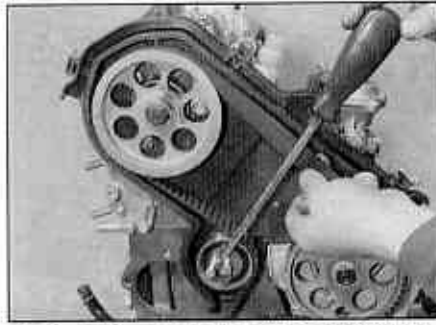
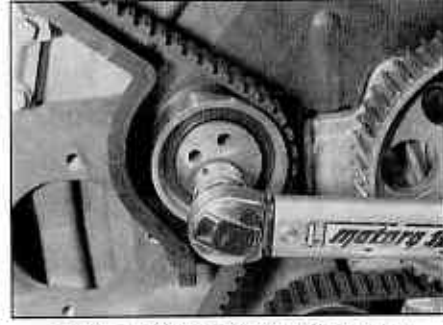




4.11 Locating the timing belt around the tensioner pulley



4.12a Using two bolts and a screwdriver to tension the timing belt



4.12b Tightening the tensioner nut

Caution: Where applicable observe the direction of rotation markings on the belt.

12 Tension the timing belt by turning the eccentrically-mounted tensioner clockwise; two holes are provided in the side of the tensioner hub for this purpose - a pair of sturdy right-angled circlip pliers can be used to do this or alternatively two bolts and a long screwdriver may be used. Fiat use a special tensioner tool located in the holes - this consists of a calibrated rod and weight. The weight is positioned 60 mm along the rod to provide the correct tension to the belt, then the tensioner nut is tightened. (see illustrations).

13 If the tensioner tool is not available, test the tension by grasping the timing belt between the finger and thumb midway between the camshaft and injection pump pulleys, and twisting it through 90° (see paragraph 5).

Caution: The above procedure serves only as a rough guide to setting the belt tension. The tension must be checked accurately by a Fiat dealer using the special tensioner tool, at the earliest opportunity.

14 Turn the engine two complete turns clockwise, check that all the timing marks are still aligned then recheck the timing belt tension. If necessary carry out the tensioning procedure again.

15 Refit the components disturbed for access, using the reverse of the removal procedure and bearing in mind the following points:

- a) Tighten all nuts and bolts to the specified torque, where given.
- b) Refit the auxiliary drivebelt(s) as described in Chapter 1B.

5 Timing belt tensioner and sprockets - removal, inspection and refitting

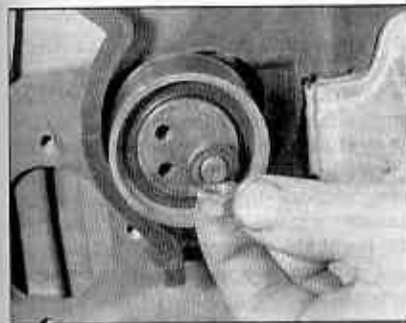


Timing belt tensioner

Removal

1 Follow the procedure for removing the timing belt in Section 4, however it is not necessary to completely remove the belt from the timing sprockets provided it is kept fully engaged with them.

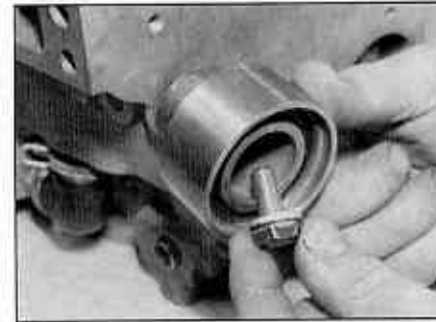
2 Unscrew the nut and slide the tensioner off the mounting stud (see illustrations).



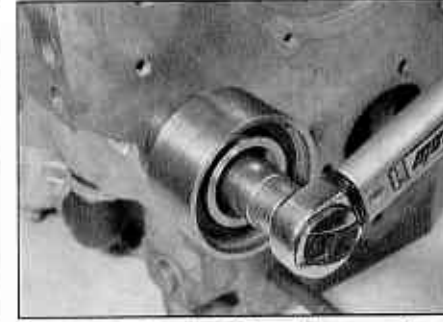
5.2a Remove the nut ...



5.2b ... followed by the timing belt tensioner pulley



5.7 Removing the idler pulley



5.9 Tightening the idler pulley mounting bolt

Inspection

3 Wipe the tensioner clean but do not use solvents that may contaminate the bearings. Spin the tensioner pulley on its hub by hand. Stiff movement or excessive freeplay is an indication of severe wear; the tensioner is not a serviceable component, and should be renewed.

Refitting

4 Slide the tensioner pulley over the mounting stud and screw on the nut.

5 Refer to Section 4 and refit the timing belt.

Timing belt idler pulley

Removal

6 Remove the timing belt as described in Section 4.

7 Unscrew the mounting bolt and remove the idler pulley from the front of the cylinder block (see illustration).

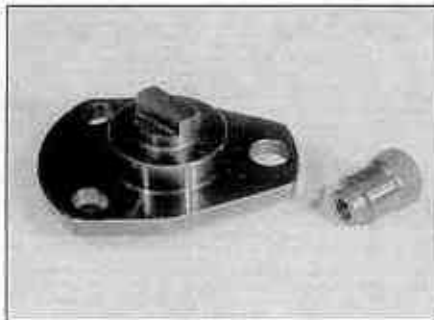
Inspection

8 Wipe the idler clean but do not use solvents that may contaminate the bearings. Spin the idler pulley on its hub by hand. Stiff movement or excessive freeplay is an indication of severe wear; the idler is not a serviceable component, and should be renewed.

Refitting

9 Refit the idler to the front of the block and tighten the bolt to the specified torque (see illustration).

10 Refer to Section 4 and refit the timing belt.



5.11 Special Fiat tool necessary to accurately position the camshaft before fitting the sprocket

Camshaft sprocket Removal

11 Remove the timing belt as described in Section 4. A special Fiat tool (see illustration) is necessary to position the camshaft before refitting the sprocket, however if the original camshaft is being re-used, use of the special tool can be avoided by accurately marking the camshaft position before removing the sprocket.

Caution: On later 1996 models the camshaft sprocket can be moved in either direction on the camshaft location dowel.

12 The camshaft sprocket must now be held stationary whilst the retaining bolt is loosened. This is no problem on later models where the sprocket incorporates holes, however some early models have a sprocket without holes - on this type Fiat technicians use a special tool



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

which clamps on the sprocket teeth. If this tool is not available, it may be possible to make up a similar tool. On later models a sprocket holding tool can easily be made (see Tool Tip).

13 On 1996-on models mark the position of the camshaft in relation to the cylinder head.



5.13 Note the location of the hose and bracket when removing the vacuum pump



5.14a Unscrew and remove the bolt and washer ...



5.14b ... and remove the sprocket from the end of the camshaft



5.22a Unscrew and remove the bolt, washer and spacer ...

This is best achieved by removing the vacuum pump from the flywheel end of the head and marking the head in relation to the drive slot in the end of the camshaft. Note the location of the hose and bracket when removing the vacuum pump (see illustration).

14 Unscrew and remove the bolt and washer and withdraw the sprocket from the end of the camshaft (see illustrations). Note the location peg on the camshaft.

Inspection

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

16 Check the sprocket teeth for damage.

17 Wipe clean the sprocket and camshaft mating surfaces.

Refitting

18 Locate the sprocket on the end of the camshaft. On 1996-on models check that the camshaft is positioned accurately to the previously made marks and also make sure that the TDC mark on the sprocket is aligned with the mark on the inner timing cover. If available use the special Fiat tool to locate the camshaft correctly. Refit the bolt and washer and tighten to the specified torque while holding the camshaft sprocket stationary using the method described previously. Recheck all alignment marks.

19 Refit the timing belt as described in Section 4.

Crankshaft sprocket

Caution: The crankshaft sprocket retaining bolt has a left-hand thread.

Removal

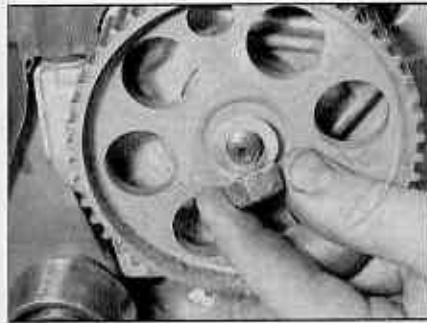
20 Remove the timing belt as described in Section 4.

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

22 Unscrew and remove the crankshaft sprocket retaining bolt (left-hand thread), washer and spacer and slide the sprocket off the end of the crankshaft (see illustrations). It is quite tight and it will be necessary to use a



5.22b ... and remove the crankshaft sprocket



5.30 Unscrewing the retaining nut for the injection pump sprocket



5.31a Use a puller to release the sprocket from the injection pump shaft



5.31b Remove the injection pump sprocket ...



5.31c ... followed by the Woodruff key



5.35 Tightening the injection pump sprocket bolt

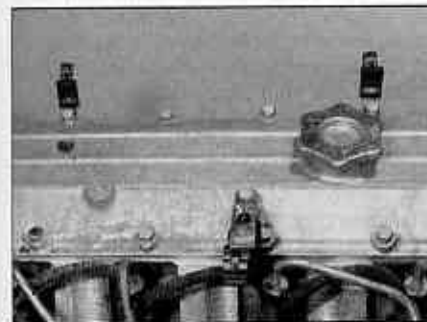
rocking motion to remove it. Note that the sprocket is located by an integral key.

Inspection

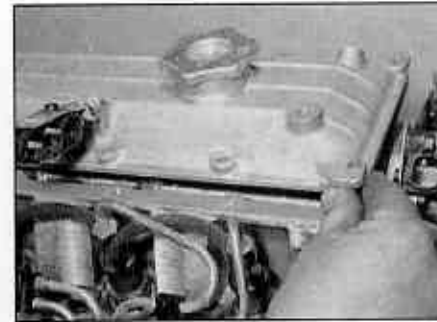
- 23 With the sprocket removed, examine the crankshaft oil seal for signs of leaking. If necessary, refer to Section 8 and renew it.
- 24 Check the sprocket teeth for damage. Also check the key and if necessary renew it.
- 25 Wipe clean the sprocket and crankshaft mating surfaces.

Refitting

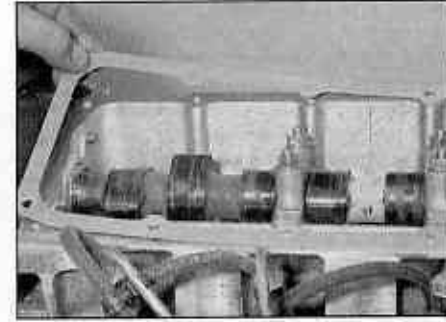
- 26 Slide the sprocket onto the crankshaft and engage the key with the slot in the crankshaft.
- 27 Refit the bolt, washer and spacer and tighten the bolt to the specified torque while holding the crankshaft stationary using the method described in paragraph 21.
- 28 Refit the timing belt as described in Section 4.



6.3a Support bracket positions on the camshaft cover



6.3b Removing the camshaft cover ...



6.4 ... and gasket

Injection pump sprocket

Removal

- 29 Remove the timing belt as described in Section 4.
- 30 Using a suitable tool hold the injection pump sprocket stationary, then unscrew the nut securing the sprocket to the injection pump shaft (see illustration).
- 31 Using a suitable puller remove the sprocket from the end of the injection pump shaft and recover the Woodruff key from the groove (see illustrations).

Inspection

- 32 With the sprocket removed, check the sprocket teeth for damage. Also check the key and if necessary renew it.
- 33 Wipe clean the sprocket and injection pump shaft.

Refitting

- 34 Locate the key in the groove making sure that it is fully inserted and parallel with the shaft surface.
- 35 Refit the sprocket onto the injection pump shaft then refit the bolt and washer and tighten the bolt to the specified torque while holding the sprocket stationary (see illustration).
- 36 Refit the timing belt as described in Section 4.

6 Camshaft cover - removal and refitting



Removal

- 1 Remove the air ducting from the camshaft cover as described in Chapter 4C, Section 2.
- 2 Unclip the coolant hoses from the camshaft cover and tie them out of the way.
- 3 Note the position of the support brackets then progressively unscrew the mounting bolts from the top of the camshaft cover and lift off the cover (see illustrations). If it sticks, do not attempt to lever it off - instead free it by working around the cover and tapping it lightly with a soft-faced mallet.
- 4 Recover the camshaft cover gasket. Inspect the gasket carefully, and renew it if damage or deterioration is evident (see illustration).
- 5 Clean the mating surfaces of the cylinder head and camshaft cover thoroughly, removing all traces of oil and old gasket - take care to avoid damaging the surfaces as you do this.

