






# Chapter 2 Part C: Engine removal and overhaul procedures

## Contents

Camshaft (diesel engines) - removal, inspection and refitting . . . . .	7	Engine overhaul - dismantling sequence . . . . .	6
Camshaft (petrol engines) - removal, inspection and refitting . . . . .	See Chapter 2A	Engine overhaul - general information . . . . .	2
Crankshaft - inspection . . . . .	15	Engine overhaul - reassembly sequence . . . . .	17
Crankshaft - refitting and main bearing running clearance check . . . . .	18	Engine removal - methods and precautions . . . . .	3
Crankshaft - removal . . . . .	12	General information . . . . .	1
Cylinder block/crankcase - cleaning and inspection . . . . .	13	Main and big-end bearings - inspection . . . . .	16
Cylinder head - dismantling . . . . .	8	Petrol engine - removal and refitting . . . . .	4
Cylinder head - reassembly . . . . .	10	Piston/connecting rod assembly - inspection . . . . .	14
Cylinder head and valve components - cleaning and inspection . . . . .	9	Piston/connecting rod assembly - refitting and big-end bearing clearance check . . . . .	19
Diesel engine - removal and refitting . . . . .	5	Piston/connecting rod assembly - removal . . . . .	11
Engine - initial start-up after overhaul . . . . .	20		

## Degrees of difficulty

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

## Specifications

### Petrol engines

#### Camshaft

Material . . . . .	Cast-iron
Location . . . . .	Central, in vee of cylinder block
Drive . . . . .	Inverted tooth chain (54 links)

#### Bearings:

Number . . . . .	5
Type . . . . .	Steel-backed, babbitt-lined

#### Cylinder heads

Material . . . . .	Aluminium alloy
Type . . . . .	Two separate heads, in-line valves, separate inlet manifold
Valve seat material . . . . .	Piston ring iron
Valve seat angle . . . . .	46° ± 1/4°
Oversize inserts available . . . . .	+ 0.25 and 0.50 mm
Inlet valve seat diameter . . . . .	37.03 mm
Exhaust valve seat diameter . . . . .	31.50 mm
Maximum permissible distortion of sealing face (typical value) . . . . .	0.0100 mm

#### Valves

Overall length . . . . .	116.59 to 117.35 mm
Angle of face . . . . .	45° to 45.5°
Valve lift . . . . .	9.49 mm
Valve clearance . . . . .	Not adjustable (hydraulic self-adjusting tappets)
Valve head diameter:	
Inlet . . . . .	39.75 to 40.00 mm
Exhaust . . . . .	34.226 to 34.480 mm
Valve stem diameter:	
Inlet . . . . .	8.664 to 8.679 mm
Exhaust . . . . .	8.651 to 8.666 mm
Stem-to-guide clearance:	
Inlet . . . . .	0.025 to 0.066 mm
Exhaust . . . . .	0.038 to 0.078 mm
Valve spring length (nominal, fitted) . . . . .	40.4 mm at 29.5 kgf
Maximum permissible valve stem play in guide (typical value) . . . . .	0.1500 mm

**Petrol engines (continued)****Cylinder block**

Material .....	Aluminium alloy
Cylinder liner type .....	Dry, cast integrally with block
Liner material .....	Cast-iron
Maximum cylinder bore ovality (typical value) .....	0.1270 mm
Maximum cylinder bore taper (typical value) .....	0.2540 mm

**Crankshaft and bearings**

Material .....	Iron, spheroidal graphite
Number of main bearings .....	5
Main bearing journal diameter (standard) .....	58.409 to 58.422 mm
Main bearing clearance .....	0.010 to 0.048 mm
Undersizes available .....	0.254 and 0.508 mm
Big-end bearing journal diameter (standard) .....	50.800 to 50.812 mm
Big-end bearing clearance .....	0.015 to 0.055 mm
Undersizes available .....	As for main bearings
Journal ovality .....	0.04 mm maximum
Crankshaft endthrust .....	Taken on centre (No 3) main bearing shell flanges
Crankshaft endfloat .....	0.10 to 0.20 mm

**Pistons**

Type .....	Aluminium alloy, with flat or concave crown
Clearance in bore (measured at bottom of skirt) .....	0.008 to 0.041 mm
Piston grades:	
Standard (Grade Z) .....	Nominal size to + 0.0075 mm
Grade A .....	+ 0.0075 to 0.0150 mm
Grade B .....	+ 0.0150 to 0.0225 mm
Grade C .....	+ 0.0225 to 0.0300 mm
Grade D .....	+ 0.0300 to 0.0375 mm
Grade letter location .....	Piston crown and cylinder block face
Oversize pistons available after rebore (ungraded) .....	+ 0.25 and 0.50 mm

**Piston rings**

Number of compression rings .....	2
Number of oil rings .....	1
Number one compression ring .....	Chrome or molybdenum barrel-faced
Number two compression ring .....	Stepped or tapered, marked TOP or T
Compression ring end gap in bore .....	0.40 to 0.65 mm
Compression ring clearance in groove .....	0.05 to 0.10 mm
Oil control ring type .....	Expander ring with top and bottom rails
Oil control ring gap in bore .....	0.38 to 1.40 mm

**Connecting rods**

Type .....	Horizontally-split big-end, solid small-end
Length between centres .....	143.71 to 143.81 mm
Endfloat on crankpin .....	0.15 to 0.36 mm

**Gudgeon pins**

Length .....	72.67 to 72.79 mm
Diameter .....	22.215 to 22.220 mm
Fit in connecting rod .....	Press fit
Fit in piston .....	Sliding fit
Clearance in piston .....	0.002 to 0.007 mm

**Torque wrench settings**

Refer to Chapter 2A Specifications.

**Diesel engines****Camshaft**

Endfloat .....	0.1 to 0.2 mm
----------------	---------------

**Cylinder head**

Material .....	Aluminium alloy
Maximum permissible distortion of sealing face (typical value) .....	0.0100 mm
Valve seat angle:	
Inlet .....	30°
Exhaust .....	45°

**Diesel engines (continued)**

**Cylinder head (continued)**

Valve recess in cylinder head:	
200 TDi engine (inlet and exhaust) .....	0.9000 to 1.1000 mm
300 TDi engine:	
Inlet .....	0.8100 to 1.0900 mm
Exhaust .....	0.8600 to 1.1400 mm

**Valves**

Valve clearance (inlet and exhaust) .....	0.20 mm
Valve stem diameter:	
Inlet .....	7.9600 to 7.9750 mm
Exhaust .....	7.9400 to 7.9600 mm
Valve head diameter:	
200 TDi engine:	
Inlet .....	39.3500 to 39.6500 mm
Exhaust .....	36.3500 to 36.6500 mm
300 TDi engine:	
Inlet .....	38.7500 to 39.0500 mm
Exhaust .....	36.3500 to 36.6500 mm
Maximum permissible valve stem play in guide .....	0.1500 mm

**Cylinder block**

Material .....	Cast-iron
Maximum cylinder bore ovality .....	0.1270 mm
Maximum cylinder bore taper .....	0.2540 mm
Cylinder bore wear limit .....	0.1770 mm
Cylinder rebore oversizes .....	0.5000 mm and 1.0100 mm

**Crankshaft and bearings**

Number of main bearings .....	5
Main bearing journal diameter:	
Production standard .....	63.4750 to 63.4870 mm
Regrind (0.25 mm undersize) .....	63.2330 to 63.2460 mm
Main bearing running clearance .....	0.0792 to 0.0307 mm
Main bearing journal wear limit .....	0.1140 mm
Big-end bearing journal diameter:	
Production standard .....	58.7250 to 58.7440 mm
Regrind (0.25 mm undersize) .....	58.4710 to 58.4900 mm
Big-end bearing running clearance .....	0.0250 to 0.0750 mm
Big-end bearing journal wear limit .....	0.0880 mm
Maximum bearing journal ovality .....	0.0400 mm
Maximum bearing journal taper .....	0.0250 mm
Maximum run-out of centre main bearing journal (front and rear main bearings supported in V-blocks) .....	0.0760 mm
Crankshaft endfloat .....	0.0500 to 0.1500 mm
Thrustwasher oversizes .....	0.0625 mm, 0.1250 mm, 0.2500 mm
Maximum variation in thickness between thrustwashers .....	0.0800 mm
Connecting rod side play .....	0.1500 to 0.3560 mm

**Pistons**

Piston-to-bore clearance* .....	0.0250 to 0.0500 mm
Maximum piston protrusion .....	0.8000 mm

\*Note: New standard service pistons are supplied 0.0250 mm oversize to allow for production tolerance on new engines. Pistons are also available in 0.5000 and 1.0100 mm oversizes.

**Piston rings**

Number of rings (per piston) .....	2 compression, 1 oil control
Ring end gap:	
Top compression .....	0.4000 to 0.6000 mm
Middle compression .....	0.3000 to 0.5000 mm
Oil control .....	0.3000 to 0.6000 mm
Clearance in piston groove:	
Top compression .....	0.1670 to 0.2320 mm
Middle compression .....	0.0500 to 0.0800 mm
Oil control .....	0.0500 to 0.0800 mm

**Connecting rods**

Maximum distortion .....	0.1270 mm
--------------------------	-----------

**Diesel engines (continued)****Gudgeon pins**

Diameter .....	30.1564 to 30.1625 mm
Clearance in connecting rod:	
200 TDi engine .....	0.0036 to 0.0196 mm
300 TDi engine .....	0.0025 to 0.0163 mm

**Torque wrench settings**

Refer to Chapter 2B Specifications.

**1 General information**

This part of Chapter 2 includes details of engine removal and refitting, and general overhaul procedures for the cylinder head(s), cylinder block/crankcase and internal engine components.

The information 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 internal engine components.

The following Sections have been compiled based on the assumption that the engine has been removed from the vehicle. For information concerning in-car engine repair, as well as information on the removal and refitting of the external components necessary to facilitate overhaul, refer to Chapter 2A or 2B, and to Section 6 of this Part.

**2 Engine overhaul - general information**

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

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, will most likely give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

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 cylinder compression check or a leakdown test to determine the extent of the work required.

Check the oil pressure with a gauge fitted in place of the oil pressure sender, and compare it with the Specifications (Chapter 2A or 2B). If it is extremely low, the main and big-end

bearings and/or the oil pump are probably worn out.

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 tune-up does not remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring the internal parts to the specifications of a new engine. During an overhaul, the pistons and rings are replaced and the cylinder bores are reconditioned. New main bearings, connecting rod bearings and camshaft bearings are generally fitted, and if necessary, the crankshaft may be reground to restore the journals. 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 a like-new engine that will give many trouble-free miles.

**Note:** *Critical cooling system components such as the hoses, drivebelts, thermostat and water pump MUST 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.*

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 all of the instructions carefully, have the necessary tools and equipment, and pay close attention to all specifications; however, it can be time-consuming. Plan on the vehicle being tied up for a minimum of two weeks, especially if parts must be taken to an engineering works for repair or reconditioning. 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 disassembled, and all components (especially the engine block) have been inspected, before*

*deciding what service and repair operations must be performed by an engineering works. Since the condition of the block will be the major factor to consider when determining whether to overhaul the original engine or buy a reconditioned unit, do not purchase parts or have overhaul work done on other components until the block has been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it does not pay to fit worn or substandard parts.*

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 removal - methods and precautions**

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

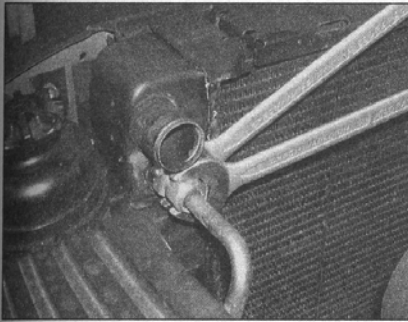
Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the vehicle, will be needed. If a garage is not available, at the very least a flat, level, clean work surface is required.

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

An engine hoist or A-frame will also be necessary. Make sure the equipment is rated in excess of the weight of the engine. Bear in mind that the petrol or diesel Discovery engine weighs considerably more than a typical unit found in an ordinary vehicle. Safety is of primary importance, considering the potential hazards involved in lifting the engine out of the vehicle.

If the engine is being removed by a novice, an assistant should 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.

Plan the operation ahead of time. Arrange for, or obtain, all of the tools and equipment you will need, prior to beginning the job. Some of the equipment necessary to perform engine removal and installation safely and with relative ease are (in addition to an engine hoist) a heavy-duty floor jack, complete sets



4.9a Loosen the union nuts . . .

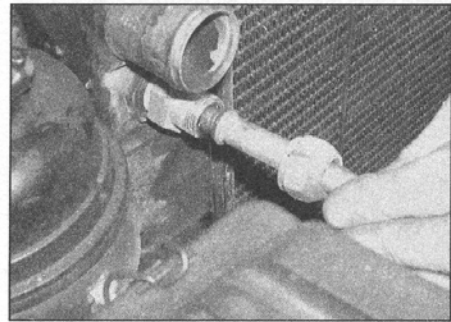
The engine is most easily removed by separating it from the transmission, and lifting the engine upwards from the engine compartment.

**4 Petrol engine - removal and refitting**



**Removal**

- 1 Ensure that the vehicle is parked on level ground, and apply the handbrake.
- 2 On fuel injection models, depressurise the fuel system as described in Chapter 4B.
- 3 Disconnect the battery negative lead.
- 4 Drain the engine oil and cooling system with reference to Chapter 1A.
- 5 Remove the bonnet as described in Chapter 12.
- 6 Remove the viscous fan unit and cowl, as described in Chapter 3.
- 7 Loosen the hose clips, and disconnect the top hose and the expansion tank hose from the top of the radiator. Disconnect the top hose from the thermostat housing, and the bottom hose from the coolant pump, and remove both hoses.
- 8 Unscrew the union nuts, and disconnect the engine oil cooler pipes from the right-hand side of the cooler. Be prepared for oil spillage, and cover the open ends of the pipes, to prevent further spillage and dirt ingress.
- 9 On models with automatic transmission, similarly disconnect the transmission fluid cooler pipes from the fluid cooler (**see illustrations**). Release the clamps securing the pipes to the engine.
- 10 Unscrew the nut and bolt securing the right-hand radiator mounting bracket to the front body panel, and remove the bracket.
- 11 Similarly, unbolt the left-hand radiator mounting bracket, noting that the power steering fluid reservoir is mounted on the bracket. Move the bracket/reservoir clear of the engine, leaving the fluid hoses connected.
- 12 Carefully lift the complete radiator assembly from the engine compartment (**see illustration**).
- 13 On carburettor models, refer to Chapter 4A and disconnect the accelerator and



4.9b . . . and disconnect the fluid pipes from the radiator

of spanners and sockets as described at the rear 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.

Plan for the vehicle 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.

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

The sequence of operations listed is not critical; the position of the person undertaking the work, or the tool in his hand, will determine to a certain extent the order in which the work is tackled. Obviously the engine cannot be removed until everything is disconnected from it, and the following sequence should ensure that nothing is forgotten.

Assemble a collection of containers for the small parts, nuts and bolts, etc, that are removed and keep them in convenient groups.

choke cables from the left-hand carburettor. Disconnect the fuel return pipe from the right-hand carburettor, and tuck it out of the way.

14 On fuel injection models with manual transmission, disconnect the accelerator cable from the bracket (**see illustration**). On automatic transmission models, unbolt the cable bracket from the plenum chamber, and lay it to one side, without disturbing the kickdown cable - see Chapter 4B.

15 Again on fuel injection models, disconnect the fuel feed union from the fuel rail. Unclip and disconnect the fuel return hose and vacuum pipe from the fuel pressure regulator. In all cases, seal the open pipe ends with tape, to prevent fuel loss and dirt entry.

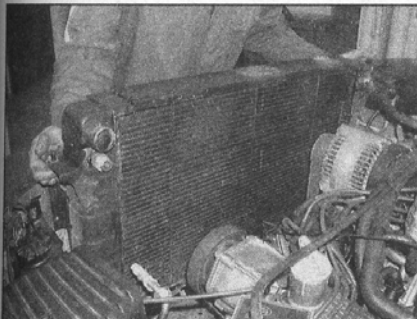
16 Disconnect the two heater hoses from the rigid pipes on top of the right-hand rocker cover (**see illustration**). Loosen and remove the bolt securing the pipe bracket to the rocker cover, then disconnect the shorter rigid pipe from the short section of hose feeding into the inlet manifold.

17 On carburettor models, remove the air cleaner assembly as described in Chapter 4A.

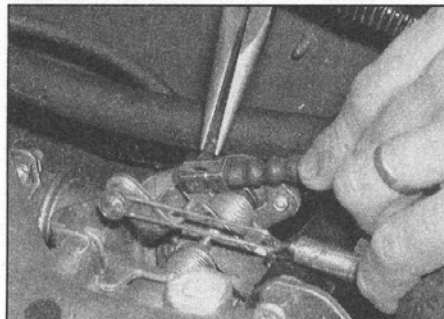
18 On fuel injection models, also remove the airflow sensor, plenum chamber and ram housing as described in Chapter 4B.

19 Remove the alternator as described in Chapter 5A.

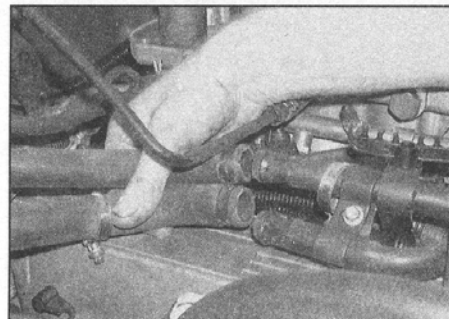
20 On models with air conditioning, unscrew and remove the coolant expansion tank mounting nuts, and remove the tank from its mounting bracket. Unbolt the compressor and, **without** disconnecting any of the pipes, move it aside and tie it to the expansion tank bracket (**see illustrations**). Make sure when



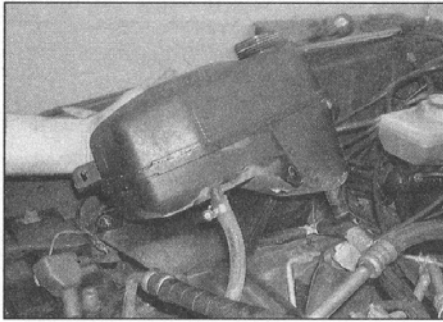
4.12 Lifting out the radiator



4.14 Disconnecting the accelerator cable



4.16 Disconnect the two heater hoses from the rigid pipes



**4.20a** Unbolt and lift out the expansion tank . . .

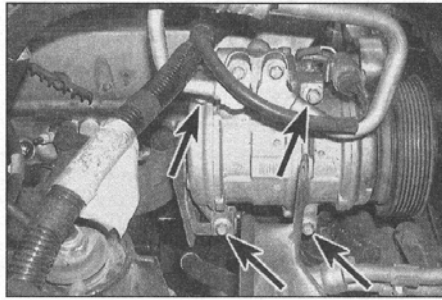
this is done that the engine oil cooler pipes do not get trapped, as these will be coming out with the engine. Take care also that the large flexible hose from the compressor does not get damaged as the engine is removed.

**21** Referring to Chapter 11, unbolt and remove the power steering pump from the left-hand cylinder head, and move it aside. There is no need to disconnect the fluid pipes.

**22** Unclip and remove the distributor cap, complete with leads. Making sure they are marked for position, disconnect the HT leads from the plugs and coil, and remove the cap and leads as an assembly.

**23** Disconnect the wiring from the following, as applicable:

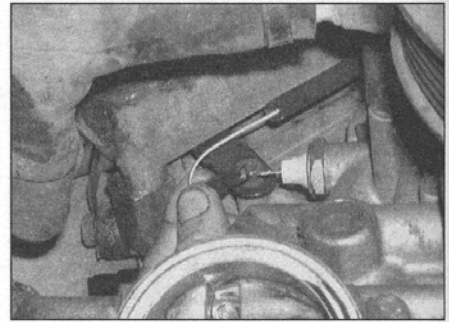
- a) Coolant temperature sensor on the thermostat housing.
- b) Fuel temperature sensor on the fuel rail.
- c) Oil pressure switch above the oil filter (see illustration) and oil level sensor on



**4.20b** . . . then remove the air conditioning compressor bolts (arrowed) and move the unit aside

- the side of the sump (where fitted).*
- d) Release the lambda sensor wiring plugs from the rear of the cylinder heads (the plug halves do not have to be separated).
- e) Fuel injectors (label each plug for position).
- f) Ignition module at the distributor or ignition coil (see illustration).
- g) Distributor pick-up wiring plug.
- h) Earth strap from rear of left-hand cylinder head, and earth strap at the left-hand front of the block (see illustration).
- i) Release all wiring from the retaining clips at the rear of the engine.

**24** Release the transmission breather pipes from the retaining clip on the rear lifting eye. Remove the bottom bolt from the rear lifting eye, and detach the starter motor wiring. **25** Particularly on later models with fuel injection, the wiring harness must now be detached from the engine itself and the engine

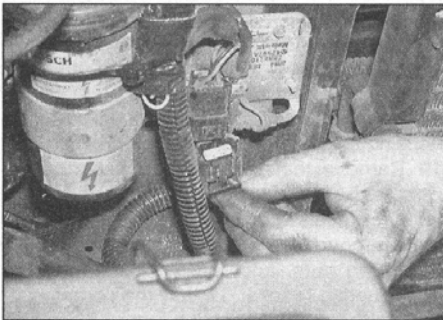


**4.23a** Disconnecting the oil pressure switch wiring

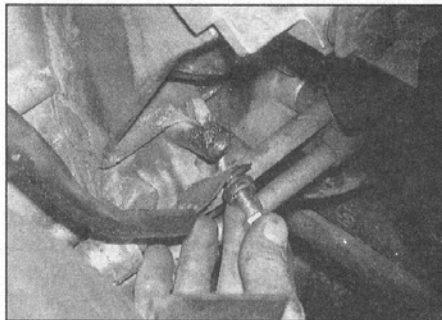
compartment earth points. The degree to which this is required will depend on the year of the vehicle, and on the equipment fitted.

