit the timing belt as described in Section 12.

### Rear oil seal

12 Remove the flywheel/driveplate as described in Section 22.

13 Punch or drill two small holes opposite each other in the seal. Screw a self tapping screw into each, and pull on the screws with pliers to extract the seal.

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

15 Lubricate the lips of the new seal with clean engine oil and carefully locate the seal on the end of the crankshaft.

16 Using a large tubular drift bearing on the hard outer edge of the seal, drive the seal into the housing until it is flush with the housing face.

17 Clean off any surplus oil then refit the flywheel/driveplate as described in Section 22.

### 21 Engine/transmission mountings - inspection and renewal

Refer to Part A, Section 18.

### 22 Flywheel/driveplate - removal, inspection and refitting



### Removal

1 With the engine removed from the car and separated from the transmission, or with the



## 2B•12 V6 engine - in-car engine repair procedures

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transmission removed as described in Chapter 7, remove the clutch assembly (manual transmission) as described in Chapter 6.

**2** Undo the eight flywheel/driveplate retaining bolts. To prevent the flywheel turning, lock the ring gear teeth using a small strip of angle iron engaged in the teeth and against, or screwed into, a transmission-to-engine retaining bolt inserted into a vacant bolt hole.

**3** Lift off the washer plate (automatic transmission), then withdraw the flywheel/driveplate from the crankshaft.

### ***Inspection***

**4** Inspect the starter ring gear on the flywheel or driveplate for wear or broken teeth. If evident, the ring gear should be renewed. This is a specialist operation and should be entrusted to a Rover dealer.

**5** The clutch friction surface on the flywheel should be checked for grooving or cracks, the latter being caused by overheating. If these conditions are evident, renewal of the flywheel is necessary.

### ***Refitting***

**6** Refitting is a reversal of removal, tightening the bolts to the specified torque in a diagonal and progressive sequence.