Refitting

- 6 Locate a new gasket on the cylinder head and make sure it is correctly seated.
- 7 Lower the cover onto the gasket making sure the gasket is not displaced.
- 8 Insert the mounting bolts and tighten them securely in a progressive sequence. Position the support brackets as noted during removal.
- 9 Clip the coolant hoses in position then refit the air ducting.

7 Camshaft oil seal - renewal

- 1 Remove the timing belt and camshaft sprocket as described in Sections 4 and 5.
- 2 Using a suitable hooked instrument, remove the oil seal from the cylinder head taking care not to damage the surface of the camshaft. Alternatively drill a small hole in the oil seal and insert a self-tapping screw - the seal can then be removed by pulling on the screw with a pair of pliers.
- 3 Clean the seating in the cylinder head and the end of the camshaft. To prevent damage to the new oil seal as it is being fitted, wrap some adhesive tape around the end of the camshaft and lightly oil it.
- 4 Dip the new oil seal in oil then locate it over the camshaft making sure that the sealing lips are facing inwards.
- 5 Using a suitable tubular drift, drive the oil seal squarely into the cylinder head. Remove the adhesive tape.
- 6 Refit the camshaft sprocket and timing belt with reference to Sections 5 and 4.

8 Crankshaft oil seals - renewal

Front (right-hand side) oil seal

- 1 The front oil seal is located in the oil pump casing on the front of the crankshaft. Remove the timing belt as described in Section 4 and the crankshaft sprocket as described in Section 5.
- 2 Using a suitable hooked instrument, remove the oil seal from the oil pump casing taking care not to damage the surface of the crankshaft. Alternatively drill a small hole in the oil seal and insert a self-tapping screw - the seal can then be removed by pulling on the screw with a pair of pliers.
- 3 Clean the seating in the oil pump and the surface of the crankshaft. To prevent damage to the new oil seal as it is being fitted, wrap some adhesive tape around the end of the crankshaft and lightly oil it.
- 4 Dip the new oil seal in oil then offer it up to the oil pump casing making sure that the sealing lips are facing inwards.



8.8a Rear oil seal and housing

- 5 Using a suitable tubular drift, drive the oil seal squarely into the casing. Remove the adhesive tape.
- 6 Refit the crankshaft sprocket and timing belt with reference to Sections 5 and 4.

Rear (left-hand side) oil seal

- Note:** The following paragraphs describe renewal of the rear oil seal leaving the housing in position. The alternative method is to remove the housing and renew the oil seal on the bench, however there is then the possibility of damaging the sump gasket. Refer to Chapter 2D for details of removing the rear oil seal housing.
- 7 Remove the flywheel as described in Section 10.
 - 8 Using a suitable hooked instrument, remove the oil seal from the rear oil seal housing taking care not to damage the surface of the crankshaft. Alternatively drill a small hole in the oil seal and insert a self-tapping screw - the seal can then be removed by pulling on the screw with a pair of pliers (see illustrations).
 - 9 Clean the seating in the housing and the surface of the crankshaft. Check the crankshaft for burrs which may damage the oil seal lip of the new seal, and if necessary use a fine file to remove them.
 - 10 Dip the new seal in clean engine oil and carefully locate it over the crankshaft rear flange making sure that it is the correct way round.
 - 11 Progressively tap the oil seal into the housing keeping it square to prevent distortion. A block of wood is useful for this purpose.
 - 12 Refit the flywheel with reference to Section 10.



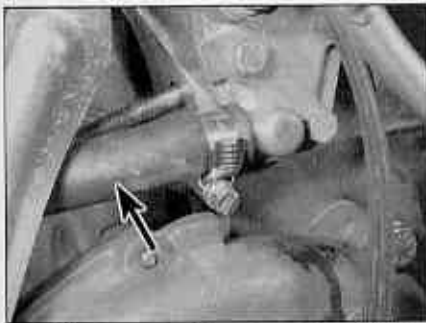
8.8b Using a self-tapping screw and pliers to remove the rear oil seal

9 Cylinder head - removal and refitting

Removal

Note: The cylinder head bolts are of special splined design and a Fiat tool should be obtained to unscrew them. A Torx key will not fit however in practise it was found that a close-fitting Allen key could be used as an alternative.

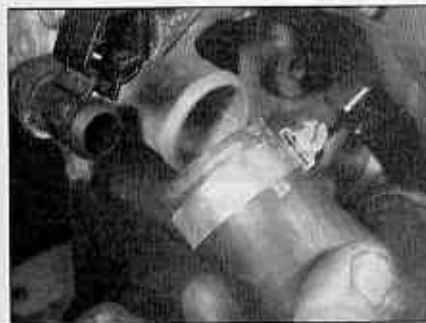
- 1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
- 2 Remove the battery as described in Chapter 5A.
- 3 Refer to Chapter 1B and carry out the following:
 - a) Drain the engine oil.
 - b) Drain the cooling system.
- 4 Remove the timing belt as described in Section 4.
- 5 Unbolt and remove the relay guard and bracket from the left-hand side of the engine.
- 6 Unbolt and remove the battery mounting tray and disconnect the wiring and lines from the modulator valve and relays.
- 7 Remove the air cleaner assembly and air duct with reference to Chapter 4C.
- 8 Loosen the clip and disconnect the vacuum hose from the vacuum pump on the left-hand end of the cylinder head.
- 9 Loosen the clips and disconnect the radiator top hose from the cylinder head outlet. Also disconnect the heater inlet hose from the thermostat housing.
- 10 Loosen the clips and disconnect the expansion tank and heater outlet hoses.
- 11 Identify all wiring connectors then disconnect them from the cylinder head.
- 12 Unscrew the expansion tank mounting screws, then disconnect the expansion tank hoses at their connections to the engine. Remove the expansion tank from the engine compartment.
- 13 Release the clip and disconnect the crankcase breather from the left-hand rear of the cylinder head.
- 14 Unbolt the power steering pump upper cover bracket then unscrew the pivot and adjustment bolts while leaving the fluid hoses still attached. Release the drivebelt (if still in place) then tie the pump to the bulkhead.
- 15 Loosen the clips and disconnect the short coolant hose from the cylinder head outlet to the coolant pump (see illustration).
- 16 At the rear of the engine, unbolt and disconnect the oil delivery pipe from the turbocharger (where applicable) and crankcase (see illustrations).
- 17 Disconnect the return hose from the thermostat housing to the coolant pump (see illustration).
- 18 Unbolt the metal coolant return pipe and pull it out from the coolant pump inlet elbow (see illustrations).



9.15 Short coolant hose from the cylinder head outlet to the coolant pump

19 Where applicable, unscrew the bolts retaining the bracket to the turbocharger and the crankcase (see illustration).

20 Unscrew the nut and slide the timing belt tensioner off its stud.



9.17 Disconnecting the return hose from the thermostat housing



9.18a Metal coolant return pipe mounting bolt



9.24 Unscrewing the union nuts from the injection pump



9.16a Disconnecting the oil delivery pipe from the turbocharger

21 Release the fuel supply and return hoses from the supports on the cylinder head.

22 Unscrew the union bolt and disconnect the fuel supply hose from the filter on the bulkhead.

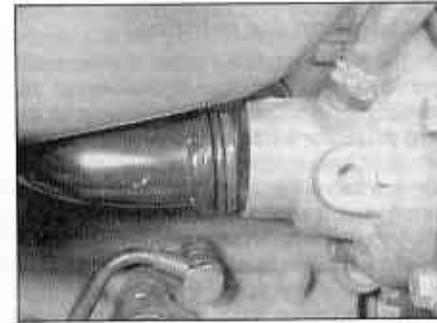
23 Loosen the clip and disconnect the fuel return hose from the injection pump.

24 Unscrew the union nuts while holding insert flats, and disconnect the fuel supply lines from the injectors and injection pump (see illustration). Cover the apertures to prevent dust entry.

25 Disconnect the glow plug supply wiring from the terminal on No 4 glow plug heater on the front left-hand side of the engine.

26 Disconnect the wiring from the maximum coolant temperature connector on the front of the engine.

27 Disconnect the fuel return line from No 1 injector.



9.18b Removing the metal coolant return pipe from the coolant pump



9.31a Bolts securing the inner timing cover to the cylinder head



9.16b Oil delivery pipe location on the crankcase

28 Unscrew the nuts securing the exhaust front pipe to the exhaust manifold. Where necessary, use a screwdriver to bend back the lock tabs. Lower the front pipe and recover the gasket.

29 Where applicable, remove the clip and disconnect the oil return hose from the turbocharger to the sump.

30 Remove the camshaft sprocket as described in Section 5.

31 Unscrew the bolts securing the timing belt inner cover to the cylinder head and injection pump bracket, then remove the inner cover (see illustrations).

32 Unbolt and remove the camshaft cover and recover the gasket. Note the location of the support brackets.

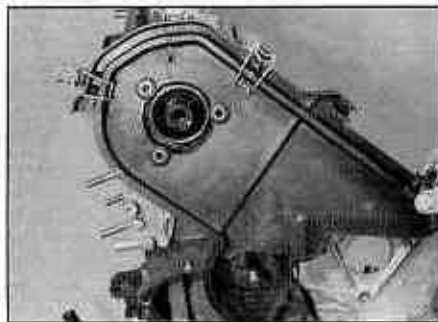
33 Unscrew and remove the bolts and washers located on the front of the cylinder head, alongside the injectors (see illustration).



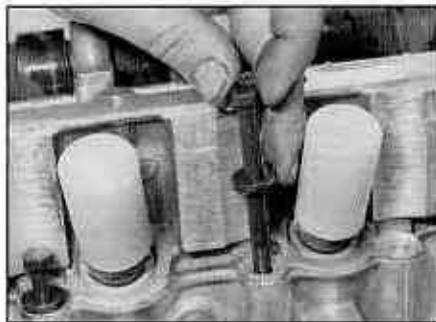
9.19 Unbolt the bracket retaining the turbocharger and manifold to the crankcase



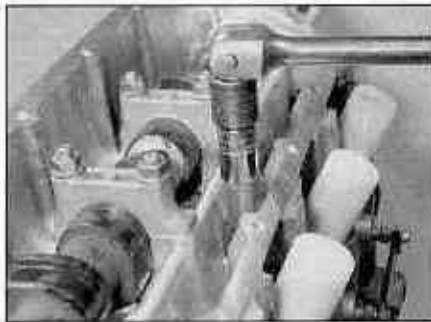
9.31b Removing the bolts securing the inner timing cover to the injection pump/oil filter bracket



9.31c Removing the inner timing cover



9.33 Removing one of the bolts at the front of the cylinder head



9.34a Unscrewing the cylinder head bolts

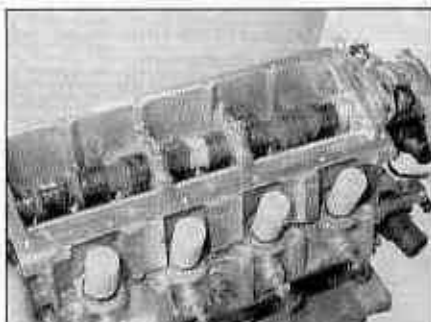
34 Working in the reverse of the sequence shown in illustration 9.52a progressively slacken the main internal cylinder head bolts, by half a turn at a time, until all bolts can be unscrewed by hand. It will be necessary to slightly turn the camshaft in order to remove the bolt located at the rear flywheel end corner as the camshaft lobe restricts access (see illustrations). **Note:** Fiat recommend that the cylinder head bolts should be renewed if they have been used more than 4 times. As it may not be possible to determine how many times the bolts have been used, and considering the stress to which the head bolts are under, it is highly recommended that they are renewed as a matter of course. Retain the washers from the old bolts as it is permissible to re-use these unless they show visible signs of distortion or damage.

35 Check that nothing remains connected to the cylinder head, then lift the head away from the cylinder block (see illustration); seek assistance if possible, as it is a heavy assembly, especially as it is being removed complete with the manifolds and turbocharger. If preferred remove the manifolds first.

36 With the cylinder head on a work surface, unscrew the nuts securing the inlet and



9.34b Turn the camshaft slightly to remove the rear flywheel end corner bolt



9.35 Lifting the cylinder head off of the block - note the protectors fitted to the injectors

exhaust manifolds and withdraw them from the studs together with the turbocharger, where applicable.

37 Recover the gasket from the studs.

38 If the cylinder head is to be dismantled for overhaul refer to Chapter 2D.

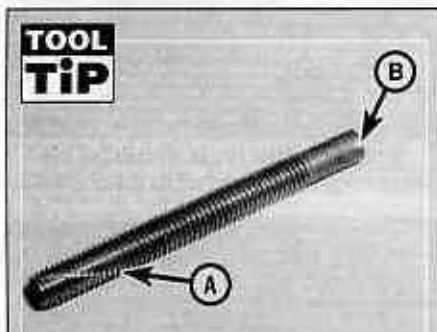
Preparation for refitting

39 The mating surfaces of the cylinder head and cylinder block/crankcase must be perfectly clean before refitting the head. Use a hard plastic or wood scraper to remove all traces of gasket and carbon; also clean the piston crowns. 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.