**26** Trace the loom to the earth points at the front left- and right-hand inner wings. One of the earth points is found inside the engine compartment fusebox, and the end fitting is released by removing the retaining screw; another earth point on the same side has the wiring secured by a single nut. The loom also has an earth connection at one of the ignition coil mounting bolts (see illustrations).

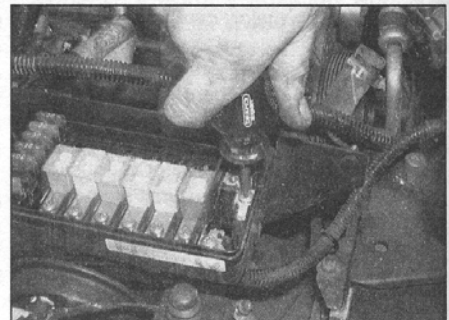
**27** Once the earth points have been disconnected, feed the wiring back to the engine, releasing it from any cable-ties or mounting clips. It may be necessary to disconnect or remove more of the heater pipework to feed the wiring underneath (see illustration). Move the loom as far to the rear of the engine compartment as possible, so that it is completely clear of the engine.



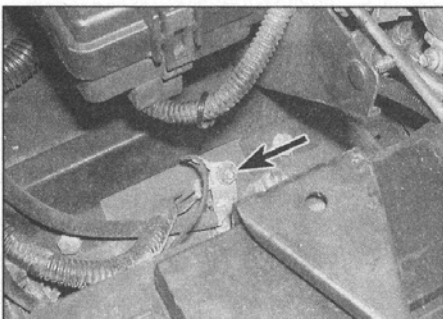
**4.23b** Unplug the wiring harness from the ignition module



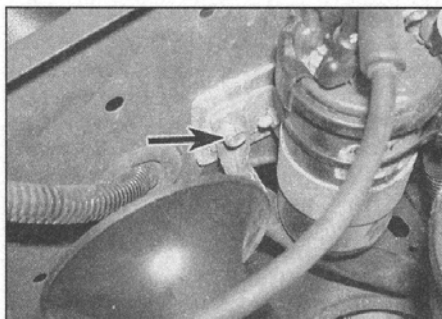
**4.23c** Disconnecting the front earth strap



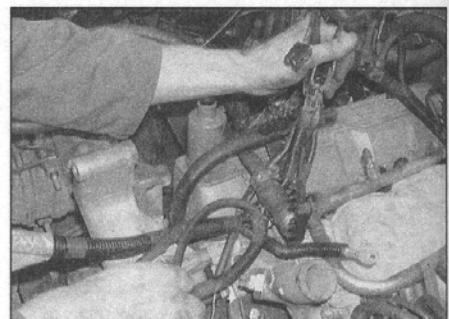
**4.26a** Removing the screw from the harness earth terminal in the fusebox



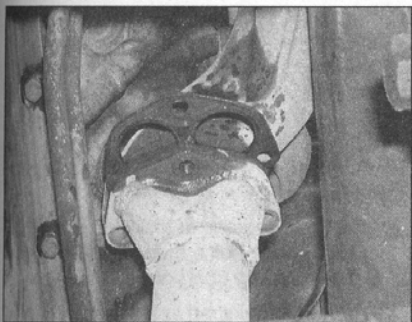
**4.26b** Harness earth point (arrowed) below the fusebox



**4.26c** Earth strap (arrowed) secured by one of the ignition coil mounting bolts



**4.27** Feeding the wiring loom under the heater pipework



**4.30 Exhaust system separated at manifold-to-downpipe connection**

28 Jack up the front of the vehicle, and support it securely on axle stands. This operation is simply to gain access to the underside of the engine - once the engine has been separated from the transmission, it will be lifted out from above.

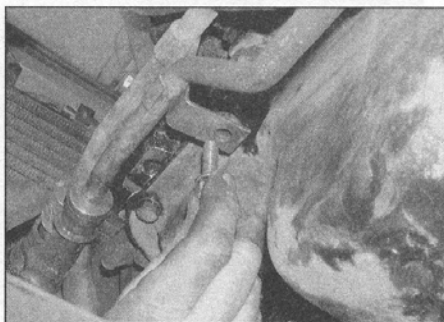
29 Disconnect the starter motor wiring, including the chassis earth strap.

30 Remove the heatshield from the right-hand exhaust downpipe (two bolts), then unscrew the exhaust manifold-to-downpipe nuts, and separate the exhaust pipes (see illustration).

31 Loosen all the engine-to-bellhousing bolts accessible from below. Those bolts which cannot be accessed when the vehicle is lowered should be removed now.

32 On models with automatic transmission, proceed as follows:

a) *Unscrew and remove the bolt which secures the fluid pipe clamp to the engine*



**4.32a Removing the transmission fluid pipe clamp bolt**

*sump, and ensure the pipes are free of the engine (see illustration).*

b) *Working under the vehicle, unscrew the securing bolts, and remove the driveplate front access plate from the transmission bellhousing. Note that two of the bolts are different to the rest - these are tapered, to help align the plate when it is refitted (see illustration).*

c) *Remove the three retaining bolts, and take off the round cover plate from the base of the transmission (see illustration).*

d) *Working through the bellhousing aperture, make alignment marks between the torque converter and the driveplate (see illustration).*

e) *Unscrew the four torque converter-to-driveplate securing bolts, rotating the crankshaft as necessary to gain access to each bolt in turn.*

33 Position a hydraulic jack and a large block of wood under the bellhousing, and raise it to support the transmission when the engine is separated from it. Ensure that the jack is completely secure, and that the transmission is steady on top of the jack, as some force may be needed to separate the engine. Arrange the jack so that the jack handle can be operated with the vehicle on its wheels.

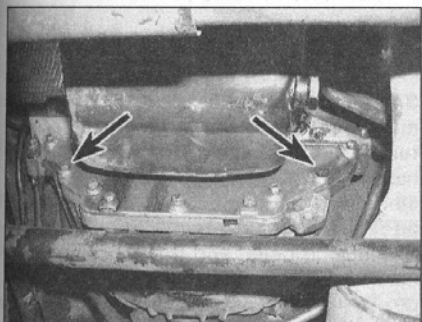
34 Lower the front of the vehicle back onto its wheels.

35 Check that there is nothing still connected to the engine which would prevent it from being lifted out, or which would be damaged when the engine is removed. On models with air conditioning, it would be worth placing a large piece of card or board behind the condenser, to prevent it being damaged as the engine is removed.

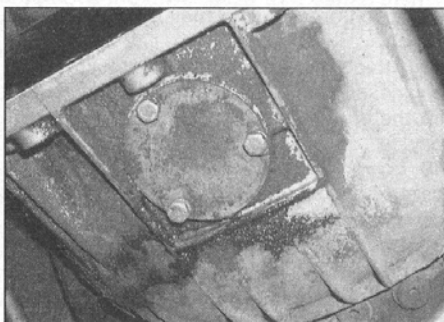
36 Fit lifting chains to the engine lifting eyes. To lift the engine safely, chains should be fitted to the left- and right-hand side of the engine, and one to the rear. If necessary, make up your own lifting eyes, and bolt them securely to the engine - the mounting points for the alternator or air conditioning compressor could be used, for example (see illustrations).

37 Take the weight of the engine using a suitable engine crane or hoist, then loosen and remove the remaining engine-to-bellhousing bolts - there are eight in total.

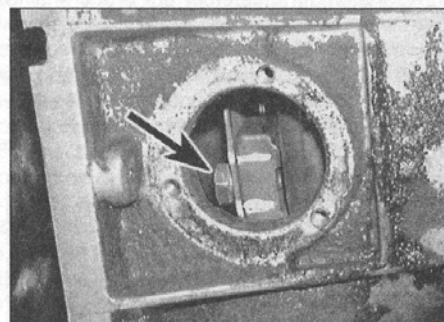
38 With the engine supported, unscrew and remove the engine mounting nuts on either side of the engine. Lift the engine so that it is clear of the mounting brackets (see illustrations).



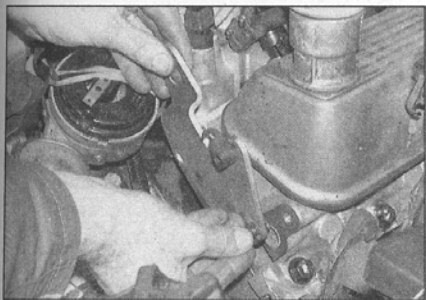
**4.32b Driveplate front access plate - two special bolts arrowed**



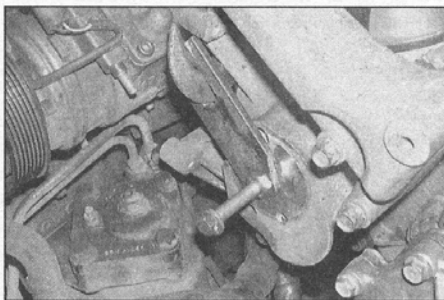
**4.32c Round cover plate on the base of the transmission**



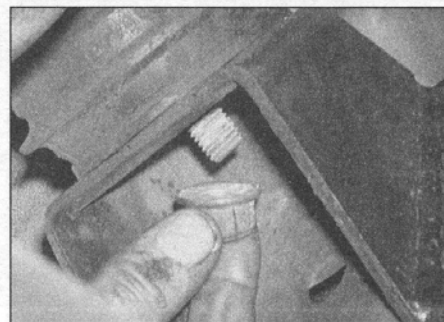
**4.32d Alignment marks and one of the torque converter bolts (arrowed)**



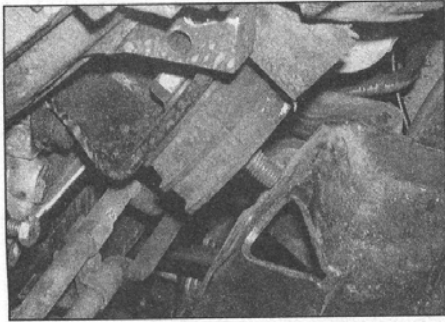
**4.36a Refit the power steering pump mounting bracket/lifting eye, using shorter bolts**



**4.36b Home-made lifting eye attached to the drivebelt tensioner mounting bolt with an extra nut**



**4.38a Remove the nut from below the engine mounting . . .**



4.38b . . . and raise the engine so that the mounting bolt clears the bracket

39 Raise the hydraulic jack under the bellhousing, so that the weight of the transmission is still supported.

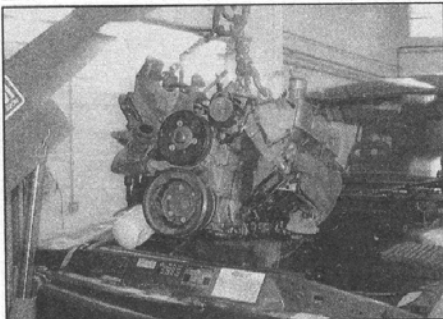
40 On models with air conditioning, unbolt and remove the engine left-hand mounting completely (left as seen from the driver's seat) (see illustration). This will allow the engine to swing over and clear the air conditioning pipes at the rear of the engine compartment, next to the rear lifting eye.

41 Carefully ease the engine forwards to disengage it from the transmission, noting that it is located on dowels. It may be necessary to raise or lower the engine as this is done, to achieve the optimum alignment, but (on manual transmission models) do not allow the weight of the engine to be taken by the input shaft, as damage may occur. As the engine is removed, check carefully that no wires, pipes, etc, become snagged.

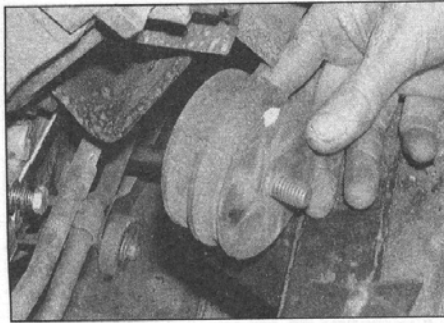
42 Once the engine is clear of the transmission, lift it carefully out of the engine bay with the help of an assistant (see illustration). Either lower it to the floor or move it onto an engine stand. If the engine must be rested on the floor (this may result in damage to the sump), place blocks under the front of the sump as additional support.

**HAYNES**  
**HINT**

*On models with a manual transmission, fasten a suitable hose clip around the transmission input shaft to prevent the release bearing from being inadvertently pushed forwards on the shaft whilst the engine is removed from the vehicle.*



4.42 Lifting out the engine



4.40 Where necessary, unbolt the left-hand engine mounting completely

43 On models with automatic transmission, if the transmission is to be left in position in the vehicle, and the engine is to be removed for some time, bolt a suitable bar across the transmission bellhousing (using the engine-to-transmission bolts) to retain the torque converter in position in the bellhousing.

**Refitting**

44 On models with manual transmission, ensure that the clutch friction disc has been centralised as described in Chapter 6.

45 On models with automatic transmission, unbolts the torque converter retaining tool from the bellhousing.

46 Where applicable, remove the hose clip from the transmission input shaft.

47 On manual transmission models, apply a little high-melting-point grease to the splines of the transmission input shaft. Do not apply too much grease, as it may contaminate the clutch.

48 Attach the hoist and lifting tackle to the engine, as during the removal procedure, and lift the engine into position over the engine bay.

49 Lower the engine into position, taking care not to damage the surrounding components.

50 Manipulate the engine and transmission as necessary to enable the two assemblies to be mated together. Alter the position of the jack supporting the transmission, and the hoist supporting the engine, until the two assemblies are correctly aligned. On manual transmission models, ensure that the weight of the engine is not allowed to hang on the input shaft, and ensure that the input shaft engages with the splines of the clutch friction disc.

51 Fit as many engine-to-bellhousing bolts as possible, and tighten by hand to help align the engine - do not tighten them fully until all the bolts are fitted. Engage the engine fully on the bellhousing dowels.

52 Refit the engine mounting (where removed), then lower the engine slowly, until it is resting fully on the engine mounts. Refit the engine mounting nuts, and tighten by hand - do not tighten the mountings fully until all the engine-to-bellhousing bolts are tightened.

53 Remove the engine lifting crane, and unbolts any home-made lifting eyes used. Jack up the front of the vehicle, and support it securely on axle stands.

54 Refit all the engine-to-bellhousing bolts, and tighten to the specified torque.

55 On models with automatic transmission, proceed as follows:

- a) Clean the threads of the torque converter-to-driveplate bolts, then coat them with thread-locking compound.
- b) Turn the crankshaft as necessary to align the marks made on the driveplate and torque converter before removal.
- c) Refit the first accessible torque converter-to-driveplate bolt, ensuring that the marks are still aligned.
- d) Refit the remaining torque converter-to-driveplate bolts, turning the crankshaft as necessary to gain access to each bolt location in turn.
- e) Tighten the torque converter-to-driveplate bolts to the specified torque (Chapter 7B).
- f) Clean the round cover plate and transmission mating faces, then refit the plate and secure with the three bolts.
- g) Clean the driveplate front access plate and bellhousing mating faces, then refit the plate. Fit all the bolts finger-tight, then tighten the two tapered bolts fully (to align the plate), followed by the remaining bolts.
- h) Refit and tighten the bolt securing the transmission fluid pipes to the base of the engine sump.

56 Reconnect the starter motor wiring, including the chassis earth strap.

57 Reconnect the exhaust pipes to the manifolds, using the information in Chapter 4D, and refit the heatshield to the right-hand pipe.

58 Lower the vehicle back onto its wheels.

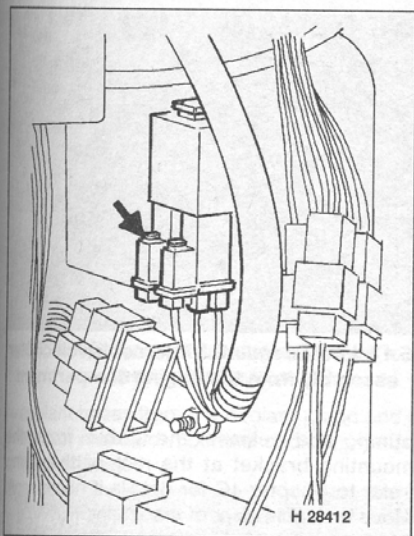
59 Tighten the remaining engine-to-bellhousing bolts, and the engine mounting nuts.

60 The remainder of refitting is a reversal of removal, noting the following points:

- a) Tighten all bolts to the specified torque, and use new seals and gaskets, as applicable.
- b) Make sure that all wiring is securely re-connected, and the wiring harness is retained as before removal - use new clips and cable-ties as necessary.
- c) When reconnecting fuel pipes and hoses, check the condition of the hose ends, and use new hose clips where necessary. Make sure that all hoses and pipes are routed as before removal, ie clear of any hot or moving parts.
- d) On completion, if the engine has been rebuilt, refer to Section 20 when restarting for the first time.

5.  
5.  
Note  
tackl  
Suito  
coat  
and t  
New  
Rings  
**Ren**  
1 En  
2 Di  
3 Dr  
Chap  
4 Dr  
5 R  
Chap  
6 O  
cap  
valv  
7 O  
5.





5.7 Air conditioning relay wiring plug (arrowed) - 300 TDi engine model

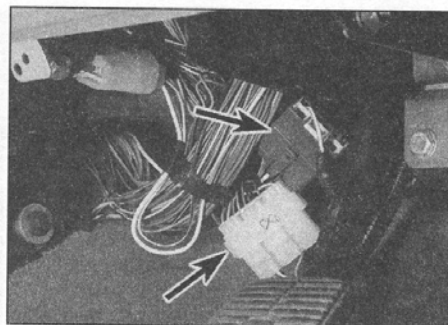
**5 Diesel engine - removal and refitting**



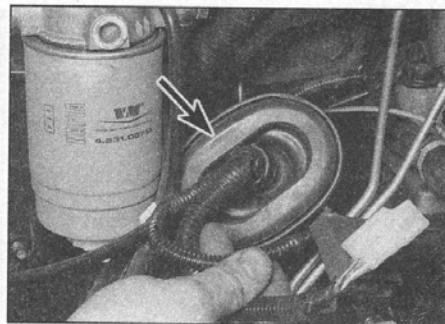
*Note: An engine hoist and suitable lifting tackle will be required for this operation. Suitable jointing compound will be required to coat the mating faces of the flywheel housing and the transmission bellhousing on refitting. New power steering and oil cooler pipe O-rings should be used on refitting.*

**Removal**

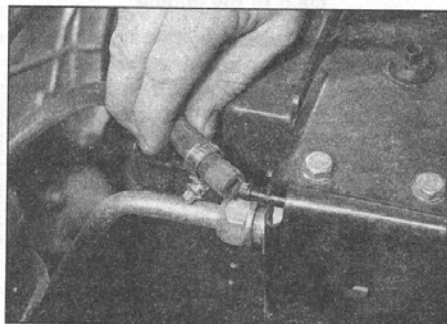
- 1 Ensure that the vehicle is parked on level ground, and apply the handbrake.
- 2 Disconnect the battery negative lead.
- 3 Drain the engine oil with reference to Chapter 1B.
- 4 Drain the cooling system as described in Chapter 1B.
- 5 Remove the bonnet as described in Chapter 12.
- 6 On 300 TDi engines, remove the oil filler cap, then unclip the plastic cover from the valve cover.
- 7 On models fitted with air conditioning,



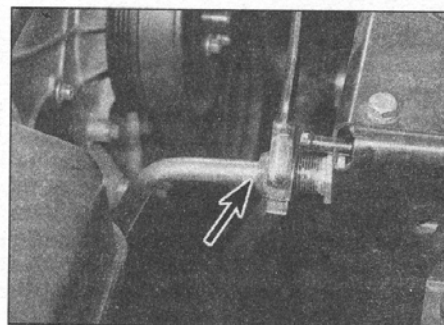
5.8a Engine wiring harness plugs (arrowed) - 300 TDi engine model



5.8b Prise the wiring grommet (arrowed) from the bulkhead - 300 TDi engine model



5.10 Disconnecting the expansion tank hose from the radiator



5.11a Disconnect the oil cooler pipes (arrowed) . . .

release the securing clips and remove the right-hand footwell trim panel, then disconnect the wiring from the air conditioning relay (see illustration).

8 On 300 TDi engine models, working in the right-hand footwell, release the securing clips and remove the lower fascia trim panel, then disconnect the two engine wiring harness plugs. Prise the wiring harness grommet from the engine compartment bulkhead, then feed the wiring harness through into the engine compartment (see illustrations).

9 Remove the viscous fan unit and cowl, as described in Chapter 3.

10 Loosen the hose clips, and disconnect the top hose and the expansion tank hose from the top of the radiator (see illustration).

11 Unscrew the union nuts, and disconnect the engine oil cooler pipes from the right-hand side of the radiator. Be prepared for oil spillage, and cover the open ends of the oil

cooler and pipes, to prevent further oil spillage and dirt ingress. Recover the O-ring seals from the unions (see illustrations).

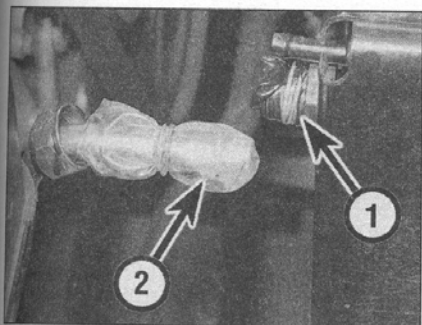
12 Similarly, disconnect the oil pipes from the oil filter adapter on the cylinder block, and remove the pipes.

13 On models with automatic transmission, similarly disconnect the transmission fluid cooler pipes from the fluid cooler.

14 Loosen the hose clips, and remove the intercooler air trunking from the engine compartment (see illustrations).

15 Unscrew the nut and bolt securing the right-hand radiator mounting bracket to the front body panel, and remove the bracket.