40 Check the mating surfaces of the cylinder block and cylinder head for nicks, deep scratches and other damage. If slight, they may be removed carefully with abrasive paper.

41 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).
42 Before refitting the cylinder head the correct new gasket must be selected, although unless new pistons have been fitted the new cylinder head gasket will be the same thickness as the old one. The following procedure will verify the correct thickness required. Using a dial gauge positioned on the cylinder block, check the protrusion of each piston by turning the crankshaft until the relevant piston is at TDC (see illustration). Make a note of the protrusion for each cylinder then add them up and divide by 4 to give a mean average protrusion. Using the following table select the correct gasket - the notches are located on the front right-hand end of the gasket.



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



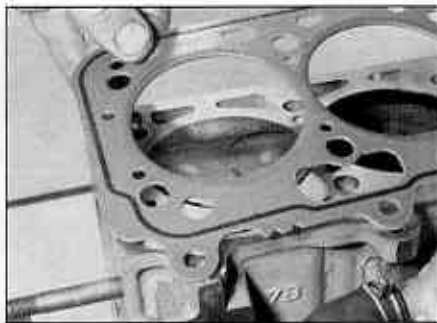
9.42 Checking the piston protrusion with a dial gauge

Average piston protrusion	Gasket thickness	Number of notches
- 0.03 to - 0.1 mm	1.65 mm	-
0.1 to 0.3 mm	1.80 mm	1
0.3 to 0.43 mm	1.95 mm	2

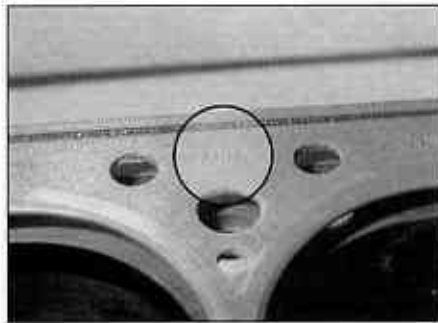
Caution: The cylinder head gasket is made of special material which hardens while the engine is running. Keep the gasket sealed in its plastic bag until just before fitting.



9.46a The locating dowel in the cylinder block



9.46b Locating the cylinder head gasket on the block



9.46c The word ALTO must be uppermost

43 It is possible for the piston crowns to strike and damage the valve heads, if the camshaft is rotated with the timing belt removed and the crankshaft set to TDC. For this reason, the crankshaft must be set to a position other than TDC on No 1 cylinder before the cylinder head is refitted. Use a socket on the crankshaft pulley centre bolt to turn the crankshaft in its normal direction of rotation, until all four pistons are positioned halfway down their bores, with No 1 piston on its upstroke - approximately 90° before TDC.

Refitting

44 If the manifolds are being refitted before refitting the cylinder head proceed as follows, otherwise fit the manifolds later when the head is refitted. Ensure that the inlet and exhaust manifold mating surfaces are completely clean, then locate the new gasket on the studs.

45 Locate the inlet and exhaust manifolds together with the turbocharger, where applicable, on the studs. Refit the nuts and washers and tighten to the specified torque.

46 Lay the new head gasket on the cylinder block engaging it with the locating dowel. The word ALTO must be uppermost (see illustrations).

47 As a means of locating the cylinder head accurately, cut the heads from two of the old cylinder head bolts. Cut a slot, big enough for a screwdriver blade, in the end of each bolt. These can be used as alignment dowels to assist in cylinder head refitting, however if the head is being refitted without the manifolds it is not necessary to take this action.

48 With the help of an assistant, place the cylinder head assembly centrally on the cylinder block ensuring that the locating dowels engage with the holes in the cylinder head. Check that the head gasket is correctly seated before allowing the full weight of the cylinder head to rest on it.

49 Where necessary, unscrew the home-made alignment dowels, using a flat bladed screwdriver.

50 The cylinder head bolt threads must be clean. Dip the bolts in engine oil, and allow them to drain for thirty minutes.

51 Carefully enter each bolt with washer into its relevant hole (do not drop them in) and screw in, by hand only, until finger-tight.

52 Working progressively and in the sequence shown, first tighten the cylinder head bolts to their Stage 1 torque setting, using a torque wrench and suitable socket (see illustrations). Go round again, in the sequence shown, and tighten the bolts to the Stage 2 torque setting.

53 Once all the bolts have been tightened to their Stage 2 setting, working again in the

given sequence, angle-tighten the bolts through the specified Stage 3 angle, using a socket and extension bar (see illustration). 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 the bolt has been rotated through the correct angle during tightening. Repeat for the Stage 4 setting.

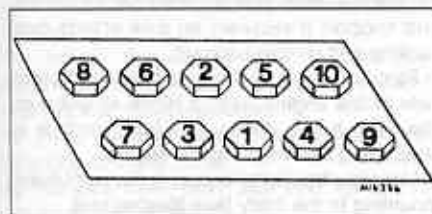
54 Refit the cylinder head front retaining bolts and tighten to the specified torque.

55 Refit the camshaft cover together with a new gasket and tighten the bolts progressively to the specified torque.

56 The remaining procedure is a reversal of the removal procedure noting the following points.

- a) Tighten all nut and bolts to the specified torque where given.
- b) When refitting the metal coolant pipe to the coolant pump, use a new O-ring (see illustration).
- c) Refit the timing belt with reference to Section 4.
- d) Use a new exhaust front pipe gasket.
- e) Refit the auxiliary drivebelt(s) as described in Chapter 1B.
- f) Refer to Chapter 4C when refitting the air cleaner and air duct.
- g) Refill the cooling system and fill the engine with new oil with reference to Chapter 1B.

57 Refer to Chapter 2D when starting the engine for the first time.



9.52a Cylinder head bolt tightening sequence



9.52b Tighten the cylinder head bolts to the Stage 1 and Stage 2 settings using a torque wrench



9.53 Angle-tightening the cylinder head bolts to the Stage 3 and Stage 4 settings



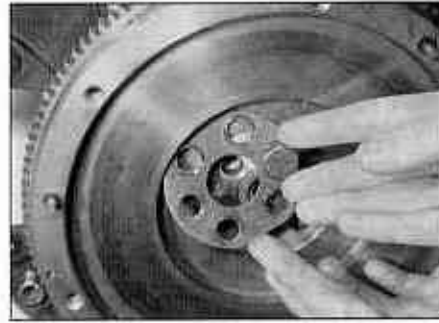
9.56 Use a new O-ring on the coolant pipe before refitting it to the pump



10.2 Locking the flywheel using a home-made tool



10.3a Unscrew the flywheel bolts . . .



10.3b . . . and remove the spacer plate

10 Flywheel - removal, inspection and refitting

Removal

- 1 Remove the transmission and clutch as described in Chapter 7A and 6.
- 2 Lock the flywheel in position using a home-made locking tool, fabricated from a piece of scrap metal. Bolt it to one of the transmission bellhousing mounting holes (see illustration). Mark the position of the flywheel with respect to the crankshaft using a dab of paint. Note that although there is only one location dowel on the flywheel, there are two holes in the end of the crankshaft and it is therefore possible to locate the flywheel 180° out resulting in the timing mark being in the incorrect position.
- 3 Unscrew and remove the flywheel mounting bolts then lift off the flywheel. Recover the spacer plate (see illustrations). Discard the flywheel retaining bolts; new ones must be used on refitting.

Inspection

- 4 If the flywheel's clutch mating surface is deeply scored, cracked or otherwise damaged, the flywheel must be renewed. However, it may be possible to have it surface-ground; seek the advice of a Fiat dealer or engine reconditioning specialist.
- 5 If the ring gear is badly worn or has missing teeth, the flywheel must be renewed.

Refitting

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

HAYNES HINT

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

- 7 If the new flywheel retaining bolts are not



10.8a Location dowel on the flywheel



10.8b Inserting the flywheel bolts

supplied with their threads already pre-coated, apply a suitable thread-locking compound to the threads of each bolt.

- 8 Offer up the flywheel to the crankshaft, using the alignment marks made during removal, and fit the new retaining bolts together with the spacer plate (see illustrations).

- 9 Lock the flywheel using the method employed on dismantling, and tighten the retaining bolts to the specified torque.

- 10 Refit the clutch as described in Chapter 6. Remove the locking tool and refit the transmission as described in Chapter 7A.

11 Engine mountings - inspection and renewal

Inspection

- 1 Firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*).
- 2 Check the mounting rubbers to see if they are cracked, hardened or separated from the metal at any point; renew the mounting if any such damage or deterioration is evident.
- 3 Check that all the mounting's fasteners are securely tightened.
- 4 Using a large screwdriver or a crowbar, check for wear in the mounting by carefully levering against it to check for free play. Where this is not possible enlist the aid of an assistant to move the engine/transmission back and forth, or from side to side, while you watch the mounting. While some free play is to be

expected even from new components, excessive wear should be obvious. If excessive free play is found, check first that the fasteners are correctly secured, then renew any worn components as described below.

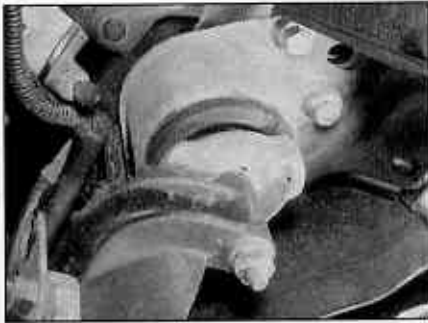
Renewal

Right-hand mounting

- 5 If not already done, firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*).
- 6 Place a trolley jack beneath the right-hand side of the engine, with a block of wood on the jack head. Raise the jack until it is supporting the weight of the engine.
- 7 Unscrew the bolts securing the right-hand mounting to the body (see illustration).
- 8 Unscrew the special long nut securing the mounting to the engine and recover the washers.



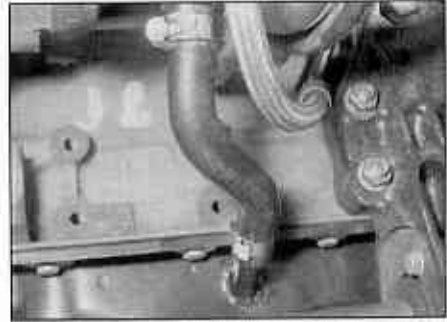
11.7 Right-hand engine mounting viewed from below



11.15 Left-hand engine mounting viewed from below



11.22 Rear engine mounting viewed from below



12.4 Turbocharger-to-sump oil drain hose

9 Lower the engine sufficiently to remove the mounting from the engine bracket.

10 Locate the new mounting in the engine bracket, refit the nut and washers and tighten securely.

11 Raise the engine and refit and tighten the mounting-to-body bolts.

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

Left-hand mounting

13 If not already done, firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*).

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

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

16 Unscrew the nut securing the mounting to the transmission bracket and recover the washers.

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

18 Locate the new mounting in the transmission bracket, refit the nut and washers and tighten securely.

19 Raise the engine and refit and tighten the mounting-to-body bolts.

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

Rear mounting

21 If not already done, firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*).

22 Working beneath the vehicle, unscrew the bolts securing the rear engine mounting to the underbody (see illustration).

23 Temporarily support the weight of the engine/transmission using a trolley jack.

24 Unbolt the rear mounting assembly from the transmission and withdraw from under the vehicle.

25 Unscrew the bolt and separate the bracket from the mounting.

26 Fitting the new mounting is a reversal of the removal procedure.

12 Sump - removal and refitting

Removal

1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

2 Firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*).

3 Drain the engine oil as described in Chapter 1B. Where applicable, remove the screws and lower the engine undertray away from the vehicle.

4 On turbo models disconnect the turbocharger oil drain hose from the sump (see illustration).

5 Working around the outside of the sump, progressively loosen and withdraw the sump retaining bolts.

6 Break the joint by striking the sump with the palm of your hand, then lower the sump and withdraw it from underneath the vehicle. Recover and discard the sump gasket.

7 While the sump is removed, take the opportunity to check the oil pump pick-up/strainer for signs of clogging. If necessary, clean or renew the strainer.

Refitting

8 Thoroughly clean the sump inside and out ensuring that all traces of gasket are removed from the mating surfaces of both the sump and the cylinder block/crankcase.

9 Ensure that the mating surfaces are clean and dry, then apply a little grease to the surface of the sump. This will retain the gasket in position while refitting the sump.

10 Lay the new sump gasket in position on the sump mating surface, then offer up the sump and refit the retaining bolts. Tighten the bolts evenly and progressively to the specified torque.

11 On turbo models reconnect the turbocharger oil drain hose.

12 Lower the vehicle to the ground then refer to Chapter 1B and refill the engine with the specified grade and quantity of oil.

13 Reconnect the battery negative terminal.

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

Removal

1 The oil pump is mounted on the timing belt end of the cylinder block and is driven by flats on the crankshaft nose. Incorporated in the oil pump body is the crankshaft oil seal.

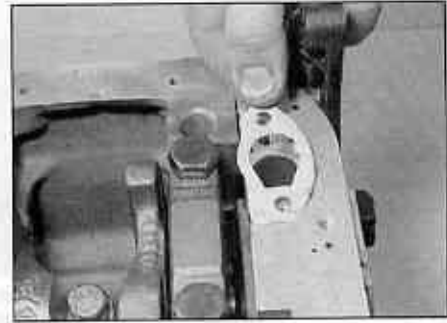
2 Remove the timing belt as described in Section 4, and the crankshaft sprocket as described in Section 5.

3 Remove the sump as described in Section 12.

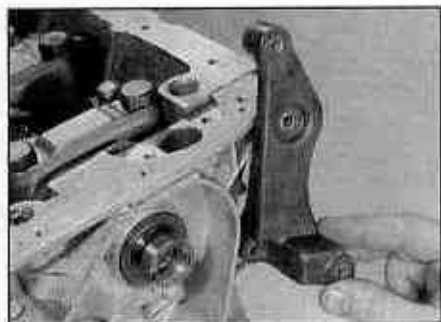
4 Unscrew the bolts securing the pick-up tube to the bottom of the oil pump. Also unscrew the bolt securing the tube to the No 2 main bearing cap. Withdraw the tube from the oil pump and crankcase. Recover the gasket (see illustrations).



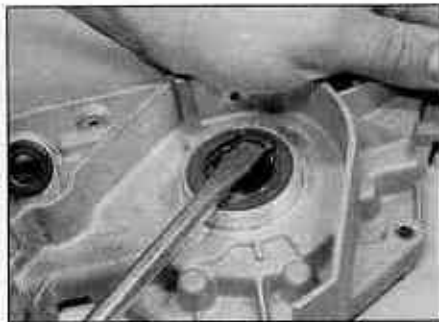
13.4a Removing the oil pump pick-up tube ...



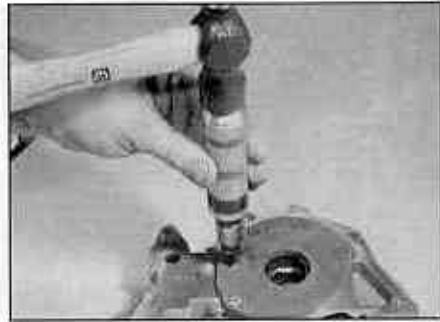
13.4b ... and gasket



13.5 Note the location of the bracket on the oil pump



13.6 Prising the oil seal from the oil pump housing



13.7 Using an impact driver to loosen the oil pump cover screws



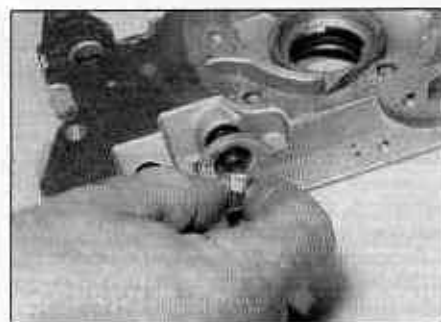
13.8a Removing the inner rotor ...



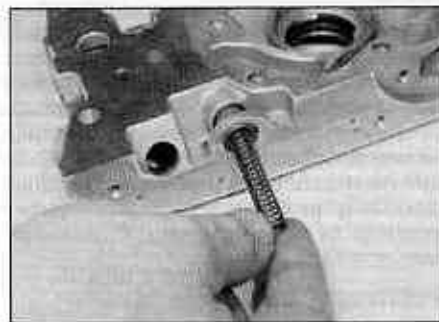
13.8b ... and outer rotor



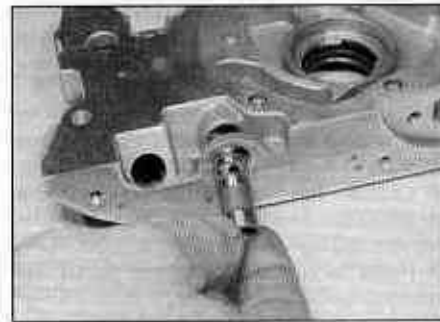
13.9a Depress the relief valve collar and remove the retaining plate ...



13.9b ... then remove the seat ...



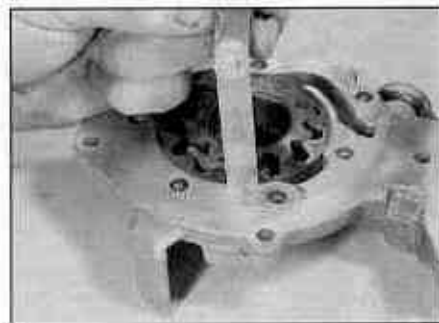
13.9c ... spring ...



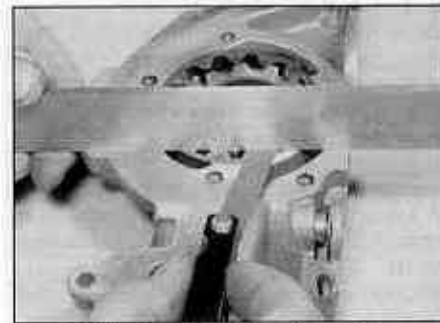
13.9d ... and valve



13.9e Oil pump housing and components



13.10a Checking the outer rotor-to-casing clearance



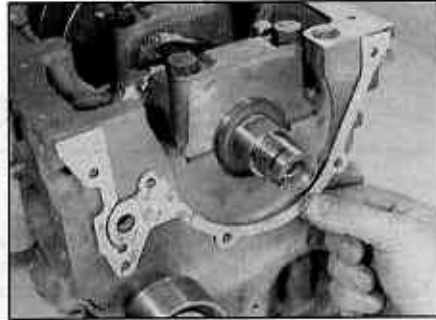
13.10b Checking the rotor endplay



13.14 Fitting the new oil seal to the oil pump casing



13.15 Engine oil dipstick rubber grommet in the oil pump casing



13.16 Positioning the oil pump gasket on the cylinder block

5 Unscrew the bolts securing the oil pump to the front of the cylinder block and withdraw it over the nose of the crankshaft. Note the location of the bracket (see illustration). Recover the gasket.

Inspection

6 Prise the oil seal from the front of the oil pump using a screwdriver (see illustration).

7 Unscrew the crosshead screws and lift off the cover. The screws are tight and are best loosened using an impact driver (see illustration).

8 Lift out the two rotors keeping them identified for position in relation to each other (see illustrations).

9 Depress the relief valve collar, then extract the retaining plate and withdraw the seat, spring and valve (see illustrations).

10 Clean the pump thoroughly, and inspect the rotors for signs of damage or wear. Using a feeler blade, check the wear between the outer rotor and oil pump casing. Using the feeler blade and a straight-edge, check the endplay of the rotors. If the rotors are worn in excess of the specified amount given in Specifications, the oil pump should be renewed as a complete unit (see illustrations).

11 Check the condition of the relief valve and seating - if worn excessively the pump must be renewed.

12 If the components are in good condition, reassemble the pump using a reversal of the dismantling procedure. Before fitting the cover the rotors should be oiled and the cavity

between them filled with clean engine oil. Make sure the cover screws are fully tightened.

13 Thoroughly clean the mating surfaces of the oil pump and cylinder block.

14 Dip the new oil seal in engine oil then locate it on the front of the oil pump with the sealing lips facing inwards. Use a suitable tubular drift (or socket) to drive the seal into the oil pump casing (see illustration).

15 Examine the dipstick tube rubber grommet in the oil pump and renew it if necessary (see illustration).

Refitting

16 Smear a little engine oil on both sides of the new gasket then locate it on the cylinder block (see illustration).

17 To prevent damage to the new oil seal as it is passed over the nose of the crankshaft, wrap some adhesive tape around it and lightly oil it.

18 Carefully locate the oil pump over the crankshaft taking care not to damage the oil seal then insert the bolts loosely. Remove the adhesive tape (see illustration).

19 Using a straight-edge, position the oil pump so that the sump mating surface is level with the surface of the crankcase (see illustration). With the pump correctly positioned, securely tighten the bolts in an even and progressive sequence.

20 Refit the oil pick-up tube together with a new gasket, and securely tighten the mounting bolts.

21 Refit the sump with reference to Section 12.

22 Refit the crankshaft sprocket with reference to Section 5 and the timing belt with reference to Section 4.

23 When starting the engine, let it idle until the oil pressure warning light goes out.

14 Oil cooler - removal and refitting

Removal

1 The oil cooler is located on the right-hand side of the engine compartment. First remove the front bumper as described in Chapter 11.

2 Unbolt the support bar for the radiator and oil cooler.

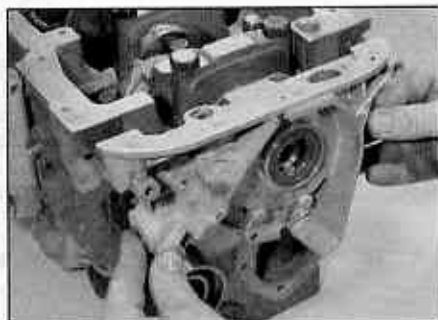
3 Support the oil cooler then unscrew the upper mounting bolt. Lower the cooler to the extent of the hoses.

4 Position a container beneath the cooler then unscrew the inlet and outlet union nuts and disconnect the hoses from the oil filter. Note the fitted positions of the hoses for correct refitting. Allow the oil to drain into the container.

5 Fully unscrew the union nuts and disconnect the hoses from the oil cooler.

Refitting

6 Refitting is a reversal of removal, but top-up the engine oil level as necessary. Run the engine and check for leaks.



13.18 Locating the oil pump over the end of the crankshaft



13.19 Checking that the oil pump and sump mating surfaces are correctly aligned with a straight-edge






Chapter 2 Part D:

Engine removal and overhaul procedures

Contents

Crankshaft - refitting and main bearing running clearance check . . .	12	Engine overhaul - dismantling sequence	5
Crankshaft - removal and inspection	8	Engine overhaul - general information	2
Cylinder block/crankcase - cleaning and inspection	9	Engine overhaul - reassembly sequence	11
Cylinder head - dismantling, cleaning inspection and reassembly . .	6	General information	1
Engine and transmission - removal, separation, connection and refitting	4	Main and big-end bearings - inspection and selection	10
Engine and transmission removal - methods and precautions	3	Pistons and connecting rods - removal, inspection, refitting and big-end bearing running clearance check	7
Engine - initial start-up after overhaul and reassembly	13		

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

Engine codes

See Chapter 2A, 2B or 2C.

Cylinder head

Camshaft bearing diameters:

Petrol engines:	
No 1 bearing	24.045 to 24.070 mm
No 2 bearing	23.545 to 23.570 mm
No 3 bearing	24.025 to 24.070 mm
Diesel engine:	
No 1 bearing (in right-hand side mount)	29.990 to 30.015 mm
No 2 bearing	25.545 to 25.570 mm
No 3 bearing	24.045 to 24.070 mm
No 4 bearing (in left-hand side mount)	23.990 to 24.015 mm
Valve seat angle	45° ± 5'

Cam follower (tappet) running clearance in head* 0.005 to 0.050 mm

Difference between swirl chamber and cylinder head surface (diesel engine only) -0.765 to 0.055 mm

* Refer to Chapter 2B for camshaft and cam follower specifications on 1242 cc (16-valve) petrol engines.

Valves

Valve stem diameter (inlet and exhaust):

Petrol engines:	
1108 cc and 1242 cc (8-valve) engines	6.982 to 7.000 mm
1242 cc (16-valve) engine	5.974 to 5.992 mm
Diesel engine	7.974 to 7.992 mm
Valve face angle	45° 30' ± 5'

Valve stem-to-guide clearance:

Petrol engines:	
1108 cc and 1242 cc (8-valve) engines	0.022 to 0.058 mm
1242 cc (16-valve) engine	0.030 to 0.066 mm
Diesel engine	0.030 to 0.066 mm
Cam follower (tappet) shim sizes	3.20 to 4.70 mm in increments of 0.05 mm

Camshaft

Camshaft bearing journal diameters:

No 1 bearing	Petrol engines 24.000 to 24.015 mm	Diesel engine 29.945 to 29.960 mm
No 2 bearing	23.500 to 23.515 mm	25.500 to 25.515 mm
No 3 bearing	24.000 to 24.015 mm	24.000 to 24.015 mm
No 4 bearing	N/A	23.945 to 23.960 mm
Camshaft bearing running clearance*	0.030 to 0.070 mm	
Camshaft endfloat*	0.070 to 0.250 mm	

* Refer to Chapter 2B for camshaft specifications on 1242 cc (16-valve) engines.