16 Similarly, unbolt the left-hand radiator mounting bracket, noting that the power steering fluid reservoir is mounted on the bracket. Move the bracket/reservoir clear of the engine, leaving the fluid hoses connected (see illustrations).



5.11b . . . and cover the open ends of the oil cooler (1) and the pipes (2)



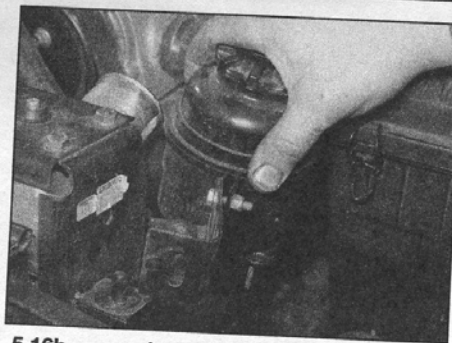
5.14a Remove the upper . . .



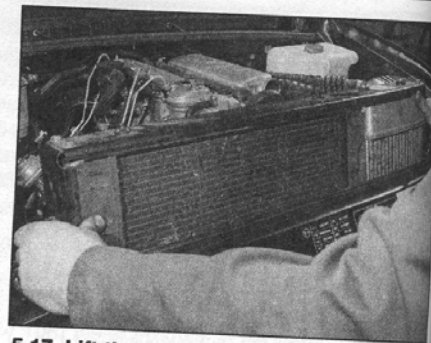
5.14b . . . and lower intercooler air trunking



5.16a Unscrew the securing nut and bolt ...



5.16b ... and move the left-hand radiator mounting bracket/power steering reservoir clear of the engine



5.17 Lift the radiator/intercooler/oil cooler assembly from the engine compartment

17 Carefully lift the complete radiator/intercooler/oil cooler assembly from the engine compartment (see illustration).

18 On models with air conditioning, have the system discharged by a Land Rover dealer, or a suitably-qualified specialist. Once the system has been discharged, unscrew the union bolts, and disconnect the refrigerant pipes from the air conditioning compressor.

**Warning:** Do not attempt to discharge the system yourself - refer to the precautions given for models with air conditioning in Chapter 3.

19 Where applicable, loosen the securing clip, and disconnect the engine breather hose from the air trunking which connects the air cleaner to the turbocharger. Loosen the securing clips, and remove the air trunking (see illustration).

20 Disconnect the coolant hoses from the rear of the cylinder head, and the rear of the manifold-mounted coolant pipe (see illustration).

21 Place a suitable container beneath the power steering pump to catch escaping fluid, then unscrew the union nut and disconnect the high-pressure fluid hose from the pump. Plug or clamp the open ends of the hose and the pump, to prevent dirt ingress and further fluid loss. Similarly, loosen the hose clip, and disconnect the fluid return hose from the pump.

22 Disconnect the coolant bypass hose from the thermostat housing then, where applicable, release the hose from the clips on the engine (see illustrations).

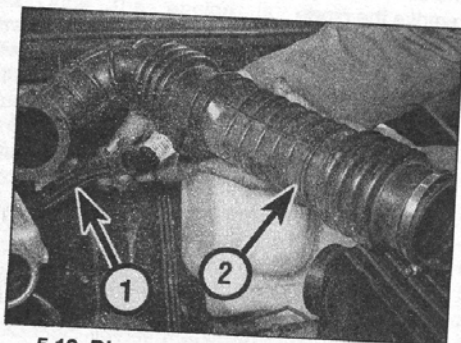
23 Where applicable, disconnect the accelerator cable from the fuel injection

pump, and release the cable from the mounting bracket at the rear of the pump (refer to Chapter 4C for details if necessary). Move the cable clear of the engine.

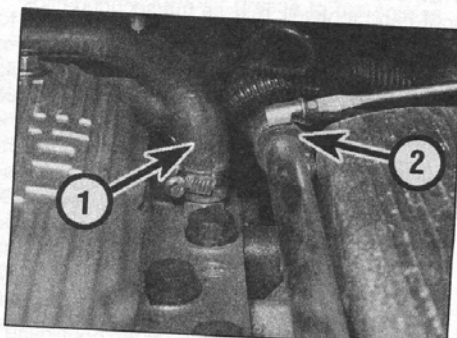
24 On models with automatic transmission, disconnect the kickdown cable from the fuel injection pump and the mounting bracket, and move the cable clear of the engine (refer to Chapter 7B for details if necessary).

25 Unscrew the banjo bolt and nut, and disconnect the fuel supply and return pipes from the fuel injection pump (note that it will be necessary to counterhold the union on the pump when disconnecting the return pipe) (see illustration). Be prepared for fuel spillage. Recover the sealing washers from the banjo unions.

**HAYNES HINT** Cover the open ends of the pipes, and plug the openings in the injection pump, to keep dirt out (the banjo bolt can be refitted to the pump and covered).



5.19 Disconnect the engine breather hose (1) and remove the air trunking (2)



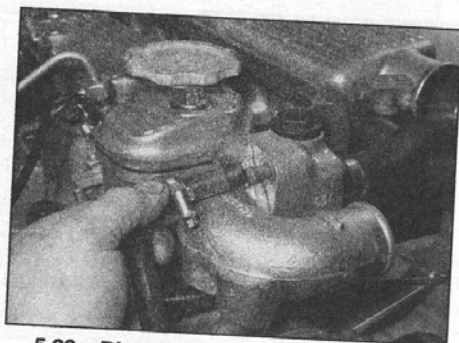
5.20 Disconnect the coolant hoses from the rear of the cylinder head (1) and the coolant pipe (2)

26 Similarly, disconnect the fuel hoses from the fuel lift pump (on the right-hand side of the engine). Again, be prepared for fuel spillage, and cover or plug the open ends of the hoses and the pump.

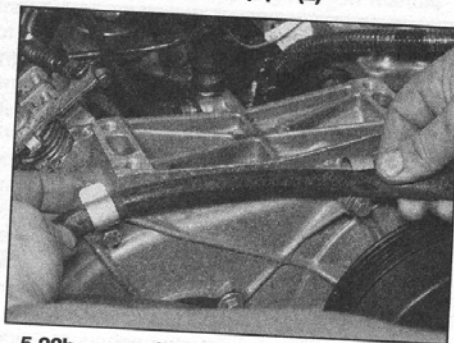
27 Release the securing clip, and disconnect the vacuum hose from the brake vacuum pump.

28 Disconnect the exhaust front section from the manifold, with reference to Chapter 4D.

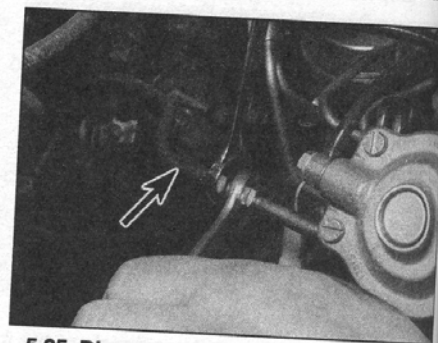
29 Loosen the hose clips, and disconnect the



5.22a Disconnect the coolant bypass hose ...



5.22b ... and release the hose from the clips



5.25 Disconnecting the fuel return hose (arrowed) from the fuel injection pump



**5.29a** Disconnect the coolant hoses from the coolant pump . . .

coolant hoses from the coolant pump and the front of manifold-mounted coolant pipe (see illustrations).

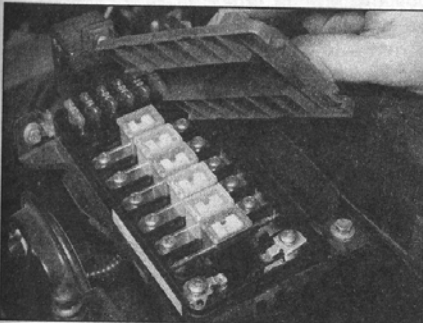


**Cover the alternator with a plastic bag, to prevent escaping coolant from entering the alternator during the engine removal procedure.**

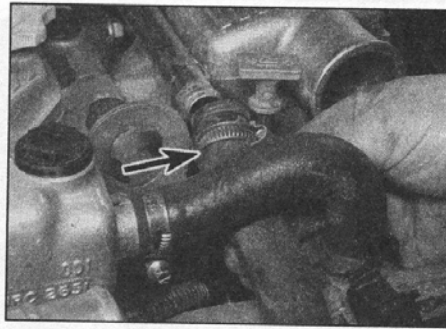
**30** On 200 TDi engines, unscrew the bolt securing the starter motor earth strap to the cylinder block. On 300 TDi engines, unscrew the bolt and disconnect the earth strap from the starter motor (see illustration).

**31** On 200 TDi engines, disconnect the engine wiring harness connections as follows:

- a) Working at the rear of the engine compartment, separate the two halves of the engine wiring harness connector at the bulkhead.



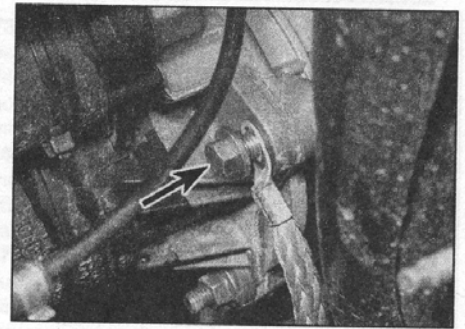
**5.32a** Unclip the circuit breaker cover plate . . .



**5.29b** . . . and the front of the coolant pipe (arrowed)

- b) Remove the cable-ties securing the engine wiring harness to the lighting wiring harness.
- c) Release the engine wiring harness from the clips on the bulkhead.
- d) Disconnect the wiring from the brake fluid level sensor on the top of the brake fluid reservoir.
- e) Pull the rubber boot from the wiring terminal at the bulkhead, and disconnect the wiring from the terminal.
- f) Check that all relevant engine wiring harness connections have been disconnected, then release the harness from any remaining clips in the engine compartment, and lay the harness on the engine (the harness is removed complete with the engine). Note the routing of the wiring harness, to ensure correct refitting.

**32** On 300 TDi engines, disconnect the engine wiring harness connections as follows:

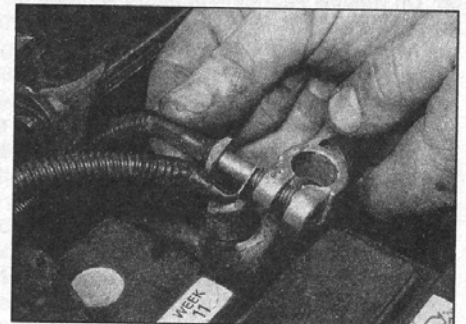


**5.30** Unscrew the earth strap bolt (arrowed) - 300 TDi engine

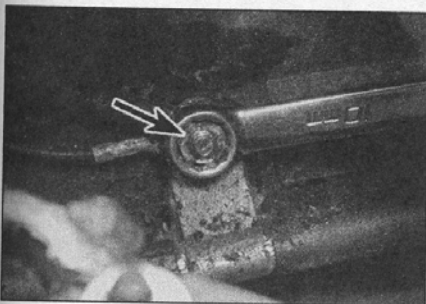
- a) Unclip the cover from the fusebox at the right-hand side of the engine compartment, then unclip the circuit breaker cover plate (see illustration).
- b) Remove the securing screw, and disconnect the left-hand wire from the fusebox connector plate (see illustration).
- c) Disconnect the battery positive lead. Unscrew the bolt from the lead clamp, and separate the secondary leads from the clamp (see illustration).
- d) Unscrew the securing nut, and disconnect the earth wires from the body panel under the fusebox (see illustration).
- e) Disconnect the wiring plug from the preheating system relay/timer unit at the rear of the fusebox (see illustration).
- f) Unscrew the two nuts securing the wiring harness clamps to the right-hand body panel (see illustration), then release the



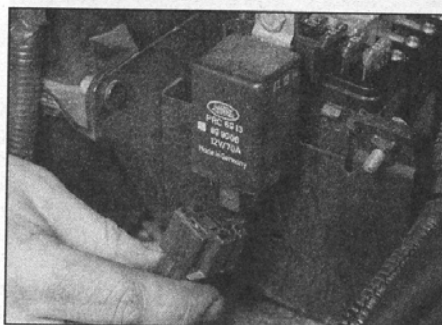
**5.32b** . . . then disconnect the left-hand wire from the connector plate



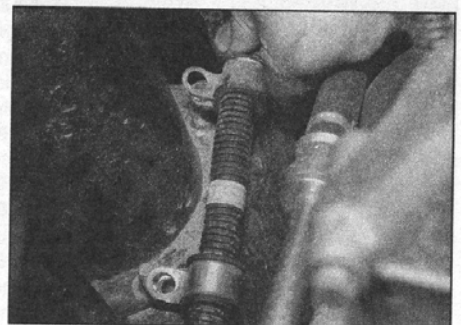
**5.32c** Separate the secondary leads from the battery positive lead clamp



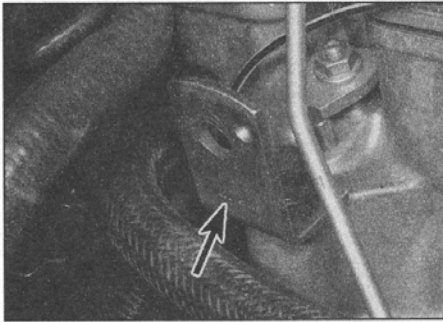
**5.32d** Unscrew the nut (arrowed) and disconnect the earth leads from the body panel



**5.32e** Disconnect the wiring plug from the preheating system relay/timer unit



**5.32f** Release the wiring harness clamps from the body panel



**5.38 Engine lifting bracket (arrowed) in position on rear cylinder head bolt**

wiring harness from any remaining clips in the engine compartment, and lay the harness on the engine (the harness is removed complete with the engine). Note the routing of the wiring harness, to ensure correct refitting.

**33** On models with Electronic Diesel Control (EDC), disconnect all relevant wiring from the system components in the engine compartment (refer to Chapter 4C for further details) to enable the wiring harness to be removed complete with the engine.

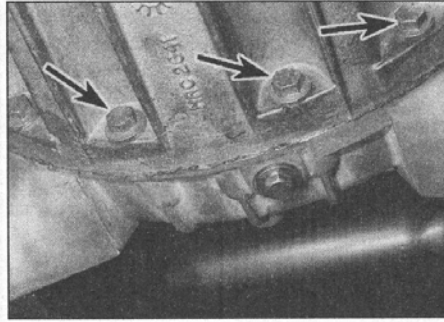
**34** On models with automatic transmission, where applicable, unbolt the transmission fluid cooler pipe bracket from the cylinder block, and move the pipes to one side, clear of the engine.

**35** Place a trolley jack under the transmission, with an interposed block of wood to spread the load. Raise the jack to support the transmission.

**36** On models with automatic transmission, proceed as follows:

- a) Working under the vehicle, unscrew the securing bolts, and remove the driveplate access panel from the transmission bellhousing. Recover the gasket.
- b) Working through the bellhousing aperture, make alignment marks between the torque converter and the driveplate.
- c) Unscrew the four torque converter-to-driveplate securing bolts, rotating the crankshaft as necessary to gain access to each bolt in turn.

**37** Make up an engine rear lifting bracket from a suitable piece of steel bar - the bracket



**5.41 Three of the flywheel housing-to-bellhousing bolts (arrowed)**

should be constructed so that it can be secured by the right-hand rear cylinder head bolt. Ensure that the bracket is strong enough to carry the weight of the engine.

**38** Carefully unscrew the right-hand rear cylinder head securing bolt, then fit the lifting bracket, and refit and tighten the cylinder head bolt to secure the bracket (see illustration).

**39** Connect a suitable hoist and lifting tackle to the front and rear engine lifting brackets on the cylinder head.

**40** Raise the hoist sufficiently to just take the weight of the engine.

**41** Working underneath the vehicle, unscrew, but do not remove, all accessible flywheel housing-to-bellhousing bolts and nuts (see illustration).

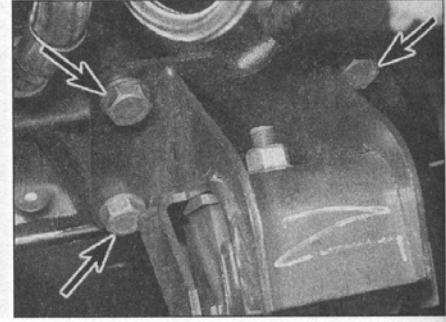
**42** Working at each side of the engine in turn, unscrew the four bolts (on each side) securing the front engine mounting brackets to the cylinder block (see illustration).

**43** Similarly, remove the two bolts on each side, securing the front engine mountings to the flywheel housing.

**44** Unscrew the nuts, and recover the washers securing the front engine mountings to the chassis, then withdraw both engine mounting assemblies from the vehicle (see illustration).

**45** Lower the engine and transmission, using the hoist and jack, for access to the three upper flywheel housing-to-bellhousing nuts.

**46** Unscrew and remove the upper flywheel housing-to-bellhousing nuts. Access is difficult, and is easiest from underneath the



**5.42 Engine left-hand mounting bracket-to-cylinder block bolts (arrowed)**

vehicle, using a suitable socket and extension bar (see illustrations).



*Have an assistant guide the socket onto the flywheel housing-to-bellhousing nuts from above.*

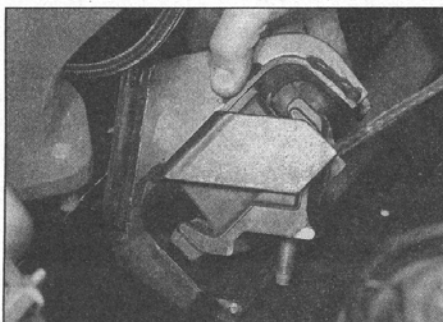
**47** Working in the engine compartment, unscrew and remove the bolt securing the transmission breather pipe bracket to the rear of the cylinder head, then move the pipe to one side, clear of the engine.

**48** Working under the vehicle, remove the remaining flywheel housing-to-bellhousing bolts and nuts. Leave the starter motor in position.

**49** Carefully raise the hoist, and lift the engine from the transmission. On manual transmission models, it will be necessary to pull the engine forwards to disengage the transmission input shaft from the clutch - take care not to allow the weight of the engine or transmission to hang on the input shaft. If necessary, alter the position of the jack supporting the transmission, and the hoist supporting the engine, until the engine is free. Note that there is sealant between the mating faces of the flywheel housing and the bellhousing.

**50** Make a final check to ensure that all hoses, pipes and wires have been disconnected from the engine to allow removal.

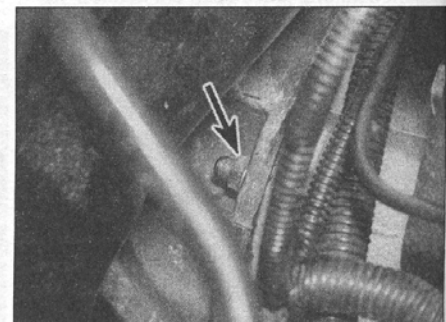
**51** With the aid of an assistant, carefully raise



**5.44 Removing the engine left-hand mounting**



**5.46a Left-hand ...**

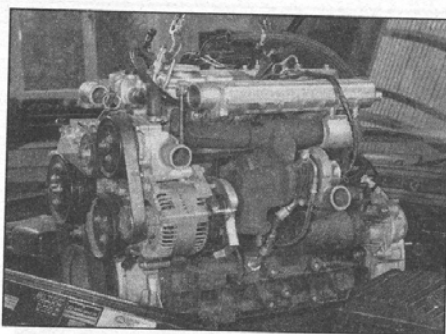


**5.46b ... and right-hand upper flywheel housing-to-bellhousing nuts (arrowed) - there is one more nut at the very top**

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



**On models with a manual transmission, fasten a suitable hose clip around the transmission input shaft to prevent the release bearing from being inadvertently pushed forwards on the shaft whilst the engine is removed from the vehicle.**



**5.51 Lifting the engine from the vehicle**

**52** On models with automatic transmission, if the transmission is to be left in position in the vehicle, and the engine is to be removed for some time, bolt a suitable bar across the transmission bellhousing (using the engine-to-transmission bolts) to retain the torque converter in position in the bellhousing.

**Refitting**

**53** Check that the rear engine lifting bracket is in position on the right-hand rear cylinder head bolt.

**54** On models with a manual transmission, ensure that the clutch friction disc has been centralised as described in Chapter 6.

**55** On models with automatic transmission, unbolt the torque converter retaining tool from the bellhousing.

**56** Where applicable, remove the hose clip from the transmission input shaft.

**57** Apply jointing compound to the cylinder block mating faces of the transmission bellhousing.

**58** On manual transmission models, apply a little high-melting-point grease to the splines of the transmission input shaft. Do not apply too much grease, as it may contaminate the clutch.

**59** Attach the hoist and lifting tackle to the engine, as during the removal procedure, and lift the engine into position over the vehicle engine compartment.

**60** Lower the engine into position, taking care not to damage the surrounding components.

**61** Manipulate the engine and transmission as necessary to enable the two assemblies to be mated together. Alter the position of the jack supporting the transmission, and the hoist supporting the engine, until the two assemblies are correctly aligned. On manual transmission models, ensure that the weight of the engine or transmission is not allowed to hang on the input shaft, and ensure that the input shaft engages with the splines of the clutch friction disc.

**62** Fit the flywheel housing-to-bellhousing bolts and nuts, and tighten them to the specified torque. If necessary, lower the engine/transmission assembly to gain access to the top nuts, as during removal.

**63** Wipe any excess jointing compound from the area around the flywheel housing-to-bellhousing mating faces.

**64** Refit and tighten the bolt securing the transmission breather pipe bracket to the rear of the cylinder head.

**65** If necessary, raise the engine slightly, then place the front engine mountings in position. Refit and tighten the bolts securing the engine mountings to the cylinder block and the flywheel housing.