Cylinder block

Bore diameter:

Petrol engines:	
1108 cc engine	70.000 to 70.030 mm
1242 cc engine	70.800 to 70.830 mm
Diesel engine	82.600 to 82.650 mm
Undersizes	Increments of 0.010 mm

Pistons and piston rings

Piston diameter:

Petrol engines:

Grade A:	
1108 cc engine	69.960 to 69.970 mm
1242 cc engine	70.760 to 70.770 mm
Grade B:	
1108 cc engine	69.970 to 69.980 mm
1242 cc engine	70.770 to 70.780 mm
Grade C:	
1108 cc engine	69.980 to 69.990 mm
1242 cc engine	70.780 to 70.790 mm
Diesel engine:	
Grade A	82.530 to 82.540 mm
Grade B	-
Grade C	82.550 to 82.560 mm
Grade E	82.570 to 82.580 mm

Piston projection above top of bore:

Diesel engine	0.637 to 1.162 mm
---------------	-------------------

Piston to bore clearance:

Petrol engines	0.030 to 0.050 mm
Diesel engine	0.060 to 0.080 mm

Maximum difference in weight between pistons

Gudgeon pin diameter	± 5g
Gudgeon pin-to-piston clearance:	17.970 to 17.974 mm

Gudgeon pin-to-piston clearance:

Petrol engines	0.008 to 0.016 mm
Diesel engine	0.003 to 0.009 mm

Piston ring-to-groove clearance:

Petrol engines:	
Top compression ring:	
1108 cc engine	0.040 to 0.075 mm
1242 cc (8-valve) engine	0.040 to 0.080 mm
1242 cc (16-valve) engine	0 to 0.06 mm
2nd compression ring:	
1108 cc and 1242 cc (8-valve) engines	0.020 to 0.055 mm
1242 cc (16-valve) engine	0 to 0.055 mm
Oil scraper ring:	
1108 cc and 1242 cc (8-valve) engines	0.020 to 0.055 mm
1242 cc (16-valve) engine	0 to 0.055 mm
Diesel engine:	
Top compression ring	0.080 to 0.130 mm
2nd compression ring	0.020 to 0.052 mm
Oil scraper ring	0.030 to 0.065 mm

Piston ring end gap:

Petrol engines:	
Top compression ring:	
1108 cc engine	0.25 to 0.45 mm
1242 cc engine	0.20 to 0.40 mm
2nd compression ring	0.25 to 0.45 mm
Oil scraper ring	0.20 to 0.45 mm
Diesel engine:	
Top compression ring	0.020 to 0.350 mm
2nd compression ring	0.300 to 0.500 mm
Oil scraper ring	0.250 to 0.500 mm

Connecting rods

Gudgeon pin-to-small end clearance:

Petrol engines	Interference fit
Diesel engine	0.014 to 0.020 mm

Crankshaft

Main bearing journal diameters:

Petrol engines:

1108 cc engine:

Grade 1	43.994 to 44.000 mm
Grade 2	43.988 to 43.994 mm
Grade 3	43.982 to 43.988 mm

1242 cc engine:

Grade 1	47.994 to 48.000 mm
Grade 2	47.988 to 47.994 mm
Grade 3	47.982 to 47.988 mm

Diesel engine:

Grade 1	52.995 to 53.004 mm
Grade 2	52.986 to 52.995 mm

Crankpin journal diameters:

Petrol engines:

1108 cc engine:

Grade A	38.001 to 38.008 mm
Grade B	37.995 to 38.001 mm
Grade C	37.988 to 37.995 mm

1242 cc (8-valve) engine:

Grade A	42.001 to 42.008 mm
Grade B	41.995 to 42.001 mm
Grade C	41.988 to 41.995 mm

1242 cc (16-valve) engine:

Grade A	41.990 to 42.008 mm
---------------	---------------------

Diesel engine:

Grade A	50.796 to 50.805 mm
Grade B	50.787 to 50.796 mm

Main bearing running clearance:

Petrol engines:

1108 cc and 1242 cc (8-valve) engines	0.025 to 0.049 mm
1242 cc (16-valve) engine	0.025 to 0.040 mm

Diesel engine

	0.027 to 0.066 mm
--	-------------------

Big-end bearing running clearance:

Petrol engines:

1108 cc and 1242 cc (8-valve) engines	0.024 to 0.062 mm
1242 cc (16-valve) engine	0.024 to 0.060 mm

Diesel engine

	0.026 to 0.063 mm
--	-------------------

Crankshaft endfloat:

Petrol engines	0.055 to 0.265 mm
Diesel engine	0.049 to 0.231 mm

2D

Torque wrench settings

Petrol engines

	Nm	lbf ft
Big-end bolt	41	30
Camshaft bearing caps (1108 cc and 1242 cc (8-valve) engines):		
M8 x 1.25	20	15
M8	10	7
Main bearing cap:		
Stage 1	40	30
Stage 2	Angle-tighten a further 90°	

Diesel engines

Big-end bolt:		
Stage 1	25	18
Stage 2	Angle-tighten a further 50°	
Camshaft bearing caps	19	14
Camshaft side mounts	19	14
Main bearing cap	113	83
Swirl chamber to head	118	87

1 General information

Included in this Part of Chapter 2 are details of removing the engine/transmission from the car and general overhaul procedures for the cylinder head, cylinder block/crankcase and all other engine internal components.

The information given ranges from advice concerning preparation for an overhaul and the purchase of replacement parts, to detailed step-by-step procedures covering removal, inspection, renovation and refitting of engine internal components.

After Section 5, all instructions are based on the assumption that the engine has been removed from the car. For information concerning in-car engine repair, as well as the removal and refitting of those external components necessary for full overhaul, refer to Part A, B or C of this Chapter (as applicable) and to Section 5. Ignore any preliminary dismantling operations described in Part A, B or C that are no longer relevant once the engine has been removed from the car.

2 Engine overhaul - general information

1 It is not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

2 High mileage is not necessarily an indication that an overhaul is needed, while low mileage does not preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine which has had regular and frequent oil and filter changes, as well as other required maintenance, should give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

3 Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks are not responsible before deciding that the rings and/or guides are worn. Perform a compression test, as described in Parts A or B (petrol engines) or C (diesel engines) of this Chapter, to determine the likely cause of the problem.

4 Check the oil pressure with a gauge fitted in place of the oil pressure switch. If it is extremely low, the main and big-end bearings, and/or the oil pump, are probably worn out.

5 Loss of power, rough running, knocking or metallic engine noises, excessive valve gear noise, and high fuel consumption may also point to the need for an overhaul, especially if

they are all present at the same time. If a complete service does not remedy the situation, major mechanical work is the only solution.

6 An engine overhaul involves restoring all internal parts to the specification of a new engine. During an overhaul, the cylinders are rebored (where applicable), the pistons and the piston rings are renewed. New main and big-end bearings are generally fitted; if necessary, the crankshaft may be reground, to restore the journals.

7 The valves are also serviced as well, since they are usually in less-than-perfect condition at this point. While the engine is being overhauled, other components, such as the starter and alternator, can be overhauled as well. The end result should be an as-new engine that will give many trouble-free miles.

Note: *Critical cooling system components such as the hoses, thermostat and coolant pump should be renewed when an engine is overhauled. The radiator should be checked carefully, to ensure that it is not clogged or leaking. Also, it is a good idea to renew the oil pump whenever the engine is overhauled.*

8 Before beginning the engine overhaul, read through the entire procedure, to familiarise yourself with the scope and requirements of the job. Overhauling an engine is not difficult if you follow carefully all of the instructions, have the necessary tools and equipment, and pay close attention to all specifications. It can, however, be time-consuming. Plan on the car being off the road for a minimum of two weeks, especially if parts must be taken to an engineering works for repair or reconditioning.

9 Check on the availability of parts and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be renewed. Often the engineering works will handle the inspection of parts and offer advice concerning reconditioning and renewal. **Note:** *Always wait until the engine has been completely dismantled, and until all components (especially the cylinder block/crankcase and the crankshaft) have been inspected, before deciding what service and repair operations must be performed by an engineering works. The condition of these components will be the major factor to consider when determining whether to overhaul the original engine, or to buy a reconditioned unit. Do not, therefore, purchase parts or have overhaul work done on other components until they have been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it does not pay to fit worn or sub-standard parts.*

10 As a final note, to ensure maximum life and minimum trouble from a reconditioned engine, everything must be assembled with care, in a spotlessly-clean environment.

3 Engine and transmission removal - methods and precautions

1 If you have decided that the engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

2 Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the car, will be needed. If a workshop or garage is not available, at the very least, a flat, level, clean work surface is required.

3 Cleaning the engine compartment and engine/transmission before beginning the removal procedure will help keep tools clean and organised.

4 An engine hoist or A-frame will also be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and transmission. Safety is of primary importance, considering the potential hazards involved in lifting the engine/transmission out of the car.

5 If this is the first time you have removed an engine, an assistant should ideally be available. Advice and aid from someone more experienced would also be helpful. There are many instances when one person cannot simultaneously perform all of the operations required when lifting the engine out of the vehicle.

6 Plan the operation ahead of time. Before starting work, arrange for the hire of or obtain all of the tools and equipment you will need. Some of the equipment necessary to perform engine/transmission removal and installation safely and with relative ease (in addition to an engine hoist) is as follows: a heavy duty trolley jack, complete sets of spanners and sockets as described in the reference section of this manual, wooden blocks, and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and fuel. If the hoist must be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand. This will save you money and time.

7 Plan for the car to be out of use for quite a while. An engineering works will be required to perform some of the work which the do-it-yourselfer cannot accomplish without special equipment. These places often have a busy schedule, so it would be a good idea to consult them before removing the engine, in order to accurately estimate the amount of time required to rebuild or repair components that may need work.

8 Always be extremely careful when removing and refitting the engine/transmission. Serious injury can result from careless actions. Plan ahead and take your time, and a job of this nature, although major, can be accomplished successfully.

4 Engine and transmission - removal, separation, connection and refitting



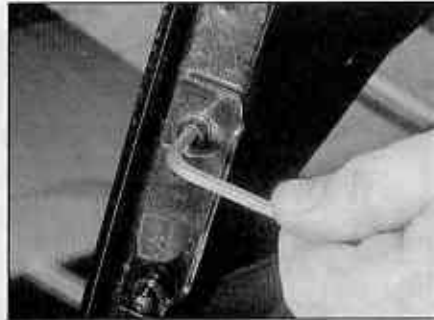
Note: The engine is lowered from the engine compartment as a complete unit with the transmission; the two are then separated for overhaul.

Removal

- 1 Remove the bonnet and disconnect the washer tubing as described in Chapter 11 (see illustrations).
- 2 Apply the handbrake, then jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove both front wheels. In order to remove the engine/transmission assembly in an upright position from under the vehicle, there must be a minimum clearance of 660 mm between the floor and the front crossmember. Additional height is necessary if the assembly is to be lowered onto a trolley.
- 3 Where fitted, unbolt and remove the engine compartment lower cover.
- 4 Remove the auxiliary drivebelt(s) with reference to Chapter 1A or 1B.
- 5 Drain the engine oil, transmission oil/fluid and coolant with reference to Chapter 1A or 1B.
- 6 Remove the battery (see Chapter 5A).
- 7 On manual transmission models with a cable clutch, disconnect the clutch cable from the transmission (refer to Chapter 6). On manual transmission models with a hydraulic clutch unbolt the clutch slave cylinder from the top of the transmission then fit a cable-tie around it to prevent the piston coming out (see illustration). Position the cylinder to one side.
- 8 Unscrew the nut and disconnect the earth lead from the transmission (see illustration).

Petrol engines

- 9 Unbolt and remove the battery tray.
- 10 Disconnect the wiring from the reversing light switch.
- 11 On manual transmission models disconnect the reverse inhibition cable from the transmission then disconnect the gear selector rod from the lever on the transmission.
- 12 Remove the air cleaner and ducting as described in Chapter 4A or 4B.
- 13 On automatic transmission models disconnect the kickdown cable and gear selector cable as described in Chapter 7B. Also disconnect the wiring for the electromagnetic clutch.
- 14 Unbolt and remove the cover from the bulkhead then disconnect the oxygen sensor wiring.
- 15 Disconnect the remaining wiring at the bulkhead and release the fuse holders at the mounting.
- 16 Disconnect the vacuum pipe from the inlet manifold, and also disconnect the wiring connector located next to it.