**66** Carefully withdraw the jack and the block of wood used to support the transmission.

**67** Lower the engine, ensuring that the engine mounting studs engage with the corresponding holes in the chassis brackets, then refit the engine mounting washers and nuts, and tighten the nuts to the specified torque.

**68** Disconnect the hoist and lifting tackle from the cylinder head.

**69** On models with automatic transmission, proceed as follows.

a) Coat the threads of the torque converter-to-driveplate bolts with thread-locking compound.

b) Turn the crankshaft as necessary to align the marks made on the driveplate and torque converter before removal.

c) Refit the first accessible torque converter-to-driveplate bolt, ensuring that the marks are still aligned.

d) Refit the remaining torque converter-to-driveplate bolts, turning the crankshaft as necessary to gain access to each bolt location in turn.

e) Tighten the torque converter-to-driveplate bolts to the specified torque (Chapter 7B).

f) Clean all traces of old gasket from the driveplate access panel and bellhousing mating faces, then refit the access panel using a new gasket. Tighten the securing bolts to the specified torque.

**70** Unscrew the right-hand rear cylinder head bolt, and remove the engine lifting bracket. Refit the cylinder head bolt, and tighten to the specified torque in the stages given in the Specifications.

**71** On models with automatic transmission, where applicable, refit the bolt securing the fluid cooler pipe bracket to the cylinder block.

**72** Reconnect all relevant engine harness wiring, and clip the harness into position, ensuring that it is routed as noted before removal (refer to paragraphs 31 to 33).

**73** Refit the bolt securing the starter motor earth strap.

**74** Reconnect the coolant hoses to the coolant pump and the front of the manifold-mounted coolant pipe.

**75** Reconnect the exhaust front section to the manifold as described in Chapter 4D.

**76** Reconnect the vacuum hose to the brake vacuum pump.

**77** Reconnect the fuel hoses to the fuel lift pump, and tighten the banjo unions.

**78** Similarly, reconnect the fuel supply and return pipes to the fuel injection pump.

**79** On models with automatic transmission, reconnect and adjust the kickdown cable as described in Chapter 7B.

**80** Where applicable, reconnect and adjust the accelerator cable as described in Chapter 4C.

**81** Reconnect the coolant bypass hose to the thermostat housing, and clip the hose into position on the timing belt cover.

**82** Reconnect the fluid hoses to the power steering pump, using new O-ring seals.

**83** Reconnect the coolant hoses to the rear of the cylinder head and to the manifold-mounted coolant pipe.

**84** Refit the air trunking connecting the air cleaner to the turbocharger and, where applicable, reconnect the engine breather hose to the air trunking.

**85** On models with air conditioning, reconnect the refrigerant pipes to the air conditioning compressor.

**86** Refit the radiator/intercooler/oil cooler assembly, and secure with the mounting brackets, ensuring that the power steering fluid reservoir hoses are correctly routed.

**87** Refit the intercooler air trunking, and tighten the securing clips.

**88** On models with automatic transmission, reconnect the transmission fluid cooler pipes to the fluid cooler.

**89** Reconnect the oil cooler pipes to the oil filter adapter and the oil cooler, using new O-ring seals.

**90** Reconnect the top hose and the expansion tank hose to the radiator.

**91** Refit the viscous fan unit and cowl as described in Chapter 3.

**92** On 300 TDi engine models, feed the engine wiring harness through the bulkhead, and push the bulkhead grommet into position.

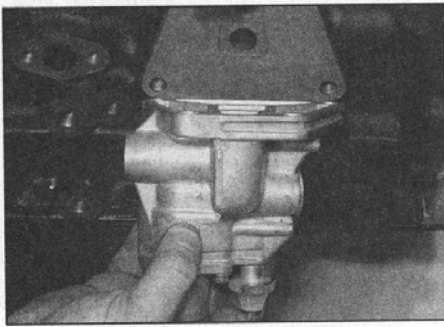
**93** Where applicable, working in the footwell, reconnect the engine wiring harness plugs, and on models with air conditioning, reconnect the wiring to the air conditioning relay. Refit the lower fascia trim panel.

**94** Where applicable, clip the plastic cover into position on the valve cover, then refit the oil filler cap.

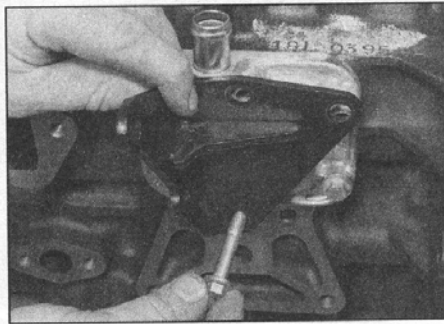
**95** Refit the bonnet as described in Chapter 12.

**96** Check the power steering fluid level, and top-up as necessary as described in Chapter 1B.

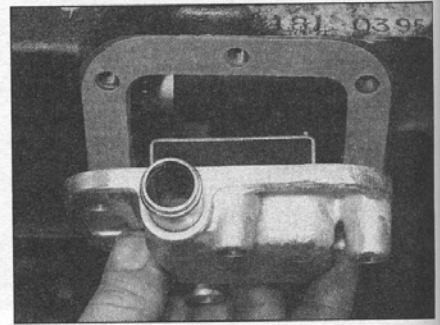
**97** On models with automatic transmission, check and if necessary top-up the transmission fluid level as described in Chapter 1B.



6.3a Removing the oil filter adapter



6.3b Remove the bolts securing the injection pump bracket ...



6.3c ... then remove the crankcase breather housing - 300 TDi engine

98 Refill the cooling system as described in Chapter 1B.

99 Refill the engine with oil as described in Chapter 1B.

100 Before starting the engine, the turbocharger **must** be primed with oil as follows. Failure to carry out this procedure may result in serious (and expensive) damage to the turbocharger.

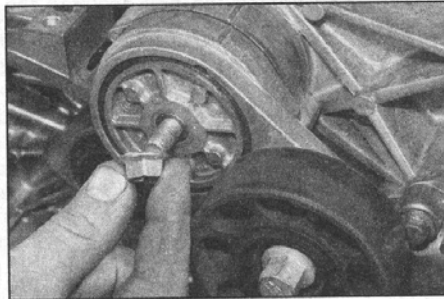
- a) Unscrew the oil feed pipe banjo bolt from the top of the turbocharger housing. Recover the two sealing washers, and move the feed pipe away from the oil hole in the housing.
- b) Fill the housing with clean engine oil of the correct type and grade, from a freshly-opened sealed container.
- c) Reconnect the oil feed pipe, and refit the banjo bolt, ensuring that one sealing washer is positioned on each side of the pipe. Tighten the banjo bolt to the specified torque.

101 On models with air conditioning, have the system re-charged with refrigerant by a Land Rover dealer, or a suitably-equipped specialist.

102 Reconnect the battery negative lead.

## 6 Engine overhaul - dismantling sequence

It is far easier to dismantle and work on the engine if it is mounted on a portable engine

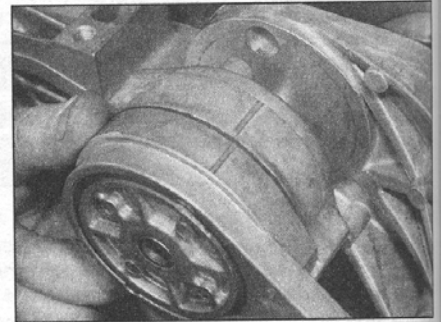


6.3d To remove the auxiliary mounting bracket on 300 TDi engines, unscrew the nut ...

stand. These stands can often be hired from a tool hire shop. Depending on the type of stand used, the flywheel/driveplate may have to be removed from the engine, to allow the engine stand bolts to be tightened into the end of the cylinder block.

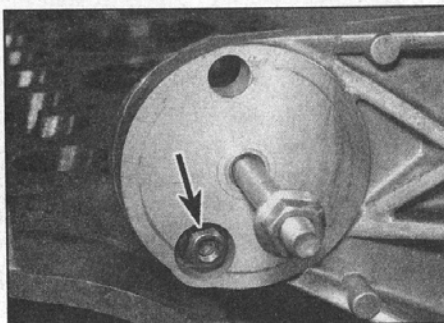
If a stand is not available, it is possible to dismantle the engine while supported on blocks on a sturdy workbench, or on the floor. Be extra-careful not to tip or drop the engine when working without a stand.

Before starting the overhaul procedure, the external engine ancillary components must be removed (this is the case even if a reconditioned engine is to be fitted, in which case, the components from the old engine must be transferred to the reconditioned unit). These components include the following (check with the supplier of a reconditioned unit to see which components are included):

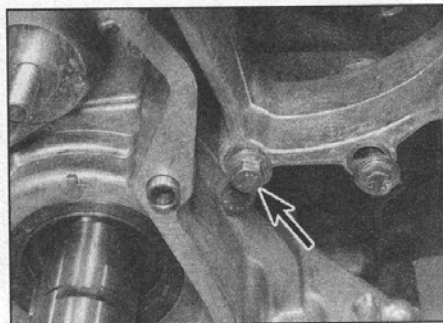


6.3e ... and remove the auxiliary drivebelt tensioner ...

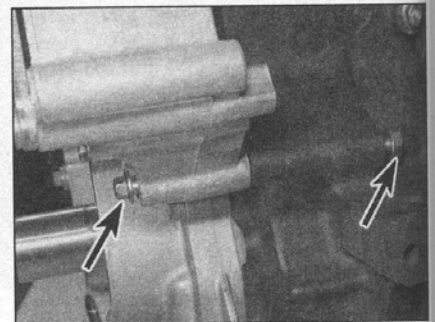
- a) Wiring looms (note all connections and routing).
- b) Spark plugs or glow plugs.
- c) Fuel injectors.
- d) Diesel injection pump.
- e) Coolant pump.
- f) Alternator.
- g) Starter motor.
- h) Power steering pump.
- i) Manifolds and turbocharger (diesel models).
- j) Thermostat and housing.
- k) Clutch.
- l) Oil pressure switch.
- m) Temperature gauge sender.
- n) Oil filter adapter (see illustration).
- o) Crankcase breather and oil separator components (see illustrations).
- p) Dipstick and tube.
- q) Auxiliary component mounting bracket(s) (see illustrations).



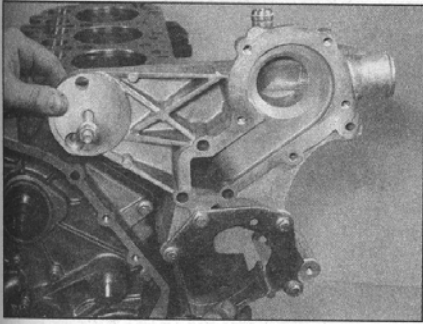
6.3f ... for access to the bracket securing nut (arrowed)



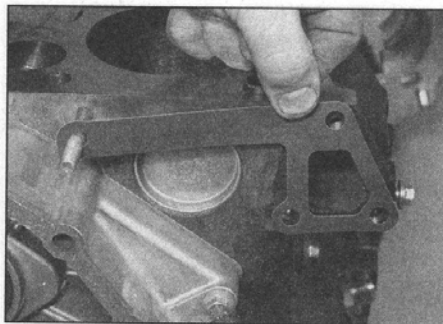
6.3g Remove the securing bolt (arrowed) ...



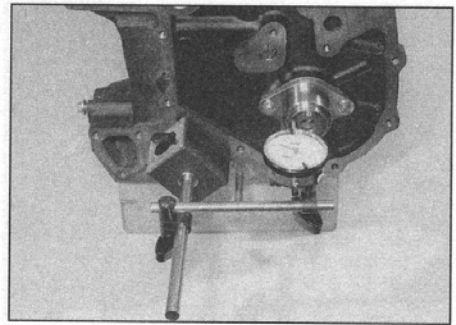
6.3h ... and the through-bolt and nut (arrowed) ...



6.3i ... then withdraw the bracket ...



6.3j ... and recover the gasket



7.5 Measuring the camshaft endfloat - engine shown inverted

**7 Camshaft (diesel engines) - removal, inspection and refitting**



**Note 1:** On 200 TDi engines, if the camshaft is renewed, the oil pump/brake vacuum pump drive skew gear must also be renewed (see Chapter 2B, Section 13). This is necessary to preserve the meshing of the skew gear teeth with the teeth on the camshaft.

**Note 2:** On petrol engines, camshaft removal is covered in part A of this Chapter.

**Removal**

- 1 With the engine removed, if not already done, remove the cylinder head, cam follower components, and the fuel lift pump (see Chapters 2B and 4C). On 200 TDi engines, remove the oil pump driveshaft, as described in part B of this Chapter. On 300 TDi engines, remove the brake vacuum pump (Chapter 10).
- 2 Remove the timing belt housing, as described in part B of this Chapter (Section 16).
- 3 Before removing the camshaft, check the camshaft endfloat as follows.
- 4 Mount a dial gauge on the end of the cylinder block, and position the probe to read from the end of the camshaft.
- 5 Push the camshaft fully into the cylinder block, and zero the dial gauge (see illustration).
- 6 Pull the camshaft fully towards the front of the engine, and note the reading on the dial gauge.
- 7 If the reading is outside the specified limits

(see *Specifications*), fit a new thrust plate on reassembly.

**8** Unscrew the two securing bolts, and remove the camshaft thrust plate, noting which way round it is fitted (**see illustration**).

**9** Carefully withdraw the camshaft from the front of the cylinder block, taking care not to allow the end of the camshaft to drop onto the bearings in the cylinder block as it is removed (**see illustration**).

**Inspection**

**10** Examine the camshaft bearing surfaces and cam lobes for wear ridges, pitting or scoring. Renew the camshaft if evident.

**11** Examine the camshaft bearing surfaces in the cylinder block (**see illustration**). Deep scoring or other damage means that the bearings must be renewed. To determine the extent of wear, the internal diameter of the bearings can be measured using a suitable internal micrometer. Renewal of the bearings is a specialist job, and should be entrusted to a suitably-equipped specialist with access to line-boring equipment.

**Refitting**

**12** Carefully offer the camshaft into position in the cylinder block, taking care not to damage the bearings or the cam lobes.

**13** Refit the camshaft thrust plate, ensuring that it is positioned as noted before removal, and tighten the securing bolts to the specified torque.

**14** Refit the timing belt housing, as described in part B of this Chapter.

**15** Refit the cam follower components, the

cylinder head, and the fuel lift pump (Chapters 2B and 4C). On 200 TDi engines, refit the oil pump driveshaft, as described in part B of this Chapter. On 300 TDi engines, refit the brake vacuum pump as described in Chapter 10.

**8 Cylinder head - dismantling**

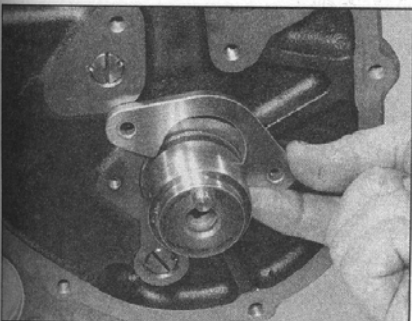


**Note:** A valve spring compressor tool will be required for this operation. New and reconditioned cylinder heads are available from the manufacturers, and from engine overhaul specialists. Due to the fact that some specialist tools are required for the dismantling and inspection procedures, and new components may not be readily available, it may be more practical and economical for the home mechanic to purchase a reconditioned head rather than to dismantle, inspect and recondition the original head.

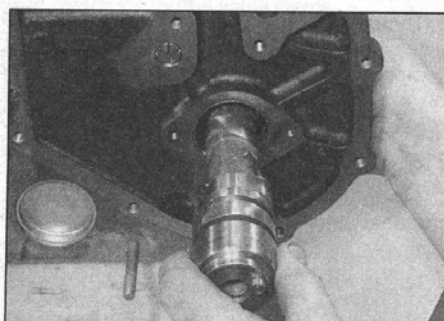
**1** With the cylinder head removed as described in Chapter 2A or 2B, clean away all external dirt, and if desired, remove any ancillaries such as engine lifting brackets, thermostat housing, etc, which are still attached to the cylinder head.

**Petrol engines**

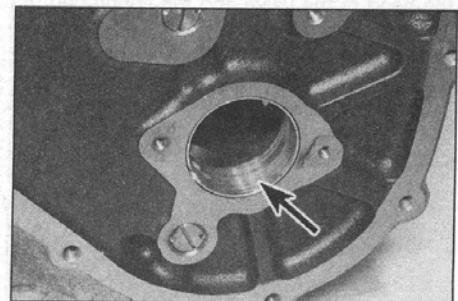
**2** Before starting to remove the valves from the cylinder head, take a piece of cardboard and pierce 8 numbered holes in it. If both cylinder heads are being done together, then make two such cards and mark one LEFT and the other RIGHT. Alternatively, bag each valve



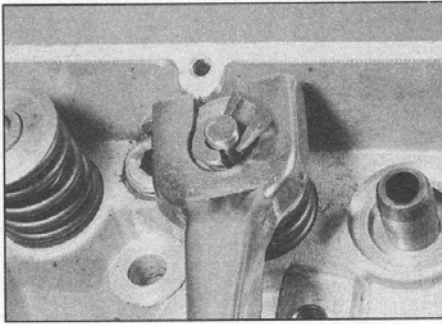
7.8 Remove the thrust plate ...



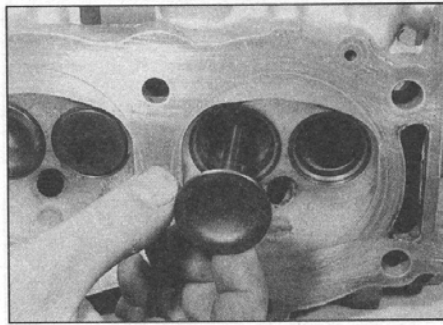
7.9 ... and withdraw the camshaft - engine shown inverted



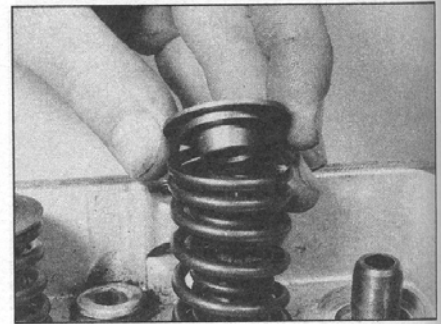
7.11 Examine the camshaft bearings in the cylinder block (arrowed) - engine shown inverted



8.4 Clamp the compressor tool and remove the collet halves



8.5a Remove the upper cup and valve spring . . .



8.5b . . . followed by the valve

and its components once removed, and label the bag No 1 LEFT, and so on. Small food or freezer bags are ideal for this, especially the self-closing type.

3 The procedure for each cylinder head is the same. Start at the front of the head and arrange a valve spring compressor tool over the first valve.

4 Clamp the tool and remove the two split collets, then release the tool (see illustration).

**HAYNES**  
**HINT** *If the spring cap sticks to the valve stem, support the compressor tool, and give the end a light tap with a soft-faced mallet to help free the spring cap.*

5 Remove the upper cup, valve spring and valve from the cylinder head (see illustrations).

6 Place the valve in the No 1 hole in the card and the spring(s), collets and upper cup in a suitably-marked container, or put all components in a clearly-marked bag.

7 Remove the rest of the valves in turn in each cylinder head, making sure that they are put into the correct holes in the card for their particular head.

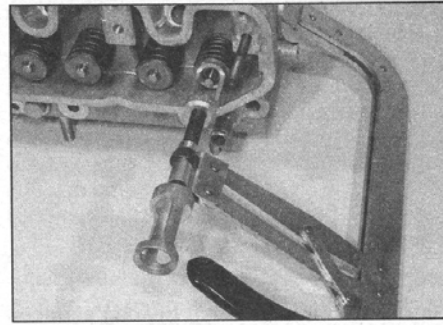
**Diesel engines**

8 If not already done, remove the caps from the tops of the valve stems, keeping them in order so that they can be refitted in their original positions.

9 To remove a valve, fit a valve spring compressor tool. Ensure that the arms of the compressor tool are securely positioned on the head of the valve and the spring cap. As the valves are recessed into the cylinder head, a suitable extension piece may be required for the spring compressor (see illustration).

10 Compress the valve spring to relieve the pressure of the spring cap acting on the collets.

**HAYNES**  
**HINT** *If the spring cap sticks to the valve stem, support the compressor tool, and give the end a light tap with a soft-faced mallet to help free the spring cap.*



8.9 Valve spring compressor tool in position on No 8 valve

11 Extract the two split collets, then slowly release the compressor tool.

12 Remove the spring cap, spring, valve stem oil seal (using long-nosed pliers if necessary), and the spring seat, then withdraw the valve from the cylinder head.

13 Repeat the procedure for the remaining valves, keeping all components in strict order so that they can be refitted in their original positions, unless all the components are to be renewed. If the components are to be kept and used again, place each valve assembly in a labelled polythene bag or a similar small container. Note that as with cylinder numbering, the valves are normally numbered from the timing belt end of the engine (see illustration).

**9 Cylinder head and valve components - cleaning and inspection**

1 Thorough cleaning of the cylinder head and valve components, followed by a detailed inspection, will enable a decision to be made on whether further work is necessary before reassembling the components.

**Cleaning**

2 Scrape away all traces of old gasket material and sealing compound from the cylinder head surfaces. Take care not to damage the cylinder head surfaces, as the head is made of light alloy.

3 Scrape away the carbon from the combustion chamber mating faces of the cylinder head, then wash the cylinder head



8.13 Place the valve components in a labelled polythene bag

thoroughly with paraffin or a suitable solvent.  
4 Scrape off any heavy carbon deposits that may have formed on the valves, then use a power-operated wire brush to remove deposits from the valve heads and stems.