4.1a Unscrewing the bonnet hinge bolts



4.1b Disconnecting the washer tubing

- 17 Unscrew the nuts and separate the engine wiring harness lead from the battery positive cable terminal.
- 18 Disconnect the accelerator cable from the engine as described in Chapter 4A or 4B.
- 19 Loosen the clip and disconnect the radiator top hose from the elbow on the left-hand end of the cylinder head. Similarly disconnect the bottom hose. On 16-valve models, remove the radiator electric cooling fan as described in Chapter 3.
- 20 Identify the hoses connected to the throttle housing, then disconnect them.
- 21 Identify the coolant heater hoses on the bulkhead for position, then loosen the clips and disconnect the hoses.
- 22 Loosen the clip and disconnect the brake servo vacuum hose from the inlet manifold. Where applicable, disconnect the remaining emission control system vacuum hoses from the inlet manifold after identifying their locations to aid refitting.
- 23 Disconnect the fuel supply and return hoses from the throttle housing.
- 24 Release the connector from the ignition/fuel ECU located on the right-hand side of the engine compartment.
- 25 Unscrew the nut and detach the earth cable from its location near the ECU.
- 26 Disconnect the diagnostic connector located near the ECU.
- 27 On models fitted with power steering, refer to Chapter 10 and unbolt the power steering pump from the front of the engine without disconnecting the hydraulic fluid lines then tie it to one side so that it will not obstruct the removal of the engine. On

- models with air conditioning, similarly unbolt the air conditioning compressor and position it clear of the engine. Do not disconnect the air conditioning refrigerant pipes/hoses.
- 28 On manual transmission models pull out the retaining plate and disconnect the gear selector cable from the lever on the transmission.
 - 29 Unscrew the nuts retaining the track rod ends on the swivel hubs and use a balljoint separator tool to disconnect them.
 - 30 Release the flexible brake fluid hoses and ABS system sensor wiring from the front suspension struts.
 - 31 On manual transmission models, unscrew the nuts from the outer ends of each driveshaft. To prevent the hubs from turning either have an assistant depress the brake pedal, or temporarily insert two wheel bolts and use a lever to hold the hub.
 - 32 On automatic transmission models use a suitable drift to drive out the roll pins securing the inner ends of the driveshafts to the transmission output stubs. Turn the driveshafts as necessary to access the roll pins.
 - 33 Unscrew the two bolts securing the right-hand swivel hub assembly to the front suspension strut, then move the hub assembly outwards. On manual transmission models release the outer end of the driveshaft from the hub assembly - on automatic transmission models slide the inner end of the driveshaft off the final drive output stub. Take care not to strain the flexible brake hose while doing this. Move the driveshaft to one side then temporarily refit the hub assembly to the strut. On manual transmission models, make



4.7 Fit a cable tie around the clutch slave cylinder to prevent the piston coming out



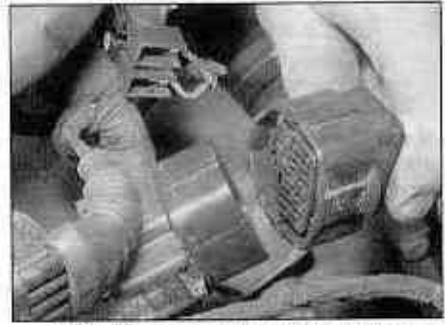
4.8 Disconnecting the earth lead from the transmission



4.36a Relay guard mounting nuts



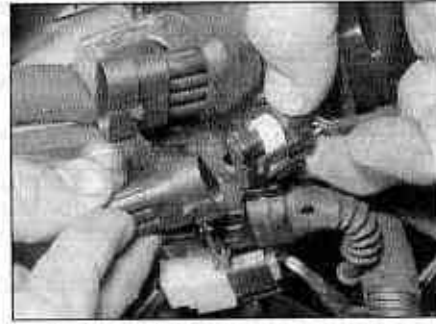
4.36b Battery tray and mounting bolts



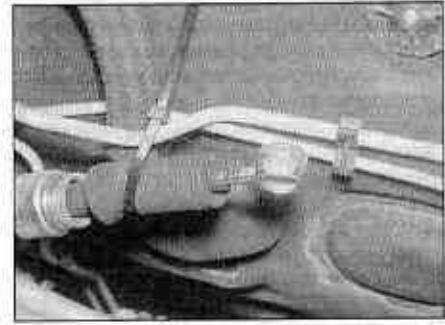
4.36c Disconnect the engine wiring harness located above the transmission ...



4.36d ... the inner wiring plug ...



4.36e ... and the outer wiring plug



4.37 Tie the gear selector cable to the bulkhead

sure that the driveshaft is positioned to clear the lower suspension arm when the engine is removed.

34 Disconnect the left-hand driveshaft using the same procedure.



4.41 Engine wiring harness connections to the battery positive cable

35 Remove the exhaust front downpipe with reference to Chapter 4D.

Diesel engines

36 Unbolt and remove the relay guard then disconnect the wiring as applicable and unbolt the battery tray (see illustrations).

37 Disconnect the gear selector cable from the transmission by removing the retaining plate and prising the socket end off the ball on the lever. Use a pair of pliers to pull out the plate. Tie the cable to the bulkhead (see illustration).

38 Unscrew the nut and disconnect the gear selector rod from the lever on the top of the transmission.

39 Remove the air cleaner and air inlet duct by unscrewing the two bolts securing the duct to the valve cover and loosening the clip securing the duct to the air cleaner. Refer to Chapter 4C if necessary.

40 Disconnect the vacuum pipe from the vacuum pump on the left-hand side of the cylinder head and disconnect the wiring plug located over the transmission.

41 Unscrew the nuts and disconnect the engine wiring harness from the battery positive cable (see illustration).

42 At the fuel filter unscrew the union bolt and disconnect the fuel delivery hose for the injection pump. Use polythene and an elastic band to cover the end of the hose (see illustrations).

43 At the fuel injection pump unscrew the clip and disconnect the fuel return hose (see illustration).

44 Disconnect the radiator top hose from the thermostat housing on the left-hand side of the cylinder head, and also disconnect the heater hose at the engine (see illustrations).

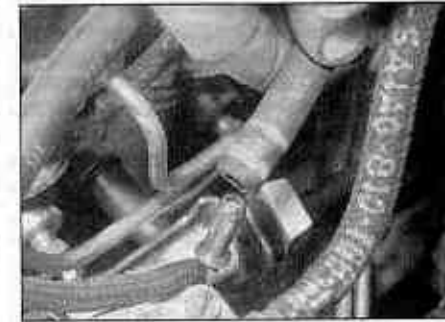
45 Disconnect the heater return hose and expansion tank hose from the elbow on the



4.42a Unscrew the union bolt and disconnect the fuel delivery hose from the fuel filter



4.42b Cover the end of the hose to prevent dust entry



4.43 Disconnecting the fuel return hose from the fuel injection pump



4.44a Disconnecting the radiator top hose from the thermostat housing



4.44b Disconnecting the heater hose at the engine



4.45a Disconnecting the heater return hose ...



4.45b ... and expansion tank hose



4.49a Remove the front bracket bolt ...



4.49b ... the belt adjustment bolt ...

left-hand side of the cylinder head, from the top of the radiator and from the expansion tank (see illustrations).

46 Disconnect the radiator bottom hose from the elbow on the cylinder head.

47 On models with a speedometer cable, disconnect the cable from the transmission.

48 On models with an electronic speedometer, if necessary disconnect the wiring connector on the support bracket. The cable may be left

attached if the transmission is not being detached from the engine.

49 On models fitted with power steering, unbolt the power steering pump from the rear right-hand side of the engine without disconnecting the hydraulic fluid lines then tie it to one side on the bulkhead so that it will not obstruct the removal of the engine. To do this first remove the front bracket bolt, remove the belt adjustment bolt, remove the rear through-bolt, lift away the cover and remove the adjustment lockbolt (see illustrations). On models with air conditioning, similarly unbolt the air conditioning compressor and position it clear of the engine. Do not disconnect the air conditioning refrigerant pipes/hoses.

50 Disconnect the coolant purge hoses from the top of the radiator and expansion tank (see illustrations).

51 Disconnect the accelerator cable from the injection pump (see Chapter 4C).



4.49c ... the rear through-bolt ...



4.49d ... the cover ...



4.49e ... and the adjustment lockbolt ...



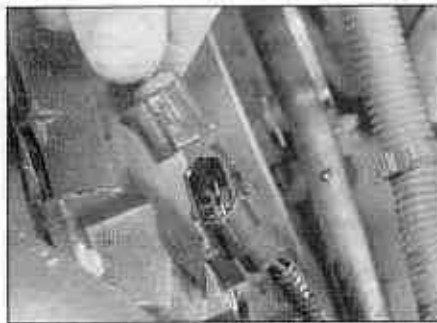
4.49f ... and tie the power steering pump to the bulkhead



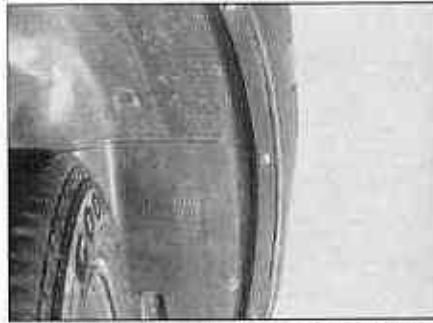
4.50a Disconnecting the coolant purge hoses from the radiator ...



4.50b ... and expansion tank



4.52 Disconnecting the radiator coolant temperature sensor wiring plug



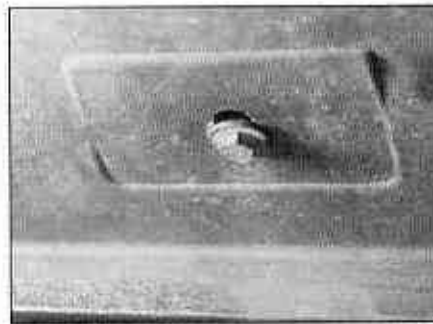
4.53a Wheel arch liner retaining screws



4.53b One of the wheel arch liner retaining screws is hidden in a recess



4.53c Bolt securing the front bumper to the valance



4.54 One of the front bumper lower retaining screws

52 On the radiator cooling fan housing, disconnect the wiring plug for the coolant temperature sensor (see illustration).

53 Unscrew the four front screws on each side retaining the wheel arch liners in order to

access the front bumper mounting bolts - one of the screws is hidden in a recess. Pull back the liners and use an extension and socket to unscrew the bolts securing the front bumper to the valance (see illustrations).

54 Unscrew and remove the front bumper lower retaining screws (see illustration).

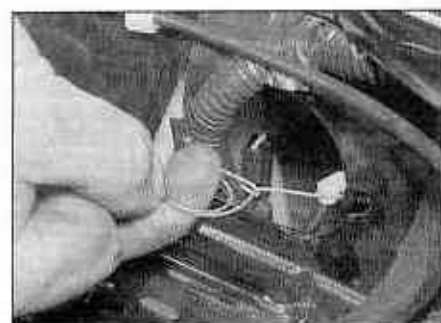
55 From inside the engine compartment, disconnect the wiring from the rear of the indicator lights and release the retaining clips (see illustration).

56 Unscrew the upper retaining screws and withdraw the front bumper from the body (see illustrations).

57 Unscrew the bolts securing the radiator lower mounting bracket to the body then prise the bracket from the rubbers on the bottom of the radiator (see illustrations).

58 Unscrew the upper mounting bolt securing the engine oil cooler then lower the cooler and support on an axle stand (see illustration). Take care not to damage the hoses.

59 Support the radiator then unscrew the radiator upper mounting bolts, and remove the radiator from the vehicle (see illustrations).



4.55 Releasing the retaining clips from the rear of the indicator lights



4.56a Side bumper retaining screw



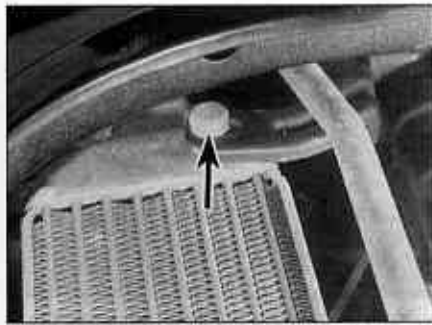
4.56b Centre bumper retaining screw



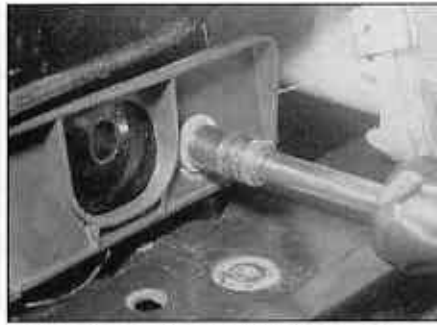
4.57a Radiator lower mounting bracket bolt



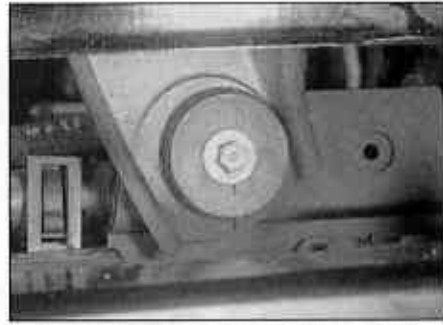
4.57b Removing the bracket from the rubbers on the bottom of the radiator



4.58 Engine oil cooler upper mounting bolt



4.59a Left-hand side radiator mounting bolt removal



4.59b Right-hand side radiator mounting bolt

60 At the oil filter, unscrew the union nuts and disconnect the oil cooler lines/hoses then remove the oil cooler from the vehicle (see illustration). Be prepared for some oil leakage. Note the fitted position of the hoses before disconnecting them so that they can be refitted correctly.

61 Disconnect the reversing light wiring from the switch on the front of the transmission (see illustration).

62 Using an Allen key, unscrew the bolts securing the inner ends of the driveshafts to the flanges on the transmission. The right-hand driveshaft is disconnected from the intermediate shaft flange on the rear of the engine. Recover the plates beneath the heads of the driveshaft bolts (see illustrations).

63 Unscrew the bolts securing the front swivel hub assemblies to the struts. Also

release the flexible brake hoses from the struts.

64 Move the swivel hub assemblies outwards and support the inner ends of the driveshafts on axle stands (see *Jacking and vehicle support*). Take care not to strain the flexible brake hoses.

65 Remove the exhaust front pipe with reference to Chapter 4D. If difficulty is experienced in separating the front pipe from the intermediate pipe, it may prove easier to remove the complete exhaust system.

All models

66 Attach a suitable hoist to the engine and transmission lifting eyes (see illustration). The left-hand eye is located on the transmission and the right-hand one on the right-hand side of the engine. Take the weight of the engine/transmission.

67 Working beneath the vehicle, unscrew the bolts securing the rear engine mounting to the underbody and transmission, and withdraw the mounting.

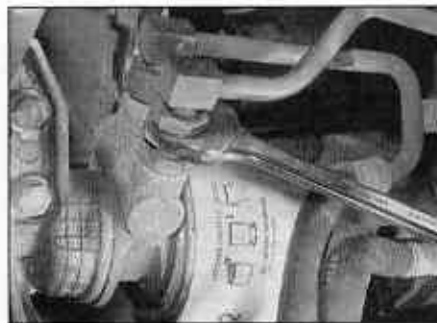
68 In the engine compartment, unscrew the bolts securing the right-hand engine mounting to the body and engine. For additional working room completely remove the mounting.

69 Unscrew the bolts securing the left-hand engine/transmission mounting to the body. For additional working room completely remove the mounting.

70 With the help of an assistant lower the engine/transmission from the engine compartment taking care not to damage the surrounding components (see illustration). Ideally lower the unit onto a low trolley so that it may be withdrawn from under the vehicle. Disconnect the hoist from the assembly.



4.59c Removing the radiator from the vehicle



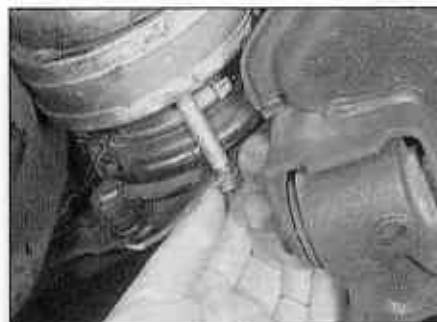
4.60 Loosening the union nuts securing the oil cooler lines to the oil filter housing



4.61 Disconnecting the reversing light wiring



4.62a Use an Allen key to unscrew the inner driveshaft bolts



4.62b Removing the driveshaft bolts and plates



4.66 Attaching a hoist to the engine and transmission assembly



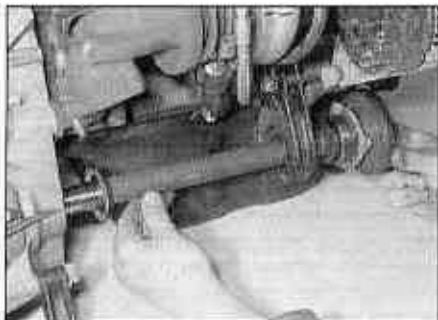
4.70 Lowering the engine/transmission assembly to the floor



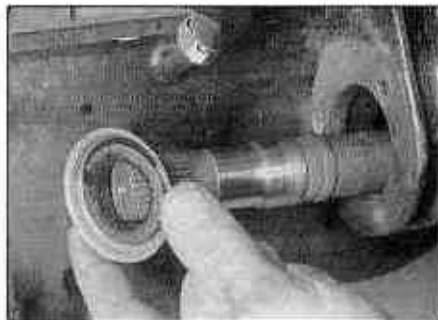
4.77 Removing the transmission lower cover



4.78 Removing the bolts securing the intermediate shaft to the bracket on the rear of the cylinder block



4.79a Withdraw the intermediate shaft . . .



4.79b . . . and recover the dust boot

Separation

71 Rest the engine and transmission assembly on a firm, flat surface, and use wooden blocks as wedges to keep the unit steady.

72 Note the routing and location of the wiring

harness on the engine/transmission assembly, then methodically disconnect it.

73 Remove the starter motor (Chapter 5A).

Petrol engines

74 Note the location of the earth leads on the

transmission support bracket on the rear of the cylinder block, then unscrew the securing bolts and move the leads to one side.

75 Unscrew the bolts on the transmission and remove the support bracket.

76 Unscrew the remaining bolts and remove the transmission lower cover.

Diesel engines

77 Unscrew the bolts and remove the transmission lower cover (see illustration).

78 Unscrew the bolts securing the intermediate shaft to the bracket on the rear of the cylinder block (see illustration).

79 Withdraw the intermediate shaft through the bracket and recover the dust boot from the inner end (see illustrations).

80 Unscrew the mounting bolts and remove the rpm sensor from the transmission (see illustrations).

Manual transmission models

81 Support the transmission with blocks of wood.

82 Unscrew the transmission-to-engine bolts. Also unscrew the nut securing the transmission to the rear of the cylinder block (see illustrations).

83 Lift the transmission complete with driveshafts directly from the rear of the engine, taking care to keep it level so that the transmission input shaft does not hang on the clutch (see illustration).

Automatic transmission models

84 Support the transmission with blocks of wood.



4.80a Unscrew the bolts . . .



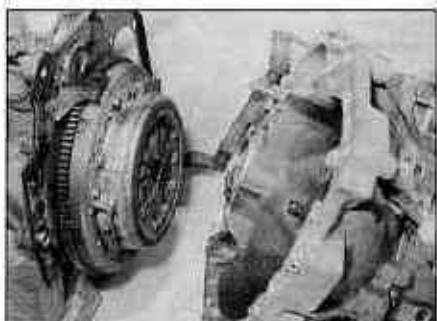
4.80b . . . and remove the rpm sensor from the transmission



4.82a Unscrewing the transmission-to-engine bolts



4.82b Nut securing the transmission to the rear of the cylinder block



4.83 Separating the engine from the transmission (petrol engine)

85 Remove the brush holder assembly from the automatic transmission as described in Chapter 7B, Section 4. The brushes bear on the slip rings at the rear of the electro-magnetic clutch housing and they may be damaged when the transmission is removed.

86 Unscrew and remove the transmission-to-engine bolts then carefully draw the transmission away from the engine, resting it securely on wooden blocks. Collect the locating dowels if they are loose enough to be extracted.

87 If the oil pump driveshaft remains engaged with the crankshaft, remove it and insert into the transmission to protect it from damage.

Connection

88 If the engine and transmission have not been separated, go to paragraph 104.

Manual transmission models

89 Smear a little high-melting-point grease on the splines of the transmission input shaft. Do not use an excessive amount as there is the risk of contaminating the clutch friction plate.

90 Carefully offer up the transmission to the engine cylinder block, guiding the input shaft through the clutch friction plate.

91 Refit the transmission-to-engine bolts and the single nut, hand tightening them to secure the transmission in position. **Note:** Do not tighten them to force the engine and transmission together. Ensure that the bellhousing and cylinder block mating faces will butt together evenly without obstruction, before finally tightening the bolts and nut securely.

Automatic transmission models

92 Check that the oil pump driveshaft is correctly engaged with the oil pump in the transmission.

93 Carefully offer up the transmission to the rear of the engine and insert the oil pump driveshaft in the centre of the electro-magnetic clutch housing. Locate the transmission on the locating dowels then insert the bolts and tighten them securely.

94 Refit the brush holder assembly to the automatic transmission with reference to Chapter 7B, Section 4.

Petrol engines

95 Refit the transmission lower cover and tighten the bolts.

96 Locate the support bracket on the lower cover, then insert the bolts hand-tight. Also insert the bolts securing the bracket to the rear of the cylinder block. With all the bolts inserted, tighten them securely.

97 Refit the earth leads and tighten the bolts.

Diesel engines

98 Refit the rpm sensor and tighten the bolts.

99 Insert the intermediate shaft through the bracket then locate the dust boot on it and insert the inner end in the transmission.

100 Refit and tighten the bolts securing the intermediate shaft to the bracket on the rear of the cylinder block.

101 Refit the transmission lower cover and tighten the bolts.

All models

102 Refit the starter motor (see Chapter 5A).

103 Refit the wiring harness to the components on the engine/transmission assembly making sure it is routed correctly.

Refitting

104 Locate the engine/transmission assembly beneath the engine compartment and attach the hoist to the lifting eyes.

105 Carefully lift the assembly up into the engine compartment taking care not to damage the surrounding components.

106 Reconnect the left-hand engine/transmission mounting to the body and tighten the bolts.

107 Reconnect the right-hand engine mounting to the body and tighten the bolts.

108 Working beneath the vehicle, refit the rear engine mounting and tighten the bolts.

109 Disconnect the hoist from the engine and transmission lifting eyes and remove the hoist from under the vehicle.

110 The remainder of the refitting procedure is the direct reverse of the removal procedure, noting the following points:

- a) Ensure that all sections of the wiring harness follow their original routing; use new cable-ties to secure the harness in position, keeping it away from sources of heat and abrasion.
- b) On vehicles with manual transmission check and if necessary adjust the gearchange cable and rod with reference to Chapter 7A.
- c) On vehicles with automatic transmission use new roll pins to secure the driveshafts to the transmission output stubs. Also check and if necessary adjust the kickdown and selector cables with reference to Chapter 7B.
- d) Ensure that all hoses are correctly routed and are secured with the correct hose clips, where applicable. If the hose clips cannot be used again; proprietary worm drive clips should be fitted in their place.
- e) Refill the cooling system as described in Chapter 1A or 1B.
- f) Refill the engine with appropriate grades and quantities of oil (Chapter 1A or 1B).
- g) Refit and adjust the auxiliary drivebelt(s) with reference to Chapter 1A or 1B.
- h) Check and if necessary adjust the accelerator cable with reference to Chapter 4A, 4B or 4C.
- i) When the engine is started for the first time, check for air, coolant, lubricant and fuel leaks from manifolds, hoses etc. If the engine has been overhauled, read the notes in Section 13 before attempting to start it.

5 Engine overhaul - dismantling sequence

1 It is much easier to dismantle and work on the engine if it is mounted on a portable engine stand. These stands can often be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel should be removed, so that the stand bolts can be tightened into the end of the cylinder block/crankcase.

2 If a stand is not available, it is possible to dismantle the engine with it blocked up on a sturdy workbench, or on the floor. Be very careful not to tip or drop the engine when working without a stand.

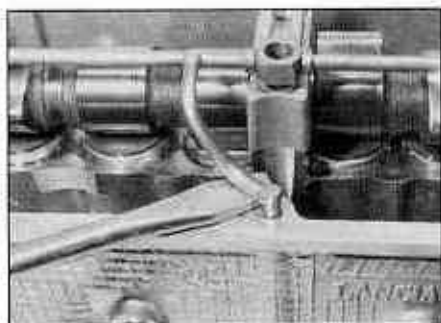
3 If you intend to obtain a reconditioned engine, all ancillaries must be removed first, to be transferred to the replacement engine (just as they will if you are doing a complete engine overhaul yourself). These components include the following:

Petrol engines

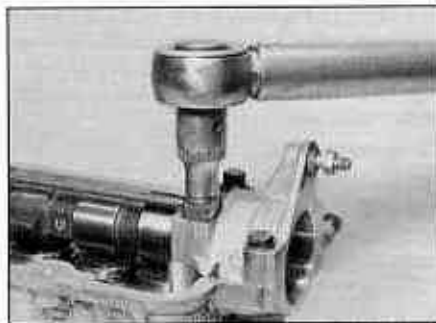
- a) Power steering pump if removed with the engine (Chapter 10).
- b) Alternator (including mounting brackets) and starter motor (Chapter 5A).
- c) The ignition system and HT components including all sensors, HT leads and spark plugs (Chapters 1A and 5B).
- d) The fuel injection system components (Chapters 4A and 4B).
- e) All electrical switches, actuators and sensors, and the engine wiring harness (Chapters 4A, 4B, 5B).
- f) Inlet and exhaust manifolds (Chapters 4A, 4B and 4D).
- g) Engine oil dipstick and tube.
- h) Engine mountings (Chapter 2A).
- i) Flywheel/driveplate (Chapter 2A).
- j) Clutch components (Chapter 6) - manual transmission.
- k) Electro-magnetic clutch components (Chapter 7B) - automatic transmission.
- l) Cooling system components (Chapter 3).