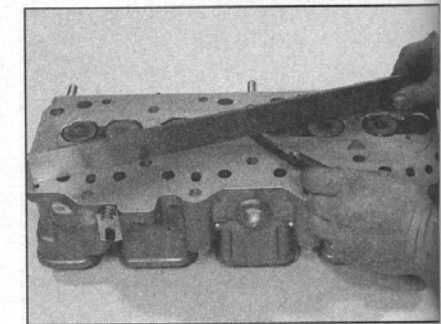
**Inspection**

**Note:** Be sure to perform all the following inspection procedures before concluding that the services of a machine shop or engine overhaul specialist are required. Make a list of all items that require attention.

**Cylinder head(s)**

5 Inspect the head(s) very carefully for cracks, evidence of coolant leakage, and other damage. If cracks are found, a new cylinder head should be obtained.

6 Use a straight-edge and feeler blade to check that the cylinder head surface is not distorted (see illustration). If the specified



9.6 Checking the cylinder head surface for distortion

disto  
to ha  
a Lar  
7 Ex  
head  
or bu  
an e  
pittin  
grind  
with  
desc  
8 If t  
side-  
be re  
engin  
stem  
relev  
appro  
gaug  
head  
amou  
speci  
been  
and l  
maxim  
9 Ch  
bearin  
of wa  
head  
possi  
**Valv**  
**Note**  
opera  
10 E  
pittin  
check  
ridges  
obvio  
pittin  
valve  
this s  
at se  
illustr  
readin  
stem.  
appar  
11 Fi  
which  
new o  
12 Cr  
above  
distan  
neces  
reduc  
entail  
valve  
13 Th  
onto t  
gas-tig  
14 Va  
Place  
bench  
give ch  
15 Sn  
paste  
and pr  
relevan



distortion limit is exceeded, it may be possible to have the cylinder head resurfaced - consult a Land Rover dealer for further information.

7 Examine the valve seats in the cylinder head. If the seats are severely pitted, cracked or burned, then they will need to be recut by an engine overhaul specialist. If only slight pitting is evident, this can be removed by grinding the valve heads and seats together with coarse, then fine, grinding paste, as described later in this Section.

8 If the valve guides are worn, indicated by a side-to-side motion of the valve, the guides can be renewed. This work is best carried out by an engine overhaul specialist. To measure the valve stem play in the guide, insert the valve into the relevant guide, with the valve head positioned approximately 8.0 mm from the seat. A dial gauge positioned against the edge of the valve head may be used to determine whether the amount of side play of the valve exceeds the specified maximum. If new valve guides have been fitted, repeat the measuring procedure, and if the valve stem play still exceeds the maximum limit, renew the valve.

9 Check the condition of the rocker shaft bearing surfaces in the cylinder head for signs of wear or damage. If evident, the cylinder head must be renewed, as no repair is possible.

#### Valves - petrol engines

*Note: A micrometer will be required for this operation.*

10 Examine the head of each valve for pitting, burning, cracks and general wear, and check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pitting and excessive wear on the end of each valve stem. If the valve appears satisfactory at this stage, measure the valve stem diameter at several points using a micrometer (see illustration). Any significant difference in the readings obtained indicates wear of the valve stem. Should any of these conditions be apparent, the valve(s) must be renewed.

11 Fit each valve in turn into the guide from which it was removed, unless the valves are new ones.

12 Check the height of the valve stems above the valve spring seat surface. This distance **must not** exceed 47.63 mm. If necessary, grind the end of the valve stem to reduce the height. However, if this is going to entail too much grinding, new valves or even valve seats may be required.

13 The valves they should be ground (lapped) onto their respective seats to ensure a smooth gas-tight seal.

14 Valve grinding is carried out as follows. Place the cylinder head upside down on a bench, with a block of wood at each end to give clearance for the valve stems.

15 Smear a trace of coarse carborundum paste on the seat face in the cylinder head, and press a suction grinding tool onto the relevant valve head.

16 With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding paste (see illustration).



**A light spring placed under the valve head will greatly ease the grinding-in operation.**

17 When a dull, matt, even surface is produced on the faces of both the valve seat and the valve, wipe off the paste, and repeat the process with fine carborundum paste. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat faces, the grinding operation is complete.

18 Carefully clean away every trace of grinding paste, taking great care to leave none in the ports or in the valve guides. Clean the valves and valve seats with a paraffin-soaked rag, then with a clean rag, and finally, if an air line is available, blow the valves, valve guides and cylinder head ports clean.



**Warning: Wear eye protection when using compressed air**

19 Repeat the valve inspection and grinding-in operations described in paragraphs 10 to 16 on the other cylinder head.

#### Valves - diesel engines

20 Examine the head of each valve for pitting, burning, cracks and general wear, and check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pitting and excessive wear on the end of each valve stem. If the valve appears satisfactory at this stage, measure the valve stem diameter at several points using a micrometer (see illustration 9.10). Any significant difference in the readings obtained indicates wear of the valve stem. Should any of these conditions be apparent, the valve(s) must be renewed.

21 The valves they should be ground (lapped) onto their respective seats to ensure a smooth gas-tight seal.

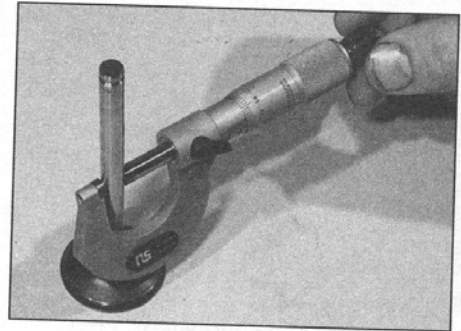
22 Valve grinding is carried out as follows. Place the cylinder head upside down on a bench, with a block of wood at each end to give clearance for the valve stems.

23 Smear a trace of coarse carborundum paste on the seat face in the cylinder head, and press a suction grinding tool onto the relevant valve head.

24 With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding paste (see illustration 9.16).



**A light spring placed under the valve head will greatly ease the grinding-in operation.**



9.10 Measuring a valve stem diameter

25 When a dull, matt, even surface is produced on the faces of both the valve seat and the valve, wipe off the paste, and repeat the process with fine carborundum paste. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat faces, the grinding operation is complete.

26 Carefully clean away every trace of grinding paste, taking great care to leave none in the ports or in the valve guides. Clean the valves and valve seats with a paraffin-soaked rag, then with a clean rag, and finally, if an air line is available, blow the valves, valve guides and cylinder head ports clean.

27 After carrying out the valve grinding operation, the valve recess from the face of the cylinder head must be measured as follows.

28 With the cylinder head supported upside-down, as during the valve grinding operation, insert the valve into its relevant guide, and push the valve onto its seat.

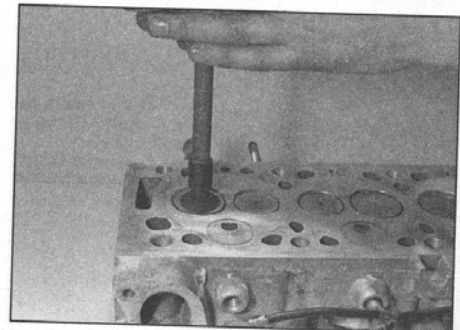
29 Place a straight-edge across the surface of the cylinder head, so that the straight-edge passes across the centre of the valve.

30 Using a feeler blade, measure the recess of the valve below the surface of the cylinder head. The recess should be within the specified limits, if not, new valves or even valve seats may be required. Repeat the measurement for all the valves.

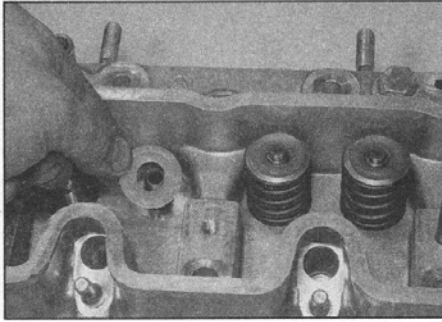
#### Valve springs

31 Check that all the valve springs are intact. If any one is broken, all should be renewed.

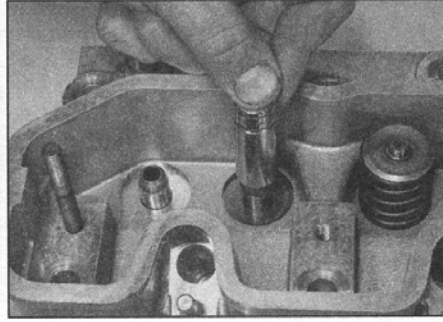
32 Stand each spring on a flat surface, and check it for squareness. If possible, check the



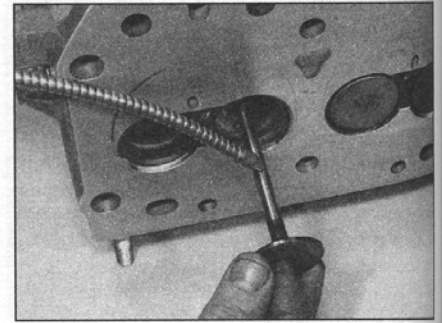
9.16 Grinding-in a valve



10.2 Fitting a spring seat



10.3 Fitting a valve stem oil seal using a socket



10.4 Fitting a valve

free height of the springs against a new spring. If a spring is found to be too short, or damaged in any way, renew all the springs as a set. Springs suffer from fatigue, and it is a good idea to renew them, even if they look serviceable.

**Valve stem oil seals**

33 All valve stem oil seals should be renewed as a matter of course.

**Valve stem caps**

34 Certain engines may be fitted with valve stem caps, which are designed to reduce wear between the rocker arms and the valve stems. Where fitted, the caps should be renewed as a matter of course. Note that, on diesel engines, if no valve stem caps are fitted, it is permissible to fit caps (the caps must be fitted to all the valves as a set, and are available from Land Rover dealers) to

compensate for wear in the valve stems and/or the rocker arm pads.

**10 Cylinder head - reassembly**

**Note:** A valve spring compressor will be required for this operation. New valve stem oil seals and (where applicable) new valve stem caps, should be fitted on reassembly.

1 With all the components cleaned, starting at one end of the cylinder head, fit the valve components as follows. If the original components are being refitted, all components must be refitted in their original positions.

2 On diesel engines, fit the spring seat to its location in the cylinder head (see illustration).

3 Lubricate the valve stem oil seal with clean engine oil, then fit the oil seal by pushing it into position on the spring seat using a suitable socket (see illustration). Ensure that the seal engages correctly over the valve guide. On petrol engines, seals are fitted to the inlet valves only.

4 Insert the appropriate valve into its guide (if new valves are being fitted, insert each valve into the location to which it has been ground), ensuring that the valve stem is well-lubricated with clean engine oil (see illustration). Take care not to damage the valve stem oil seal as the valve is fitted.

5 Fit the valve spring (either way up) and the spring cap (see illustrations).

6 Fit the spring compressor tool, and compress

the valve spring until the spring cap passes beyond the collet groove in the valve stem.

7 Apply a little grease to the collet groove, then fit the split collets into the groove, with the narrow ends nearest the spring (see illustration). The grease should hold them in the groove.

8 Slowly release the compressor tool, ensuring that the collets are not dislodged from the groove. When the compressor is fully released, give the top of the valve assembly a tap with a soft-faced mallet to settle the components (see illustration).

9 Where applicable, fit a new valve stem cap.

10 Repeat the procedure for the remaining valves, ensuring that if the original components are being used, they are all refitted in their original positions.

11 On petrol engines, repeat the procedures to reassemble the remaining cylinder head.

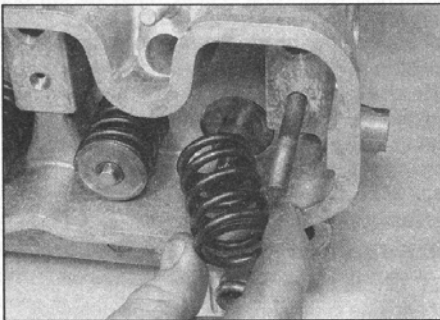
12 Where applicable, refit any brackets, etc, which were removed before dismantling the cylinder head.

**11 Piston/connecting rod assembly - removal**

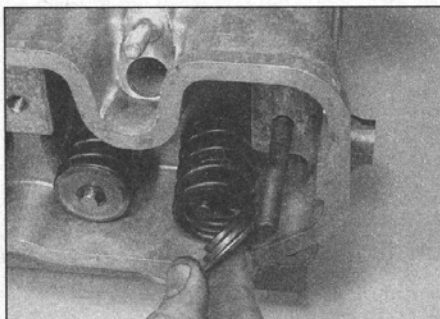
**Petrol engines**

1 Before proceeding, the following components must be removed as described in Chapter 2A:

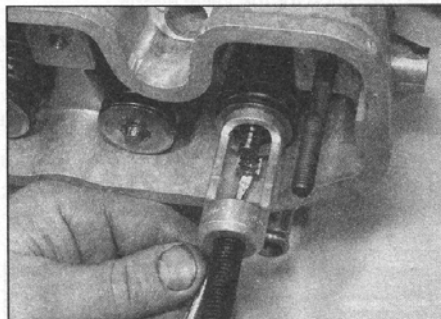
- a) Cylinder heads.
- b) Sump.



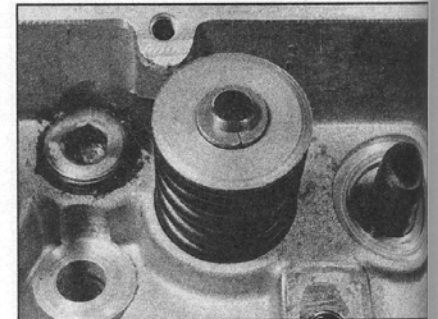
10.5a Fitting a valve spring ...



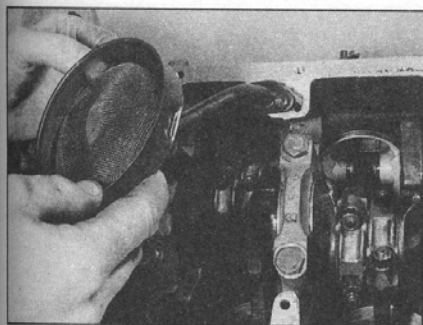
10.5b ... and a spring cap



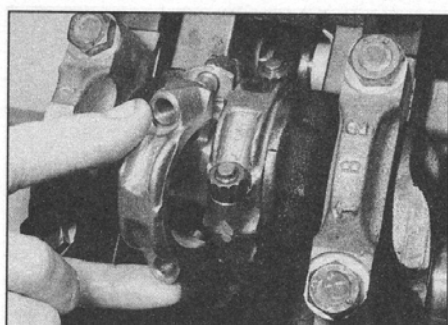
10.7 Fitting a split collet



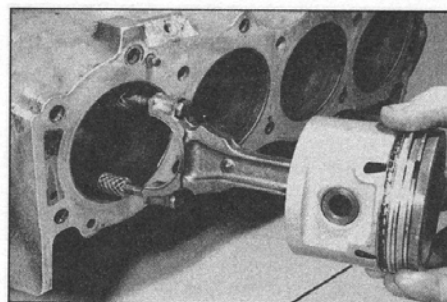
10.8 Valve components assembled with collets correctly seated



**11.2 Removing the oil pick-up pipe and strainer**



**11.7 Take off the No 1 cylinder connecting rod cap**



**11.11 Withdrawing the piston and connecting rod assembly - note tubing fitted to bolt threads**

2 Unscrew the two bolts securing the oil pick-up pipe and strainer, and remove the assembly, recovering the gasket (see illustration).

3 Note that the cylinders are numbered from front to rear, even numbers on the right-hand bank and odd numbers on the left-hand bank. The big-end caps for the odd numbered assemblies are on the front of the shared crankshaft journals, and the even numbered assemblies fit on the rear of the journals.

4 The big-end caps and con-rods are not marked, so great care must be taken and each connecting rod and cap must be scribed with its appropriate number as it is removed. So that no confusion can arise, make up two boxes big enough to each take four piston and connecting rod assemblies. Mark one box 2-4-6-8 and the other one 1-3-5-7. Place each assembly in order in its correct box as it is removed.

5 If the operation is being carried out with the engine in the vehicle, since it is easy to withdraw the pistons through the tops of both banks of cylinders with the engine upright, the assemblies can be removed from front to rear, starting at No 1 and working through to No 8.

6 With the engine on the workbench it is easier to work down one side, removing the odd or even numbered assemblies first, and then to turn the cylinder block over onto the other side and repeat the operation for the other cylinder bank.

7 Rotate the crankshaft so that the

connecting rod cap nuts for No 1 cylinder are easily accessible. Undo and remove the nuts and withdraw the cap (see illustration).

8 Mark the cap with the appropriate cylinder number.

9 Cut two short lengths of plastic tubing and fit them over the connecting rod bolts so that when the assembly is withdrawn, the bolt threads do not damage the journals or cylinder walls.

10 Push the connecting rod and piston assembly up the bore; if necessary, tap the end of the connecting rod bolts with the wooden handle of a hammer.

11 Withdraw the piston and connecting rod through the top of the bore, and remove the protective tubing from the bolts (see illustration). Note that if there is a pronounced wear ridge at the top of the bore, there is a risk of damaging the piston as the rings foul the ridge. However, it is reasonable to assume that a rebore and new pistons will be required in any case if the ridge is so pronounced.

12 Scribe the connecting rod with the cylinder number and then refit the connecting rod cap and nuts to the assembly. Note that the rib on the bearing cap faces in the same direction as the boss on the connecting rod.

13 Place the assembly in the appropriate box in its correct place.

14 Rotate the crankshaft to reach the next pair of connecting rod cap nuts, and repeat the operations already described for all the other piston and connecting rod assemblies.

### 200 TDi engine

15 Before proceeding, the following components must be removed as described in Chapter 2B:

- a) Cylinder head.
- b) Sump.
- c) Oil pump.

16 Unscrew and remove the ten bolts securing the ladder frame to the lower face of the cylinder block (see illustration).

17 Gently tap the ladder frame with a soft-faced mallet to break the seal, then withdraw the ladder frame from the cylinder block.

18 Rotate the crankshaft so that No 1 big-end cap (nearest the timing belt end of the engine) is at the lowest point of its travel. If the

big-end cap and connecting rod are not already numbered, mark them with a centre-punch. Mark both cap and rod to identify the cylinder they operate in, noting that No 1 is nearest the timing belt end of the engine (normally, the connecting rods and caps are already numbered, the numbers being read from the camshaft side of the engine).

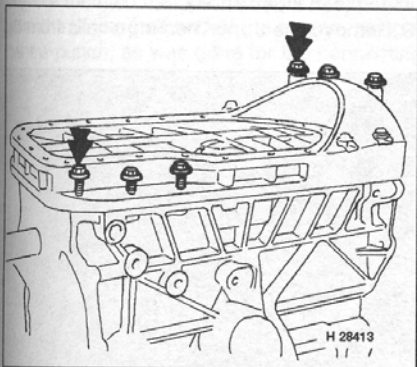
19 Before removing the big-end cap, use a feeler blade to check the amount of side play between the connecting rod/cap and the crankshaft webs (the limit is given in the Specifications).

20 Unscrew and remove the big-end bearing cap nuts. Withdraw the cap, complete with bearing shell, from the connecting rod (see illustration). Strike the cap with a wooden or copper mallet if it is stuck.

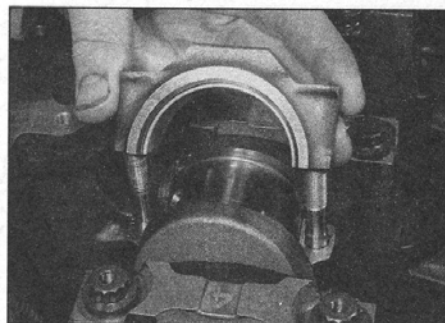
**HAYNES HINT** Tape the bearing shell to the cap if it is to be re-used.

21 If only the bearing shells are being attended to, push the connecting rod up and off the crankpin, and remove the upper bearing shell. Tape the bearing shell to the rod if it is to be re-used.

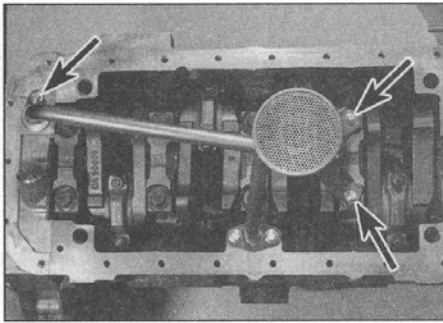
22 If desired, push the connecting rod up, and remove the piston and rod assembly from the bore. Note that if there is a pronounced wear ridge at the top of the bore, there is a risk of damaging the piston as the rings foul the ridge. However, it is reasonable to assume that a rebore and new pistons will be required in any case if the ridge is so pronounced.



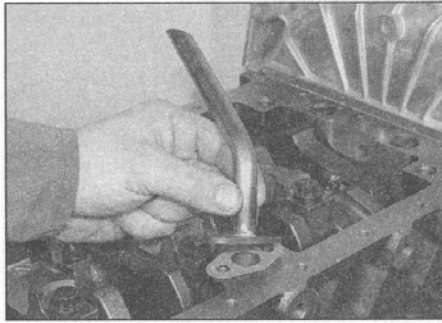
**11.16 Unscrew the securing bolts (arrowed) and remove the ladder frame - 200 TDi engine**



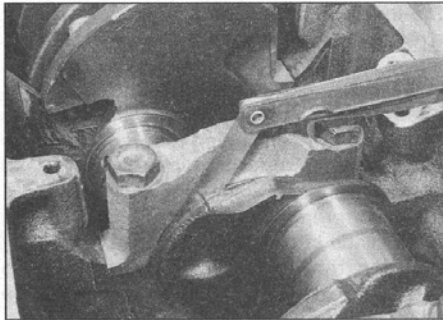
**11.20 Removing a big-end bearing cap**



11.26 Oil strainer securing bolts (arrowed) - 300 TDi engine



11.27 Removing the oil return pipe - 300 TDi engine



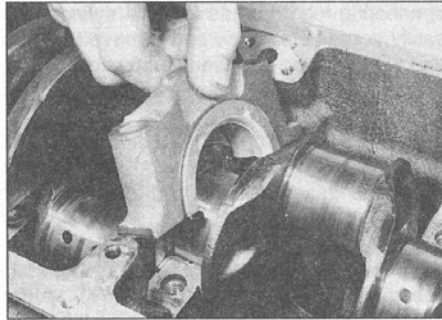
12.3 Checking the crankshaft endfloat at the centre bearing

23 Repeat the procedure for the remaining piston/connecting rod assemblies. Ensure that the caps and rods are marked before removal, as described previously, and keep all components in order.

### 300 TDi engine

24 Before proceeding, the following components must be removed as described in Chapter 2B:

- a) Cylinder head.
- b) Sump.



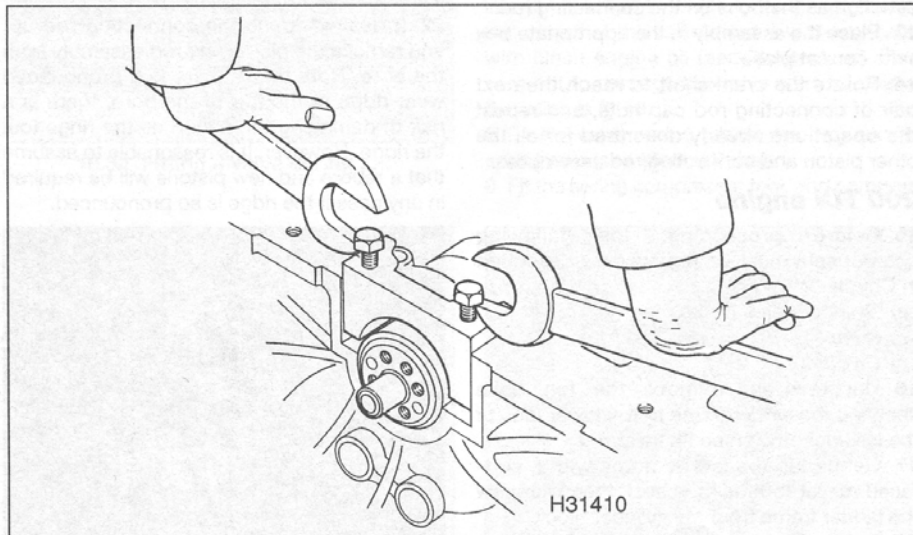
12.5 Removing the centre main bearing cap with its flanged bearing shell

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

26 Unscrew the bolt securing the oil pick-up pipe to the timing belt housing, then withdraw the strainer (see illustration). Recover the O-ring from the pick-up pipe.

27 Unscrew the two bolts securing the oil return pipe to the cylinder block (see illustration). Recover the gasket.

28 Proceed as described in paragraphs 18 to 23 inclusive.



12.6 Using a pair of large spanners to prise up the rear main bearing cap

## 12 Crankshaft - removal

### Petrol engines

1 Before proceeding, the following components must be removed:

- a) Timing chain and cover (Chapter 2A).
- b) Flywheel (Chapter 2A).
- c) Piston/connecting rod assemblies (Section 11).

2 Before the crankshaft is removed, check the endfloat using a dial gauge in contact with the end of the crankshaft. Push the crankshaft fully one way, and then zero the gauge. Push the crankshaft fully the other way, and check the endfloat. If the result is out of specification, this will be due to wear in the flanges on the centre (No 3) bearing shell (diesel engines have thrustwashers in the same location). Endfloat is corrected by fitting flanged shells (or thrustwashers) of the correct size.

3 If a dial gauge is not available, feeler blades can be used. First push the crankshaft fully towards the flywheel end of the engine, then slip the feeler blade between the web of No 2 crankpin and the thrustwasher of No 3 main bearing (located in the crankcase) (see illustration).

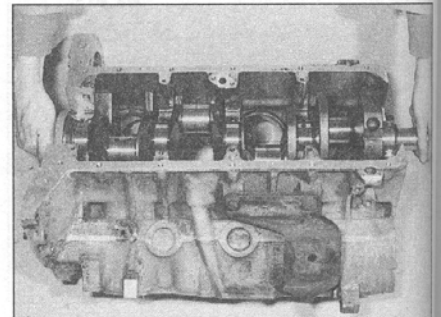
4 Undo the main bearing cap retaining bolts.

5 Remove the first four bearing caps and bolts, together with the lower bearing shells (see illustration). Note that the first four caps are numbered from the front 1-2-3-4. The rear one, which is larger and easily identified, is not marked. The caps also have arrows on them which point to the front of the engine.

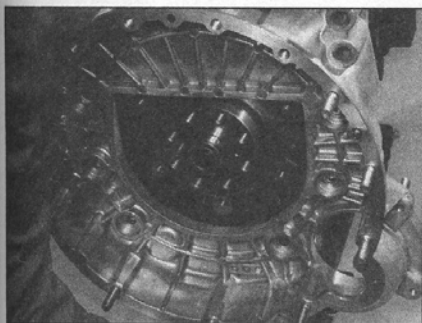
6 The rear cap will have to be eased out, as it also forms part of the rear oil seal construction. Remove the bolts securing the rear main bearing cap, then screw two of the sump retaining bolts into the holes at the front of the cap. Using pliers or a pair of large spanners on the bolt heads, carefully pull or prise the cap from its location, taking care not to damage any sealing surfaces (see illustration).

7 Hold the crankshaft at both ends, and lift it out carefully; the rear oil seal will come out with it (see illustration).

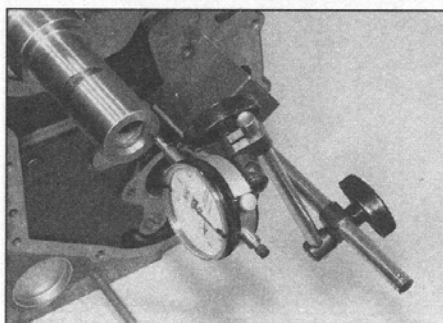
8 Remove the upper bearing shells from the



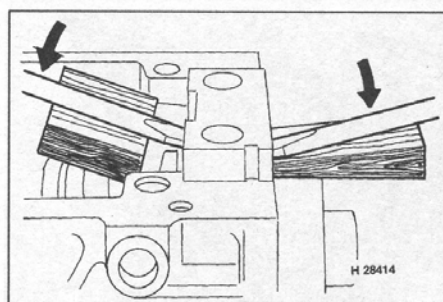
12.7 Lifting out the crankshaft



**12.11 Removing the flywheel housing - 300 TDI engine**



**12.13 Checking the crankshaft endfloat using a dial gauge**



**12.16 Using two screwdrivers to lever No 5 main bearing cap from its location. Note location of blocks of wood**

bearing seats. Note that the centre bearing (No 3) has a flanged shell, as this bearing takes the endthrust of the crankshaft. Identify the shells if they are to be re-used.

9 Remove the lower bearing shells from the bearing caps only if they are to be renewed.

### Diesel engines

10 Before proceeding, the following components must be removed:

a) Timing belt housing (Chapter 2B, Section 16).

b) Flywheel (Chapter 2B).

c) Piston/connecting rod assemblies (Section 11).

11 Working at the rear of the cylinder block, unscrew the securing bolts, and remove the flywheel housing (see illustration). Note the locations of any brackets secured by the external housing bolts. Where applicable, recover the gasket.

12 On 300 TDI engines, unscrew the securing bolts, and remove the crankshaft rear oil seal housing from the rear of the cylinder block. Discard the housing, and recover the gasket (and the sealing ring, if it is loose).

13 Before the crankshaft is removed, check the endfloat as described in paragraphs 2 and 3 (see illustration). The result can be compared with the specified amount, and will give an indication as to whether new thrustwashers are required.

14 Check the main bearing caps for identification marks, and if none are present, number them so that the numbers can be read from the timing belt end of the engine, using a centre-punch, as was done for the connecting

rods and caps. Again note that No 1 cylinder is at the timing belt end of the engine.

15 Unscrew and remove the main bearing cap securing bolts.

16 Withdraw the caps, complete with bearing shells. Tap the caps with a wooden or copper mallet if they are stuck (the caps locate on dowels). Note that the sides of No 5 bearing cap are sealed to the cylinder block using plastic seals on each side, which may cause difficulty in removing the cap. If necessary, the cap can be levered from its location using a suitable bar inserted in the hole in the inside face of the cap - place a suitable piece of wood on the crankshaft web, and lever against the wood (see illustration).

17 Carefully lift the crankshaft from the crankcase.

18 Remove the thrustwashers at each side of No 3 main bearing, then remove the bearing shell upper halves from the crankcase (see illustration). Place each shell with its respective bearing cap.

### 13 Cylinder block/crankcase - cleaning and inspection



#### Cleaning

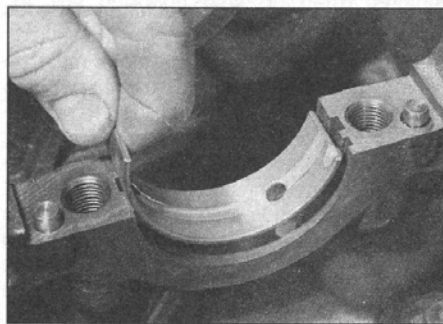
1 For complete cleaning, the core plugs should be removed. Drill a small hole in them, then insert a self-tapping screw and pull out the plugs using a pair of grips or a slide-hammer (see illustration). Also remove all external components, brackets and senders (if not already done), noting their locations.

2 On diesel engines, remove the securing bolts, and withdraw the piston oil spray jets from the bottom of the cylinder block (see illustration). Where applicable, recover the sealing washers.

3 Remove all oil gallery plugs, and where applicable, recover the sealing washers. Note that the plugs may be fitted using sealant.

4 Scrape all traces of gasket and sealant from the cylinder block, taking care not to damage the head and sump (or ladder frame on 200 TDI engines) mating faces.

5 Where applicable, also remove all traces of sealant from the mating faces of the cylinder block and the flywheel housing.



**12.18 Removing a main bearing shell upper half from the crankcase (engine inverted)**

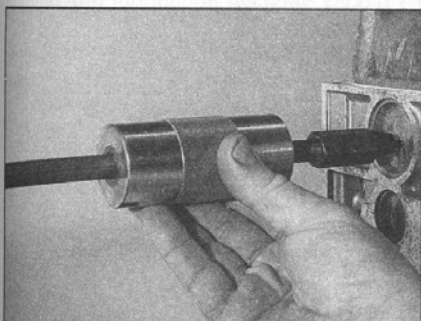
6 If the block is extremely dirty, it should be steam-cleaned.

7 After the block has been steam-cleaned, clean all oil holes and oil galleries one more time. Flush all internal passages with warm water until the water runs clear, then dry the block thoroughly and wipe all machined surfaces with a light rust-preventative oil. If you have access to compressed air, use it to speed up the drying process, and to blow out all the oil holes and galleries.

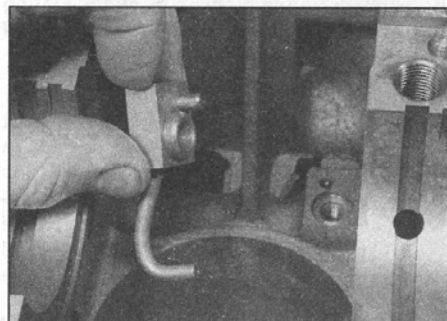


**Warning: Wear eye protection when using compressed air.**

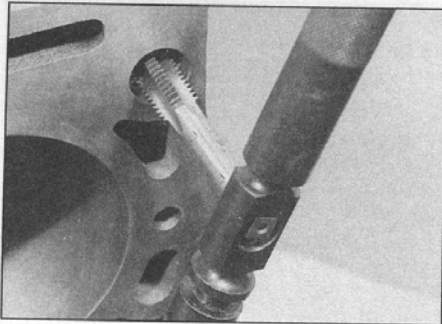
8 If the block is not very dirty, you can do an adequate cleaning job with hot soapy water and a stiff brush. Take plenty of time, and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, dry the block



**13.1 Using a slide hammer to remove a core plug**



**13.2 Removing a piston oil spray jet - 300 TDI engine**



**13.9** Using a tap to clean a cylinder block bolt thread

completely, and coat all machined surfaces with light oil.

**9** The threaded holes in the block must be clean, to ensure accurate torque wrench readings during reassembly. Run the proper-size tap into each of the holes to remove rust, corrosion, thread sealant or sludge, and to restore damaged threads (see illustration). If possible, use compressed air to clear the holes of debris produced by this operation, noting the warning given in paragraph 7. Now is a good time to clean the threads on the head bolts and the main bearing cap bolts as well.

**10** After coating the mating surfaces of the new core plugs with suitable sealant, refit them in the cylinder block. Make sure that they are driven in straight and seated properly, or leakage could result. Special tools are available for this purpose, but a large socket, with an outside diameter that will just slip into the core plug, will work just as well.

**11** Refit the oil gallery plugs, using new sealing washers or sealant where applicable.

**12** On diesel engines, check the oil holes in the piston oil spray jet securing bolts, and the oil holes in the jets themselves for blockage (see illustration). Clean if necessary, then refit the jets and tighten the securing bolts. Ensure that the locating pegs on the jets engage with the corresponding holes in the cylinder block. Where applicable, ensure that the larger-diameter sealing washer fits under the bolt head.

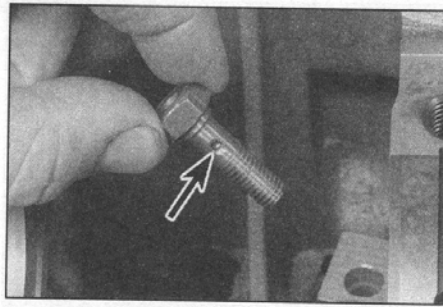
**13** If the engine is not going to be reassembled right away, cover it with a large plastic bag, to keep it clean and prevent it rusting.

**14** On 200 TDi engines, thoroughly clean both the cylinder block and sump mating faces of the ladder frame, and remove all traces of old sealant.

### Inspection

**15** Visually check the block for cracks, rust and corrosion. Look for stripped threads in the threaded holes. If there has been any history of internal water leakage, it may be worthwhile having an engine overhaul specialist check the block with special equipment. If defects are found, have the block repaired, if possible, or renewed.

**16** Check the cylinder bores for scuffing and scoring. Normally, bore wear will be evident in the form of a wear ridge at the top of the bore.



**13.12** Check the oil holes (arrowed) in the piston oil jet securing bolts for blockage - 300 TDi engine

This ridge marks the limit of piston travel.

**17** Measure the diameter of each cylinder at the top (just under the ridge area), centre and bottom of the cylinder bore, parallel to the crankshaft axis.

**18** Next measure each cylinder's diameter at the same three locations across the crankshaft axis. If the measurements taken indicate excessive cylinder bore taper or ovality (see Specifications), then remedial action must be considered.

**19** Repeat this procedure for the remaining cylinders.

**20** If the cylinder walls are badly scuffed or scored, or if they are excessively out-of-round or tapered, have the cylinder block rebored. New pistons (oversize in the case of a rebore) will also be required.

**21** If the cylinders are in reasonably good condition, then it may only be necessary to renew the piston rings.

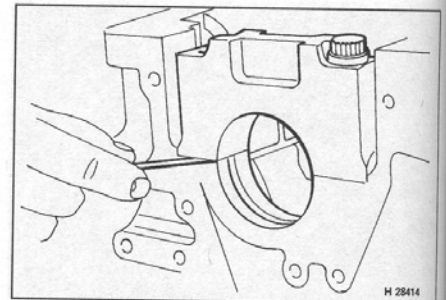
**22** If this is the case, the bores should be honed, in order to allow the new rings to bed-in correctly and provide the best possible seal. The conventional type of hone has spring-loaded stones, and is used with a power drill. You will also need some paraffin or honing oil and rags.

**23** The hone should be moved up and down the cylinder to produce a crosshatch pattern, and plenty of honing oil should be used. Ideally, the crosshatch lines should intersect at approximately a 60° angle. Do not take off more material than is necessary to produce the required finish.

**24** If new pistons are being fitted, the piston manufacturers may specify a finish with a different angle, so their instructions should be followed. Do not withdraw the hone from the cylinder while it is still being turned - stop it first. After honing a cylinder, wipe out all traces of the honing oil.

**25** If equipment of this type is not available, or if you are not sure whether you are competent to undertake the task yourself, an engine overhaul specialist will carry out the work at a moderate cost.

**26** Refit the main bearing caps, without the bearing shells, and tighten the old bolts to the specified torque. Loosen and remove the bolt on one side of each bearing cap, and check, using a feeler blade, that no clearance exists



**13.26** Checking the clearance between the mating face of a main bearing cap and the cylinder block

between the mating faces of the bearing cap and the cylinder block (see illustration). If a clearance exists, this indicates one of the following problems:

- a) One of the bearing cap bolts is bent.
- b) The bearing cap is distorted.
- c) The block and/or the bearing cap has been filed or machined in a misguided attempt to compensate for bearing wear.

**27** Main bearing caps are not available separately from the cylinder block, and if a clearance exists between the cap and the block, the block must be renewed.

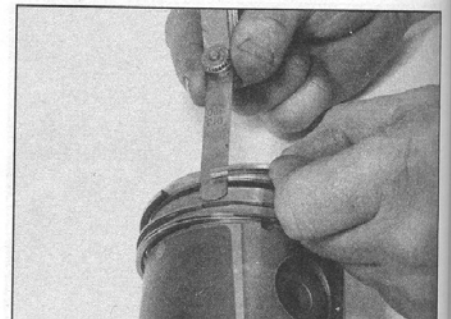
**28** Where applicable, refit all external components and senders in their correct locations, as noted before removal.

**29** On 200 TDi engines, check that the ladder frame is not distorted, and is free from burrs and damage to the mating faces, which may cause oil or gas leaks. Renew the ladder frame if it is damaged.

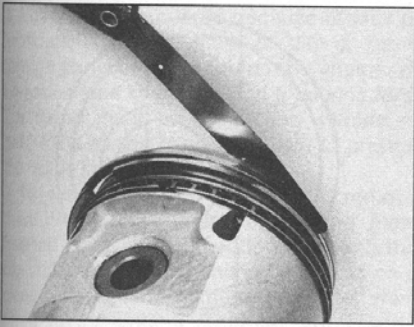
### 14 Piston/connecting rod assembly - inspection

**1** Before the inspection process can begin, the piston/connecting rod assemblies must be cleaned, and the original piston rings removed from the pistons.

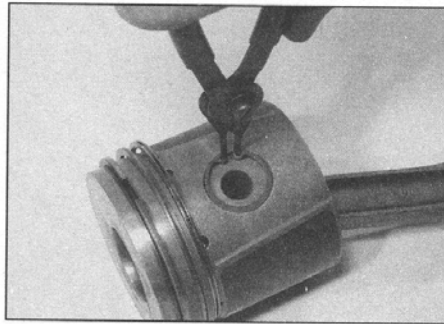
**2** Carefully expand the old rings over the top of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves (see illustration). Note that the oil control ring has two sections.



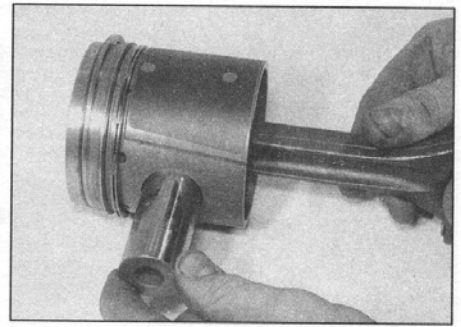
**14.2** Using a feeler blade to aid removal of a piston ring



14.10 Checking the piston ring-to-groove clearance



14.13a Prise out the circlip . . .



14.13b . . . and push out the gudgeon pin

3 Scrape away all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once the majority of the deposits have been scraped away.

4 Remove the carbon from the ring grooves in the piston by cleaning them using an old ring. Break the ring in half to do this. Be very careful to remove only the carbon deposits; do not remove any metal, nor nick or scratch the sides of the ring grooves. Protect your fingers - piston rings are sharp.

5 Once the deposits have been removed, clean the piston/connecting rod assembly with paraffin or a suitable solvent, and dry thoroughly. Make sure that the oil return holes in the back sides of the ring grooves are clear.

6 If the pistons and cylinder bores are not damaged or worn excessively, and if the cylinder block does not need to be rebored, the original pistons can be re-used. Normal piston wear appears as even vertical wear on the piston thrust surfaces, and slight looseness of the top ring in its groove. New piston rings, however, should always be used when the engine is reassembled.

7 Carefully inspect each piston for cracks around the skirt, at the gudgeon pin bosses, and at the piston ring lands (between the piston ring grooves).

8 Look for scoring and scuffing on the sides of the skirt, holes in the piston crown, and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively-high operating temperatures. The cooling and lubricating systems should be checked thoroughly. Scorch marks on the sides of the pistons show that blow-by has occurred. A hole in the piston crown, or burned areas at the edge of the piston crown indicates that abnormal combustion (pre-ignition, knocking, or detonation) has been occurring. If any of the above problems exist, the causes must be investigated and corrected, or the damage will occur again. The causes may include incorrect injection pump or ignition timing, or a fuel system fault.

9 Corrosion of the piston, in the form of small pits, indicates that coolant is leaking into the combustion chamber and/or the crankcase.

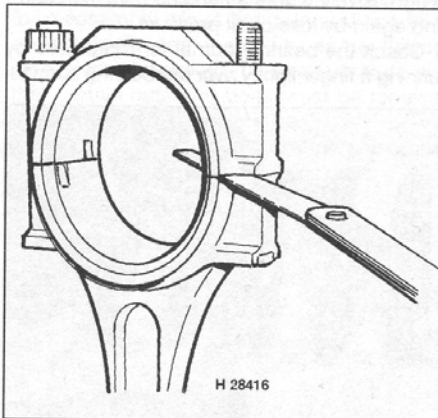
Again, the cause must be corrected, or the problem may persist in the rebuilt engine.