Diesel engines

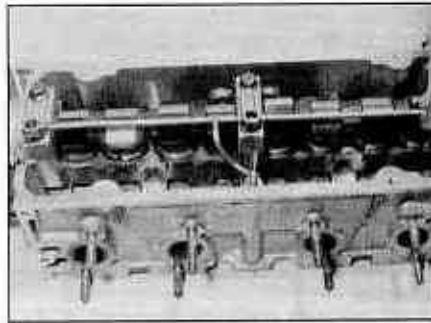
- a) Power steering pump if removed with the engine (Chapter 10).
- b) Alternator (including mounting brackets) and starter motor (Chapter 5A).
- c) The glow plug/pre-heating system components (Chapter 5C).
- d) All fuel system components, including the fuel injection pump, all sensors and actuators (Chapter 4C).
- e) The vacuum pump.
- f) All electrical switches, actuators and sensors, and the engine wiring harness (Chapter 4C and 5C).
- g) Inlet and exhaust manifolds and, where applicable, the turbocharger (Chapter 4C and 4D).
- h) The engine oil level dipstick and its tube.
- i) Engine mountings (Chapter 2C).



6.5a Prising out the feed stub of the camshaft lubricating pipe



6.5b Unscrewing the camshaft bearing/banjo union bolt



6.5c Removing the camshaft lubricating pipe

- j) Flywheel (Chapter 2C).
- k) Clutch components (Chapter 6).
- l) Cooling system components (Chapter 3).

Note: When removing the external components from the engine, pay close attention to details that may be helpful or important during refitting. Note the fitted position of gaskets, seals, spacers, pins, washers, bolts, and other small components.

4 If you are obtaining a short engine (the engine cylinder block/crankcase, crankshaft, pistons and connecting rods, all fully assembled), then the cylinder head, sump, oil pump, timing belt (together with its tensioner and covers), coolant pump, thermostat housing, coolant outlet elbows, oil filter housing and where applicable oil cooler will also have to be removed.

5 If you are planning a full overhaul, the engine can be dismantled in the order given below:

- a) Flywheel/driveplate.

- b) Timing belt, sprockets, and tensioner.
- c) Inlet and exhaust manifolds.
- d) Cylinder head.
- e) Sump.
- f) Oil pump.
- g) Pistons and crankshaft.

6 Cylinder head - dismantling, cleaning, inspection and reassembly

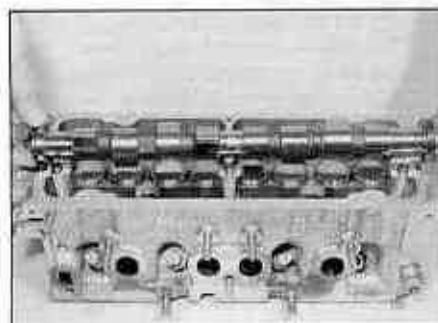
Note: New and reconditioned cylinder heads are available from the manufacturer or engine overhaul specialists. Be aware that some specialist tools are required for the dismantling and inspection procedures, and new components may not be readily available. It may therefore be more practical and economical for the home mechanic to purchase a reconditioned head, rather than dismantle, inspect and recondition the original head.

Dismantling

Note: On 8-valve petrol engines and diesel engines, the camshaft and cam followers are located in the cylinder head assembly and the relevant dismantling and reassembly procedures are contained in this Section. On 16-valve petrol engines, the camshafts and cam followers are located in a separate housing (cylinder head extension) which is bolted to the top of the cylinder head. All procedures relating to the camshafts and cam followers on 16-valve engines are therefore contained in Chapter 2B. Proceed to paragraph 15 for cylinder head dismantling



6.5d When removing the camshaft bearing caps, note the position of the long and short locating dowels



6.6 Removing the camshaft



6.8a Unscrew and remove the bolts from the thermostat housing, noting the location of the bracket



6.8b Removing the thermostat housing ...

procedures on 16-valve engines, and ignore any references to camshafts, cam followers and oil seals in the paragraphs that follow.

- 1 Remove the cylinder head as described in Part A, B or C of this Chapter (as applicable).
- 2 If not already done, remove the inlet and exhaust manifolds with reference to the relevant Part of Chapter 4. Also remove the spark plugs, glow plugs and injectors as applicable.
- 3 Remove the camshaft sprocket with reference to Chapter 2A or 2C.

Petrol engines

- 4 Mark the positions of the camshaft bearing caps, numbering them from the timing end.
- 5 Unbolt and remove the lubrication pipe (prise the oil feed stub out with a screwdriver). Unscrew the remaining bolts and take off the bearing caps (see illustrations).
- 6 Lift the camshaft carefully from the cylinder head, checking that the valve clearance shims and cam followers are not withdrawn by the adhesion of the oil (see illustration).
- 7 Remove the shims and cam followers, but keep them in their originally fitted order.

Diesel engines

- 8 Unbolt the thermostat housing and gasket, and vacuum pump from the left-hand end of the cylinder head. Also if necessary unbolt the coolant cover and gasket from the right-hand end of the head. Note the location of brackets (see illustrations).
- 9 Using a soft metal drift, carefully tap out the left-hand side mount and recover the gasket (see illustrations).
- 10 At the timing belt end of the cylinder head,



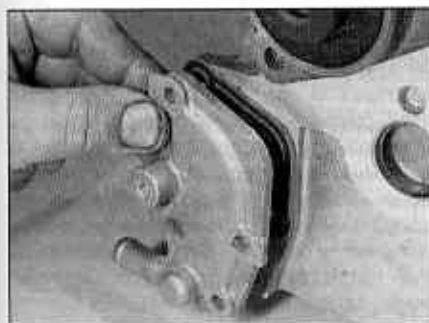
6.8c ... and gasket



6.8d Unscrew the vacuum pump mounting nuts noting the location of the bracket



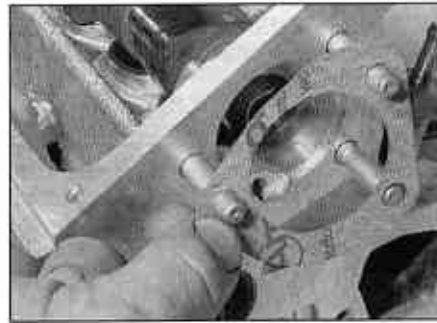
6.8e Removing the vacuum pump



6.8f Removing the coolant cover



6.9a Removing the camshaft left-hand side mount ...



6.9b ... and gasket

unscrew the bolts securing the right-hand side mount to the head. Carefully tap out the right-hand side mount and recover the gasket (see illustrations).

11 Mark the positions of the camshaft bearing

caps, numbering from the timing belt end. 12 Progressively unscrew the bearing cap nuts then take off the bearing caps. Note the location dowels on the mounting studs (see illustrations).

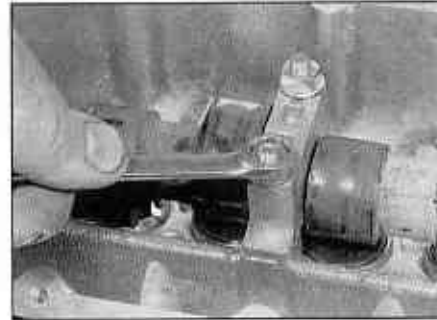
13 Lift the camshaft towards the timing end, then remove it from the cylinder head (see illustration). Make sure the valve clearance shims and cam followers are not withdrawn by the adhesion of the oil.



6.10a Removing the camshaft right-hand side mount ...



6.10b ... and gasket



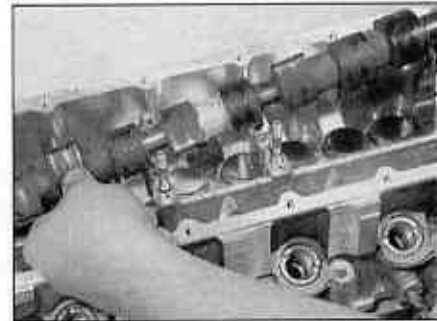
6.12a Unscrew the nuts ...



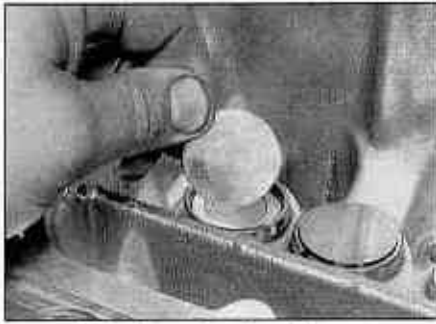
6.12b ... and remove the bearing caps



6.12c The camshaft mounting studs incorporate location dowels



6.13 Removing the camshaft from the cylinder head



6.14a Removing the shims ...



6.14b ... and cam followers



6.16a Removing the upper spring seat ...

14 Remove the shims and cam followers, but keep them in their originally fitted order (see illustrations).

All engines

15 Stand the cylinder head on its end. Using a valve spring compressor, compress each valve spring in turn, extracting the split collets when the upper valve spring seat has been pushed far enough down the valve stem to free them. If the spring seat sticks, lightly tap the upper jaw of the spring compressor with a hammer to free it.

16 Release the valve spring compressor and remove the upper spring seat, valve spring and lower spring seat (see illustrations).

17 Withdraw the valve from the head gasket side of the cylinder head, then use a pair of pliers to extract the valve stem oil seal from the top of the guide (see illustrations). If the

valve sticks in the guide, carefully deburr the end face with fine abrasive paper. Repeat this process for the remaining valves.

18 On diesel engines, if the swirl chambers are badly coked or burned and are in need of renewal, they may be removed by unscrewing the retaining collars and carefully tapping them out from the combustion chamber side. Recover the washers and keep them identified for position (see illustration).

19 It is essential that each valve is stored together with its collets, retainer, spring, and spring seat. The valves should also be kept in their correct sequence, unless they are so badly worn that they are to be renewed. If they are going to be kept and used again, place each valve assembly in a labelled polythene bag or similar small container (see illustration). Note that No 1 valve is at the timing belt end of the engine.

Cleaning

20 Using a suitable degreasing agent, remove all traces of oil deposits from the cylinder head, paying particular attention to the journal bearings, cam follower bores, valve guides and oilways, as applicable. Scrape off any traces of old gasket from the mating surfaces, taking care not to score or gouge them. If using emery paper, do not use a grade of less than 100. Turn the head over and using a blunt blade, scrape any carbon deposits from the combustion chambers and ports.

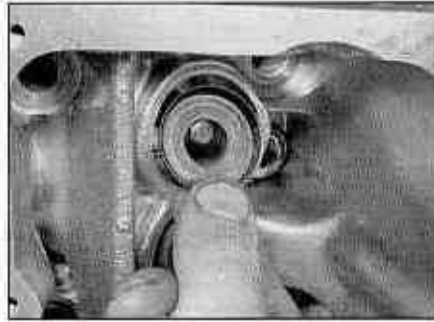
Caution: Do not erode the sealing surface of the valve seat.

21 Finally, wash the entire head casting with a suitable solvent to remove the remaining debris.

22 Clean the valve heads and stems using a fine wire brush. If the valve is heavily coked,



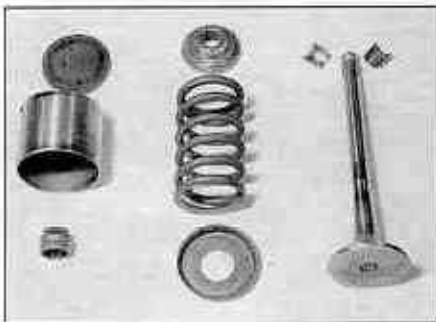
6.16b ... spring ...



6.16c ... and lower spring seat



6.17a Removing the valve stem oil seals



6.17b Valve and cam follower components



6.18 Swirl chamber retaining collar (diesel engine)



6.19 Keep groups of components together in labelled bags or boxes