10 If new rings are being fitted to old pistons, measure the piston ring-to-groove clearance by placing a new piston ring in each ring groove and measuring the clearance with a feeler blade (see illustration). Check the clearance at three or four places around each groove. If the measured clearance is outside the specified limits, new pistons will be required. If the new ring is excessively tight, the most likely cause is dirt remaining in the groove.

11 Check the piston-to-bore clearance by measuring the cylinder bore (see Section 12) and the piston diameter. Measure the piston across the skirt, at a 90° angle to the gudgeon pin, approximately halfway down the skirt. Subtract the piston diameter from the bore diameter to obtain the clearance. If this is greater than the figures given in the Specifications, the block will have to be rebored, and new pistons and rings fitted.

12 Check the fit of the gudgeon pin by twisting the piston and connecting rod in opposite directions. Any noticeable play indicates excessive wear, which must be corrected.

13 On diesel engines, separate a piston from its connecting rod, prise out the circlips and push out the gudgeon pin (see illustrations). Hand pressure is sufficient to remove the pin. Identify the piston and rod to ensure correct reassembly.



14.16 Checking for a clearance between a big-end bearing cap and connecting rod

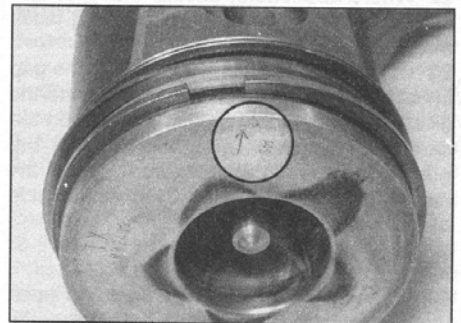
14 The gudgeon pins on petrol engines cannot be removed without access to a hydraulic press.

15 The connecting rods themselves should not need renewal, unless seizure or some other major mechanical failure has occurred. Check the alignment of the connecting rods visually, and if the rods are not straight, take them to an engine overhaul specialist for a more detailed check.

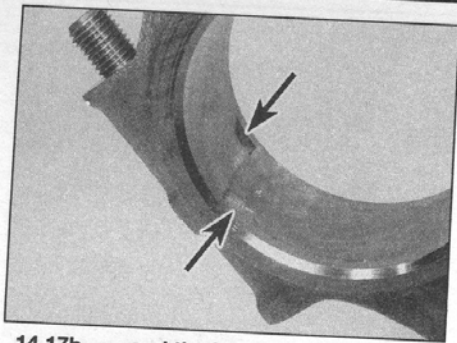
16 Fit the appropriate bearing cap to each of the connecting rods, then refit the securing nuts, and tighten them to the specified torque. Loosen and remove the nut on one side of the bearing cap, and check, using a feeler blade, that no clearance exists between the mating faces of the bearing cap and the connecting rod (see illustration). If clearance is evident, this suggests that the connecting rod is distorted, or the mating faces of the big-end caps and connecting rods have been machined or filed, in a mistaken attempt to take up bearing wear. If there is any clearance, then the connecting rod and the bearing cap must be renewed.

17 Where applicable, reassemble the pistons and rods. Make sure that the pistons are fitted the right way round:

a) On diesel engines, the arrow on the piston crown should point towards the timing belt end of the engine, and the bearing shell locating cut-outs in the connecting rod and bearing cap should be positioned on the camshaft side of the cylinder block (see illustrations). Oil the gudgeon pins before fitting them. When



14.17a The arrow on the piston crown should point towards the timing belt end of the engine . . .



**14.17b** ... and the bearing shell locating cut-outs (arrowed) should be on the camshaft side of the cylinder block

assembled, the piston should pivot freely on the rod.

b) On petrol engines, the domed boss on the connecting rod must face forwards for the right-hand bank of cylinders (2-4-6-8) and rearwards for the left bank (1-3-5-7). When the assemblies are refitted, the domed bosses should face each other on the crankshaft journals.

**18** Before refitting the rings to the pistons, check their end gaps by inserting each of them in their cylinder bores. Use the piston to make sure that they are square. Check that the gaps are within the specified limits (see illustration). Land Rover rings are supplied pre-gapped; no attempt should be made to adjust the gaps by filing.

**19** Once the ring end gaps have been checked, the rings can be fitted to the pistons.

**20** Fit the piston rings using the same technique as for removal. Fit the bottom (oil control) ring first, and work up. **Note:** Always follow the instructions supplied with the new piston ring sets - different manufacturers may specify different procedures. Do not mix up the top and middle rings, as they have different cross-sections.

### Petrol engines

**21** When fitting the oil control ring, first insert the expander so that the ends do not overlap but just abut each other. Fit the rails, one at a time, making sure that they locate snugly within the piston groove.

**22** Where applicable, ensure that the TOP marking on the face of the piston ring faces the piston crown.

**23** Fit the compression rings so that the gap in each ring is diametrically opposite, and the oil control ring so that its gap appears on the same side between gudgeon pin and the piston thrust face but staggered. Locate the rail ring gaps approximately 25 mm either side of the expander join.

### Diesel engines

**24** When fitting the oil control ring, first insert the expander, then fit the ring.

**25** Where applicable, ensure that the TOP marking on the face of the piston ring faces the piston crown. Position the oil control ring



**14.18** Measuring a piston ring end gap

gap to the manifold side of the piston (the left-hand side, when viewed with the arrow on the piston crown pointing forwards). Arrange the gaps of the middle and upper rings 90° either side of the oil control ring gap, but make sure that no gap is positioned on the thrust side of the piston (see illustration).

### 15 Crankshaft - inspection

**Note:** A micrometer will be required for this operation.

**1** Clean the crankshaft using paraffin or a suitable solvent, and dry it, preferably with compressed air if available. Be sure to clean the oil holes with a pipe cleaner or similar probe, to ensure that they are not obstructed.

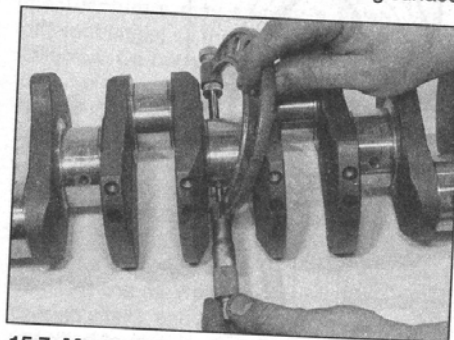
**Warning:** Wear eye protection when using compressed air.

**2** Check the main and big-end bearing journals for uneven wear, scoring, pitting and cracking.

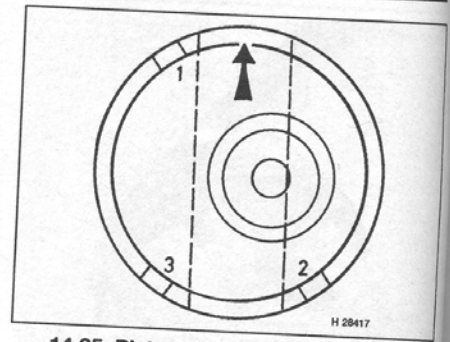
**3** Big-end bearing wear is accompanied by distinct metallic knocking when the engine is running, particularly noticeable when the engine is pulling from low revs, and some loss of oil pressure.

**4** Main bearing wear is accompanied by severe engine vibration and rumble - getting progressively worse as engine revs increase - and again by loss of oil pressure.

**5** Check the bearing journal for roughness by running a finger lightly over the bearing surface.



**15.7** Measuring a crankshaft main bearing journal



**14.25** Piston ring end gap positions (viewed from top of piston)

- 1 Top compression ring gap
- 2 Lower compression ring gap
- 3 Oil control ring gap

Any roughness (which will be accompanied by obvious bearing wear) indicates that the crankshaft requires regrinding.

**6** If the crankshaft has been reground, check for burrs around the crankshaft oil holes (the holes are usually chamfered, so burrs should not be a problem, unless regrinding has been carried out carelessly). Remove any burrs with a fine file or scraper, and thoroughly clean the oil holes as described previously.

**7** Using a micrometer, measure the diameter of the main and big-end bearing journals, and compare the results with the Specifications (see illustration). By measuring the diameter at a number of points around each journal's circumference, you will be able to determine whether or not the journal is out-of-round. Take the measurement at each end of the journal, near the webs, to determine if the journal is tapered. If the crankshaft journals are damaged, tapered, out-of-round or worn beyond the limits given in the Specifications, the crankshaft will have to be reground, and undersize bearings fitted.

**8** Check the oil seal contact surfaces at each end of the crankshaft for wear and damage. If the seal has worn an excessive groove in the surface of the crankshaft, consult an engine overhaul specialist, who will be able to advise whether a repair is possible or whether a new crankshaft is necessary.

### 16 Main and big-end bearings - inspection

**1** Even though the main and big-end bearings should be renewed during engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine. The bearing shells carry identification marks to denote their size, in the form of a code marked on the back of the shell. If the shells are to be renewed, without carrying out any crankshaft regrinding, the old shells should be taken along when obtaining new shells, to ensure that the correct shells are obtained.



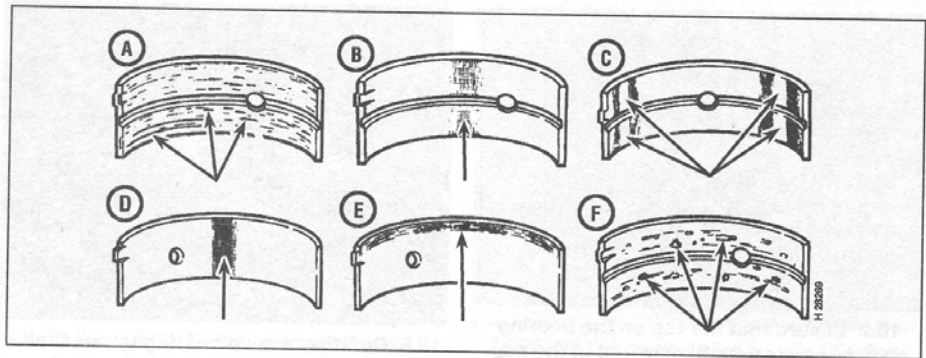
2 Bearing failure occurs because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine, or corrosion (see illustration). If a bearing fails, the cause must be found and eliminated before the engine is reassembled, to prevent the failure from happening again.

3 To examine the bearing shells, remove them from the cylinder block, the main bearing caps, the connecting rods and the big-end bearing caps, and lay them out on a clean surface, in the same order as they were fitted to the engine. This will enable any bearing problems to be matched with the corresponding crankshaft journal.

4 Dirt and other foreign particles can enter the engine in a variety of ways. Contamination may be left in the engine during assembly, or it may pass through filters or the crankcase ventilation system. Normal engine wear produces small particles of metal, which can eventually cause problems. If particles find their way into the lubrication system, it is likely that they will eventually be carried to the bearings. Whatever the source, these foreign particles often end up embedded in the soft bearing material, and are easily recognised. Large particles will not embed in the bearing, and will score or gouge the bearing and journal. To prevent possible contamination, clean all parts thoroughly, and keep everything spotlessly-clean during engine assembly. Once the engine has been installed in the vehicle, ensure that regular engine oil and filter changes are carried out at the recommended intervals.

5 Lack of lubrication (or lubrication breakdown) has a number of interrelated causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil leakage (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which may be the result of misaligned oil holes in a bearing shell, will also starve a bearing of oil, and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the steel backing of the bearing. Temperatures may increase to the point where the steel backing turns blue from overheating.

6 Driving habits can have a definite effect on bearing life. Full-throttle, low-speed operation (labouring the engine) puts very high loads on bearings, which tends to squeeze out the oil film. These loads cause the bearings to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually the bearing material will loosen in pieces, and tear away from the steel backing. Regular short journeys can lead to corrosion of bearings, because insufficient engine heat is produced to drive off the condensed water and corrosive gases which form inside the engine. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the bearings, the acid attacks and corrodes the bearing material.



16.2 Typical bearing failures

- A Scratched by dirt; dirt embedded into bearing material
- B Lack of oil; overlay wiped out
- C Improper seating; bright (polished) sections
- D Tapered journal; overlay gone from entire surface
- E Radius ride
- F Fatigue failure; craters or pockets

7 Incorrect bearing installation during engine assembly will also lead to bearing failure. Tight-fitting bearings leave insufficient bearing lubrication clearance, and will result in oil starvation. Dirt or foreign particles trapped behind a bearing shell results in high spots on the bearing, which can lead to failure.

8 If new bearings are to be fitted, the bearing running clearances should be measured before the engine is finally reassembled, to ensure that the correct bearing shells have been obtained (see Sections 18 and 19). If the crankshaft has been reground, the engineering works which carried out the work will advise on the correct-size bearing shells to suit the work carried out. If there is any doubt as to which bearing shells should be used, seek advice from a Land Rover dealer.

### 17 Engine overhaul - reassembly sequence

Before reassembly begins, ensure that all new parts have been obtained, and that the tools are available. Read through the entire procedure, to familiarise yourself with the work involved, and to ensure that all items necessary for reassembly are at hand. In addition to all normal tools and materials, some thread-locking compound will be needed. Note also that certain nuts and bolts must be renewed when reassembling the engine.

To save time and avoid problems, reassembly can be carried out in the following order:

#### Petrol engines

- a) Crankshaft.
- b) Pistons/connecting rod assemblies.
- c) Sump.
- d) Flywheel/driveplate.
- e) Camshaft.
- f) Timing cover and chain.
- g) Cylinder heads.
- h) Engine external components (use appropriate new gaskets and seals where necessary).

#### Diesel engines

- a) Crankshaft.
- b) Pistons/connecting rod assemblies.
- c) Ladder frame (200 TDi engine only).
- d) Flywheel housing and flywheel/driveplate.
- e) Oil pump.
- f) Timing belt housing.
- g) Camshaft.
- h) Timing belt.
- i) Sump.
- j) Cylinder head(s).
- k) Engine external components (use appropriate new gaskets and seals where necessary).

### 18 Crankshaft - refitting and main bearing running clearance check

**Note:** Suitable seals will be required when refitting No 5 main bearing cap - see text. A new gasket or suitable sealant will be required when refitting the flywheel housing - see text. New main bearing cap bolts, and new crankshaft oil seals, must also be used on refitting.

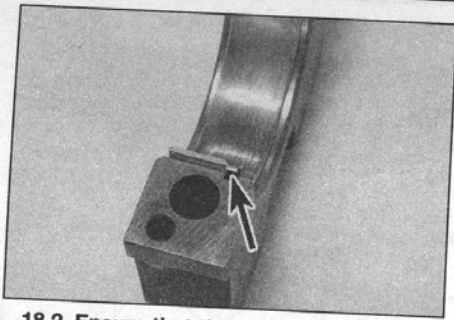
#### Main bearing running clearance check

**Note:** Suitable measuring equipment will be required for this check - see text.

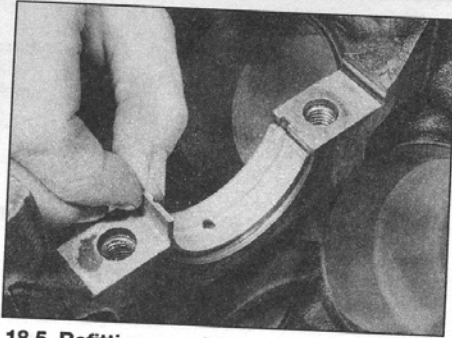
1 Clean the backs of the bearing shells, and the bearing recesses in both the cylinder block and main bearing caps. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin.

2 Press the bearing shells without oil holes into the caps, ensuring that the tag on the shell engages in the cut-out in the cap (see illustration). Note that No 5 bearing shells are wider than the remaining bearing shells.

3 Press the bearing shells with the oil holes/grooves into the recesses in the



**18.2** Ensure that the tag on the bearing shell engages with the cut-out in the cap (arrowed)



**18.5** Refitting a main bearing upper shell - note oil groove



**18.6** Plastigauge in place on crankshaft main bearing journal

cylinder block. Note that if the original main bearing shells are being re-used, these must be refitted to their original locations in the block and caps.

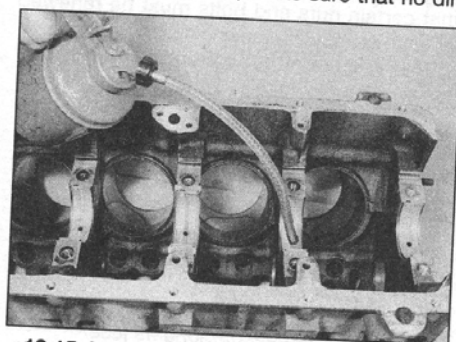
**4** Before the crankshaft can be permanently installed, the main bearing running clearance should be checked; this can be done in either of two ways:

a) One method is to fit the main bearing caps to the cylinder block, with the bearing shells in place. With the original cap retaining bolts tightened to the specified torque, measure the internal diameter of each assembled pair of bearing shells using a vernier dial indicator or internal micrometer. If the diameter of each corresponding crankshaft journal is measured, and then subtracted from the bearing internal diameter, the result will be the main bearing running clearance.

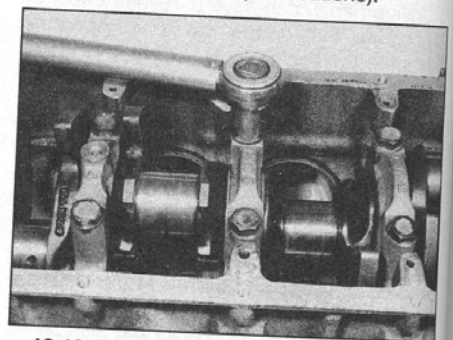
b) The second (and more accurate) method is to use an American product known as Plastigauge. This consists of a fine thread of perfectly-round plastic, which is compressed between the bearing cap and the journal. When the cap is removed, the deformation of the plastic thread is measured with a special card gauge supplied with the kit. The running clearance is determined from this gauge. Plastigauge is sometimes difficult to obtain in the UK, but enquiries at one of the larger specialist chains of quality motor factors should produce the name of a stockist in your area. The procedure for using Plastigauge is as follows.



**18.10** Measuring the width of the deformed Plastigauge using the card gauge



**18.15** Lubricate the main bearing shells generously



**18.19** Tightening the main bearing cap bolts

**5** With the upper main bearing shells in place (the upper shells have oil grooves), carefully lay the crankshaft in position (see illustration). Do not use any lubricant; the crankshaft journals and bearing shells must be perfectly clean and dry.

**6** Cut several pieces of the appropriate-size Plastigauge (they should be slightly shorter than the width of the main bearings), and place one piece on each crankshaft journal axis (see illustration).

**7** With the bearing shells in position in the caps (the shells have no oil grooves), fit the caps to their numbered or previously-noted locations. Take care not to disturb the Plastigauge.

**8** Starting with the centre main bearing and working outward, tighten the original main bearing cap bolts progressively to their specified torque setting. Don't rotate the crankshaft at any time during this operation.

**9** Remove the bolts and carefully lift off the main bearing caps, keeping them in order. Don't disturb the Plastigauge or rotate the crankshaft. If any of the bearing caps are difficult to remove, tap them from side-to-side with a soft-faced mallet.

**10** Compare the width of the crushed Plastigauge on each journal to the scale printed on the Plastigauge envelope, to obtain the main bearing running clearance (see illustration).

**11** If the clearance is not as specified, the bearing shells may be the wrong size (or excessively-worn, if the original shells are being re-used). Before deciding that different-size shells are needed, make sure that no dirt

or oil was trapped between the bearing shells and the caps or block when the clearance was measured.

**12** If the Plastigauge was wider at one end than at the other, the journal may be tapered.

**13** Carefully scrape away all traces of the Plastigauge material from the crankshaft and bearing shells, using a fingernail or something similar which is unlikely to score the shells.

### Final refitting - petrol engines

**14** Carefully lift the crankshaft out of the cylinder block once more.

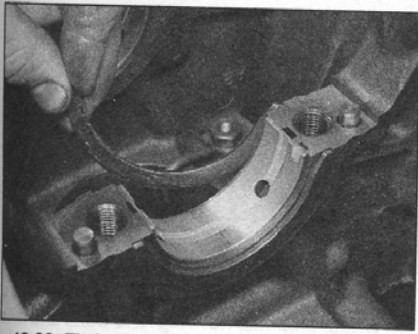
**15** Liberally lubricate each bearing shell in the cylinder block, and lower the crankshaft into position (see illustration).

**16** Lubricate the bearing shells, then fit Nos 1 to 4 bearing caps in their numbered or previously-noted locations. Fit the new main bearing cap bolts, but tighten them only hand-tight at this stage. Check the crankshaft endfloat as described in Section 12.

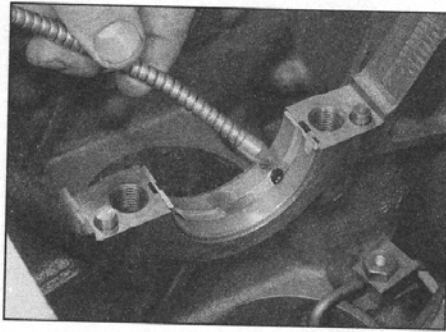
**17** Thoroughly clean the No 5 bearing cap and the oil seal area of the engine block, removing all traces of oil and sealant. Also check for burrs or sharp edges which may damage the new seals on fitting.

**18** When refitting the No 5 (rear) bearing cap, refer to the crankshaft rear oil seal renewal procedure (Chapter 2A, Section 9).

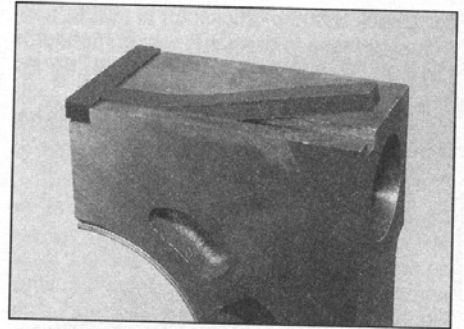
**19** Progressively tighten the bearing cap bolts to the specified torque, working outwards from the centre (No 3) bearing cap (see illustration). Note that the No 5 bearing cap bolts are tightened to a greater torque than those for Nos 1 to 4, and requires a special lubricant (see Specifications).



18.22 Fitting the thrustwashers to No 3 main bearing location



18.23 Lubricate the bearing shells



18.26 Fit the seals to No 5 main bearing cap

20 Check that the crankshaft is free to turn. Some stiffness is normal if new components have been fitted, but there must be no jamming or tight spots.

**Final refitting - diesel engines**

21 Carefully lift the crankshaft out of the cylinder block once more.

22 Use a little grease to stick the thrustwashers to each side of No 3 main bearing location in the crankcase. Ensure that the oilway grooves on each thrustwasher face outwards from the bearing location, towards the crankshaft webs (see illustration).

23 Liberally lubricate each bearing shell in the cylinder block (see illustration), and lower the crankshaft into position.

24 Lubricate the bearing shells, then fit Nos 1 to 4 bearing caps in their numbered or previously-noted locations. Ensure that the caps locate correctly over the dowels. Check

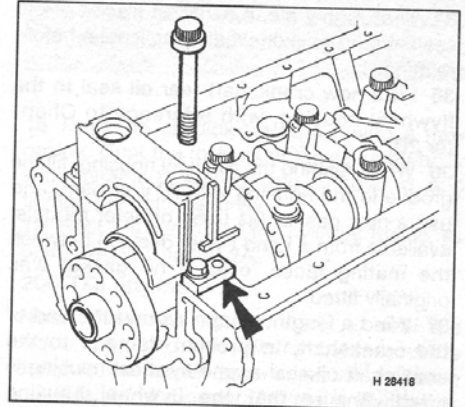
the crankshaft endfloat as described in Section 12.

25 To prevent the possibility of the No 5 main bearing cap oil seals becoming trapped between the bearing cap and the crankcase, chamfer the lower inner edge of each seal to between 0.40 and 0.80 mm wide.

26 Smear the seals with clean engine oil, then locate the seals in the bearing cap. Do not trim the seals (see illustration).

27 To prevent damage to the No 5 main bearing cap oil seals, make up two seal guide tools as shown. Ensure that the tools are fitted parallel to the edge of the cylinder block, and use two of the sump bolts to secure them (see illustration). Alternatively, two old feeler blades can be used to protect the seals as the bearing cap is fitted.

28 If feeler blades are to be used to protect the seals, lay the feeler blades in position between the cylinder block and the bearing cap.

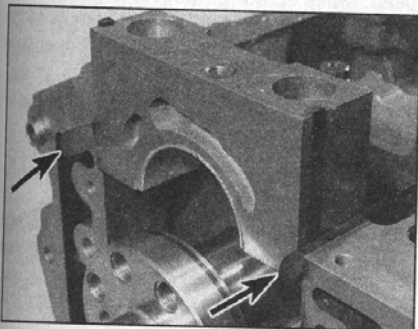


18.27 No 5 main bearing cap seal guide tool (arrowed) in position on cylinder block

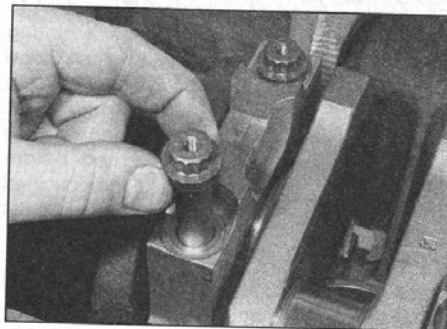
Carefully fit the bearing cap, complete with the bearing shell (see illustration). If feeler blades have been used, withdraw the feeler blades as the bearing cap is pushed into position. If guide tools have been used, remove the tools once the bearing cap is in position.

29 Fit new main bearing cap bolts, noting that the bolts with the threaded holes for the oil pick-up pipe should be fitted to No 4 bearing cap, and progressively tighten the bolts to the specified torque, working outwards from the centre (No 3) bearing cap (see illustrations).

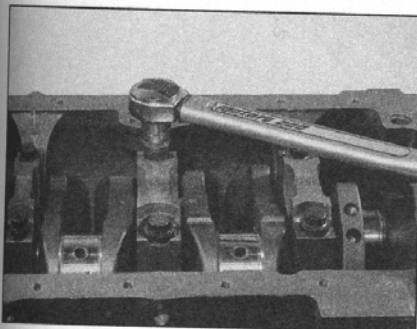
30 Trim the No 5 main bearing cap seals to approximately 0.80 mm above the face of the cylinder block. Also trim the seals flush with end face of the cylinder block (see illustrations).



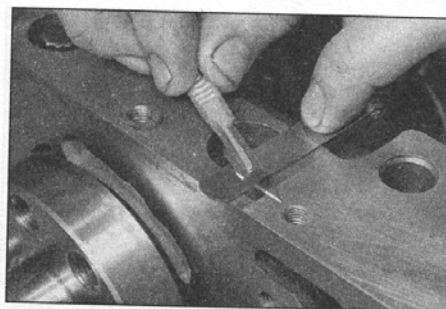
18.28 Feeler blades (arrowed) in position to protect No 5 main bearing cap seals



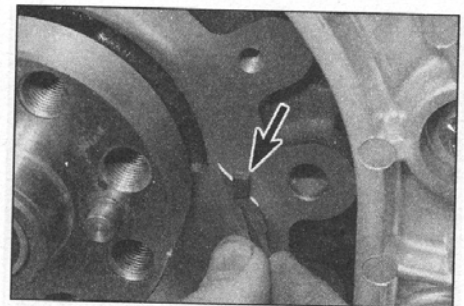
18.29a Fit the main bearing cap bolts with the threaded holes to No 4 bearing cap



18.29b Tighten the main bearing cap bolts to the specified torque



18.30a Using a 0.80 mm feeler blade and knife to trim the No 5 main bearing cap seals



18.30b Trimming No 5 main bearing cap seal (arrowed) flush with the end face of the cylinder block

31 Check that the crankshaft is free to turn. Some stiffness is normal if new components have been fitted, but there must be no jamming or tight spots.

32 Refit the flywheel housing as follows, according to engine type.

**Early 200 TDi engines**

33 On early models, the mating faces of the cylinder block and flywheel housing are sealed, using a bead of RTV sealant in an annular groove around the oil seal housing. No gasket was fitted in production, but note that a gasket may have been fitted if the housing has been removed previously during service.

34 Thoroughly clean away all traces of old sealant (and gasket, where applicable) before refitting.

35 Fit a new crankshaft rear oil seal to the flywheel housing, with reference to Chapter 2B.

36 When refitting the flywheel housing, fill the groove in the housing with RTV sealant, and use a new gasket (as used on later models, available from a Land Rover dealers) between the mating faces, even if no gasket was originally fitted.

37 Wind a length of tape around the end of the crankshaft, to prevent damage to the crankshaft oil seal as the flywheel housing is fitted. Ensure that the flywheel housing engages with the dowels in the cylinder block.

38 Refit the securing bolts, ensuring that any brackets are in position as noted before removal, and tighten the bolts to the specified torque.

39 Remove the tape from the end of the crankshaft.

40 Proceed to paragraph 54.

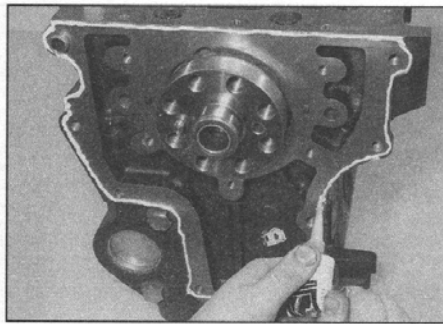
**Later 200 TDi engines**

41 On later models, the mating faces of the cylinder block and flywheel housing are sealed using a gasket.

42 Thoroughly clean away all traces of old gasket before refitting.

43 Fit a new crankshaft rear oil seal to the flywheel housing, with reference to Chapter 2B.

44 Wind a length of tape around the end of the crankshaft, to prevent damage to the crankshaft oil seal as the flywheel housing is



**18.50 Apply a bead of RTV sealant to the flywheel housing mating face of the cylinder block - 300 TDi engine**

fitted, then refit the flywheel housing using a new gasket. Ensure that the flywheel housing engages with the dowels in the cylinder block.

45 Refit the flywheel housing securing bolts, ensuring that any brackets are in position as noted before removal, and tighten the bolts to the specified torque.

46 Remove the tape from the end of the crankshaft.

47 Proceed to paragraph 54.

**300 TDi engines**

48 On 300 TDi engines, the mating faces of the cylinder block and flywheel housing are sealed using RTV sealant around the periphery of the cylinder block mating face.

49 Thoroughly clean away all traces of old sealant from the cylinder block and flywheel housing before refitting. Also clean the crankshaft rear oil seal housing mating face of the cylinder block.

50 Apply a bead of suitable RTV sealant to the periphery of the cylinder block mating face, then fit the flywheel housing (see illustration). Ensure that the flywheel housing engages with the dowels in the cylinder block.

51 Refit the securing bolts, ensuring that any brackets are in position as noted before removal, and tighten the bolts to the specified torque. Note that the longer, shouldered bolts fit at the top.

52 Clean away any surplus sealant.

53 Fit a new crankshaft rear oil seal assembly as described in Chapter 2B.

**All models**

54 On completion, refit the piston/connecting

rod assemblies as described in Section 19. Refit the flywheel and timing belt housing as described in Chapter 2B.

**19 Piston/connecting rod assembly - refitting and big-end bearing running clearance check**

**Note:** A piston ring compressor tool will be required for this operation. A new oil pick-up pipe gasket will be needed on petrol engines. On diesel engines, new big-end bolts and nuts must be used on refitting. Suitable sealant will be required when refitting the sump, and the ladder frame on 200 TDi engines. On 300 TDi engines, a new oil pick-up pipe O-ring and a new oil return pipe gasket must be used on refitting.

1 On diesel engines, remove the big-end bolts from the connecting rods (carefully tap them out using a hammer if necessary), and fit new bolts (see illustration). Where applicable, ensure that the eccentrics on the bolt heads locate correctly in the connecting rod recesses.

2 Clean the backs of the big-end bearing shells and the recesses in the connecting rods and big-end caps. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe the shells and connecting rods dry with a lint-free cloth.

3 Press the big-end bearing shells into the connecting rods and caps, in their correct locations if the original shells are to be re-used. Make sure that the locating tabs on the shells are engaged with the cut-outs in the connecting rods and bearing caps (see illustrations).

**Big-end bearing running clearance check**

**Note:** Suitable measuring equipment will be required for this check - see text.

4 Lubricate No 1 piston and piston rings, and check that the piston ring end gaps are positioned as described in Section 14.

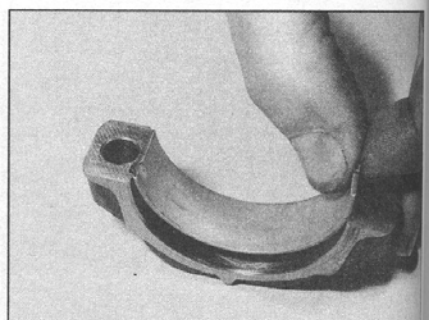
5 Wrap a layer of tape around the connecting rod bolts, or fit plastic sleeves over the bolt threads, to prevent damage to the crankshaft bearing surfaces as the rods are fitted.



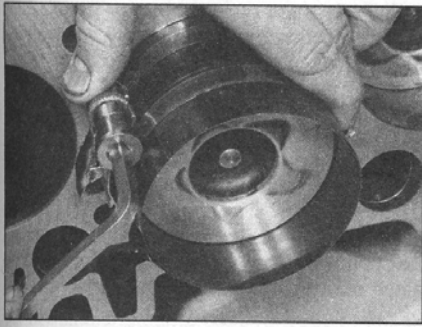
**19.1 Tapping a big-end bolt from a connecting rod**



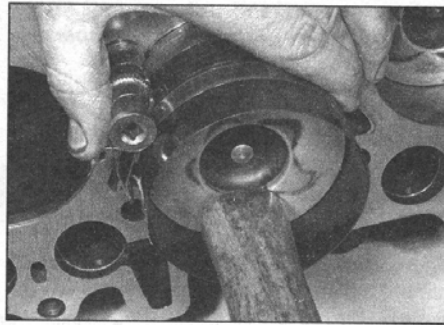
**19.3a Fitting a new bearing shell to the connecting rod big-end**



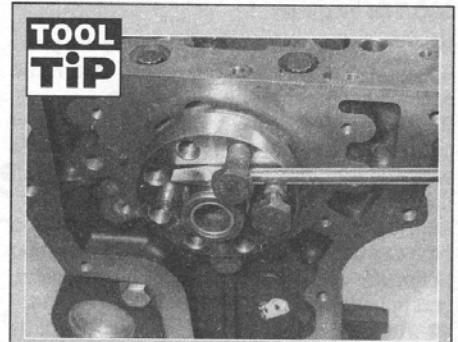
**19.3b Engage the tab in the cut-out when fitting the big-end cap shells**



19.9a Insert the piston and connecting rod into the cylinder with a piston ring compressor fitted . . .



19.9b . . . then drive the piston into the cylinder



**TOOL TIP**  
To turn the crankshaft, refit two of the flywheel securing bolts to the end of the crankshaft, and use a screwdriver to lever the crankshaft round

6 Fit a ring compressor to No 1 piston, then insert the piston and connecting rod into No 1 cylinder.

7 On petrol engines, the domed boss on the connecting rod must face forwards for the right-hand bank of cylinders (2-4-6-8) and rearwards for the left bank (1-3-5-7). When the assemblies are refitted, the domed bosses should face each other on the crankshaft journals.

8 On diesel engines, the arrow on the piston crown should point towards the timing belt end of the engine, and the combustion chamber in the piston crown should be on the camshaft side of the engine. Note also that the bearing shell locating cut-outs in the connecting rod and bearing cap should be positioned on the camshaft side of the engine.

9 With No 1 crankpin at its lowest point, drive the piston carefully into the cylinder with the wooden handle of a hammer, at the same time guiding the connecting rod onto the crankpin (see illustrations).

10 To measure the big-end bearing running clearance, refer to the information contained in Section 18; the same general procedures apply.

11 If the Plastigauge method is being used, ensure that the crankpin journal and the big-end bearing shells are clean and dry, then engage the connecting rod with the crankpin. Place the Plastigauge strip on the crankpin, fit the bearing cap in its previously-noted position (see Section 11), then tighten the nuts to the specified torque. Do not rotate the

crankshaft during this operation. Remove the cap and check the running clearance by measuring the Plastigauge as previously described.

12 Repeat the above procedures on the remaining piston/connecting rod assemblies (see Tool Tip).

### Final refitting

13 Having checked the running clearance of all the crankpin journals and taken any corrective action necessary, clean off all traces of Plastigauge from the bearing shells and crankpin.

14 Liberally lubricate the crankpin journals and big-end bearing shells. Refit the bearing caps once more, ensuring correct positioning as previously described. On petrol engines, the rib on the edge of the cap faces in the same direction as the domed boss on the connecting rod, so that when the two connecting rods and caps are refitted to each of the four journals, the ribs face each other (see illustrations).

15 Tighten the big-end bearing cap nuts to the specified torque, and turn the crankshaft each time to make sure that it is free before moving on to the next assembly (see illustration).

16 Proceed as follows according to engine type.

### Petrol engines

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

18 Refit the oil pick-up pipe, using a new gasket. Coat the threads of the securing bolts with suitable thread-locking compound, and tighten the bolts securely.

19 Refit the sump and the cylinder heads, as described in Chapter 2A.

### 200 TDi engine

**Note:** Since the sealant used to seal the ladder frame to the cylinder block and the sump to the ladder frame cures within fifteen minutes, it is important that the ladder frame, oil pump and sump are fitted together without undue delay.

20 Check that the cylinder block and sump mating faces of the ladder frame are clean.

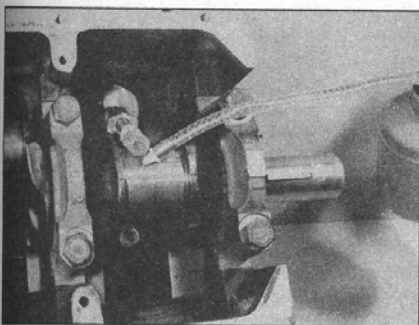
21 Apply Hylogrip Primer to the mating faces of the cylinder block and the ladder frame. This will clean the surfaces, and speed up curing of the sealant.

22 Apply RTV sealant to the joint between the cylinder block and the flywheel housing at the ladder frame mating face.

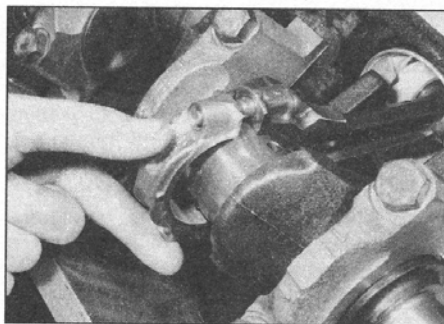
23 Apply Hylogrip 2000 to the cylinder block mating face of the ladder frame, then loosely fit the ladder frame to the cylinder block.

24 Fit the bolts securing the ladder frame to the cylinder block, and the four bolts securing the ladder frame to the flywheel housing, then tighten the bolts to the specified torque.

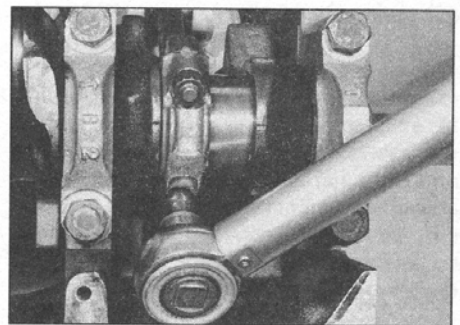
25 Refit the oil pump, the sump and the cylinder head, as described in Chapter 2B.



19.14a Lubricate the crankshaft journal as the connecting rod is drawn onto it



19.14b Refitting a petrol engine big-end cap - note rib on cap



19.15 Tightening the big-end bearing cap nuts

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

27 Refit the oil return pipe, using a new gasket. Coat the threads of the securing bolts with suitable thread-locking compound, and tighten the bolts to the specified torque.

28 Refit the oil strainer using a new pick-up pipe O-ring. Coat the threads of the securing bolts with suitable thread-locking compound, and tighten the bolts to the specified torque.

29 Refit the sump and the cylinder head, as described in Chapter 2B.

## 20 Engine - initial start-up after overhaul



1 With the engine refitted to the vehicle, double-check the engine oil and coolant levels, and check that the battery is well charged. Make a final check that everything has been reconnected. Make sure that there are no tools or rags left in the engine compartment.

### Petrol models

2 Remove the spark plugs, referring to Chapter 1A for details.

3 The engine must be immobilised such that it can be turned over using the starter motor, without starting. Disconnect the HT lead from the ignition coil. On fuel injection models, also disable the fuel pump by removing the fuel pump fuse (refer to the information on depressurising the system in Chapter 4B).

**Caution: On vehicles with a catalytic converter, it is potentially damaging to immobilise the engine by disabling the ignition system without first disabling the fuel system, as unburnt fuel could be supplied to the catalyst. When the engine**

converter may ignite and irreparably damage the converter.

4 Turn the engine using the starter motor until the oil pressure warning light goes out. If the light fails to extinguish after several seconds of cranking, check the engine oil level and that the oil filter is secure. Assuming these are correct, check the security of the oil pressure switch wiring - do not progress any further until you are satisfied that oil is being pumped around the engine at sufficient pressure.

5 Refit the spark plugs and ignition coil wiring, and refit the fuel pump fuse, where applicable.

### Diesel models

6 Prime the fuel system as described in Chapter 4C.

7 Before starting the engine, the turbocharger must be primed with oil as follows. Failure to carry out this procedure may result in serious (and expensive) damage to the turbocharger.

a) *Unscrew the oil feed pipe banjo bolt from the top of the turbocharger housing.*

*Recover the two sealing washers, and move the feed pipe away from the oil hole in the housing.*

b) *Fill the housing with clean engine oil of the correct type and grade, from a freshly-opened sealed container.*

c) *Reconnect the oil feed pipe, and refit the banjo bolt, ensuring that one sealing washer is positioned on each side of the pipe. Tighten the banjo bolt to the specified torque.*

8 Prime the remainder of the lubrication circuit by disconnecting the stop solenoid in the injection pump and cranking the engine on the starter motor in several ten-second bursts, pausing for half a minute or so between each burst. Reconnect the solenoid when satisfied that oil pressure has been established (ensure that the oil pressure warning light on the fascia extinguishes when the engine is cranked).

9 Fully depress the accelerator pedal, then turn the ignition key to position M and wait for the preheating warning light to go out.

### All models

10 Start the engine, but be aware that as fuel system components have been disturbed, the cranking time may be a little longer than usual.

11 Once started, keep the engine running at fast tickover. Check that the oil pressure light stays out, then check that there are no leaks of oil, fuel or coolant. Check the power steering pipe/hose unions for leakage. On models with automatic transmission, check the transmission fluid cooler pipe unions for leakage. Do not be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.

12 On petrol models, the hydraulic tappets may initially run noisily, but the engine should quieten down after a few seconds' running.

13 Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose.

14 Check the ignition timing or fuel injection pump timing, as applicable, as described in Chapter 5B or 4C.

15 Check the engine idle speed as described in the relevant part of Chapter 4, then switch off the engine and allow it to cool.

16 Once the engine has cooled, recheck the oil and coolant levels, and top-up as necessary.

17 There is no need to re-tighten the cylinder head bolts once the engine has been run following reassembly.

18 If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 600 miles (1000 km). Do not operate the engine at full-throttle, or allow it to labour at low engine speeds in any gear. It is recommended that the engine oil and filter are changed at the end of this period.